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Contributing Factors to Key Performance Indicators of Saudi Arabian Construction Project Success

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ABSTRACT

Practitioners and scholars express concern about construction projects that are unable to achieve the specified goals or objectives. Therefore, this study sought to identify the factors that impact Key Performance Indicators (KPIs), which are crucial to every successful construction project. Construction performance measurement often uses objective KPIs to quantify project success. Project success is presumed if it is completed on schedule, according to budget, and with the specified quality, known as the "iron triangle." Subsequently, reviewing relevant literature, crucial KPIs for construction projects were selected. Then, a pilot study finalized the empirical survey questionnaire. The survey was administered to 124 practitioners in the KSA Construction industry, and the response rate was 85%. Employing SPSS version 26, the relative importance index (RII) and mean value were calculated to prioritize. The internal consistency and overall value of the coefficient alpha test were 0.717, and the Kaiser-Meyer-Olkin (KMO) statistics were 0.716 > 0.5, confirming sufficient sample size and further study. The survey determined that respondents placed KPIs in construction projects from 3.802 to 4.387 and RII from 0.877 to 0.760. Most respondents rated "time of project" as the first highest ranking on KSA construction projects, with a mean score of 4.387 and RII of 0.877. The second highest was "cost of project," followed by "quality," "safety," and "sustainable construction." The lowest five ranks were "Defects," "Procurement," "Maintenance," "Human Resource Management," and "Business Performance," with mean scores of 3.802 and RII 0.760. This research adds to the corpus of knowledge on the Saudi Arabian key performance indicators for construction projects.

1. Introduction

The construction industry is crucial to every nation's growth. Buildings, roads, and bridges are physical infrastructure examples that may gauge economic progress. Developing a construction project requires many partners, methods, phases, and stages of work and much input from the public and private sectors [1]. The construction sector in the Kingdom of Saudi Arabia (KSA) is booming as a result of several government programmes, with construction projects becoming massive,

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complicated, fast-paced, and highly competitive as multinational firms invest in the region. The construction sector is Saudi Arabia's second largest after the petrochemical industry and one of the fastest expanding in the Gulf area, with an annual spend of $120 million [2]. It is significant to emphasise that the effectiveness of the various parties' management, financial, technical, and organisational performance substantially influences the degree of success in carrying out construction project development activities [3,4]. The Baldridge National Programme classifies performance into four (4) categories: product and service, customer-focused, financial and marketplace, and operational. While each category reflects performance, their respective focuses vary [5]. Within the framework of a construction project, the success of the project may be evaluated differently by construction companies based on their aims [6]. What observed measure of success on one project may be considered an indicator of utter failure on another? In reality, it is difficult to determine if a project's performance is a success or a failure since the definition of success is ambiguous among project participants. When a construction project is completed on schedule, within budget, according to specifications, and with the satisfaction of all stakeholders, either individually or collectively, it is deemed successful [7]. The construction projects are unique, novel, specialised, and time-sensitive. Due to the complexity and unpredictability of projects, project-based organisations face significant challenges. The success of construction projects is difficult to predict [8,9].

The profitability of the construction industry has a considerable impact on the overall national economy. A successful project execution strategy is required, and given the global influence of the construction sector, it is critical to regularly monitor project performance [10]. The concept of project success and the metrics for measuring project performance are the most extensively researched topics in construction management. Numerous studies have been conducted in order to establish construction performance indicators [11,12]. However, with growing environmental concerns and ever-changing client needs, project success is challenging. Global economic circumstances, limited resources, a lack of skilled team members, a limited budget, and severe competition for the construction firm are some of the issues [13,14]. A thorough review of the engineering management and project management literature indicated that the majority of the studies identified performance categories for measuring performance in various situations [15]. More research is needed to determine the relative importance of the components that contribute to the key performance indicators of Saudi construction project success. This study uses a questionnaire technique to investigate the viewpoints of KSA construction experts in order to identify and evaluate the indicators. The purpose of this study is to establish the significance of KPIs in the completion of construction projects, identify the most significant performance metrics, and adopt a set of KPIs for the Kingdom of Saudi Arabia (KSA) construction industry. The critical performance areas highlighted by this research will thus serve as critical indications for construction professionals to increase project success.

1.1 Construction Industry in KSA

The construction industry in the KSA is experiencing astonishing growth due to different government initiatives, with construction projects becoming enormous, complex, fast-paced, and highly competitive due to global corporations' investment in the region [16,17]. Saudi Arabia has the largest construction industry in the Middle East, spending over USD 120 billion annually and employing over 15% of the country's population [18]. This surge in the construction industry increased the demand for governmental and private development projects [19]. According to Alharbi [20], oil exports have fuelled Saudi Arabia's construction boom. His statement that oil exports account for 80% of the KSA's GDP implies that construction activity rises and falls with oil prices. Population growth in Saudi Arabia is boosting the need for houses and infrastructure, promising a successful future for the country's construction industry [21]. In terms of infrastructure, the government-built railroads linked north and south. Another line connects Jeddah to Dammam's King Abdul Aziz Port and Jubail's King Fahd Port. An extension of the Holy City Railway commenced in 2008. It serves Dammam, Jubail, Jeddah, Makkah, and Medina. Riyadh, Makkah, and Medina are all getting railways. Simultaneously, the government promotes private commercial real estate development initiatives [20-22].

Several significant infrastructure and development projects in Saudi Arabia's Vision 2030 are called "giga projects." The "New Enterprise Operating Model" (NEOM) aims to build a city on the Kingdom's Red Sea coast's northwest coast using cutting-edge urban design and automation technologies. Sustainable technology, zero-carbon infrastructure, and a business-friendly administration will cost $500 billion in the NEOM future metropolis [23]. "THE LINE" is a million-person city that retains 95% of nature within NEOM, with no cars, no streets, and no carbon emissions [24]. The second "Giga project" is the Red Sea, a large-scale tourist resort on Saudi Arabia's Red Sea coast. The Saudi Arabian government allocated more than $23 billion to build a full metro network in Riyadh, the capital city of the Kingdom and one of the largest cities in the Middle East. Riyadh Metro Project, 176 km across six lines and 85 stations, has been under construction since 2013 [25]. Riyadh Metro Project is also part of Vision 2030 and one of KSA's "Giga Projects" [26].

1.2 The Project Performance Measurement in Construction Industry

The New York Bureau of Municipal Research introduced performance assessment as a distinct procedure in the 1940s. The idea grew and improved during the 1960s and 1970s. In the 1970s, the accounting industry employed financial indicators (lagging indicators) to assess performance. The 1980s witnessed the rise of zero-based budgeting, which became a major concern in the 1990s [27]. Each project possesses distinct characteristics, and the evaluation of project performance is based on the effective achievement of the project's goals. Project information can be used to scrutinise and oversee the triumph or execution of a project, with the aim of establishing a repository of knowledge and improving the management of future initiatives. Historically, project performance has been determined and assessed based on the quantity of resources required to complete the project [28]. Performance measurement can help answer three key questions: "How well does an organisation perform?" "How well does an individual perform?" How well is the organisation doing? "How much has the organisation improved since last time?". Performance measurement aims to improve programme efficiency and organisational or project effectiveness by evaluating project performance, including financial and non-financial aspects [29]. A lack of knowledge, poor contracts, insufficient planning, and a lack of vision are among the issues listed by Palalani [30] the year 2000. In a construction project, essential participants engage in multiple ways, continually cooperating inside systems. Construction participants are both customers and suppliers, and their capacity to produce value is vital to successful projects [31]. The performance of each stakeholder in the construction process is strongly interrelated [29]. Construction projects are successful if they are completed on time, on budget, and to the customer's satisfaction [28].

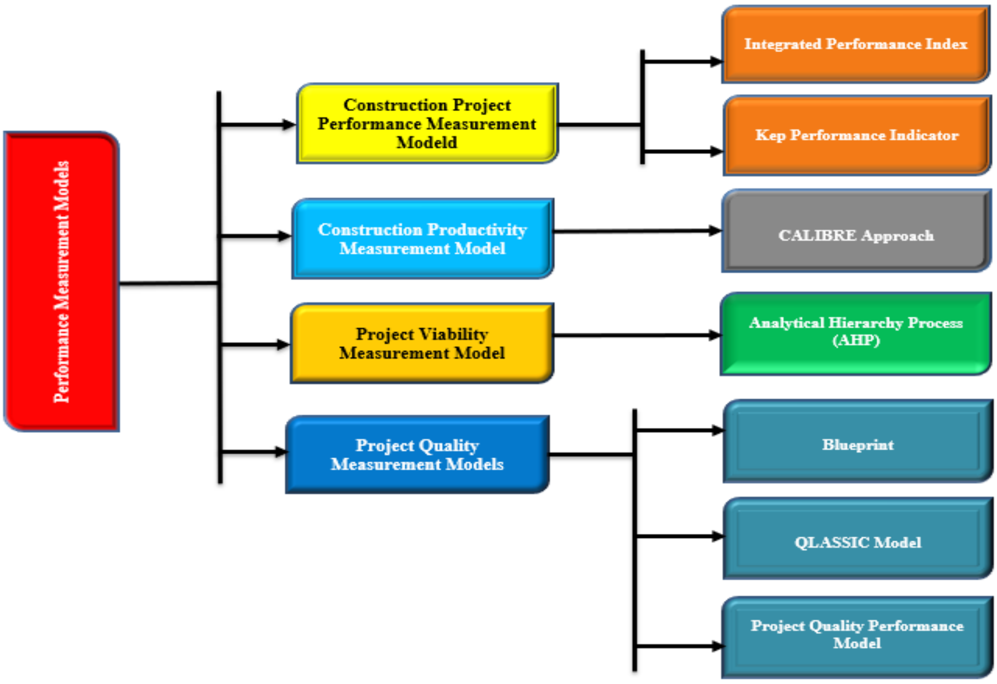

Fig. 1. Performance measurement models

1.3 Key Performance Indicators (KPIs)

KPIs were established and introduced as one of the performance measurement tools, and they have since become the most prominent performance measurement metric in the construction industry, especially after "Rethinking Construction" [29-32]. Many construction organisations have introduced performance measurement via KPIs. KPIs in construction allow the industry to measure project and organisational performance [5]. A KPI measures the performance of an activity critical to an organisation or project [1]. Generally, it is widely accepted that the most significant variables to consider when evaluating a project's performance are time, cost, and quality. The success of a construction project can be evaluated using the fundamental criteria of cost, schedule, and quality, which have traditionally been used as hard-key performance indicators (KPIs) in construction. According to a researcher, these three key components are known as the "iron triangle" [33,34]. Soft KPIs like customer and project participant satisfaction are important markers of project success. External data and project management systems are commonly used to create hard KPIs. On the other hand, soft KPIs are based on subjective indications supplied by respondents and can be acquired via surveys or interviews. Soft indicators that measure participant satisfaction with interpersonal interactions may be used to advocate for the importance of stakeholder collaboration in achieving project goals [35].

In response to the Egan Report, established a KPIs Framework for the UK construction sector, including seven groups: time, cost, quality, client satisfaction, client changes, business performance, and health and safety, which are characterised by the headline, operational, and diagnostic indicators. The headline indicators measure a firm's overall "rude" state of health. The operational indicators focus on specific aspects of a firm's activities and should enable management to identify and focus on areas for improvement. The diagnostic indicators explain why specific headline or operational indicator changes may have occurred. Constructing Excellence in the United Kingdom provides KPI wall charts for several groups in the UK construction sector each year. These are the UK Economic (all construction), Environment, Respect for People, Consultants, Construction Products, Repairs & Maintenance and Refurbishment (Housing), Non-Housing, Housing, and Infrastructure, and ME Contractor KPIs.

i. KPIs for the UK construction sector is divided into three categories [36]:
ii. KPI charts for main sub-divisions;
iii. Graphs that provide additional analysis of the headline KPIs; and
iv. Users requested additional indicators (e.g., contractor satisfaction with the client).

The Scottish Construction Centre (SCC) first introduced the Scottish Construction Industry's (SCI) KPI framework in 2007 to encourage organizations within the SCI at all levels to use performance measurement. It comprises nine key performance indicators (KPIs): product, service, quality, time, cost, safety, environment, people, and business. The KPI suite created for the UK construction industry by the KPI Working Group (2000) serves as the foundation for the SCI KPIs. The primary distinction is the addition of "environment" to the SCC KPIs. While this demonstrates the growing importance of environmental concerns in the built environment, it is not a major global construction KPI [37].

The Danish construction industry has following fourteen (14) KPIs, published by the Benchmark Centre for the Danish Construction Sector (BEC) in 2005: Actual construction time, Actual construction time, concerning planned construction time, Defect remediation within the first year, The number of problems discovered during the handover process, Frequency of accidents, ratio of contributions, The margin of contribution per man-hour, The margin of contribution per wage crown, The intensity of work in man-hours per m2 productivity of labour, Price changes for the project throughout construction, price per square metre, and customer satisfaction with the construction process [38].The Construction Industry Institute of the United States of America measures contractors' performance online using four key performance indicators (KPIs): performance, construction productivity, engineering productivity, and practices [5].

This paper's evaluation addressed a wide variety of construction KPIs. The examination reveals many current KPIs, making it difficult for organisations unfamiliar with KPIs to choose appropriate KPIs for measurement. Despite the array of KPIs reviewed, it is clear that some are utilised more often than others. Time, cost, quality, defects, productivity, and other construction-related KPIs are recurring themes. Moreover, the cost of the project, time of the project, quality of the project, safety, sustainable construction, client satisfaction, productivity labour, profitability, procurement, risk management, maintainability, defects, human resource management, and business performance construction-related KPIs are to be implemented for the Saudi Construction project's success.

2. Research Methodology

In order to accomplish the objectives, the data was collected via a thorough review of relevant literature, and the key performance indicators for construction projects in the Saudi construction sector were identified. A questionnaire study was used to collect data for this research to establish the most critical KPIs for the Saudi construction industry.

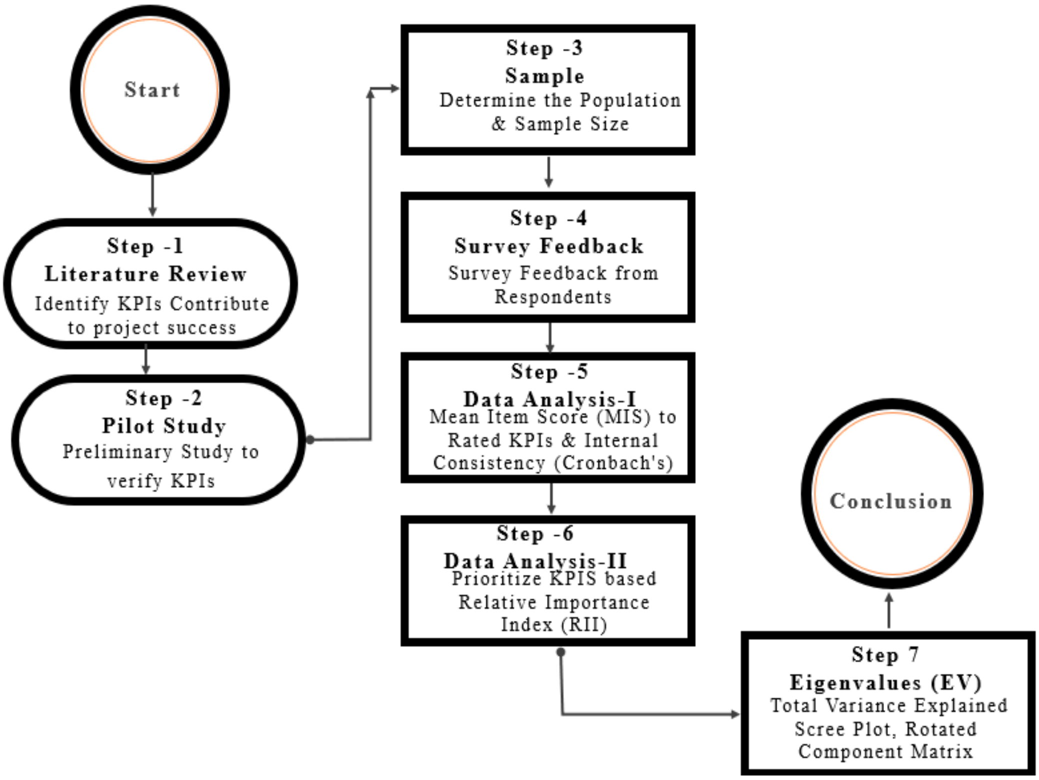

Fig. 2. Research methodology diagram

According to the Saudi Council of Engineers, there are 230943 registered engineering professionals (architecture, civil, electrical, and mechanical engineers) [39]. For more accurate estimates, the researchers have taken the largest number, which resulted in 4,5000 as the target research population. Regarding the sample size, the study used Slovin's formula for the sample data collection.

$$n = \frac{N}{1 + \mathrm{N}\,(C^2)} \qquad (1)$$

C = margin of error, taken as 9% = 0.09, N= total population taken as 245000, n = Sample size. Applying the equation: $n = \frac{245000}{1 + 245000\,(0.09^2)}$ $n = 123.39 \approx 124$.

The respondents were asked to evaluate the most important construction sector KPIs using a five-point Likert scale, and the researched factors were ranked based on the mean item score.

The Statistical Package for the Social Sciences (SPSS), a computer programme made to evaluate data relating to social phenomena, was used to analyse the quantitative data. The programme was used to generate various statistics, including descriptive statistics, which offer a basic overview of all components of the data. The advantages of utilising SPSS include ranking, analysing quantitative data, and doing multivariate analysis rapidly [40]. SPSS also improves the presentation of data in a logical format, minimising the time spent calculating scores. However, the quality of the outcomes is greatly dependent on the inputs, highlighting the need to capture the questionnaire's data accurately [8-41].

The study used a 5-point Linkert scale, which provided a wider range of potential scores and increased the statistical analyses available to the researcher. The 5-point Linkert scale is in the following agreement form:

1= Strongly Disagree (SD), 2=Disagree (D), 3=Neutral (N), 4=Agree (A), and 5=Strongly Agree (SA); the 5-point scale was transformed to a mean item score abbreviated as (MIS).

The sum of all weighted replies was used to compute the mean item score (MIS), which was then related to the total number of responses on each aspect. The factors were ranked from most important to least important using the mean item score. For each MIS, it is expressed and determined as follows:

$$MIS=\frac{1n2 + 2n2 + 3n3 + 4n4 + 5n5}{\sum N} \quad (2)$$

where, n1 = number of respondents for strongly disagree, n2 = number of respondents for disagree, n3 = number of respondents for neutral, n4 = number of respondents for agree, n5 = number of respondents for extremely likely or strongly agree, N = Total Number of respondents

Furthermore, to evaluate and prioritized the importance of each KPIs, the relative importance index (RII) was used [42,43]. To determine the RII, apply the formula below:

$$RII = \frac{\sum w}{A*N};\ (0 \le RII \le 1) \quad (3)$$

Where, W= weight given to each KPIs by the respondents with the range 1-5; A= the highest weight (5); N=the total number of respondents (in this study: 106).

First, the pilot study was carried out, and twelve (12) questionnaires were distributed to construction professionals in Saudi Arabia. The respondents were requested to evaluate the clarity and convenience of the questionnaire format and provide recommendations for the finalised main questionnaire of the survey.

Descriptive analysis was used to determine the mean item score, and the RII was then arranged in a descending manner to highlight the height and the least impact.

The adequacy of the information depends on the reliability of the data collected from the questionnaire survey. The reliability of the survey data was checked, and the reliability test is important because it is the basis for data analysis. Examining the consistency with which various items express the same concept is a common method of estimating reliability [44]. The Cronbach's alpha coefficient method was employed in this study to evaluate the data's reliability. Ceng and Huang [45] suggested that a value of Cronbach's alpha of 0.7 or higher normally indicates a reliable set of items. However, Hair *et al.,* [46] consider 0.60 to less than 0.70 moderate and adequate for the study. Afterward, the gathered data were examined for feasibility using Bartlett's Test of Sphericity and the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy. According to Nudurupati *et al.,* [47], KMO equal to or greater than 0.5 with p 0.05 is appropriate for analysis.

3. Results and Discussion

The Saudi Construction Industry Field Survey was conducted using a standardised questionnaire sent to the respondents. The 106 returned questionnaires, 85% of the 124 sent out, indicate a fairly excellent return rate [48]. Findings revealed 19.8% architects, 59.4% civil engineers, 14.2% electrical engineers, and 6.6% mechanical engineers. 60.4% have bachelor's degrees, 34.5% have master's, and 4.7% have Ph.D. When asked about respondents' work experience, the findings showed that 28.3% had between 5 and 10 years of work experience, 51.9% had 11–15 years of experience, and 19.8% had 16 years and above working experience in the construction industry, as shown in Table 1.

Table 1
Demographic profile of respondents

Respondents’ Information	Frequency	Percentage
Education		
Bachelor's	64	60.4
Master's	37	34.5
PhD	5	4.7
Profession		
Architect	21	19.8
Civil Engineer	63	59.4
Electrical Engineer	15	14.2
Mechanical Engineer	7	6.6
Organization		
Client	11	10.4
Consultant	42	39.6
Contractor	53	50.0
Discipline		
Planning & Management	16	15.1
Design	25	23.6
Construction	65	61.3
Working Experience		
5-10 years	30	28.3
11-15 years	55	51.9
16 Years and above	21	19.8

SPSS version 26 was used to analyse the data, which used descriptive statistics, Cronbach's Alpha, mean score, and standard deviation to determine the degree of the critical success factors. The first step in analysing the questionnaire data was to test the questionnaire's reliability. The reliability of the five-point scale used in the survey was determined using Cronbach's coefficient alpha, which determines internal consistency among variables. If Cronbach's alpha is 0.7 or more, the items are likely reliable [44]. The five-point scale measurement was accurate because the overall value of the coefficient alpha test was 0.717, as shown in Table 2, greater than 0.70, which means that this test was credible. The closer the response variable is to 1, the better the linear relationship between it and the predictors. The linear relationship gets worse the closer it is to 0. The predicted squared multiple regression correlation is for Items 1 and 2, 0.674, and 0.440 [49].

Table 2
Internal consistency (Cronbach's)

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.717	0.723	15

Furthermore, the section "Cronbach's alpha if item Deleted" meant that if the researcher deleted one of the items, Cronbach's alpha values were almost the same, even smaller than those deleted. It followed what had been said that the instrument had a higher consistency and reliability, so it was unnecessary to delete any item from the scale as shown in Table 3. Hair *et al.,* [46], considers the study moderate and adequate to be 0.60 to less than 0.70

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-
-
-

Table 3
Item-total statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Cost of Project	55.830	23.399	.430	.674	.712
Time of Project	55.623	22.771	.416	.440	.696
Quality of Project	55.906	21.972	.413	.414	.692
Safety	55.915	22.307	.496	.327	.695
Sustainable Construction	55.962	22.437	.566	.420	.698
Client Satisfaction	56.019	21.638	.493	.419	.684
End-User Satisfaction	56.038	22.360	.626	.497	.702
Productivity of Labour	56.066	21.377	.446	.665	.687
Profitability	56.076	22.280	.531	.698	.702
Procurement	56.104	22.665	.612	.557	.704
Risk management	56.057	24.111	.476	.486	.732
Maintainability	56.113	22.730	.471	.408	.709
Defects	56.085	21.964	.407	.518	.693
Human resource management	56.132	24.116	.516	.442	.724
Business Performance	56.208	22.471	.571	.635	.709

Table 4 shows that the value of KMO statistics is 0.716 > 0.5 with a significance of 0.000, indicating that sampling is adequate, and data was eligible for further factor analysis. The adequacy of the correlation matrix is tested using Bartlett's Sphericity test.

Table 4
KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.716
Bartlett's Test of Sphericity	Approx. Chi-Square	239.801
	df	105
	Sig.	.000

The eigenvalues and total Variance explained are shown in Table 5. The principal component analysis extraction procedure was used in this study for factor analysis. Eleven linear components are established within the data set prior to extraction. After extraction and Rotation, the data set contains six distinct linear components with eigenvalues greater than one. The six factors are extracted, accounting for 62.743% of the total Variance. The retained factors are suggested to explain at least 50% of the total variance. The results show that six factors can account for 62.743% of the common Variance shared by fifteen variables.

Table 5
Eigenvalues (EV) and Total Variance Explained

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.300	21.999	21.999	3.300	21.999	21.999	1.965	13.098	13.098
2	1.441	9.609	31.608	1.441	9.609	31.608	1.696	11.308	24.406
3	1.324	8.825	40.433	1.324	8.825	40.433	1.551	10.339	34.746
4	1.172	7.814	48.247	1.172	7.814	48.247	1.538	10.254	45.000
5	1.115	7.430	55.678	1.115	7.430	55.678	1.516	10.106	55.106
6	1.060	7.066	62.743	1.060	7.066	62.743	1.146	7.637	62.743
7	.886	5.906	68.650						
8	.774	5.162	73.811						
9	.730	4.867	78.679						
10	.656	4.373	83.052						
11	.624	4.159	87.211						
12	.592	3.948	91.159						
13	.519	3.460	94.619						
14	.429	2.860	97.479						
15	.378	2.521	100.000						
Extraction Method: Principal Component Analysis									

The KMO value of 0.716 is deemed acceptable and implies that factor analysis is beneficial for the variables. The preliminary solution implies that the final solution will only extract six factors. With an eigenvalue of 3.300, the first component explained 13.098% of the total Variance. With an eigenvalue of 1.441, the second component explained 11.308% of the Variance. With an eigenvalue of 1.324, the third component explained 10.339% of the Variance. The sixth component explained 7.637% of the total Variance with an eigenvalue of 1.060.

In Figure 3, the Scree test is represented as a graph with the eigenvalues on the y-axis and the extraction order of the fifteen component numbers on the x-axis. The number of elements to keep is decided using the scree plot. The scree plot demonstrates that six factors account for the majority of the total variability in the data, and each has an eigenvalue greater than one. Large factors with higher eigenvalues are the first extracted factors, followed by smaller factors. The remaining components are seen as less significant because they only contribute little to the variability.

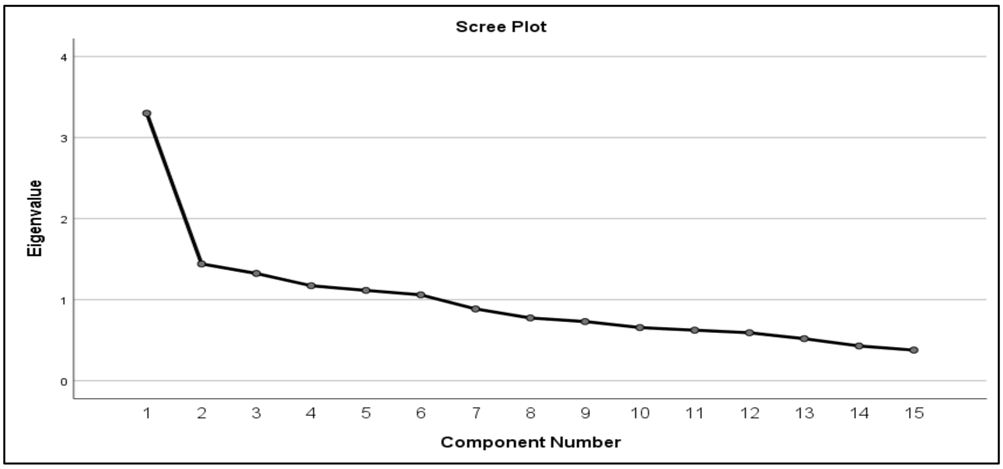

Fig. 3. Scree plot

According to the findings (Table 5), the Quality of project, Sustainable Construction, and Client Satisfaction KPIs fall under Component 1. Component 2 also includes the Safety of Project, End-User Satisfaction, and Productivity of Labour. Similarly, Time of Project, Profitability, and Procurement follow component 3. the Cost of Project, and Maintainability, are components 4. Moreover, the Defects, Human resource management, and Business Performance are components 5. Finally, we have Risk management for component 6.

Table 6
Rotated component matrix

	Component					
	1	2	3	4	5	6
Cost of Project				.764		
Time of Project			.435			
Quality of Project	.669					
Safety		.651				
Sustainable Construction	.788					
Client Satisfaction	.728					
End-User Satisfaction		.745				
Productivity of Labour		.418				
Profitability			.417			
Procurement			.840			
Risk management						.883
Maintainability				.621		
Defects					.631	
Human resource management					.616	
Business Performance					.772	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Respondents with a combined employment history of over 11 years dominated the sample, making up 72% of the responses. The respondent's extensive expertise is essential to acquiring high-quality data for any research. In a recent study, these knowledgeable respondents will offer the information needed based on their years of experience.

As shown in Table 7, the respondents placed the KPIs in construction projects mean range from 3.802 to 4.387 and RII ranged from 0.877 to 0.760. The result indicated that most respondents considered "Time of Project" the first highest ranking on construction projects in KSA, with a mean score of 4.387 and with a RII score 0.877. The second highest ranking was "Cost of Project," third was "Quality of Project," fourth was "Safety," and the fifth was "Sustainable Construction." Furthermore, the lowest five ranks were "Defects," "Procurement," "Maintainability," "Human resource management," and "Business Performance," with a mean score of 3.801 and RII 0.760 of in the construction projects in the KSA.

Table 7
Descriptive statistics for proposed construction projects' KPIs

KPIs	Relative index	Mean item score	Rank	Importance level
Time of Project	0.877	4.387	1	H
Cost of Project	0.836	4.179	2	H
Quality of Project	0.821	4.104	3	H
Safety	0.819	4.094	4	H
Sustainable Construction	0.809	4.047	5	H
Client Satisfaction	0.798	3.991	6	H-M
End-User Satisfaction	0.794	3.972	7	H-M
Risk management	0.791	3.953	8	H-M
Productivity of Labour	0.789	3.943	9	H-M
Defects	0.785	3.925	10	H-M
Profitability	0.783	3.915	11	H-M
Procurement	0.781	3.906	12	H-M
Maintainability	0.779	3.896	13	H-M
Human resource management	0.775	3.877	14	H-M
Business Performance	0.760	3.802	15	H-M

While the performance of the Saudi construction industry remains a cause of concern, it is anticipated that adopting a set of KPIs would improve construction industry participants in evaluating their performance to improve overall performance levels. The KPIs established in this research were part of a wider pool identified from the literature review and existing KPIs in leading economies with high-performing construction sectors. The approach in this study ensures that the outcomes of the literature study, questionnaire-based survey, and high return rate for the survey could be due to the respondents' high interest in the subject and, in part, to a short questionnaire design that made it easy to complete and return the questionnaires. The returns rate of 82% shows the respondent group as a good representation of the sample and thus reinforces generalizations that can be made for the overall Saudi construction industry. The accumulated total provided a measure of the respective measures' relevance, with higher mean item score values indicating greater relevance and lower Mean item score values indicating less relevance. The indicators were ranked in order of relative importance to each other, and time of construction received the highest Mean Item score, followed by Cost of Construction and Quality. The fourth place with less score was safety and sustainability construction, followed by Client Satisfaction. Maintainability and Human resource management scored lower, and Business Performance obtained the lowest Means Item Score.

The results of this study are just some of the contributing factors to important KPIs. The inclusion of Quality, Cost, and Time in the first three contributing factors is consistent with popular construction management literature, which identifies these measures as the ultimate goals of every construction client. These KPIs can serve as a starting point for those in the KSA construction sector who are new to performance measurement. They can be used as the foundation for benchmarking performance against best-in-class organizations, measuring performance, and setting targets for improving performance to internationally competitive levels by KSA construction players. KPIs are a tool for evaluating the efficiency of construction services. Such KPIs differ depending on the reason for the assessment and the type of facility under consideration. Other researchers, including Mahmoud *et al.,* [50], have identified their effectiveness in assessing project construction performance.

The results of this research are similar to those of previous studies conducted by Trigunarsyah *et al.,* [51] and Hamadan *et al.,* [52], which identified Cost of Construction as the most relevant KPI, followed closely by Time of Construction, Quality and Defects, and Client Satisfaction. Their research also rated high Health and Safety, Productivity, and End-User Satisfaction. Regardless of this research, according to the data analysis, the Time of the Project is the respondents' most relevant KPI for the construction industry. It is closely followed by cost and quality. The overall aggregated ratings for these three criteria represent the proportion of respondents who consider these highly relevant and hence the extent to which they are important to the KSA construction industry. Safety, Sustainable Construction Performance, and Client Satisfaction are also highly ranked by respondents, even though they are less relevant to the KSA construction industry than the top three indicators. Maintainability, human resource management, and business success are ranked in decreasing order of importance, with lower overall cumulative ratings, as shown in Table 7. In contrast, according to Ansari *et al.,* [53], the three basic and most important performance indicators in construction projects are Safety, Environmental, and Cost, followed by others such as Profitability, Schedule, Productivity, Sustainability, Quality, Client satisfaction, and Team satisfaction.

The results of this study differ from those of the study by Sibiya *et al.,* [54], which named construction time, profitability, project management, material ordering, handling, and management as the most crucial key performance indicators (KPIs) for construction projects in South Africa. Additionally, their study found that the KPIs with the least significance were construction cost, defects, and human resource management. Ali *et al.,* [55] performed a study on key performance indicators (KPIs) in the construction industry of Malaysia. Their findings revealed that the most important KPIs are functionality, clients' satisfaction, and health and safety. On the other hand, the least significant KPIs are the level of complaints, time, and cost.

The KPIs proposed in this paper are just some of the important KPIs. They are the ones deemed most pertinent to the KSA construction industry. The inclusion of Cost, Time, and Quality in the first three KPIs is consistent with popular construction management literature, which identifies these measures as the ultimate goals of every construction client. These KPIs can serve as a starting point for those in the KSA construction sector who are new to KPIs and performance measurement. They can be used as the foundation for benchmarking performance against best-in-class organizations, measuring performance, and setting targets for improving performance to internationally competitive levels by KSA construction players.

4. Conclusion

Construction projects significantly impact developing countries' economic, social, and environmental activities. When considering implementation, their sustainability performance should be thoroughly evaluated. Because effective evaluation indicators are rarely available in practice, the sustainability of construction projects is frequently under-assessed. Numerous performance measures are in use, and the sheer number of measures can cause issues for the construction project. Too many, too few, or inappropriate performance measures can have a negative impact on overall performance. In this paper, existing KPI groups were investigated in order to identify the most popular KPIs and the first formal set of KPIs for the KSA construction industry. Popular KPIs identified in the literature were subjected to a survey of selected individuals, and the survey results were validated. This paper establishes that using performance measures is an effective strategy to enhance project management success.

According to all respondents, the fifteen most significant KPIs for construction projects in Saudi Arabia are: construction time, construction cost, quality, safety, sustainable construction, client satisfaction, end-user satisfaction, risk management, labour productivity, profitability, defects, procurement, maintainability, human resource management, and business performance. Moreover, according to the reviewed literature, the most important key performance indicators (KPIs) for construction projects are scope and quality. Further investigation revealed that cost, time, and quality are the three basic and most important performance indicators in construction projects: safety, functionality, and client satisfaction.

The construction teams should concentrate on project activities, classify key activities, and accomplish accurate milestones. The teams are encouraged to improve cost-related areas by monitoring cash flows and conducting earned value analysis. In terms of quality, the project should undertake quality audits and avoid non-conformities. Performance indicators such as safety: the project construction team should schedule frequent safety training sessions and raise awareness of safe practices on the job site to avoid accidents and delays in construction. Furthermore, sustainable construction entails employing recyclable and renewable construction materials, minimising waste, reworking, and minimising environmental impact. The study's findings will help stakeholders in the project prioritise their efforts to achieve outstanding performance. It is advised that construction projects employ a performance management framework to inspire the project management team to perform better in order to achieve project success.

However, these findings regarding KPIs indicate that project management, risk management, and quality assurance are all regarded as key indicators in the Saudi Arabian construction industry. This demonstrates the Saudi Arabian construction industry's dynamic character since the KPIs mentioned earlier have never been included in prior research. It is also recommended that future research be conducted to establish methods for measuring the qualitative indicators in the KPI suite developed in this research.

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