



Critical Review to Evaluate Performance of Ready-Mix Concrete Production Plant

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Abstract

This study focuses on the performance evaluation of ready-mix concrete production plants in the Republic of Iraq. The lack of modern plant performance assessment technology has hindered the construction industry's progress. Traditional evaluation methods relying on financial measures have yielded unrealistic results. To address this issue, there is a need to utilize modern models and methods for performance evaluation. The main objective of this study was to conduct a systematic literature review on the evaluation of concrete production plants. A literature review methodology was used, utilizing digital databases and scientific platforms from (2015 to 2023). The study provides a comprehensive overview of performance evaluation, including definitions, importance, and introduction to modern models and methods. No previous studies on evaluating ready-mix concrete production plants in Iraq were found, but relevant studies from Egypt, Sudan, and India were analyzed. These studies discussed concrete mixing plant classification, advantages, disadvantages, and factors influencing plant performance. They also conducted statistical analyses using the SPSS software and evaluated plant performance, including plant arrangement, quality control systems, and final product quality. Previous studies revealed that 75% of concrete production plants did not meet the required criteria, while only 25% demonstrated satisfactory performance. The study proposes improvements to enhance the performance rate by considering influential variables identified in the literature and using modern models for performance evaluation.

Keywords: Balanced Scorecard, Ready-Mix Concrete Plant, Performance Evaluation, Key Performance Indicators, Mckinsey 7s Model.

مراجعة نقدية لتقييم أداء مصانع إنتاج الخرسانة

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الخلاصة:

تركز هذه الدراسة على تقييم أداء مصانع إنتاج الخرسانة الجاهزة في جمهورية العراق. أدى الافتقار إلى التكنولوجيا الحديثة لتقييم أداء المصانع إلى إعاقة تقدم صناعة البناء. أسفرت طرق التقييم التقليدية التي تعتمد على التدابير المالية عن نتائج غير واقعية. لمعالجة هذه المشكلة ، هناك حاجة إلى استخدام النماذج والأساليب الحديثة لتقييم الأداء. كان الهدف الرئيسي من هذه الدراسة هو إجراء مراجعة منهجية للأدبيات حول تقييم مصانع إنتاج الخرسانة. تم استخدام منهجية مراجعة الأدبيات ، باستخدام قواعد البيانات الرقمية والمنصات العلمية من (2015 إلى 2023). تقدم الدراسة لمحة شاملة عن تقييم الأداء ، بما في ذلك التعريفات والأهمية ومقدمة للنماذج والأساليب الحديثة. لم يتم العثور على دراسات سابقة حول تقييم مصانع إنتاج الخرسانة الجاهزة في العراق ، ولكن تم تحليل الدراسات ذات الصلة من مصر والسودان والهند. ناقشت هذه الدراسات تصنيف مصنع خلط الخرسانة ومزاياها وعيوبها والعوامل التي تؤثر على أداء المصنع. كما أجروا تحليلات إحصائية باستخدام برنامج SPSS وقاموا بتقييم أداء المصنع ، بما في ذلك ترتيب المصنع وأنظمة مراقبة الجودة وجودة المنتج النهائي. أظهرت الدراسات السابقة أن 75٪ من معامل إنتاج الخرسانة لم تستوف المعايير المطلوبة ، بينما أظهرت 25٪ فقط أداءً مرضياً. تقترح الدراسة تحسينات لتعزيز معدل الأداء من خلال النظر في المتغيرات المؤثرة المحددة في الأدبيات واستخدام النماذج الحديثة لتقييم الأداء.



1. Introduction

Building the theoretical framework and presenting studies related to the research topic represents one of the most important steps in scientific research. The literature review is essential in constructing the research idea, identifying the knowledge gap in the literature, and selecting measurement methods. Additionally, a literature review contributes to enabling researchers to understand the frontiers of knowledge in the research topic and gain insight into the latest findings [1].

A critical review to evaluate the performance of a ready-mix concrete production plant involves analyzing various aspects of its operations, processes, and outcomes in the context of defining systematic review, and several definitions address this topic. It is a specialized type of literature review that provides additional advantages. It involves reviewing a formulated question using clear methodological approaches. In order to critically identify, select, and evaluate relevant research and collect and analyze data from the studies included in the review, defined systematic review as a transparent and methodical process for identifying the research question, searching for studies, evaluating their quality, and synthesizing the results qualitatively or quantitatively [2]. With a focus on minimizing bias in the literature and the results obtained through the literature review, the process of systematic review is defined as a research process through which relevant literature related to a specific question is identified and collected using clear methods, including explicit criteria for inclusion/exclusion, search methods, and details [3].

All organizations strive to achieve the best performance by improving their performance level in all functions. They carry out review and evaluation processes to identify the overall performance level of the organization [4]. Due to the vital role that plays in economic development, examining their conditions, monitoring their activities, and living in and the tremendous development in the management world, it was necessary to search for modern standards, tools, and models for measuring performance, analyzing performance, identifying deviations, and taking necessary corrective actions in a way that suits the size of the developments and changes they face [5]. Therefore, like any other manufacturing facility, concrete plants in Baghdad require evaluation to assess their performance and identify areas for improvement. Baghdad's ready-mix concrete production plants lack modern evaluation techniques or models that keep pace with the latest technological advancements. Because lack of attention to performance evaluation and the use of traditional methods and financial measures to assess their performance. Moreover, to address this problem, there is a need to introduce modern evaluation models to enable a more comprehensive and accurate assessment of plant performance.

The following are some reasons that make evaluating ready-mix concrete production plants in Baghdad using modern evaluation models important [6]:

- 1) Increased efficiency: Evaluation helps identify areas where the plant's performance can be improved. Using modern evaluation methods, plant managers can identify opportunities to streamline processes, reduce waste, and improve the use of resources such as materials, energy, and labour.
- 2) Quality improvement: Evaluation models can help identify areas where the quality of the produced concrete can be improved. This can lead to improved customer satisfaction, increased sales, and an improved reputation for the plant.
- 3) Safety promotion: Modern evaluation models can help identify potential safety risks and hazards in the plant. By addressing these issues, plant managers can improve worker safety and reduce the risk of accidents.
- 4) Increased profitability: By improving efficiency, quality, and safety, plants can increase profitability. This can be achieved by reducing costs, improving customer satisfaction, and increasing sales.

Several concepts of "Performance" are presented in the reviewed literature. It has been defined, among other things, performance refers to the level of achievement or effectiveness of a person, organization, system, or process in achieving their goals or objectives [7]. It measures how well a task, activity, or project has been executed in terms of quality, timeliness, efficiency, and effectiveness. Performance can be measured using a variety of metrics, such as productivity, customer satisfaction, financial results, and stakeholder engagement. In project management, performance is often evaluated regarding the project's ability to meet the scope, schedule, cost, quality, and stakeholder expectations. Effective performance management involves setting clear goals and expectations, monitoring progress, providing feedback, and taking corrective actions to improve Performance [8].

Performance evaluation It is an extensive and multifaceted procedure that incorporates the key performance indicators that aid in performance evaluation, improvement is addressed, and its execution calls for a target or aim, allowing for assessment and evaluation against the right benchmark [9].

Performance evaluation is a management tool that determines the success or failure of performance, whether organizationally or functionally; evaluation can be viewed as a way to answer three fundamental questions: "How effectively is an organization operating? Is the organization reaching its goals? How much progress has the organization achieved since the previous period?" [7]. Moreover, Managers do performance measurements because they "want to know where they stand and what they need to do to improve." Thus, PMSs are utilized extensively in the business sector [10]. Performance evaluation is a systematic procedure for getting accurate information on an organization's performance and the elements that affect performance [11]. Performance evaluation determines how successfully organizations or individuals have achieved their aims and plans. In



order to evaluate an organization's vital signs, the outputs of organizational strategic and operational processes are quantified and measured. The relationship between performance management and measurement can be understood in a broader context from an input-process-output perspective. It is a method for identifying unnecessary sources of waste so that the organization knows where to concentrate its efforts [12].

The researcher defines performance measurement as the process of evaluating and quantifying the performance of an individual, organization, system, process, or project. It involves collecting and analyzing data and information about various aspects of performance, such as quality, cost, productivity, efficiency, effectiveness, and customer satisfaction. Performance evaluation assesses an individual, group, or organization's performance against pre-determined objectives, goals, and standards. It involves gathering and analyzing data to measure the achievement level and identify strengths, weaknesses, and areas for improvement. Performance evaluation can be conducted regularly, such as annually, or on an ad-hoc basis, depending on the organization's needs [13,14].

The main aim of performance evaluation is to identify areas for improvement, determine the effectiveness of the project management approach, and ensure that the project meets the required standards. The evaluation process helps project stakeholders to make data-driven decisions, allocate resources effectively, and manage potential risks and opportunities [15]. By carefully and regularly evaluating a Construction Project's Performance, performance evaluation enables a company to define its position. It also stimulates action by defining what needs to be done, who needs to act, and how. Conversely, a construction project's performance evaluation provides a mechanism to learn from the past and evaluate future contemporary trends in using the construction project's facilities. Therefore, collecting, interpreting and analyzing information about the Performance of Projects is key to better planning and design for the future [16]. Evaluation helps make decisions about the management process, ensuring the most effective and efficient use of resources, determining the extent to which the organization is on track, and making the required modifications accordingly. Evaluate the success of goals and a project's efficiency, effectiveness, and influence [17]. Evaluation systems can be useful for giving continuous feedback on how effectively projects achieve their objectives, spot problems early on, and offer solutions. Keep an eye on the project's accessibility to all target demographics, evaluate the company's efficiency in accomplishing its overall goals, and provide guidelines for developing current construction projects. Moreover, some objectives are as follows:

- 1) To measure the construction project's quality.
- 2) To determine which goals have been done and to what degree.
- 3) To indicate the strengths and weaknesses.

- 4) To identify the difficulties that prevented the construction project's development.
- 5) To offer suggestions for the future in order to enhance the construction project.
- 6) To make the report easy to understand.
- 7) To increase the construction project's visibility.

Performance evaluation is becoming more common in construction. Three are three reasons listed. First, the construction industry became extremely interested in performance evaluation development due to its rapid expansion in other industries. The second factor is the complexity of construction projects growing, necessitating proper evaluating tools and models to optimize performance [18]. The third factor is the evolution and difficulties of construction project management and building technology in recent years. (An organization can develop and achieve its goals by measuring its progress. That demonstrates the significance of performance evaluation and measurement as key requirements for best construction practices. Based on the findings from internal performance evaluation, performance evaluation helps businesses take action to achieve improvements [19].

Performance measurement aims to offer fast and accurate feedback on the efficacy and productivity of activities and to direct attention toward continual improvement [13]. Moreover, please provide feedback to individuals, groups, or organizations on their performance and identify improvement areas. It is also used to make decisions related to rewards, promotions, and other personnel actions [20].

Performance Evaluation is particularly important in ready-mix concrete plants for several reasons [21][22][23]:

Quality control: Ready-mix concrete plants produce a critical building material, and evaluation performance is essential for ensuring that the product meets certain quality standards. By evaluating performance, plants can identify areas where the quality of the concrete may be compromised and take corrective action to ensure that the product is of high quality.

Efficiency: Ready-mix concrete production plants operate on a tight schedule and must produce a consistent product on time. Evaluation performance can help plants identify areas where efficiency can be improved, such as optimizing production processes, reducing waste, and improving delivery logistics.

Cost control: Evaluation performance can help ready-mix concrete production plants control costs by identifying areas where resources can be better allocated, waste reduced, and production processes optimized. This can lead to cost savings and more competitive pricing.

Safety: Ready-mix concrete production plants can be hazardous environments, and evaluation performance is crucial for ensuring the safety of workers and the public. By measuring and evaluating safety performance, plants can identify areas that need improvement and take corrective action to prevent accidents and injuries.



Customer satisfaction: Evaluation performance can help ready-mix concrete production plants meet the needs of their customers by ensuring that the product is of high quality, delivered on time, and meets the specifications of the customer's project. Overall, evaluation performance is critical for the success of ready-mix concrete production plants. It can help ensure quality, efficiency, cost control, safety, and customer satisfaction. By continually evaluating performance and taking corrective action, plants can improve their processes, increase competitiveness, and achieve better outcomes for all stakeholders.

The process of evaluating performance in a construction company goes through some stages in sequence, as shown in Fig.1. which are as follows [22][24]:

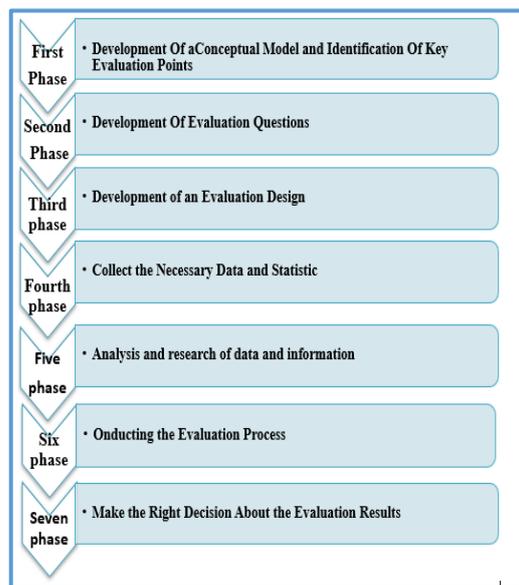


Figure (1): Phases of performance evaluation

First Phase: Development of a conceptual model and identification of key evaluation points: Every proposed evaluation should begin with applying a conceptual model to the design. This conceptual model can be used to ensure a shared understanding of the organization's structure, relationships, and desired outcomes and to aid in concentrating the evaluation design on the most important program elements.

Second Phase: Development of evaluation questions, building on the conceptual model and specification of measurable results, identification of key stakeholders and audience, formulation of potential evaluation questions of interest to the stakeholders and audiences, and formulation of a list of measurable outcomes. Defining quantifiable outcomes.

Third Phase: The third phase is the development of an evaluation design. Developing the design involves:

- 1) Identifying the type of design necessary to answer the questions posed.
- 2) Choosing a methodological method and data collection tools.
- 3) Choosing a group to compare with.
- 4) Sampling.

- 5) Choosing the right time, order, and frequency for data collection.

Fourth Phase: Collect the necessary data and statistics for the organization.

Five Phase: Analysis and research of data and information on the correctness and reliability of the metrics, ratios, and indicators required for the performance evaluation procedure.

Six Phase: Conducting the evaluation process using relevant criteria and indicators of the organization's activity, with the evaluation process covering the entire organization's activity, i.e., all of its centres of responsibility, to reach an objective, accurate, and reliable judgment.

Seven Phase: Make the right decision about the calendar results and inform interested audiences.

2.Key Performance Indicators (KPIs)

KPIs (a set of measurable metrics that help organizations evaluate their performance and progress towards achieving specific business objectives) [25]. KPIs track and measure progress towards critical goals and targets and identify improvement areas [26].

In construction companies, key performance indicators (KPIs) are used to monitor customer feedback, faults, time, money spent, Concrete production rate, Waste reduction, Energy consumption, profitability, environmental impact, and more. In 1961, D. Ronald Daniel began implementing KPIs to refine his company's approach to business. Benchmarking is central to the thinking behind performance assessment indicators [27, 28]. KPIs are essential for enhancing all facets of building projects, from effectiveness and efficiency to decision-making [29].

These KPIs can help plant managers evaluate the performance of a ready-mix concrete plant and make data-driven decisions to improve efficiency, reduce waste, and meet customer needs [30]. A performance measurement system (PMS) is a collection of key performance indicators (KPIs) that serve as a management tool and play a crucial role in assessing the inputs and outputs in "manufacturing operations" or "building activities". Establishing a performance measurement system (PMS) is the initial stage in evaluating a plant's Performance Systems for measuring performance offers a way to concentrate on broader business performance indicators, allowing businesses to undertake business improvement [31].

As a result of markets compelling businesses to evolve, clients, investors, and other stakeholders expect continual improvement [32]. On the other hand, traditional performance evaluation methodologies are increasingly criticized in contemporary economic content [14]. State that traditional performance evaluation systems do not aid in resolving managerial problems that arise in dynamic business environments; Since a long time ago, Performance evaluation has been based on information about financial activities and has examined indications of profitability, liquidity, solvency, and other financial indicators. This appraisal has established a conventional viewpoint



that is adopted by corporations today. These systems are incapable of evaluating actual factors that contribute to value creation. Consequently, modern performance evaluation methods are becoming increasingly popular in business performance evaluation.

Following is a discussion of prevalent contemporary performance evaluation techniques.:

- 1) Analytical Hierarchy Process (AHP)
- 2) Topsis Method
- 3) Balanced Scorecard
- 4) Mckinsey 7s model

1) Analytical Hierarchy Process (AHP)

The Analytical Hierarchy Process (AHP) is a decision-making method developed by Thomas Saaty in the 1970s. It provides a systematic approach for evaluating and comparing different alternatives when making decisions. AHP breaks down complex decision problems into a hierarchy of criteria and alternatives, allowing decision-makers to structure their thinking and assess the relative importance of different factors. The process involves defining the problem, establishing a hierarchy, making pairwise comparisons, determining criteria weights, evaluating alternatives, calculating weighted scores, performing sensitivity analysis, and making a final decision [33]. AHP is widely used in various fields, such as business, engineering, project management, and strategic planning to help decision-makers prioritize criteria and alternatives based on their relative importance. It provides a structured and rational framework for decision-making, leading to more informed and rational choices. However, the framework has significant drawbacks. A pyramid, for example, can be mistaken for a hierarchy and not offer a way to raise performance [34].

2) Topsis Method

The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is a decision-making method that evaluates and ranks alternatives based on their similarity to an ideal solution. It involves several steps, including defining the decision problem, determining criteria weights, constructing a decision matrix, normalizing the matrix, identifying ideal and negative-ideal solutions, calculating distances to these solutions, determining relative closeness, and ranking the alternatives [35]. TOPSIS helps decision-makers evaluate alternatives by considering multiple criteria and their relative importance. Normalizing the decision matrix ensures that the criteria are on the same scale. The method then calculates the distance of each alternative to both the ideal and negative-ideal solutions, reflecting their proximity to the best and worst possible outcomes. The relative closeness is determined based on these distances, and the alternatives are ranked accordingly. TOPSIS is a practical and intuitive approach that helps decision-makers make informed choices by considering alternatives' positive and negative aspects and their performance on multiple criteria. It provides a systematic and objective way to identify the most favourable alternatives based on their proximity to an ideal solution [36].

3) Balanced Scorecard (BSC)

The Balanced Scorecard is a strategic performance management framework developed by Robert Kaplan and David Norton in the early 1990s. It provides organizations with a comprehensive view of their performance by measuring and tracking key indicators across four perspectives: financial, customer, internal processes, and learning and growth; it recognizes the importance of non-financial measures in assessing organizational performance and incorporates them into the evaluation process [37]. The financial perspective focuses on financial indicators, while the customer perspective looks at customer satisfaction and loyalty. The internal processes perspective assesses the efficiency and quality of internal operations, and the learning and growth perspective emphasizes employee development and innovation. By translating strategy into key performance indicators for each perspective, organizations can monitor progress, identify areas for improvement, and align actions with strategic objectives [38]. The Balanced Scorecard provides a balanced and holistic approach to performance management, considering financial and non-financial aspects to achieve long-term success [39].



Figure (2): Balanced Scorecard

4) Mckinsey 7s model

The McKinsey 7S Model is a framework developed by McKinsey & Company consultants Tom Peters and Robert Waterman in the 1980s. It assesses the effectiveness of an organization based on seven interrelated elements: Shared Values, Strategy, Structure, Systems, Style, Staff, and Skills [40].

Seven elements (7S) identified by the McKinsey model as the primary determinants of organizational performance include shared values, strategy, structure, system, staff, style, and skills. The interactions between these variables in the McKinsey model determine how well an organization performs. This system's focal point is "shared values", representing employees' beliefs, expectations, and attitudes [41]. As shown in Fig.3. [42].

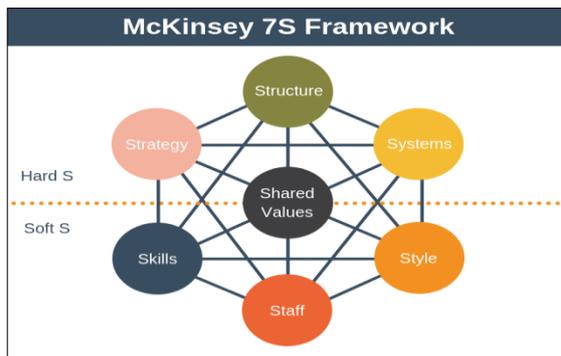


Figure (3): McKinsey 7S model

The diagram consists of two parts. Structure, strategy, and a system constitute the "difficult" portion. The structure is a representation of the organizational responsibilities and position. This model is frequently used to describe hierarchies, permissions, responsibilities, and roles. The systems (procedures) are the processes within an organization that manage, coordinate and direct the promotion and transfer of people to meet the organization's objectives. A strategy is an organization's operations to accomplish its goals and objectives [43]. Other components make up the soft portion of the model. 'Skills' is defined as the sum of the individual capabilities of each employee in an organization; 'staff' are people employed by the organization with varying knowledge and experience, intelligence, ability, and training; 'style' is a method of allocating rights and responsibilities within an organization; and shared values are the beliefs, expectations, and attitudes regarding Work, organization, and acceptable behaviour shared by the majority of employees, as well as any communicable beliefs. The 'hard' elements pertain to the organization's technical characteristics, while the soft elements represent its social side.

Regarding management, soft aspects are deemed more significant [44]. McKinsey 7S Model is a simple and relatively straightforward framework used to analyze the effectiveness of an organization through Shared Values, Strategy, Structure, Systems, Style, Staff, and Skills, as shown in Table 1 [45]. The McKinsey 7S model can be used as a diagnostic tool to assess the organisation's internal capabilities and evaluate the effectiveness of implemented changes. This can provide specific ways for construction firms to enhance their effectiveness [46].

Table (1): Definition of the elements of the McKinsey 7S model.

Dimensions	Definition
Strategy	Plans an organization makes in response to modifications in its external.
Structure	Strategy, organizational size, and diversity are the main determinants of the basis of specialization and coordination.
Systems	Formal and informal procedures support the strategy and structure.
Style	the following two parts: Corporate

	culture comprises the prevailing values, beliefs, and norms that are relatively durable aspects of organizational life. Management style is more about what managers do than what they say, how they spend their time, and what they do with it.
Staff	Methods for managing people and human resources, including the socialization of new employees and methods for training managers.
Skills	company's unique competencies—what it does best.
Shared Values	A business's guiding concepts and core beliefs must be straightforward, usually expressed in abstract terms, and have enormous significance within the firm, even if outsiders do not see or understand them.

3. Method

In the current study, to evaluate the literature on concrete production plants, the following digital databases were utilized: (1) ScienceDirect, a leading global scientific, technical, and medical repository that provides quality services to researchers in academic environments, scientific institutions, and research and development departments within companies through innovative information, products, and services; (2) Springer, a global leader in scientific, technical, and medical fields, offering high-quality content to researchers in academic settings, scientific institutions, and research and development departments within organizations through innovative information, products, and services; (3) Google Scholar database; (4) Iraqi Scientific Journal; and (5) Gate Research. These databases encompass scientific and technical publications and provide abundant information about researchers' activities across various sectors. The following are the results of the first query search of 236 articles: The studies were selected, followed by three rounds of screening and filtering. 63 Duplicate articles were removed in the initial version, and only studies published between 2015 and 2023 were considered. The second round involved filtering based on titles and abstracts; 125 publications were eliminated, leaving 48 studies, excluding publications outside the scope of the study. In the third round, articles were examined through full-text reading, and 44 items that fell outside the study's requirements were eliminated, leaving 4 studies similar to the study problem, as depicted in Fig.4.

In all three cycles, the same qualifying requirements were used. In May 2023, 'Performance Evaluation, 'Ready-mix plant Performance evaluation of Ready-Mix Concrete Plant.

The search operations can be visualized as depicted in Fig.5.

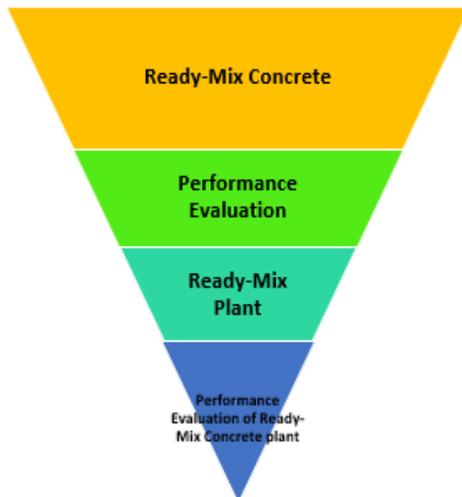


Figure (5): Review process

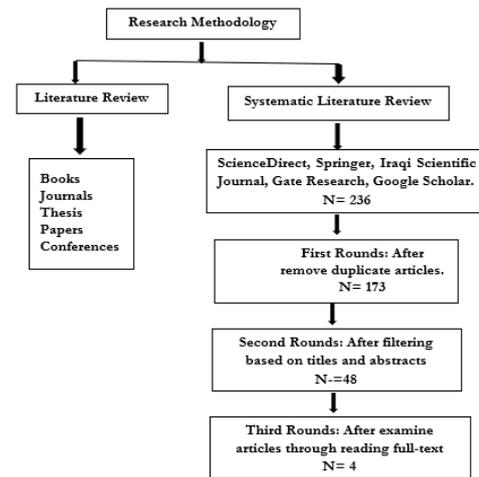


Figure (4): methodology and sequence of study

4. Results

Based on the systematic research and review conducted across different digital databases, four studies assessed the performance of ready-mix concrete production plants in multiple Arab countries. These findings are presented in Table 2 below.

Table (2): Summary of Similar Previous Studies on The Evaluation of Ready-Mix Concrete Production Plant

No	Title of Study	Researcher Name	Year	Country	Tools & Techniques	Statical methods	Construction model
1	An evaluation of ready-mixed concrete plants operating at Khartoum State, Sudan	Yahia and Elshaikh [47]	2018	Sudan	Interviews & observation	Questionnaire analysis	None
	<p>Research Objective: - This research had three primary objectives (1) to identify and survey RMC plants in Khartoum State, Sudan; (2) to evaluate the surveyed plants to determine their compliance with some selected attributes; and (3) to classify the plants according to the Saudi Manual for RMC facilities establishment.</p> <p>Research Description: - This study describes the findings of a survey and audit conducted to identify, evaluate, and categorize RMC plants operating in Khartoum State, Sudan. The findings revealed 19 RMC plants in Khartoum State, the earliest of which was founded in 1998. Sixteen plants were examined thoroughly regarding plant arrangement, laboratory and internal quality control system, and the final output quality.</p>						
2	Statistical model for predicting and improving ready mixed concrete batch plants' performance a ratio under different influences	Aziz [48]	2018	Egypt	Historical data	SPSS	Simplified prediction models
	<p>Research Objective: - This study's main objective was to evaluate and improve concrete batch plants' performance ratio by analyzing big data sets from multiple concrete batch plants and identifying the most influential components.</p> <p>Research Description:- This study has seven main parts: (1) Introduction; (2) Literature Review; (3) Methodology of Data Source, Field Measurement; (4) Collecting Data and Analyzing its Effect on Concrete Batch Plants' Performance Ratio; (5) Developing General and Simplified Models between concrete batch plant performance ratio as dependent variable with all effective variables as independent variables; (6) Applying a real Case Study to test the proposed model's accuracy; and (7) Determining the Conclusion and Recommendation.</p>						



3	A simulation-based model for evaluating the performance of ready-mixed concrete (RMC) production processes.	(Nellickal et al.)[49]	2015	India	Field visits & Field analysis	None	discrete-event simulation (DES) mode Simulation model
	Research Objective: - This research aims to explain RMC production processes and develop a simulation-based model to evaluate RMC production scenarios and calculate the environmental factors of the understudied RMC production process. The study analyses RMC truck and batching plant energy, carbon, and utilization. Processes include daily concrete production, truck number, journey distance, and speed.						
	Research Description: -This study uses a discrete-event simulation model to investigate RMC production scenarios and assess equipment (batching plant and truck) utilization, energy use, and carbon emissions. The operation of the RMC production processes is reviewed in great depth. Finally, this study offers some suggestions for enhancing the performance of the RMC sector.						
4	An engineering approach to allocating and evaluating performance influencing factors for the ready mixed concrete batch plant under different effects	Aziz [50]	2018	Egypt	Historical data	SPSS	
	Research Objective: - The main objective of this study is to analyze a clear understanding of measuring any concrete batch plant performance ratio by analysing collected data from more real concrete batch plants and determining the most effective factors that greatly affect a concrete batch plant's performance ratio. Predicting the actual future performance ratio and production rates for any concrete batch plant according to groups of effective factors is the essential sector suggested in this study using smart modelling analysis.						
	Research Description: This study comprises seven main parts: (1) Introduction; (2) Literature Review; (3) Methodology of Data Source, Field Measurement; (4) Collecting Data and Analyzing its Effect on Concrete Batch Plants' Performance Ratio; (5) Developing General and Simplified Models between concrete batch plant performance ratio as dependent variable with all effective variables as independent variables; (6) Applying a real Case Study to test the proposed model's accuracy; and (7) Determining Conclusion and Recommendation.						

5. Conclusion

The researcher in this study emphasized the importance of conducting a systematic literature review to build the research idea and benefit from similar studies related to the research sample. This approach helps identify the evaluation methods used, identify gaps in these studies, and focus on the most influential factors on performance. Furthermore, the researcher suggests using modern performance evaluation models in his study that have not been previously applied in similar previous studies.

The classification can reveal gaps and deficiencies in the studies conducted to evaluate the performance of ready-mix concrete production plants in Iraq for several reasons, including:

- 1) Studies not written in English.
- 2) Studies focus on the characteristics and applications of concrete mixtures produced in the plant and their environmental impact rather than evaluating their performance.

The study emphasizes the systematic review of previous studies and the utilization of modern models and methods to assess the efficiency and productivity of ready-mix concrete plants in Iraq. Furthermore, a comparison between this study and previous studies is summarized in Table 3. Conducting this comprehensive study in Iraq is highly recommended due to its significant importance and detailed relevance to the research topic.

Table (3): Comparison between the current study and the previous study

Current study		Previous study
Researcher Location	Iraq	Khartoum State, Sudan, Alexandria, Egypt, India.
Research Objective	This study uses Mckinsey 7S Model to evaluate a ready-mix concrete plant.	In general, evaluate and improve concrete batch plants' performance ratio and develop a simulation-based model to evaluate RMC and classify the plants.
Research population	Ready-mix concrete plant in Baghdad, Iraq	ready-mix concrete plant in different places
Research Tools & Techniques	Previous literature, documented data, semi-structured interviews, questionnaires, and Field visits. MCKINSEY 7S Model.	Field visits and Field Analysis, Historical data, Interviews, and observation



Statistical methods	Critical review	Questionnaire analysis and SPSS.
Research Case study	Al-Shumoukh columns plant for ready-mix concrete production plant, Naqaa Al-Saad plant for ready-mix concrete production plan, and others.	Different plants for ready-mix concrete plants.

NOMENCLATURE

RMC	Ready-Mixed Concrete
SPSS	Statistical Package for Social Sciences
KPIs	Key Performance Indicators
BSC	Balanced Scorecard
AHP	Analytical Hierarchy Process
DES	Data Encryption Standard

6. References:

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