

# Production Efficiency and its Application in Some Engineering Construction Projects

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## **Abstract:**

This research aims to clarify the image of project management in its construction projects based on the opinions of experts, where the most important standards of production efficiency in some construction projects will be identified. It also aims to provide a vision on productive efficiency standards in engineering management and give officials and practitioners practical recommendations to enhance performance and productivity in order to improve current practices. Engineering in Tripoli, Libya, evaluate the extent to which these standards can be applied in a small number of engineering construction projects, and provide recommendations in light of the results of questionnaire data for 53 samples from the community.

**Keywords:** Construction Projects, Standards, Productivity, And Efficient Use Of Resources.

## **1. INTRODUCTION :**

Because engineering construction projects are essential to the social and economic advancement of communities, they are regarded as one of the most difficult professions. These initiatives support the development of the infrastructure required for advancement and success across a range of industries. These projects call for the meticulous management and coordination of a wide range of resources, including personnel, supplies, and equipment. It is now vital to concentrate on production efficiency requirements in order to guarantee reaching the greatest levels of performance, quality, and profitability due to the growing demand for these projects. Achieving production efficiency becomes crucial in this environment, since it is one of the key elements that makes construction projects successful and help them reach their objectives. The capacity to maximize output with the least number of inputs is known as productive efficiency. In order to increase the project's total productivity, productive efficiency in the context of construction projects refers to the measurement and analysis of the performance of the various resources used, including personnel, materials, equipment, etc.

Therefore, the availability of these standards of production efficiency in various engineering construction projects in Tripoli will be determined in this article, together with their standards of production efficiency in those projects.

## **2. PRODUCTION EFFICIENCY:**

The idea of efficiency is no longer as important as the core of production. While productivity measures the overall performance of an economic system or a facility, efficiency measures the results and

accomplishments of human resources. The emphasis is on measuring efficiency at the facility level and on added value rather than production volume because added value refers to adding to the final value. Some argue that efficiency is the economic criterion and productivity is the performance criterion for the economy, which is determined by the difference between sales and expenses. These two criteria are referred to as technical maturity. Because of the strong trends in organizational management toward optimizing the utilization of available financial and human resources while also considering their scarcity, efficiency is one of the key performance indicators that business organizations frequently use. As indicated by the ratio of inputs to outputs [9], it refers to optimizing the relationship between inputs and outputs. Efficiency is the ratio of actual units produced to the standard rate of expected production in a time period, standard hours produced to actual hours worked (more time taken means less efficient), and actual volume of production in value to standard volume in a time period. Productivity, on the other hand, measures output relative to a given input. When it comes to economic value, efficiency is the outcome of a business's operations and represents a portion of the impact necessary to finance expenditures [11]. The ability to produce a product with standard requirements from the limited resources that go into making its components is known as production efficiency.

The intended productivity increases with the number of these components, indicating the product's originality, quality, and capacity for innovation.

As you are aware, productive efficiency describes the connection between the inputs used in the production process and the final products that come from it. The proportion of output derived from resources rises with production efficiency. Therefore, manufacturing efficiency serves as a broad indicator of how well requirements and product quality are met. In order to estimate the product or ascertain the extent of its quality and effectiveness on the ground, it looks for the degree to which the project's objectives are met and discloses the effectiveness of resources to obtain outputs of concrete benefit [1].

The amount of production or outputs attributable to a certain component of production or outputs is known as productive efficiency, according to experts from the Economic Cooperation Organization [4]. Productive efficiency, according to the International Labor Office, is the relationship between the outputs produced by a production system that uses inputs to produce outputs. It further specified that it is the economical and efficient utilization of labor as well as capital, land, raw materials, energy, information, and time [3]. Considering the aforementioned, one of the most extensive and frequently applied criteria that encompasses the stages of planning, implementation, and control is production efficiency.

Production efficiency is a requirement that is hard to disregard in our construction projects since it establishes a relationship between product and cost.

In view of the aforementioned, it may be claimed that productive efficiency is dependent on both goal achievement, or effectiveness, and efficient use of the resources at hand. As such, it is a complete assessment that establishes the degree to which standards are fulfilled, encompassing goal attainment, resource effectiveness, and performed work.

### **3. MEASURES OF PRODUCTION EFFICIENCY:**

Because labor productivity offers a dynamic assessment of an economy's competitiveness, economic development, and living standards, it is included in economic indicators. The essential economic tenets required for both social development and economic success can be better understood through an examination of labor productivity measurement and all of its components. The quantity of goods produced by a worker over a certain period of time is used to calculate labor

productivity. Thus, it is imperative for enterprises to ascertain the most effective metrics for measuring productivity, which include the following: [13].

**RESPONSE:**

To adapt to shifting consumer and market demands, businesses using a product leadership approach must quickly alter organizational and manufacturing procedures. This calls for a wider range of competencies, increased focus on quality, and dedication to company objectives. High levels of human resource participation, a set of individual and group criteria for performance evaluation, and rigorous and ongoing training and development that boosts productivity are how HR practices, with a long-term emphasis, achieve these objectives. [16].

To be successful, it needs to be based on the ideas and efforts of a highly motivated workforce that are in line with the organization's and the employees' interests. In order to increase productivity and efficiency, organizations that wish to implement HR engagement programs must figure out how to reward HR dedication and loyalty. Since work-life balance has several advantages that can aid in achieving this objective, the HR division ought to be heavily involved in overseeing any organizational change [10].

**TIME:**

Time investment unavoidably boosts and enhances productivity, and it necessitates organizational process work to complete some jobs effectively and efficiently while utilizing tools and skills to reach organizational goals. As a result, efficient time management is essential for achieving high performance levels, which are required for organizational success. Time management is then perceived or portrayed as a collection of time management abilities, and it becomes a process by which people complete organizational tasks and goals [12].

**FLEXIBILITY:**

The ability and effectiveness of human resources management and the degree to which it improves an organization's capacity to adjust successfully over time to events and changes in the external environment or within the organization are referred to as flexibility. Therefore, in addition to having the ability to create a resource system, attention should be given to multitalented personnel and understanding of each of their experiences, behaviors, and educational backgrounds. Humanity as an organizational feature that would completely manage workers to enable the company to compete on the basis of adapting to changes in the external environment and reaching high productivity levels, Human resource flexibility is viewed as an opportunity to help an organization deal with changing environmental conditions. This adaptability is thought to help an organization boost performance, increase productivity, and gain a competitive edge over other businesses in the region [15].

**THE QUALITY:**

As businesses progress toward greater industrialization and modernization and toward opening up and integrating into the global economy, qualified human resources become more and more important. The human component is the one that matters most in the aforesaid process's successful completion. Human resources of the highest caliber and qualifications will accelerate the nation's process of regeneration and produce better outcomes. The nation needs a number of crucial elements, including resources, capital, research, and technology, for industrialization and modernization. nature; nonetheless, the human being continues to be the most significant and determining force. Human resources are an internal aspect as opposed to external resources.

determines whether a company will succeed or fail in its social and economic development; as a result, when it comes to resources, human resources—especially skilled human resources—always hold a vital

place and are essential to the nation's industrialization and modernization. Therefore, the degree of experience, knowledge, and skill needed to complete the duties assigned to the members in order to accomplish the goals defines the quality of human resources. Institutional [14].

#### **COST:**

Since human resources are frequently "underutilized" due to their performance being below the upper limit of its potential, the cost of human resources plays a significant role in an organization's ability to gain a competitive advantage and profit from this potential source. He maintained that organizational structures that provide HR the power to regulate how employees carry out their jobs and the effects that HRM practices have on employee abilities and motivation can both have an impact on this discretionary effort. Through the acquisition and development of the organization's human capital, the cost of human resources management affects employee skills. Recruitment processes that yield a large pool of qualified applicants, combined with a valid and reliable selection process, will have a substantial impact on quality, increased productivity, and the kinds of skills possessed by new hires. [8].

#### **4. INCREASE PRODUCTION EFFICIENCY:**

There are steps involved in developing a strategy that helps increase production efficiency. These include defining the facility's goals and production goals in light of material information, planning and scheduling activities to increase productivity, removing evident and visible barriers to productivity, carefully designing methods and systems for measuring productivity, putting in place a plan for productivity improvement, motivating people to carry it out while maintaining performance and productivity levels attained, and monitoring and assessing the plan's execution.

#### **STRATEGIES TO RAISE OUTPUT INCLUDE:**

Because capital resources are expensive, they require special care, so increasing their productivity has a significant positive impact on the institution. Reducing waste and resource wasting is one of the most crucial aspects of increasing the productivity of capital resources. Resources account for a significant portion of production costs—40% on average—so consideration should be given to their design so that wear and tear on the machinery does not increase material consumption, appropriate manufacturing method selection, and worker training throughout the production process in order to maximize resource productivity. While paying attention to packing to preserve the resources, avoid harming the products, ensure their safe delivery to work, and maximize the use of waste materials, the stages of handling, transportation, and storage are properly designed to minimize damaged and lost materials.

Energy needs to be saved and used wisely. On the other hand, because energy accounts for a sizeable amount of manufacturing costs, the urge to lower energy consumption is a national aim in every nation on the planet because of the unpredictability of energy supplies. Measuring present energy consumption rates is one of the processes in the preparation of energy rationalization projects. In order to lower the energy, cost per unit, it is necessary to measure and monitor the outcomes of the rationalization program in addition to analyzing the energy cost per unit of products and setting goals for reducing energy consumption rates. It is preferable to improve maintenance than therapy. One could interpret this component of programs to improve manufacturing efficiency as a catchphrase. This crucial component of productivity is based on the state and functionality of machinery, equipment, and fixed assets, including buildings and other types of fixed capital. After then, care should be taken to keep these resources in better condition and increase their level of performance. It directly contributes to increased productivity. On the other hand, decreasing the amount of downtime and failures brought on by faulty equipment also adds to production indirectly.

Similarly, since the cost of replacing assets is considerable due to the ongoing increases in machinery, equipment, etc., good asset maintenance lessens the constraints placed on businesses. The degree to which the product complies with standards is referred to as improving quality, and this is the design quality. However, quality is determined by how well a product fulfills its intended purpose; this is also known as the quality of use. [2].

##### **5. THE SIGNIFICANCE OF PRODUCTION EFFICIENCY:**

The management of construction engineering projects places a high priority on production efficiency. Here, we strive to attain the maximum level of benefit and profit anticipated from these initiatives while also lowering service prices, improving quality, shortening working hours, and improving the environment that supports production. Through its numerous national projects, the nation's economy has grown thanks in part to production efficiency. Because of the financial benefits it offers, attaining a high standard of quality, and boosting the effectiveness of the administrative and human components, it helps to raise national income. Paying close attention to both the qualitative and quantitative aspects is crucial when it comes to production efficiency. The problem is with the product quality that engineering building projects provide, which benefits the recipients—of which society is an essential component—and leads to a broad sense of contentment with these projects across the nation. The issues of rising unemployment and inflation are resolved by increasing productive efficiency. The country's entire economic picture is influenced by the levels and rates of the workforce that contribute to productivity in these initiatives, as well as by their increased efficiency. When it comes to helping an individual improve his financial circumstances, encouraging incentives and motivations to work harder and produce more, and boosting morale through consistent performance improvement and efficiency gains through experience, productive efficiency is crucial.

The institution's capacity to compete in the markets grows as a result of the quality of its output; it achieves low prices in relation to the cost; it is characterized by ease and ease of production; it decreases waste in the financial and time domains; and it creates opportunities for self-financing. At the institutional level, energy use rates improve; production quantity and rates increase; direct costs and non-unit production decrease. or alliances with domestic and international corporate and public sectors. At the state level, economic growth is picking up speed, the balance of payments is clearly improving, the inflation factor is under control, living standards are rising, prices are effectively controlled, the cash surplus required for more investments is available, and finally, wage levels are rising, which boosts citizens' sense of well-being. [7,5].

##### **6. PRODUCTION EFFICIENCY IN ENGINEERING CONSTRUCTION PROJECTS:**

Based on recent study, a list of findings has been made regarding this topic. The degree to which engineering construction projects are able to make the best use of the material, facilities, and human resources available to obtain a distinguished product in accordance with established standards at the lowest possible cost is the procedural definition of productive efficiency in engineering construction projects. In engineering construction projects, manufacturing efficiency has advantages. By implementing it, the extent to which engineering building projects may leverage the physical facilities and human capital available to provide a superior product in accordance with international standards at the lowest feasible cost can be demonstrated. This allows us to ascertain, via project management, its attributes in compliance with the established and intended criteria, and conditions are considered accordingly. Contracting the



project in accordance with previously established criteria is a crucial step in utilizing productive efficiency in engineering construction projects. Without a doubt, we discover that ensuring that the quality of the tools, materials, and equipment utilized in the project meets the requirements set in the contract is crucial to production efficiency in engineering building projects. Through it, we verify the degree of commitment to improving the project's outcomes according to the observations monitored after applying the agreed-upon standards for the project. With the goal of ensuring that the project implementation procedures are sequential and consistent with the agreed upon standards for it, and thus we can determine a timeline through which the project will be delivered according to what was stipulated in the agreed standards upon which the contract was concluded. One of the advantages of increased production efficiency in engineering building projects is the ability to compute project costs and ensure that they meet the established benchmarks. This helps to accomplish the nature of commitment to the project implementation schedule and degrees of balance between the project's estimated risk costs and their actual costs. It also prevents disasters that could delay project delivery in terms of schedule rather than budget while it is in its final stages. Project management can apply the agreed-upon standards for the project and pay attention to the stage of continuous diagnosis of the problems facing the project and work to solve them immediately to ensure its conformance with the agreed-upon standards for it. Project management is also keen to spread the management culture of productive efficiency because we are interested in achieving productive efficiency in engineering construction projects. The goal of the project is for all project personnel to work toward its accomplishment, which necessitates giving them complete authority to meet the project's established standards.

We conclude that there are project implementation processes that follow a sequential approach that adheres to established criteria, based on the discussion that has taken place. There is a commitment to improving the project's outcomes in accordance with the observations that are monitored after applying the agreed-upon standards. The project must be delivered in accordance with what was specified in the agreed-upon standards and the contract was concluded around it. is chosen for the project, and the budget is determined using the specified criteria. It is necessary to consider how much the project's anticipated risks would cost and how much they will actually cost. Applying the project's standards must be a priority for the project management team.

To make sure that the project complies with the established standards, it is imperative that problems are identified on a regular basis, worked on promptly, and that the project management team instills in all project personnel a culture of productive efficiency.

## **7. RESEARCH METHODOLOGY:**

To gather information on a certain phenomenon or circumstance and convey it in a qualitative or quantitative way, the descriptive analytical method was employed in this study. The quantitative statement attempts to sufficiently explain these facts by providing a numerical description that explains the amount of the phenomena, whereas the qualitative expression characterizes the phenomenon and explains its features. A standardized questionnaire was administered to a representative sample of heads of engineering construction projects in Tripoli, executive directors of these projects, engineers, and some university experts in the field in order to determine the level of availability of productive efficiency in some of these projects.

## 8-SEARCH-INSTRUMENTS:

### Use the search:

1. A list of production efficiency standards that accomplish these projects' main objectives in a workable way.
2. A uniform survey designed by subject-matter experts and specialists to gauge production efficiency availability in a few Tripoli engineering construction projects.

The goal of the current study is to identify the degree of production efficiency in a few Tripoli engineering and construction projects. As several engineering building projects in Tripoli were coming to a close, it became imperative to ascertain the requirements of production efficiency and, from the perspective of subject-matter experts, to prioritize the most significant ones. The actions that were taken were as follows:

### FIRST, SET UP YOUR RESEARCH INSTRUMENTS:

- A set of productive efficiency standards for engineering construction projects is identified by a questionnaire.
- A survey to find out how risk management affects production effectiveness in a few engineering construction projects in Tripoli.

We'll talk about the procedures for getting research instruments ready below.

A survey that provides a list of criteria for engineering construction projects' productive efficiency:

#### (1.1.8) THE PURPOSE FOR CREATING THE QUESTIONNAIRE WAS:

This questionnaire was created with the intention of creating a set of guidelines for production efficiency in engineering building projects based on the insights of subject-matter specialists. Given this, a questionnaire was developed to ascertain how risk management affects production efficiency in a few Tripoli engineering construction projects.

#### (2.1.8) RESOURCES USED TO CREATE THE SURVEY:

The current study used the following resources to build the questionnaire:

- Sources, references, and literature pertaining to the subject of the current study.
- Prior research and studies pertaining to the subject of the current study.
- Guidelines for designing questionnaires.

#### (3.1.8) THE INITIAL VERSION OF THE QUESTIONNAIRE:

The open-ended questionnaire was designed with the intention of monitoring certain benchmarks of productive efficiency in engineering construction projects. It was administered to a group of specialists and experts. Subsequently, the questionnaire was developed in a closed format and reintroduced to the arbitrators and subject matter experts to assess its level of appropriateness for the intended purpose. For each standard of production efficiency in engineering construction projects, the following options were provided on a five-dimensional rating scale: strongly agree, agree, neutral, disagree, and strongly disagree. The results are appended. Other standards you would like to include. The arbitrator was also granted the option to rearrange the criteria or change the language used in the questionnaire's "Modify" section.

#### (4.1.8) GUIDELINES FOR FILLING OUT THE QUESTIONNAIRE:

The research focused on the preparation of instructions, taking into consideration the goal of the questionnaire and the need for them to be precise, succinct, and able to explain to the responder the answer to each aspect.

**(5.1.8) TO GUARANTEE THE QUESTIONNAIRE'S VALIDITY:**

The questionnaire was first prepared and then given to a group of experts in the subject. They were asked to provide their feedback on the questionnaire regarding the following:

- The degree to which these standards accurately reflect the intention behind their preparation.
- The degree to which engineering construction projects' production efficiency criteria are related to each standard.
- The precision and integrity of developing standards using science as a guide.
- The accuracy of the standard's language formulation.
- Correctness of instructions for answering the questionnaire.
- Include, remove, or alter the criteria as they see fit.

The questionnaire was changed in light of the arbitrators' feedback, and some of the arbitrators' suggestions and opinions were taken into consideration when the final version of the questionnaire was created. Certain arbitrators proposed changing the criteria's language, while others proposed adding new ones or eliminating existing ones.

**(6.1.8) VALIDITY OF THE SURVEY:**

Following the completion of the questionnaire's original preparation, steps were taken to codify it, guarantee its scientific accuracy, and make the required adjustments. The resulting calculation was as follows:

**CONTENT INTEGRITY:**

The questionnaire was given to a panel of knowledgeable professors, who provided feedback and recommendations that were put into practice. The suitability of the criteria, their intent, and the clarity of the assertions it made were then put to a panel of arbitrators drawn from the engineering faculties of several Libyan universities. Several arbitrators made remarks about They provided several remarks and several suggestions for changes, all of which were taken into consideration when the questionnaire's final version was being created. They then gave it to a few arbitrators once more, and they approved the questionnaire in its completed version.

**QUESTIONNAIRE STABILITY:**

The stability of the questionnaire refers to its measurement and observational accuracy, its self-consistency, its ability to yield consistent results when administered repeatedly under the same or comparable conditions, and the various methods available for determining its reliability.

**INTERNAL CONSISTENCY:**

The goal is to ascertain whether the questionnaire is internally consistent, which means that every statement seeks to measure the same function that every other statement does. The questionnaire's internal consistency validity is utilized to weed out false statements. Correlation coefficients were computed between each statement and the questionnaire's overall score in order to assess internal consistency. The results indicated at the level of (0.01, 0.05), the correlation coefficients are statistically significant. As a result, the research tool—a questionnaire for determining standards of productive efficiency—enjoyed a high degree of internal consistency. The stability of the research tool was determined using the Crombach alpha coefficient, using the statistical program (SPSS). The research tool was administered to a sample of



30 field experts using (Google Form). The questionnaire's dependability level was attained (0.863), and this level permits the research tool to be used to reveal its goals.

**Table (1) provides a detailed representation of the correlation coefficients for a sample of 30 questionnaire statements that determine productive efficiency norms.**

**Table (1)**

Questionnaire	12	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
																		1.000	1
																	1.000	.516*	2
																1.000	.405*	.412*	3
															1.000	.452*	.411*	.475*	4
														1.000	.401*	.530*	.533*	.481*	5
												1.000	.763*	.467*	.500*	.411*	.467*		6
											1.000	.445*	.455*	.506*	.457*	.456*	.441*		7
										1.000	.356*	.405*	.516*	.401*	.363*	.545*	.480*		8
									1.000	.523*	.521*	.411*	.544*	.504*	.556*	.422*	.444*		9
								1.000	.522*	.425*	.481*	.422*	.384*	.412*	.456*	.738*	.385*		10
							1.000	.385*	.752*	.544*	.506*	.500*	.525*	.467*	.541*	.477*	.515*		11
						1.000	.576*	.507*	.455*	.384*	.456*	.454*	.583*	.455*	.386*	.465*	.410*		12
					1.000	.523*	.565*	.371*	.763*	.454*	.578*	.405*	.450*	.457*	.511*	.580*	.580*		13
				1.000	.365*	.546*	.465*	.577*	.408*	.545*	.725*	.461*	.371*	.485*	.544*	.350*	.425*		14
			1.000	.515*	.606*	.507*	.465*	.523*	.367*	.424*	.541*	.387*	.545*	.372*	.363*	.523*	.480*		15
		1.000	.492*	.566*	.593*	.713*	.565*	.475*	.474*	.580*	.528*	.461*	.523*	.481*	.467*	.474*	.526*		16
	1.000	.548*	.596*	.477*	.422*	.418*	.477*	.506*	.422*	.415*	.526*	.545*	.544*	.455*	.484*	.364*	.588*		17
1.000	.605*	.526*	.395*	.485*	.506*	.455*	.408*	.520*	.422*	.386*	.500*	.488*	.412*	.367*	.475*	.461*	.412*		18
1.000	.456*	.556*	.748*	.535*	.583*	.744*	.584*	.834*	.422*	.301*	.555*	.585*	.542*	.481*	.704*	.565*	.605*	.375*	Quasi Normal ity

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

\* . Correlation is significant at the 0.05 level (2-tailed).

The following are the findings from the experts' questionnaire response regarding a set of requirements for productive efficiency in engineering construction projects:

From the perspective of field experts, Table (2) displays the degree and level of approval, frequencies, percentages, and relative weight of production efficiency criteria in engineering construction projects for a sample of 30.

**Table (2)**

Approval level	K <sup>2</sup>	Relative weight	Level of acceptance					/a %	Phrase	No.
			Vehemently disagree	Don't Agree	Impartial	Agree	Completely concur			
Vehemently agree	.000	4.5000	—	—	—	18	18	K	The qualities of a project are determined by the standards that have been agreed upon and targeted.	1
			—	—	—	50.0	50.0	5%		
Vehemently agree	12.200	4.4667	—	—	1	14	15	K	Considering the project's contract terms in the context of the previously established criteria.	2
			—	—	3.3	46.7	50.0	5%		
Vehemently agree	12.600	4.3000	—	—	1	13	16	K	Examine the tools, materials, and equipment quality utilized in the project in relation to the standards that were agreed upon and outlined in the contract.	3
			—	—	3.3	43.3	53.3	5%		
Vehemently agree	.000	4.5000	—	—	—	19	15	K	The processes used to implement projects are step-by-step and adhere to established norms.	4
			—	—	—	50.0	50.0	5%		
Vehemently agree	.133	4.3333	—	—	—	14	16	K	Completing the project in line with the predetermined criteria in order to fulfill the terms of the contract.	5
			—	—	—	46.7	53.3	5%		
Vehemently agree	.000	4.3000	—	—	—	16	18	K	A dedication to enhancing the project's results in light of the findings obtained from the application of the established project criteria.	6
			—	—	—	50.0	50.0	5%		
Agree	2.600	4.1667	—	—	6	13	11	K	The project's cost is in line with the predetermined parameters.	7
			—	—	20.0	43.3	36.7	5%		
Vehemently agree	1.200	4.4000	—	—	—	18	12	K	The proportionality between the project's anticipated risk costs and their actual costs.	8
			—	—	—	60.0	40.0	5%		
Vehemently agree	12.200	4.4333	—	1	—	14	15	K	Adherence to the schedule for carrying out the project's phases until its conclusion.	9
			—	3.3	—	46.7	50.0	5%		
Agree	16.333	5.7333	2	2	5	14	7	K	Refrain from projecting disasters that could impede the timely and cost-effective completion of the project.	10
			6.7	6.7	16.7	46.7	23.3	5%		

Vehemently agree	.000	4.5000	—	—	—	15	15	K	The interest of project management in implementing established guidelines for the project.	.11
			—	—	—	50.0	50.0	%		
Vehemently agree	14.600	4.5667	—	—	1	11	14	K	Diagnosing and fixing the project's issues on a continual basis to make sure it complies with the established requirements.	.12
			—	—	3.3	36.7	60.0	%		
Vehemently agree	9.800	4.3667	—	—	2	15	13	K	Fostering a culture of efficient and productive work among all project staff through project management in order to achieve it.	.13
			—	—	6.7	50.0	43.3	%		
Agree	5.467	3.8333		6	3	11	10	K	Giving project employees complete authority to complete the project in accordance with the established standards.	.14
				20.0	10.0	36.7	33.3	%		
Agree	11.400	4.2000	—	—	1	18	9	K	Proposals that enhance the work of all project participants can be made possible by project management.	.15
			—	—	10.0	60.0	30.0	%		
Vehemently agree	.133	4.4667	—	—	—	16	14	K	An atmosphere that is supportive of attaining the established project criteria is guaranteed by project management.	.16
			—	—	—	53.3	46.7	%		
Vehemently agree	12.200	4.4667	—	—	1	14	15	K	In line with its dedication to the established standards and its eagerness to meet them, project management is concerned with realizing the goals and objectives of the project clients.	.17
			—	—	3.3	46.7	50.0	%		
Vehemently agree	22.800	4.3667	1	—	1	13	15	K	The project management team is eager to track customer satisfaction levels throughout the project.	.18
			3.3	—	3.3	43.3	50.0	%		

Given the aforementioned findings, it is evident that the research sample's degree of agreement with the specified criteria for productive efficiency in engineering building projects fell between the range of strong agreement and level of agreement. This shows how important the standards it is founded on are when assessing engineering building projects in a way that is methodologically precise and practical. When it is found to be available in these projects, it must also be activated.

**(8.1.8) THE COMPLETED QUESTIONNAIRE IMAGE:**

The questionnaire was finalized and presented after undergoing the necessary modifications, including additions, deletions, and modifications in light of the arbitrators' opinions. This was done in order to ensure a suitable level of accuracy when identifying the list of productive efficiency standards in engineering construction projects. After consulting with several industry experts and incorporating their suggestions, the final version of the list of requirements for production efficiency in engineering building projects were created.

**Table (3)**

In response					Standard	No.
Not really accessible	Not accessible	Indifferent	Accessible	Extremely accessible		
					The degree to which engineering construction projects are able to make the best use of the facilities, materials, and labor resources available to get a distinguished product in accordance with international standards at the lowest feasible cost is known as production efficiency.	
					The qualities of a project are determined by the standards that have been agreed upon and targeted.	1
					Considering the project's contract terms in the context of the previously established criteria.	2
					Examine the tools, materials, and equipment quality utilized in the project in relation to the standards that were agreed upon and outlined in the contract.	3
					The processes used to implement projects are step-by-step and adhere to established norms.	4
					Completing the project in line with the predetermined criteria in order to fulfill the terms of the contract.	5
					A dedication to enhancing the project's results in light of the findings obtained from the application of the established project criteria.	6
					The project's cost is in line with the predetermined parameters.	7
					The proportionality between the project's anticipated risk costs and their actual costs.	8

In response					Standard	No.
Not really accessible	Not accessible	Indifferent	Accessible	Extremely accessible		
					Adherence to the schedule for carrying out the project's phases until its completion.	9
					Efforts from projecting standards that could impede the timely and cost-effective completion of the project.	10
					The intent of project management in organizing established guidelines for the project.	11
					Engaging and firing the project's team on a constant basis to make sure it complies with the established requirements.	12
					Forming a culture of efficiency and productivity work among all project staff through project management in order to achieve it.	13
					Giving project employees complete authority to complete the project in accordance with the established standards.	14
					Proposals that enhance the work of all project participants can be made possible by project management.	15
					An atmosphere that is supportive of meeting the established project criteria is generated by project management.	16
					In line with its dedication to the established standards, the organization is committed to meet them. Project management is concerned with	17

In response					Standard	No.
Not really accessible	Not accessible	Indifferent	Accessible	Extremely accessible		
					realizing the goals and objectives of the project clients	
					The project management team is eager to track customer satisfaction levels throughout the project	18

**9. STUDY SAMPLE:**

To ensure a diverse range of perspectives, the study incorporated a representative sample of individuals including engineers, department heads, project managers, university experts, and executive directors from various institutions. The sample was deliberately chosen to precisely analyses specific characteristics of it

through testing. Employ appropriate statistical methodologies to obtain accurate results. The equation devised by Stephen Thompson was employed to determine the population size of 60.

**Whereas:**

Z: standard score equal to (1.96) and comparable to the level of significance (0.95)

N: The community's size has reached 60

d: the error rate, or (0.05)

P: Equivalent to 0.50, the ratio of the property's availability to neutrality

$$n = \frac{N \times P(1 - P)}{[N - 1 \times (d^2 \div z^2)] + p(1 - p)}$$

Next, the 53 study population members in Tripoli that comprised the sample were identified.

$$n = 60 * 0.50 (1 - 0.50) / [60 - 1 * \{(0.05)^2 / (1.96)^2\} + 0.50 (1 - 0.50)]$$

$$n = 60 * 0.50 * 0.50 / [59 * (0.0025 / 3.841)] + 0.50 * 0.50$$

$$n = 60 * 0.25 / [59 * 0.00065] + 0.25$$

$$n = 15 / 0.03835 + 0.25$$

$$n = 15 / 0.28834 = \underline{52.0201144}$$

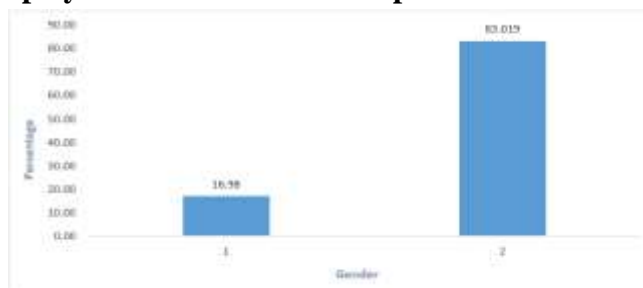
**(1.9) Analysis of the primary data (categorical variables) obtained from the questionnaire:** Presented below is an overview of the primary statistical data (pertaining to categorical variables) for the research sample:

**FIRSTLY, THE GENDER:** variable is shown in Table 3 and Figure 1, illustrating the distribution of respondents according to their gender.

**Table (3) displays the distribution of responders based on the gender variable.**

Percentage	Number of answers	Gender
16.98	9	Female
83.019	44	Male
100%	53	Sum

**Figure (1) displays the distribution of respondents based on their gender.**



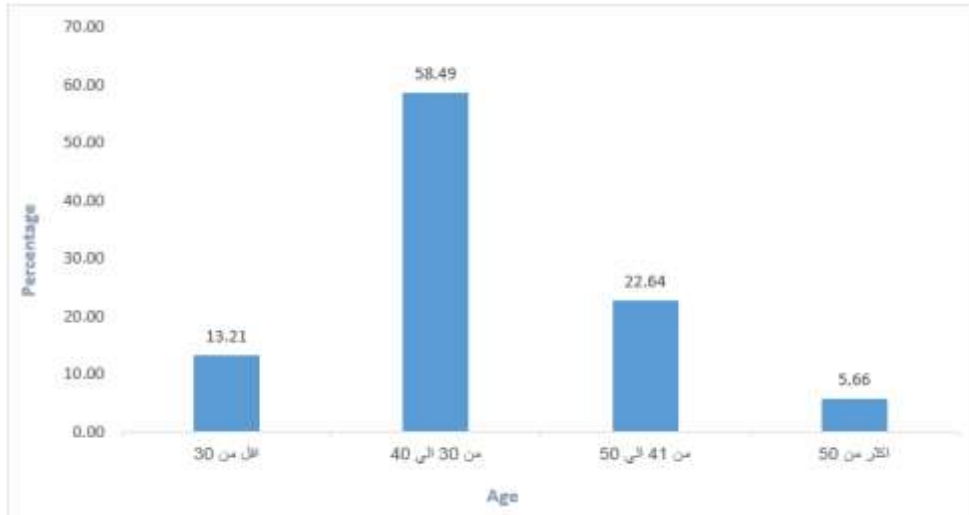
**SECONDLY:** the age variable comes in second. The age variable's distribution of respondents is displayed in Table No. (4) and Figure No. (2).



Table (4) displays the distribution of responders based on the age variable.

Percentage	Number of answers	Age
13.21	7	Less than 30
58.49	31	From 30 to 40
22.64	12	From 41 to 50
5.66	3	More than 50
100%	53	Sum

Figure (2) displays the distribution of responders based on their age.

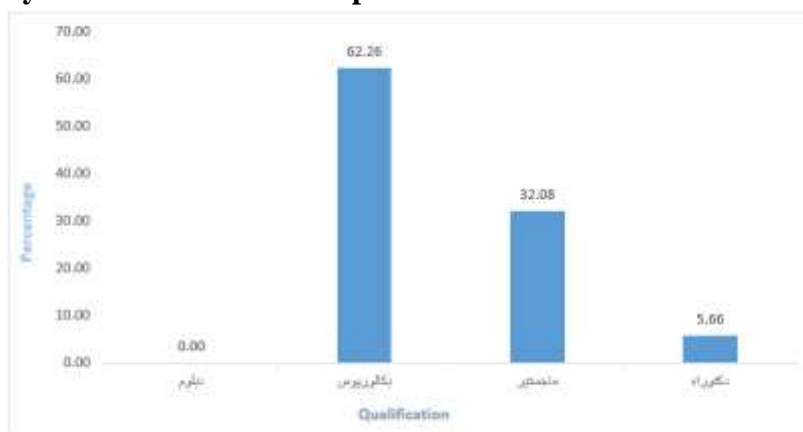


**THIRD:** The variable for academic qualification: The distribution of respondents based on academic qualification is displayed in Table No. (5) and Figure No. (3).

Table (5) presents the distribution of respondents based on their academic qualifications.

Percentage	Number of answers	Qualification
0.00	0	Diploma
62.26	33	Bachelor's
32.08	17	Master's
5.66	3	PhD
100%	53	Sum

Figure (3) displays the distribution of responders based on their educational qualification.

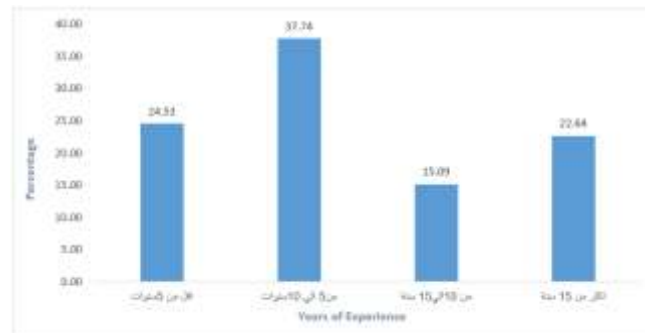


**FOURTH:** The experience variable: The distribution of respondents by experience is displayed in Table No. (6) and Figure No. (4).

The table (6) presents the distribution of responders based on their level of experience.

Percentage	Number of answers	Years of Experience
24.53	13	Less than 5 years
37.74	20	From 5 to 10 years
15.09	8	From 10 to 15 years
22.64	12	More than 15 years
100%	53	Sum

Figure (4) displays the distribution of responders based on their level of experience.

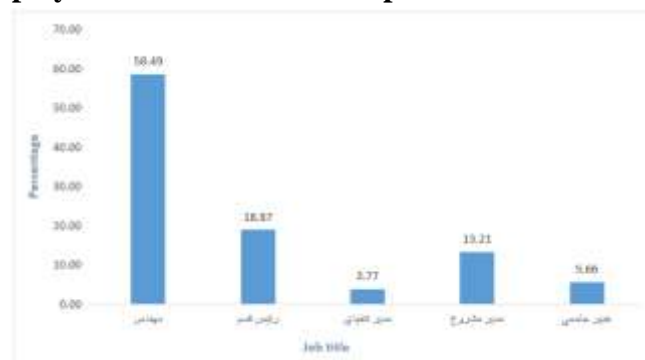


**FIFTH:** Job title variable: The distribution of respondents based on the job title variable is displayed in Table (7) and Figure (5).

The table (7) presents the distribution of responders based on their job title variable.

Percentage	Number of answers	Job title
58.49	31	Engineer
18.87	10	Head of the Department
3.77	2	Executive Director
13.21	7	Project manager
5.66	3	University expert
100%	53	The total

Figure (5) displays the distribution of responders based on their work title.



**(2.9) A FEW COMPUTATIONS MADE IN THE COURSE OF EXAMINING THE QUESTIONNAIRE'S PRIMARY AXES:**

The Statistical Package for the Social Sciences (SPSS) was utilized in conjunction with other suitable statistical techniques to accomplish the study's goals and analyze the data that was gathered. Following the distribution of the surveys, the data and responses pertaining to the five-point scale were encoded using a digital technique, as shown in table (8).

**Table (8)**

Not really accessible	Not accessible	Indifferent	Accessible	Extremely accessible	The answer
1	2	3	4	5	Degree

For every statement on the questionnaire, the hypothetical average was also computed. This is represented by Equation No. (1), which multiplies the highest degree of the user's Lickerth scale by the percentage that experts in the relevant field find satisfactory.

must be compared to the sample's (realistic) arithmetic mean, and to perform the necessary statistical tests in order to obtain precise findings.

For the Lickerd scale, the hypothetical mean is equal to the % times the highest answer score. (1) 3.5 is the hypothetical mean, or 70% times 5.

All of the results will be examined, debated, and the research hypothesis addressed in the results.

**10. STATISTICAL TREATMENT:**

To address the research issues and evaluate the viability of the hypotheses, the following statistical techniques were applied: chi2 value, proportions, relative weights, and frequencies.

Standard deviations and averages.

The T-test is used to illustrate the variations between the theoretical and actual means. The degree of correlation between each axis and the phrases that are produced from it, as well as between the axes and one another, is displayed by the Pearson correlation coefficient.

**11. RESULTS:**

In order to test the validity of the research hypotheses in light of the theoretical framework and prior studies, this chapter presents the research procedures in terms of experimental design, sample members, research tools, and steps for conducting them. It also discusses and interprets the statistical analysis results, which reveal the impact of risk management on production efficiency in some engineering construction projects. The research findings that came about as a result of the statistical analysis are presented below. These findings were given in accordance with the following question and hypothesis.

**RESEARCH QUESTION:**

How efficient are some engineering building projects in Tripoli in terms of production?

**HYPOTHESIS-FOR-SEARCH:**

Certain engineering building projects in Tripoli do not adhere to production efficiency criteria.

**12- Results related to the question and its hypothesis:**

How efficient are various engineering building projects in Tripoli in terms of production? Theory: Some engineering construction projects in Tripoli do not adhere to production efficiency criteria. Table (9) presents the targeted research sample's perspective on the arithmetic means, standard deviations,

t-value, and statistical significance of the production efficiency axis in various engineering construction projects in Tripoli.

**Table (9)**

**The intended study sample in Tripoli was analyzed to determine the arithmetic means, standard deviations, (t) value, and statistical significance of the degree of production efficiency in engineering building projects.**

Sig. (2-tailed)	df	t	Std. Error Mean	Std. Deviation	N	Mean	
			0.000	0.000	53	3.500	Hypothetical mean
0.000	52	5.845	0.175	1.290	53	2.471	The processes used to implement projects are step-by-step and adhere to established norms.
			0.000	0.000	53	3.500	Hypothetical mean
0.000	52	5.075	0.167	1.366	53	2.547	Completing the project in line with the predetermined criteria in order to fulfil the terms of the contract.
			0.000	0.000	53	3.500	Hypothetical mean
0.000	52	4.974	0.191	1.394	53	2.547	A dedication to enhancing the projects results in light of the findings obtained from the application of the established project criteria.
0.000	52	4.932	0.000	0.000	53	3.500	Hypothetical mean
			0.185	1.350	53	2.584	The project's cost is in line with the predetermined parameters.
			0.000	0.000	53	3.500	Hypothetical mean
0.000	52	7.509	0.169	1.234	53	2.226	The proportionality between the projects anticipated risks costs and their actual costs.
			0.000	0.000	53	3.500	Hypothetical mean
0.000	52	7.199	0.169	1.230	53	2.293	Adherence to the schedule for carrying out the projects phases until its conclusion.
Sig. (2-tailed)	df	t	Std. Error Mean	Std. Deviation	N	Mean	
			0.000	0.000	53	3.500	Hypothetical mean
0.000	52	5.167	0.158	1.156	53	2.679	The qualities of a project are determined by the standards that have been agreed upon and targeted.
			0.000	0.000	53	3.500	Hypothetical mean
0.000	52	6.144	0.167	1.218	53	2.471	Considering the project's contract terms in the context of the previously established criteria.
			0.000	0.000	53	3.500	Hypothetical mean
0.000	52	6.705	0.164	1.198	53	2.596	Examine the tools, materials, and equipment quality utilized in the project in relation to the standards that were agreed upon and outlined in the contract.

Sig. (2-tailed)	df	t	Std. Error Mean	Std. Deviation	N	Mean	
0.000	52	5.304	0.000	0.000	53	3.500	Hypothetical mean
			0.168	1.230	53	2.603	Retrain from projecting disasters that could impede the timely and cost-effective completion of the project.
0.000	52	4.046	0.000	0.000	53	3.500	Hypothetical mean
Sig. (2-tailed)	df	t	Std. Error Mean	Std. Deviation	N	Mean	
0.000	52	6.587	0.000	0.000	53	3.500	Hypothetical mean
			0.181	1.324	53	2.301	Giving project employees complete authority to complete the project in accordance with the established standards.
0.000	52	5.882	0.000	0.000	53	3.500	Hypothetical mean
			0.165	1.202	53	2.528	Proposals that enhance the work of all project participants can be made possible by project management.
0.000	52	4.271	0.000	0.000	53	3.500	Hypothetical mean
			0.187	1.388	53	2.698	An atmosphere that is supportive of attaining the established project criteria is guaranteed by project management.
			0.188	1.374	53	2.735	The interest of project management in implementing established guidelines for the project.
0.000	52	5.562	0.000	0.000	53	3.500	Hypothetical mean
			0.195	1.420	53	2.415	Diagnosing and fixing the project's issues on a continual basis to make sure it complies with the established requirements.
0.000	52	5.139	0.000	0.000	53	3.500	Hypothetical mean
			0.181	1.323	53	2.598	Fostering a culture of efficient and productive work among all project staff through project management in order to achieve it.



0.000	52	5.863	0.000	0.000	53	3.500	Hypothetical mean
			0.207	1.511	53	2.283	In line with its location to the established standards and its eagerness to meet them, project management is concerned with realizing the goals and objectives of the project clients.
0.000	52	5.568	0.000	0.000	53	3.500	Hypothetical mean
			0.191	1.393	53	2.434	The project management team is eager to track customer satisfaction levels throughout the project.
0.000	52	-15.694	1.161	8.454	53	44.773	Production efficiency axis
			0.000	0.000	53	63.000	Hypothetical average production efficiency

We can respond to the question and hypothesis by generally examining the facts in the preceding table, since it is evident that certain engineering construction projects in Tripoli lack production efficiency criteria. The hypothetical and realistic averages of production efficiency standards in some engineering construction projects in Tripoli have a statistically significant effect in favor of the hypothetical average at the level ( $0.05 \geq \alpha$ ), meaning that some engineering construction projects in Tripoli lack production efficiency standards. The study sample's outcomes were broken down into the following details:

1. Through their comments, the research sample attested to the fact that the project management does not ascertain its qualities in accordance with the established and intended criteria. The calculated (t) recorded a statistically significant value of (5.167), in favor of the hypothesized average, despite the realistic average being lower. This suggests that project management should define its characteristics in line with the agreed upon and targeted standards.
2. According to the research sample, the project's contract terms are not evaluated in accordance with the previously established standards. The calculated (t) recorded a statistically significant value of (6.144), in favor of the hypothetical average, indicating that the realistic average was less than the hypothetical average. This indicates that it is crucial to consider the project's contract terms in light of the previously established criteria.
3. The study sample's response verified that the requirements mentioned in the contract are not being followed when evaluating the quality of the tools, materials, and equipment used in the project. The computed (t) yielded a statistically significant value of (6.705), favoring the hypothetical average, since the realistic average was lower than the hypothetical average. This demonstrates how crucial it is to check that the tools, materials, and equipment utilized for the project meet the requirements specified in the contract.
4. The research sample attested to the fact that the project execution methods are not sequential and in accordance with the established criteria; the calculated (t) recorded a statistically non-significant value of 5.848, and the practical average was less than the hypothetical average. This emphasizes how important it is to set up project implementation processes that follow a set of agreed-upon criteria and are sequential.
5. The research sample's responses verified that the project is not being completed in accordance with the terms specified in the standards that were agreed upon when the contract was signed; the hypothetical average was recorded as having a statistically significant value of (5.075), favoring the

- hypothetical average; the realistic average was less than the hypothetical average. This demonstrates how crucial it is to complete the project in accordance with the requirements outlined in the criteria that were agreed upon, and around which the contract was signed.
6. The research sample's responses led to a thorough knowledge that no effort is being made to improve the project's outcomes based on the observations that are tracked following the application of the project's established standards. The computed (t) yielded a statistically significant value of (4.974), favoring the hypothetical average, since the realistic average was lower than the hypothetical average. This shows how crucial it is to be dedicated to enhancing the project's results based on the observations that are tracked following the use of the established project criteria
  7. The research sample's replies revealed that the project cost is not determined using the established criteria. The calculated (t) revealed a statistically significant value of (4.932), in favor of the hypothetical average, despite the fact that the practical average was more than the hypothetical average. This means that the project cost must be determined in compliance with the established guidelines.
  8. The research sample showed that there is an unbalanced cost between the project's anticipated hazards and their actual costs. The calculated (t) recorded a statistically significant value of (7.509), in favor of the hypothetical average, indicating that the realistic average was lower than the hypothetical average. This indicates the significance of accounting for the balance between the project's expected risk costs and their actual costs.
  9. The research sample's replies revealed that the project's implementation timeline is not followed through to its conclusion. The estimated (t) yielded a statistically significant value of (7.199), favoring the hypothetical average, because the practical average was lower than the hypothetical average. This means that the project's timeline must be followed in order to carry it out in its entirety.
  10. The study sample's response verified that disasters that could delay project completion shouldn't be prevented in terms of money but rather time; the hypothetical average was greater than the realistic average, and the calculated (t) value showed a statistically significant value of (5.304), favoring the hypothetical average. This demonstrates how crucial it is to steer clear of calculation disasters that could impede the timely and cost-effective completion of projects.
  11. The research sample revealed that the project management has no interest in implementing the standards that have been decided upon for the project. The calculated (t) revealed a statistically significant value of (4.046), in favor of the hypothetical average, since the realistic average was lower than the hypothetical average. This suggests that adopting the established criteria for the project is something that project managers need to be mindful of.
  12. The research sample's replies revealed that the project's issues are not continuously identified and worked to resolve in order to guarantee that it complies with the requirements set forth for it. The calculated (t) revealed a statistically significant value of (5.562), in favor of the hypothetical average, since the practical average was lower than the hypothetical average. This demonstrates that in order to guarantee that the project complies with the requirements set forth for it, faults should be continuously identified and worked to remedy right away.
  13. The research sample's replies led to a thorough knowledge that not all project personnel are encouraged to strive toward a culture of productive efficiency by the project management. The calculated (t) yielded a statistically significant value of (5.139), favoring the hypothesized average, because the realistic average was lower than the postulated average. This highlights how crucial it is for project

managers to instill a culture of productive efficiency among all project participants in order to achieve it.

14. The research sample's responses demonstrated that not all authority is given to project workers to meet the project's established standards; the calculated (t) value of (6.587), favoring the hypothetical average, was statistically significant, and the realistic average was lower than the hypothetical average. This demonstrates how crucial it is to provide project personnel complete authority in order to complete the project to the predetermined standards.
15. According to the research sample's comments, project management does not welcome suggestions that would enhance the work of individual project participants. The calculated (t) recorded a statistically significant value of (5.882), in favor of the hypothetical average, despite the fact that the realistic average was higher. This means that the project management must be receptive to suggestions that enhance the work of all project participants.
16. According to the research sample's comments, project management cannot ensure that an atmosphere will be created that will help the project meet its predetermined standards. The calculated (t) yielded a statistically significant value of (4.271), favoring the hypothetical average, because the realistic average was lower than the hypothetical average. This means that in order to help the project reach its predetermined goals, project management must guarantee that a conducive atmosphere is available.
17. The research sample's reaction verified that the project management is committed to meeting the established criteria and is eager to do so, even if it means that it does not give a damn about the goals and dreams of the project clients. The calculated (t) showed a statistically significant value of (5.863), in favor of the hypothetical average, indicating that the practical average was lower than the hypothetical average. This attests to the significance of project management's focus on fulfilling the goals and ambitions of the project's clients in line with its dedication to the established standards and its eagerness to do so.
18. The research sample's responses verified that the project management is not enthusiastic about regularly gauging the project clients' level of satisfaction. The computed (t) yielded a statistically significant value of (5.568), favoring the hypothetical average, since the realistic average was lower than the hypothetical average. This demonstrates how crucial it is for project managers to continuously gauge the level of customer satisfaction with their work.
19. The research sample's overall answer to the axis of productive efficiency in engineering construction projects verified that Tripoli's engineering construction projects do not exhibit a degree of productive efficiency that is acceptable. The calculated (t) yielded a statistically significant value of (15.694), favoring the hypothesized average, because the realistic average was lower than the postulated average.

### 13. CONCLUSION:

This paper aims to disclose the degree of production efficiency in a few engineering construction projects located in Tripoli. Upon field application of the tool, the following conclusions were drawn about the production efficiency in a few engineering construction projects located in Tripoli:

- Certain engineering building projects in Tripoli do not adhere to production efficiency criteria. From the perspective of the research sample, it has been demonstrated through field application that certain engineering construction projects in Tripoli lack production efficiency norms.

**14. RECOMMENDATIONS:**

- It is imperative to consider the availability of continual monitoring systems for both the project's internal and external environments in order to keep an eye out for potential changes.
- Project management must keep an eye on how project methods and procedures are being implemented.
- Care must be taken to ensure that the tools, materials, and equipment utilized for the project meet the requirements outlined in the contract.
- The requirement to enhance the project's results in accordance with the observations made following the application of the established project standards.
- In order to guarantee that the project complies with the established criteria, issues should be continuously identified and addressed.
- The significance of project management's focus on fulfilling the goals and ambitions of the project's clients in line with its dedication to the contracting standards and its eagerness to do so.

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**16-Addendices:**

In response					Standard	No.
Not really accessible	Not accessible	Indifferent	Accessible	Extremely accessible		
The degree to which engineering construction projects are able to make the best use of the facilities, materials, and labor resources available to get a distinguished product in accordance with international standards at the lowest feasible cost is known as production efficiency.						
					The qualities of a project are determined by the standards that have been agreed upon and targeted.	1
					Considering the project's contract terms in the context of the previously established criteria.	2
					Examine the tools, materials, and equipment quality utilized in the project in relation to the standards that were agreed upon and outlined in the contract.	3
					The processes used to implement projects are step-by-step and adhere to established norms.	4
					Completing the project in line with the predetermined criteria in order to fulfill the terms of the contract.	5
					A dedication to enhancing the project's results in light of the findings obtained from the application of the established project criteria.	6
					The project's cost is in line with the predetermined parameters.	7

In response					Standard	No.
Not really accessible	Not accessible	Indifferent	Accessible	Extremely accessible		
					In line with its dedication to the established standards and its eagerness to meet them, project management is concerned with realizing the goals and objectives of the project clients.	17
					The project management team is eager to track customer satisfaction levels throughout the project.	18



In response					Standard	No.
Not really accessible	Not accessible	Indifferent	Accessible	Extremely accessible		
					The proportionality between the projects anticipated risk costs and their actual costs.	8
					Adherence to the schedule for carrying out the project's phases until its conclusion.	9
					Refrain from projecting disasters that could impede the timely and cost-effective completion of the project.	10
					The interest of project management in implementing established guidelines for the project.	11
					Diagnosing and fixing the project's issues on a continual basis to make sure it complies with the established requirements.	12
					Fostering a culture of efficient and productive work among all project staff through project management in order to achieve it.	13
					Giving project employees complete authority to complete the project in accordance with the established standards.	14
					Proposals that enhance the work of all project participants can be made possible by project management	15
					An atmosphere that is supportive of attaining the established project criteria is guaranteed by project management	16