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PROJECT MANAGEMENT PRACTICES AND PROJECTS SUCCESS AMONG DEVELOPING ECONOMIES– AN EGYPTIAN COMPARATIVE STUDY

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Research Paper

Abstract: *This work aims to improve comprehension of the practices system by examining the interrelationships among them with the DEMATEL technique. A number of project management best practices have been identified and corroborated by prior studies and semi-structured interviews with project specialists. Relationships among these practices have been categorised as "cause" and "effect" factors. Data on 537 engineers, project managers, and administrators was collected, encoded, and assessed. Nonparametric tests and descriptive have been utilised to characterise the sample, evaluate hypotheses, and address the enquiries. All responders agreed and endorsed the necessity of the techniques specified in this project. Despite this total being consistent, significant disparities in the perceived relevance of these best practices emerge between construction professionals and the project team. A statistically significant correlation existed between the cause and effect of best practices, alongside notable differences in participants' perceptions of best practices and success indicators based on gender, age, education level, profession, current work experience, and overall experience. Ultimately, recommendations were provided to the construction sector to enhance their project management methods.*

Keywords: *DEMATE Technique; Best Practices; Project Management; Project Success Indicators; Construction Projects; Egypt; Developing Economies Projects.*

1. Introduction

For any economy, but especially for one that is still growing like Egypt's, the success of projects is very important. But sometimes, projects don't meet their most important operating performance standards and are turned in late, over budget, or not at all. One of the main reasons projects don't meet practical performance standards is because of bad management and the wrong steps they take (Alias et al., 2012). A project is a one-

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time, separate set of activities with a clear start and finish date that use resources in a planned and organised way to reach a certain goal. This is different from activities that happen all the time, like routine tasks (Ilieş et al., 2010). This study seeks to identify the best Egyptian construction project management methods and their impact on project success. Question 1: What are poor countries' construction best practices? How do these practices cause each other? (3) What are project success indicators? (4) Do these practices help projects? Structure of the study: Section 2 addresses background and literature, Section 3 describes the technique, Section 4 shows DEMATEL results, Section 5 examines findings, and Section 6 concludes and recommends.

1.1 Project Success and Project Management

A project involves activities with a purpose and plan to generate a product that meets standards. Project quality management system/guidelines (ISO10006, 2019) defines project as a distinct process with numerous controlled and coordinated actions to reach a specific objective with a specific start and finish date, specific requirements, and resource, time, and money restrictions. Construction projects are special because they produce long-term structures that affect people's lives (ISO10006, 2019). A more complete project classification should incorporate all classification criteria.

1.2 Construction Projects

Construction projects are typically distinguished by a sequential progression of activities and actions that are designed to deliver results. The "inputs" of the construction process consist of resources such as manpower, materials, designing, technological skills, and financing that make the project happen. The "output" is the finished product with its specific requirements. A construction project is considered to be successful when it stays within the quality-time-cost triangular constraints. According to Ghaben (2015), construction projects have defining characteristics: project-based, as they are taken by workers, contractors, and engineers for a fixed duration to complete the project; fragmentation, in that the design and construction processes are segmented and managed separately; complexity, because of the interdependencies of tasks and uncertainties in the project environment; uniqueness, since every project is different and calls for adaptability, flexibility, acquisition of external resources, informal communication, innovation, creativity, and forward thinking; and risk, where construction projects are exposed to various uncertainties such as dynamic organizational structures, financial demands, adverse environmental conditions, intricate processes, and extended timelines.

1.3 Project Management

It entails the accomplishment of a project's objectives—performance, budget, and schedule—through activities that have defined start and end points and produce measurable outcomes (Al-Zwainy, 2016). It is essential for organizations, offering tools to effectively plan, execute, and control activities, resources, and people in line with predetermined goals (Meredith & Mantel Jr, 2011). With the increasing prominence of project management across all spheres and sectors, the Project Management Body of Knowledge was formed by the Project Management Institute as a framework, followed by PMBOK. The PMBOK outlines standard practices, processes,

methods, and techniques for effective management of projects (Varajão et al., 2014).

1.4 Project Management Phases

According to Larson and Gray (2015), project management consists of five main stages: (1) Initiating Phase, where the work is assessed for its potential and suitability to meet an objective; (2) Planning Phase, which takes place in defining the work scope and setting objectives explicitly; (3) Executing Phase, where resources and inputs are acquired, and various activities in the work schedule are performed; (4) Monitoring and Controlling Phase, which involves monitoring, gathering data, and intervening in order to bring actual work performance in line with that which was planned; and (5) Closing Phase, where the work accomplished is completed, either fully or partially meeting its target. Throughout these phases, successful management of materials, resources, personnel, strategies, and plans is essential in ensuring the project is delivered within defined budget, time, and specifications. Whenever there occurs a setback in any of these areas, it most likely reflects the performance of project management.

1.5 Best Practices and Project Management

Best practices are procedures, techniques, or methodologies that have proven to be more effective and efficient than other methods or approaches for achieving specific goals in a given situation (Ilieş et al., 2010). According to Awang (2008), best practices are strategies or activities validated by research and evaluation in a particular discipline or field of study. Best practices in projects considerably enhances the probability of success. For example, Ofori (2013) evaluated project management practices in Ghana and found some key success factors, including stakeholder involvement, clear project goals, effective communication, and top management support. The dissemination and documentation of these indicators and best practices are important for improving the quality of project management, especially in developing economies. Serpell et al. (2015) explained that poor risk management in construction projects often subordinates the success of projects; however, best practices in project management can further risk management capabilities.

According to Smallwood (2000), leadership, motivation, communication, and supervision skills for construction management are the essentials with different knowledge and skills requirements at different management levels. Top management includes for instance: cost estimation, risk analysis, and competitive tendering, and it has labour forecasting, while operational management has focused more on. Quality management, cost control, and contract administration emerged among the top ten management practices, as was revealed in Smallwood's study. It was further recommended that construction management programs place importance on the management of resources besides the technical knowledge. Spiegle (2015) described best practices as including creation of a planning horizon, proactive identification of risks, scope creep prevention, monitoring for warning signs, solving issues quickly, alignment of contracts, and obtaining sponsor approval for scope changes. The author also emphasized planning, team strengthening, customer satisfaction, and contract alignment in the best practices of project management. While these practices address core elements of construction projects, their role as influencing variables on project success remains underexplored.

1.6 Project Success

Project success has diverse definitions and dimensions. Kerzner (2017) proposes an all-inclusive definition that considers both key and peripheral factors. Primary factors comprise quality standards met, staying within budget requirements, and adhering to deadlines. Peripheral factors would include the client's ability to offer a reference about the project, the competencies of the key personnel working on it, and even the project's complexity level. Successful management of project time, risk, cost, and requirements is all that it takes to get a project done (Varajão et al., 2014). Naeem et al. (2018) emphasize that project success depends on meeting predefined requirements, but these requirements vary in their criticality depending on the specific element they address. Not all success indicators carry equal weight, highlighting the need for nuanced prioritization in evaluating project outcomes.

1.7 Critical Success Indicators

Critical Success Factors (CSFs) are key elements within management systems that either directly or indirectly contribute to project success (Ogwueleka, 2011). Gar (2015) identified CSFs specific to dam construction projects in Myanmar, including budget determination, cost estimation and control, quality checklists, resource estimation, requirements collection, budget performance monitoring, schedule development, stakeholder management planning, and risk identification. Gudienė et al. (2013) suggested a CSF model for construction projects in Lithuania, with 7 factor groups. Haron et al. (2017) gave a summary of the commonly used CSFs in several project management studies, thereby providing a comprehensive reference to understand factors influencing project outcomes. The CSFs details are summarized in Table 1.

Table 1: Project Critical Success Indicators (CSFs) (Source: Adopted from (Haron et al., 2017))

Critical Success Factor (CSFs)	
Adequate Resources	Top Management Support/Commitment
Actual Planning	Effective Communication/ Information Sharing
Feedback and Monitor Performance	Client Involvement
Common Goals /Project Mission	Project Team's Competency
Risk Management	Authority of the Project Manager/Leader
Customer Satisfaction	Realistic Time and Cost Estimates
Well-Laid Out Specification	Acceptable Project Control
Use of Technology/ Effective Selection	Abilities to Solve Problems

Aneesha (2017) highlighted that competitive advantage can be achieved only by the efficiency and success of the project. They determined the key success indicators for construction projects, such as top management support, problem-solving abilities, a competent project team, realistic time and cost estimates, effective communication, and the competency of the project manager. Alias et al. (2012) also mentioned that best practices in Malaysian construction projects can be implemented only if the project managers strengthen personal characteristics, skills, and knowledge to obtain successful results.

2. Methodology

The purpose of this exploratory and analytical study is to examine the best project management techniques used in Egypt's construction industry and assess how these techniques affect project success. A 5 points scale survey questionnaire was created to gather primary data for the current study in order to gauge the degree of best practices for project management in the Egyptian construction industry. This was done in addition to utilizing a variety of literature and references found in libraries, books, research, and websites pertaining to the topic of study and theses. First, a preliminary model includes a number of best practices for project management and the CSFs for building projects. Then, using a semi-structured interview process, a number of project specialists were chosen and contacted to assess these practices and CSFs, validate them, and recommend any additional ones. Second, the first project management impact relationship map was created by analyzing the impact relationships between these practices using the DEMATEL technique. Third, a unique survey was created to gather the views of administrative members and project management managers regarding these CSFs and their contribution to the success of building projects. Lastly, a thorough analysis of the findings and useful suggestions will be provided. The study design flowchart is displayed in Figure 1.

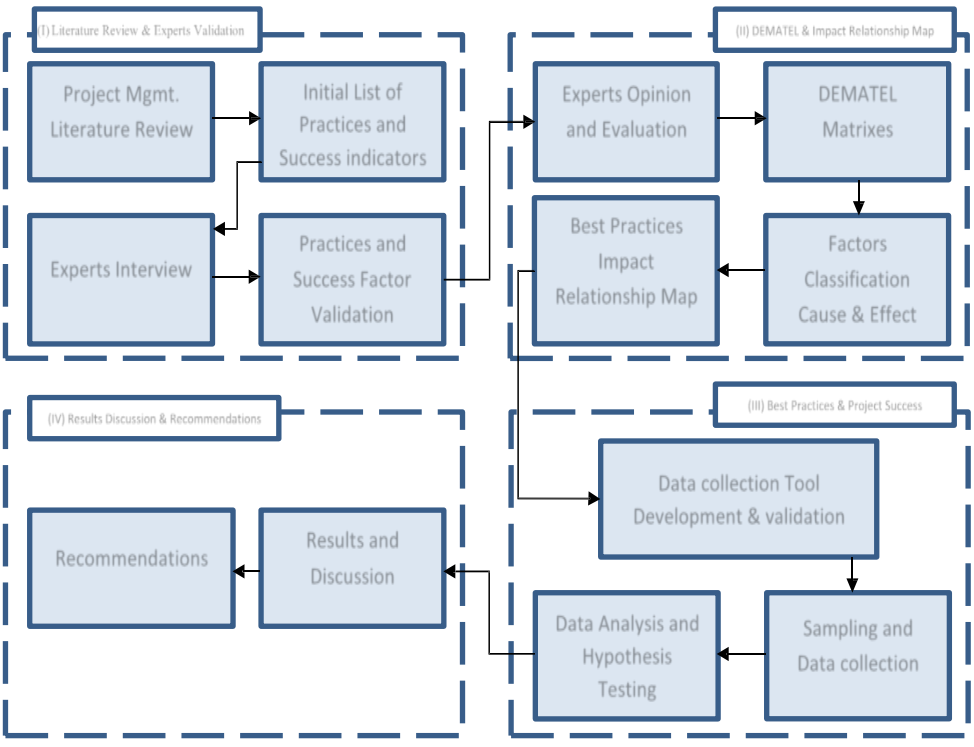

Figure 1: Study Flow Chart

2.1 Stage 1: Background and Framework Validation

In order to comprehend typical project management techniques in the construction industry and the elements affecting project success, this step entails a review of related studies. Four professionals from the Egyptian construction industry

were also interviewed in order to validate the most often used procedures and success metrics found in the literature. Experts were chosen on the basis of their more than 20 years of experience and whether or not they have managed construction projects as project managers.

Semi-structured interviews using a checklist were employed to gather primary data. By allowing the interviewer to delve deeper and elaborate on responses, a semi-structured interview facilitates greater depth (Rubin & Rubin, 2011). In order to ensure that the interview stays focused on the goals of the study while allowing for in-depth questioning, researchers advise employing a checklist to cover all pertinent topics during such interviews (Berg, 2004). Open-ended questions concerning the primary elements influencing project performance and the techniques employed to gauge success were asked in the first section of the two-part interview. In the second section, participants were asked to score 10 project success indicators and 19 project management practices (from the literature research) according to how relevant they were to project success. The details about project management practices are summarized in Table 2.

Table 2: Project Management Practices

Top Management Support	Synergy of the Team
Sponsor Involvement Within the Project	Clearly Defined Roles and Responsibilities
Owner Involvement within the Project	Competent Project Team Members
Stakeholders Satisfaction	Adequate Use of Technical Skills
Client Acceptance of the Results	Adequate Use of Project Management Techniques
Provision of Timely Data to Key Players	Timely and Comprehensive Control
Communication and Consultation with Stakeholders	Accurate Schedule and Plan
Ability to Handle Unexpected Problems	Clearly Defined Goals and Directions

The researcher selected the top ten project management techniques and ten success factors to be employed in the following phases after evaluating the data and calculating the average responses from the experts (Table 3).

Table 3: Validated Practices and CSFs

Project Mgmt. Best Practices	Critical Success indicators (CSFs)
Synergy of the Team	Identifying/Agreeing Objectives
Experience and Expertise of Project Management	Speed
Competent Project Team Members	Flexibility
Ability to Handle Unexpected Problems	Cost/Budget Aspects
Clearly Defined Goals and Directions	Quality
Synergy of the Team	Identifying/Agreeing Objectives
Experience and Expertise of Project Management	Speed

2.2 STAGE 2: Decision Making Trial and Evaluation Laboratory (DEMATAL)

2.2.1 DEMATEL Stages and Steps

The Battelle Memorial Institute of Geneva's Science and Human Affairs Program created DEMATEL in 1979 to research complex, linked problems. It is now a major technique for analyzing assessment criterion cause-and-effect linkages (Alkhatib et al., 2015; Lin & Tzeng, 2009). The approach helps uncover and analyses factor

relationships, revealing how different elements affect each other. DEMATEL technique application is shown in Figure 2.

This method will examine the effects of Project Management Best Practices by creating a cause-and-effect diagram. DEMATEL's major steps are: 1) Making average matrix A. Each participant estimated the direct influence of any two factors using an integer value from 0,1,2,3, and 4 for "no influence", "low influence", "moderated influence", "high influence", and "very high influence". Xij represents how much the participant thinks factor I impacts factor j. Set diagonal elements to zero for i=j. As seen in equation 1, the average matrix A= [aij] includes all H participant opinions.

$$a_{ij} = \frac{1\sum_{k=1}^{h} x_{ij}^{k}}{H}$$ Equation (1)

2) Creating the normalized initial direct-relation matrix D using equation 2.

D = A × S Equation (2)

Where

$$S = \frac{1}{\max_{1\le i\le n}\sum_{j=1}^{n} a_{ij}}$$

1) Calculate the total relation matrix T; it is defined as equation 3:

T= D (I-D)-1 Equation (3)

2) Calculating row and column sums in matrix T helps analyses factor relationships. Factor i gives other factors direct and indirect effects, while factor j receives them. Each factor i's overall effect is ri + ci, reflecting its combined influence in the system and its importance. Whether factor i is a cause or an effect is determined by its net contribution, ri - ci. A threshold value (α) is calculated by averaging all matrix T components to eliminate insignificant impacts. Finally, showing the coordinate pairs (ri + ci, ri - ci) for each factor visualizes the cause-and-effect interactions and identifies the system's most influential factors.

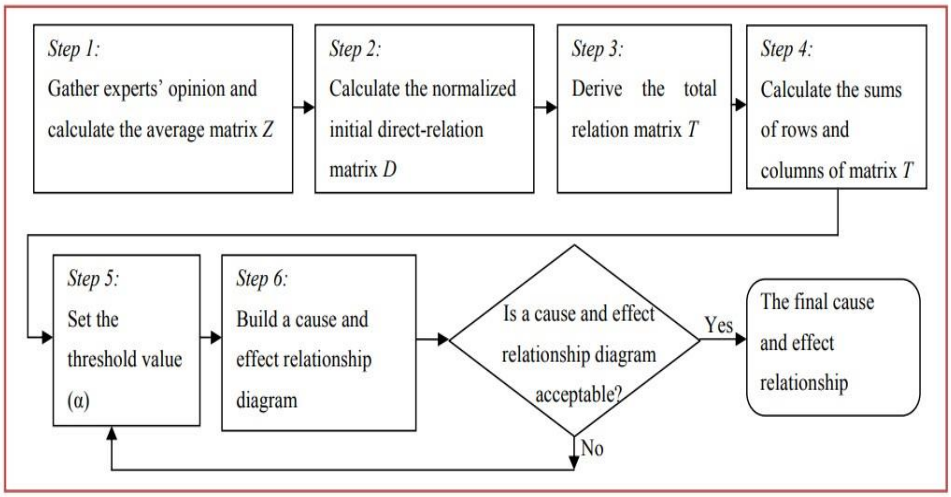

Figure 2: The Procedure of the DEMATEL Method (Sumrit & Anuntavoranich, 2013)

2.2.2 Sample and Population

At this stage, ten experts were chosen to respond to the DEMATEL questionnaire. Experts were selected due to their extensive experience of 20 or more years and their participation in numerous construction projects as project managers. The sample consisted of managers overseeing the largest construction projects in Egypt during the previous two years.

2.3 Stage 3: Analysis of The Data Collected

This stage involved studying the impact of prevalent practices on project success indicators through the development of a questionnaire, which was administered to workers at various levels in construction projects. This questionnaire was developed following the completion of the prior phase of the DEMATEL analysis. The ten remaining project management practices were categorized into cause and effect groups (independent and dependent) according to expert experience. The questionnaire comprised two primary sections: best practices in project management and indicators of project success.

2.3.1 Questionnaire Development

The researcher developed an initial questionnaire, subsequently submitting it to her supervisor for evaluation and feedback. Following the supervisor's feedback, the researcher utilized it to enhance the questionnaire. The revised questionnaire was subsequently translated from English to Arabic and resubmitted to the supervisor for additional review. The final version of the questionnaire, revised based on additional feedback, was distributed to a pilot sample of 10 individuals representing diverse educational backgrounds, including high school, diploma, bachelor's, and postgraduate levels. The final version of the questionnaire was developed by incorporating all comments from the pilot sample.

2.4 Structure of Questionnaire

Section One—Background Information: Gender, age, education, university major, job title, tenure with present organization, and professional experience are collected here. Second Part—Study Dimensions: Ten independent and dependent project management best practices are examined in this section based on previous research. Participants score each practice on a five point Likert scale (strongly agree =5, strongly disagree =1) across ten paragraphs measuring key success factors.

2.5 Population and Sample

The study population comprises all construction companies registered with the Construction Union in Egypt, totalling 1,701 companies as of early 2018 (Ghorfa, 2018). Companies were categorized according to their years of experience, with those possessing significant expertise in the field being chosen. Twenty-five experienced organizations with an average of 50 employees participated in the research. Researchers collected 549 completed questionnaires from 600. Reviewing the responses eliminated 12 invalid questionnaires, leaving 537 genuine submissions. Table 4 shows demographic distribution of sample members.

Table 4: Demographic Distribution of Study Sample

Variable	Category	Percentage	Frequency
Gender	Male	80.6	433
	Female	19.4	104
	Total	100.0	537
Age	20-29 Years	19.9	107
	30-39 Years	49.2	264
	40-49 Years	15.1	81
	+50 Years	15.8	85
	Total	100.0	537
Educational Level	High School	22.0	118
	Diploma	15.8	85
	Bachelor	44.1	237
	Postgraduate	18.1	97
	Total	100.0	537
University Specialization	Engineering	30.2	162
	Management	21.0	113
	Accounting	26.3	141
	Other, Select	22.5	121
	Total	100.0	537
Job Title	Administrative Worker	57.5	309
	Contractor	.9	5
	Engineer	18.4	99
	General Manager	3.5	19
	Department Manager	19.6	105
	Total	100.0	537
Experience in Current work	Less than Five Years	60.9	327
	5-10 Years	34.5	185
	More than 11 Years	4.7	25
	Total	100.0	537

2.6 Statistical Techniques

The SPSS was used to analyse the stage three data using a number of descriptive metrics. The following statistical techniques were used because the majority of responses were "Agree" or "Strongly Agree," indicating a skewed distribution: a Normality Test, which is applied to demographic variables like age and gender, to determine whether the sample distribution is normal; In order to answer the research questions, descriptive statistics are used to compute the mean, standard deviations, percentages, and ratios; Cronbach's Alpha to assess the study tool's internal consistency (reliability) to make sure it measures the things it's supposed to; Non-parametric tests include the Kendall's Tau-b Test, which gauges the degree of correlation between variables; the Kruskal-Wallis H Test, which determines statistically significant differences between more than two groups; the Mann-Whitney Test, which is comparable to the Kruskal-Wallis H test but is specifically used to compare two independent groups; and Spearman's Rank-Order Correlation, which measures the association between two ranked variables.

2.7 Validity and Reliability

The instrument's validity was assessed by presenting its preliminary form to multiple specialised arbitrators with expertise in project management, business administration, and contracting. To assess the stability of the questionnaire, a test-

retest method was employed on a sample of 10 employees not included in the study sample, with a two-week interval, utilising a T-test. The instrument's field consistency was evaluated using the Cronbach Alpha formula, as presented in Table 5.

High Cronbach's Alpha stability coefficients (0.74–0.88) are suitable for use. Most studies recommend a stability factor acceptance ratio of 0.70 (Sekaran, 2016). Pearson correlation coefficients show acceptable dependability and stability, with values ranging from 0.71 to 0.84, statistically significant at $\alpha \leq 0.05$. The researcher divided the study model variables' approval ratings into low, moderate, and high using an arithmetic average.

Table 5: Best Practices and Success Indicators of Kronbach Alpha Findings

Field	Pearson Application Coefficient	Stability Coefficient Cronbach α
Clearly Defined Goals and Directions	0.84*	0.85
Synergy of the Team	0.72*	0.75
Project Success Indicators	0.74*	0.88
Compliance with the Planned Budget, Time Frame and Performance	0.84*	0.86
Timely and Comprehensive Control	0.76*	0.81
Ability to Handle Unexpected Problems	0.74*	0.76
Accurate Schedule and Plan	0.77*	0.84
Best Practices for Project Management as a Whole	0.74*	0.80
Client Acceptance of the Result	0.71*	0.74
Competent Project Team Members	0.74*	0.79
The Tool as a Whole		0.86

3. Results and Discussion

3.1 DEMATEL Outcomes

Where m is the number of experts and n is the number of factors, each expert rated the influence of each best practice on each other. While xii shows how factor i influences others. Answer scores of 0 indicate no influence, 1 low, 2 moderate, 3 high, and 4 very high. Equation (1) created the average matrix A= [aii] to collect all expert replies numbered (m). A is the average matrix from Table (6). The details are in Table 6.

Table 6: The Average Matrix (A)

Average Matrix	1	2	3	4	5	6	7	8	9	10	Sum
1.6	1.3	1.2	1.4	2.2	0.4	0.3	1.3	2.9	0	12.6	12.6
8	3.4	2.4	1	2.6	2.7	1.4	1.6	0	3.3	2.6	21
4	3.1	1.5	1.6	0	2.8	1.3	0.9	2.6	2.6	2.3	18.7
29.6	25.2	17	25.2	30.3	19.7	19.7	27.8	36.3	33.1		
5	3.7	2.7	1.8	2	0	1.1	0.7	3	3.1	3	21.1
1.6	1.3	1.2	1.4	2.2	0.4	0.3	1.3	2.9	0	12.6	12.6
4	3.1	1.5	1.6	0	2.8	1.3	0.9	2.6	2.6	2.3	18.7
3.6	2.7	0.6	1.6	3.4	0.8	1	1.1	0	3.2	18	18
4	3.1	1.5	1.6	0	2.8	1.3	0.9	2.6	2.6	2.3	18.7
8	3.4	2.4	1	2.6	2.7	1.4	1.6	0	3.3	2.6	21
1.6	1.3	1.2	1.4	2.2	0.4	0.3	1.3	2.9	0	12.6	12.6

Table 7 shows how equation (3) is used to calculate the total relation matrix T. Calculating matrix T's column and row sums returned c and r. Since ri is the sum of all i values in matrix T's row, it shows factor i's direct and indirect effects on other factors. Also, ci is the sum of all i values in matrix T's column, reflecting all other factors' direct and indirect impacts on factor i. Ri + ci are factor i's total effects. However, (ri-ci) shows factor i's net system contribution. When positive, independent factor i causes (ri-ci). Ri-ci negatively impacts factor i as shown in Table 8.

Table 7: Total Relation Matrix T.

S.No	1	2	3	4	5	6	7	8	9	10	Sum
1	0.1815	0.1710	0.1230	0.1426	0.1047	0.190	0.1605	0.2154	0.1319	0.2010	1.62
2	0.1660	0.1377	0.1206	0.1290	0.0948	0.200	0.1803	0.2106	0.2201	0.1042	1.56
3	0.1919	0.1788	0.1158	0.0745	0.1107	0.208	0.1890	0.2226	0.2368	0.2138	1.74
4	0.1425	0.1369	0.0814	0.0938	0.0668	0.159	0.0724	0.1621	0.1770	0.1207	1.21
5	0.1696	0.1543	0.0825	0.1055	0.0669	0.099	0.1341	0.1863	0.2032	0.1598	1.36
6	0.1708	0.1389	0.0600	0.1089	0.1307	0.183	0.1717	0.1870	0.2031	0.1644	1.51
7	0.1088	0.1094	0.1039	0.0690	0.0402	0.129	0.1013	0.1451	0.1534	0.1376	1.09
8	0.1578	0.0761	0.0893	0.0843	0.0884	0.166	0.1463	0.1885	0.1940	0.1503	1.34
9	0.1604	0.0965	0.0671	0.0682	0.0659	0.170	0.1109	0.0914	0.1836	0.1458	1.16
10	0.0573	0.0817	0.0428	0.0667	0.0368	0.117	0.0861	0.1391	0.1099	0.0898	0.82
Sum	1.5066	1.2816	0.8866	0.9424	0.8058	1.626	1.3525	1.7482	1.8129	1.4873	

The threshold value (α) was determined by averaging all matrix values (α = 0.1345092). Figure 3 shows shaded cells above this value in the Project Management Best Practices Impact Relationship Map.

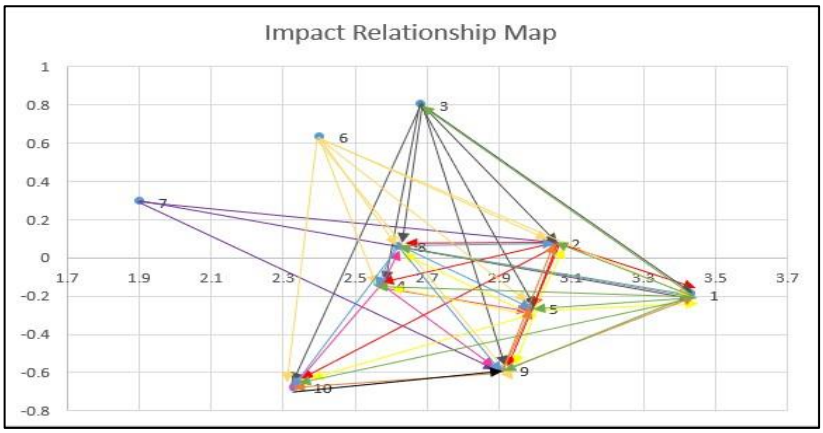

Figure 3: Project Management Best Practices Impact Relationship Map

Table 8: Practices Classification based on the Values of ri+ci and ri-ci

Practices	ri-ci	ri+ci	ci	ri	Type
Clearly Defined Goals and Directions	0.07632	3.050998	1.4873	1.5637	Cause
Experience and Expertise of Project Manager	0.80003	2.684868	0.9424	1.7424	Cause
Ability to Handle Unexpected Problem	-0.139	2.565913	1.3525	1.2134	Effect
Timely and Comprehensive Control	-0.2651	2.988687	1.6269	1.3618	Effect
Competent Project Team Member	0.63244	2.405644	0.8866	1.519	Cause
Synergy of the Team	0.29271	1.904361	0.8058	1.0985	Cause
Adequate of Project Management Techniques	0.06023	2.623385	1.2816	1.3418	Cause
Accurate Schedule and Plan	-0.588	2.908483	1.7482	1.1603	Effect
Client Acceptance of the Results	-0.6785	2.334686	1.5066	0.8281	Effect

3.2 Practice (1) Compliance with the Planned Budget, Time-Frame and Performance Standards: Effect Practice

Practice (9), "accurate schedule and plan," has the greatest impact because budget changes—positive or negative—can affect schedule and plan accuracy and project time and quality. Practice (1) is affected by eight practices, with practice (3), "experience and expertise of the project manager," being particularly important. Experienced project managers ensure budget and plan adherence to avoid delays or failure. Thus, practice (1), "compliance with the planned budget," causes practice (3), "experience and expertise of the project manager."

3.3 Practice (2) Clearly Defined Goals and Directions: Cause Practice

Most affected by practice (2), "Clearly defined goals and directions," is practice (1), "compliance with the planned budget, time frame, and performance standards." Starting with clear goals and directives helps the customer and contractor stay on budget. In contrast, poorly stated goals can cause budget overruns and project failure. Seven other practices influence this activity, with the project manager's knowledge and expertise (activity 3) helping set goals and directions. This method relies on the project manager's knowledge.

3.4 Practice (4) Ability to Handle Unexpected Problems: Effect Practice

Practice (3), "experience and expertise of the project manager," affects practices (1) "compliance with the planned budget, time frame, and performance standards," (9) "accurate schedule and plan," (5) "timely and comprehensive control," (10) "client acceptance of the result," and (8) "adequate project management techniques." Worker strikes or material specification changes can disrupt the budget, timeline, and performance requirements, compromising client acceptance of the project end. Five practices affect practice (4), with practice (3) directly affecting unanticipated problem-solving. Project managers with greater experience and expertise make better decisions and solve problems faster.

3.5 Practice (5) Timely and Comprehensive Control: Effect Practice

Practice 5, "timely and comprehensive control," affects five others: (1) "compliance with the planned budget, time frame, and performance standards," (9) "accurate schedule and plan," (10) "client acceptance of the result," (2) "clearly defined goals and directions," and (8) "adequate project management techniques and tools." Timely and thorough control improves project plan, budget, schedule, and customer acceptability. Seven additional practices affect practice (5), and the project manager's experience, expertise, and talents affect its efficacy.

3.6 Practice (6) Competent Project Team Member: Cause Practice

"Competent project team members," practice (3), affects seven practices: (1) "compliance with the planned budget, time frame, and performance standards," (2) "clearly defined goals and directions," (4) "ability to handle unexpected problems," (5) "timely and comprehensive control," (8) "adequate project management techniques and tools," (9) "accurate schedule and plan," and (10) "client acceptance of the result." Practice (1) is most affected, whereas practice (8) is least affected. No other practice influences practice as much (3).

3.7 Practice (7) Synergy of the Team: Cause Practice

The project team's synergy affects three practices: budget, time, and performance compliance (1), correct schedule and plan (9), and clearly specified goals and instructions (2). No practice affects this practice more. Synergy helps the team meet budget, schedule, and performance criteria, create accurate timetables, and set clear targets.

3.8 Practice (8) Adequate of Project Management Techniques and Tools: Cause Practice

This approach has the greatest impact on budget, goal, and direction compliance (1). Proper methods and tools ensure that any project meets these requirements. These techniques help define clear goals and directions (1), solve unanticipated difficulties (4), control the project (5), ensure an accurate plan and schedule, and gain customer acceptance of the project end. Six practices affect practice (8), with "experience and expertise of the project manager" having the most impact.

3.9 Practice (9) Accurate Schedule and Plan: Effect Practice

This practice directly affects four other practices, most notably budget, time, performance, and quality compliance (1). Meeting these standards requires a precise schedule and plan. The remaining nine elements affect practice (9), with "experience and expertise of the project manager" having the largest impact. Project managers can create reliable schedules and plans with more expertise, experience, and knowledge.

3.10 Practice (10) Client Acceptance of the Result: Effect Practice

This practice affects customer acceptance of the result weakly but significantly (9) and is influenced by eight other practices. Project management experience and expertise had the greatest impact (3). Compliance with the budget, clearly defined goals and directions, resolving unanticipated challenges, project control, team harmony, and using acceptable techniques and tools all moderately to highly effect customer approval. Project success, as evaluated by customer happiness and results acceptability, depends on the effective implementation of many project management best practices.

4. Descriptive Analysis

Based on 537 replies, the mean, standard deviations, and importance of each practice, success factor, and statement were computed. Project managers value all practices moderately to highly (Table 9).

Table 9: Means and Standard Deviations for all Best Practices in the Study

Field	Level	Standard Deviation	Mean
Accurate Schedule and Plan	High	0.76	3.91
Client Acceptance of the Result	High	0.76	3.77
Experience and Expertise of Project Management	Moderate	0.94	3.54
Timely and Comprehensive Control	High	0.99	3.77
Synergy of the Team	Moderate	1.02	3.32

Field	Level	Standard Deviation	Mean
Adequate Use of Project Management Techniques and Tools	Moderate	0.99	3.50
Ability to Handle Unexpected Problems	Moderate	0.88	3.51
Clearly Defined Goals and Directions	Moderate	1.05	3.41
Compliance with the Planned Budget, Time Frame and Performance	Moderate	1.00	3.50
Competent Project Team Members	Moderate	0.96	3.53

The mean project management best practices is 3.58, indicating that all are important with modest variances. The averages are 3.32–3.91, indicating modest relevance. Highest was "Accurate schedule and plan" with a mean of 3.91 and a standard deviation of 0.76, while lowest was "Synergy of the team" with 3.32 and 1.02. By mean, the most prevalent best practices in Egyptian construction are accurate schedule and plan > timely control > client acceptance > experience and competence > competent team > ability to handle difficulties > use of tools > budget compliance > time frame > goals > team synergy. Table 10 shows that most project success characteristics were 'High' with a mean of 3.77.

Table 10: Means Standard Deviations and Level of "Project Success Indicators"

Field	Level	Standard Deviation	Mean
Possess the Necessary Backing and Dedication from Upper Management.	Moderate	1.27	3.52
Boost the Team's Sense of Professional Fulfilment	High	1.23	3.73
Increase Societal Value	Moderate	1.11	3.63
Based on Open Communication among all Members of the Team	High	1.05	3.91
Have Been Planned and Carried Out in a Manner that Complies with all Requirements	High	1.04	3.85
Be Accomplished within Agreed Budget	High	1.05	3.73
Meet the Strategic Goals of the Project	Moderate	1.05	3.65
Add Value for Society	Moderate	1.11	3.63
Meeting the Demands and Specifications of all Parties Involved	High	1.18	3.79
Delivered on Time as Scheduled	High	0.95	3.68
Be With high Quality Standards	High	0.95	3.96
" Project Success Indicators " as a Whole	High	3.77	-

5. Hypothesis Testing

Figure 4 shows hypothesis testing results. Project management approaches are valued by both men and women, yet there are substantial disparities ($p \leq 0.05$) in goal-setting, expertise, team synergy, budget compliance, timeliness, performance, and problem-solving. This means female and male project managers and administrative workers priorities these best practices differently. Gender has no significant impact on project success indicators or practices (e.g., timely control, precise scheduling, client acceptance) ($p \leq 0.05$). Both men and women project managers/administrators favor these methods. They priorities project success metrics similarly. Age strongly impacts project management best practices ($p \leq 0.05$), except for timely and accurate control and scheduling. There are significant age differences ($p \leq 0.05$) in project performance measures. Project managers/administrators evaluate best practices differently. Sample figures show that 30-39-year-olds, the largest age group, value

best practices differently. Thus, project managers/administrators assess project success differently. Educational level strongly affects project management best practices, including well-defined goals, experienced management, competent team members, team synergy, and effective use of techniques and tools ($p \leq 0.05$). No significant influence of education on project success indicators or best practices, such as budget compliance, time frame, performance, problem-solving, control, accuracy, and client acceptability ($p \leq 0.05$).

Postgraduate project managers rank optimal practices and performance criteria differently. University specialization in project management significantly impacts practices including goal clarity, experienced managers, and budget compliance ($p \leq 0.05$). Time frame, performance, and customer acceptability are unaffected. No significant differences in project success metrics by university specialization. Except for "accurate schedule and plan," job title affects project management practices, with the 'General Manager' scoring highest for best practices and success indicators. Experience was significantly different ($p \leq 0.05$) in project management best practices such as "clearly defined goals and directions," "experience and expertise of the project manager," "competent project team members," "synergy of the team," "adequate use of project management techniques and tools," "compliance with the planned budget, time frame, and performance," "ability to handle unexpected problems," and "client acceptance." There were no significant differences for "timely and comprehensive control" and "accurate schedule and plan." No major variations were detected in project success indicator experience.

Age Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Dependent is the same across categories of Age.	Independent-Samples Kruskal-Wallis Test	.024	Reject the null hypothesis.
2	The distribution of Indepneden3 is the same across categories of Age.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Education Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Dependent is the same across categories of Edu.	Independent-Samples Kruskal-Wallis Test	.351	Retain the null hypothesis.
2	The distribution of Indepneden3 is the same across categories of Edu.	Independent-Samples Kruskal-Wallis Test	.010	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Specilization Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Dependent is the same across categories of University.	Independent-Samples Kruskal-Wallis Test	.869	Retain the null hypothesis.
2	The distribution of Indepneden3 is the same across categories of University.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Job Title Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Dependent is the same across categories of Job.	Independent-Samples Kruskal-Wallis Test	.413	Retain the null hypothesis.
2	The distribution of Indepneden3 is the same across categories of Job.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Exp Current Job Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Dependent is the same across categories of ExpCurrent.	Independent-Samples Kruskal-Wallis Test	.798	Retain the null hypothesis.
2	The distribution of Indepneden3 is the same across categories of ExpCurrent.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Total Exp Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Dependent is the same across categories of ExpGener.	Independent-Samples Kruskal-Wallis Test	.230	Retain the null hypothesis.
2	The distribution of Indepneden3 is the same across categories of ExpGener.	Independent-Samples Kruskal-Wallis Test	.044	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Figure 4: Hypothesis Testing Summary

5.1 Spearman's and Kendall's Tau_B Test (Correlation of Dimension)

Spearman's and Kendall's tau_b correlations assess ranked variables. This research compares Dependent and Independent 1, 2, and 3 variables. Table 11 shows Spearman's correlation (ρ) from 0.165 to 0.884 and Kendall's tau_b from 0.116 to 0.734. The strongest correlation is 0.691 between Independent-1 (cause practices) and Dependent (project performance indicators). Construction project managers in lower economies should focus on 'Cause Project Practices' and align them with success indicators because they significantly impact project success.

Table 11: Spearman's and Kendall's Correlation Coefficients

Spearman's *rho*		Indepneden1	Indepneden3	Indepneden2	Dependent
Dependent	Correlation Coefficient	.165**	.453**	.691**	1.000
	Sig. (2-tailed)	.000	.000	.000	.
	N	537	537	537	537
Indepneden1	Correlation Coefficient	1.000	.884**	.519**	.165**
	Sig. (2-tailed)	.	.000	.000	.000
	N	537	537	537	537
Indepneden2	Correlation Coefficient	.519**	.838**	1.000	.691**
	Sig. (2-tailed)	.000	.000	.	.000
	N	537	537	537	537
Indepneden3	Correlation Coefficient	.884**	1.000	.838**	.453**
	Sig. (2-tailed)	.000	.	.000	.000
	N	537	537	537	537
Kendall's *tau_b*		Indepneden1	Indepneden3	Indepneden2	Dependent
Dependent	Correlation Coefficient	.116**	.322**	.522**	1.000
	Sig. (2-tailed)	.000	.000	.000	.
	N	537	537	537	537
Indepneden1	Correlation Coefficient	1.000	.734**	.378**	.116**
	Sig. (2-tailed)	.	.000	.000	.000
	N	537	537	537	537
Indepneden2	Correlation Coefficient	.378**	.661**	1.000	.522**
	Sig. (2-tailed)	.000	.000	.	.000
	N	537	537	537	537
Indepneden3	Correlation Coefficient	.734**	1.000	.661**	.322**
	Sig. (2-tailed)	.000	.	.000	.000
	N	537	537	537	537

5.2 DEMATEL Experts and Project Managers/Administrative Evaluations

Both DEMATEL experts and project managers/administrative staff stress the importance of the studied project techniques and performance metrics. Despite this consensus, some behaviors and indicators are ranked differently. Analysts and workers score "accurate schedule and plan" and "compliance with the planned budget, time frame, and performance." differently. Per SPSS investigation, Egyptian construction workers value an accurate timetable and plan as the most significant project management approach. Employees feel that reliable schedules and plans help projects be completed on time, under budget, and to specification.

6. Conclusion

Successful project implementation requires project management. Tested methods boost efficiency and effectiveness. Projects in developing economies often fail to satisfy performance criteria and are late or over budget. Egypt lacks construction performance metrics and best practices, resulting in inconsistent project management. This study examined Egyptian construction project management best practices and success indicators. Based on findings, some suggestions are made:

A) Egyptian construction unions and contracting bodies should embrace best practices throughout the project lifecycle and focus on crucial success indicators to protect owners, contractors, and consultants.

B) Egyptian universities should teach project management and success indicators to engineers who will lead future construction projects.

C) Construction unions and contracting bodies should build a project follow-up system to effectively implement best practices and performance indicators.

D) Professional associations should educate construction workers about these practices through training.

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