KICEM Journal of Construction Engineering and Project Management
Online ISSN 2233-9582

www.jcepm.org
http://dx.doi.org/10.6106/JCEPM.2016.12.4.007

Success Factors of Highway Construction Projects in Egypt: AHP Approach

Ahmed Ebrahim Abu El-Maaty [1], Saad El-Hamrawy[2] and Ahmed Yousry Akal[3]

Abstract: ***While the idea of the existence of a set of key factors for success in planning, designing and construction of projects is not new, it remains one of the most important issues in the field of construction management. This is due to project success factors are inputs to project management practice which can lead directly or indirectly to project success. This study identifies the success factors which can be used for improving the highway projects performance in Egypt during the project pre-construction and construction phases. Through a detailed literature review 35 success factors are identified. Furthermore, the AHP is adopted to prioritize the studied factors through the application of questionnaire survey. The study establishes that implementing an effective quality control and assurance systems, allow sufficient time for feasibility studies, design, drawing and tender preparation, effective cost control system and frequency of project budget updates, preparing adequate designs and drawings and determining sufficient time to implement the desired scope of work are the most important success factors for enhancing the highway projects performance in Egypt.***

Keywords: Success Factors, Construction Projects, Highway Projects, Egypt, AHP

I. INTRODUCTION

Project success is almost the ultimate goal for every project [1]. Success on a project means that certain expectations for a given participant were met, wether owner, planner, engineer, contractor [2]. Long et al. [3] defined successful project as one that is completed within the agreed contract budget and deadline, in accordance with required specifications and to the satisfaction of stakeholders. Similar related definitions were used by Handa and Adas [4] and Williams [5]. Furthermore, Chan et al. [6] highlighted that studying project success is considered to be one of the vital ways to improve the effectiveness of project delivery.

One approach to studying project success is to focus on factors leading to the project success [7]. Over the past few decades the investigation on project critical success factors has attracted the interest of many researchers and practitioners [8, 9]. The term critical success factors (CSFs) in the context of the management of projects was first used by Rockart in 1982 [10] and was defined by Sanvido et al. [2] as "those factors predicting success on projects". While, Reh [11] defined project critical success factors as "a course of action which is pursued to reach project objectives".

A large body of research elucidates the importance of project success factors in the construction industry. Chua et al. [12] concluded that the identification of the critical success factors will enable limited resources of time, manpower and money to be allocated appropriately. While, Yu and Kwon [13] recognized that without a common

understanding of the success factors of a project, it is very difficult to monitor and control project performance effectively. Consequently, the identification of appropriate success criteria is important for project owners and managers, who need a specific and measurable framework for tracking key project outcomes.

On the other hand, McCabe [14] and Chan [15] showed the importance of success factors for managers of construction projects as it represents a vital factor for managers to improve their organization in the sense that it will indicate the progress is being made in particular areas. Furthermore, project managers attend to these success factors in an intuitive and ad hoc fashion as they attempt to manage and allocate resources across various project areas.

The present study seeks to identify the success factors for highway construction projects in Egypt during the project pre-construction and construction phases. Moreover, prioritizing and ranking the identified factors based on accumulative knowledge and judgment of experts in highway construction industry in Egypt through the application of the analytical hierarchy process (AHP).

II. REVIEW OF CONSTRUCTION PROJECT SUCCESS FACTORS

Several studies have been carried out on the success factors of construction projects and every researcher came up with his/her methodology in identifying these factors. Chua et al. [12] recognized that the CSFs identified in various studies ranged from general conceptual guidelines [2, 16] to more specific execution strategies [17], and

[1] Associate Professor of Highway and Airport Engineering, Faculty of Engineering, Menoufia University, Egypt, e-mail: maaty5000@yahoo.com
[2] Professor of Highway and Airport Engineering, Faculty of Engineering, Menoufia University, Egypt, e-mail: S_Hamrawy@Yahoo.com
[3] PhD Candidate, Civil Engineering Department, Faculty of Engineering, Menoufia University, Egypt, e-mail: a_yousry85@yahoo.com

stated that most of the previous work had only identified the CSFs for project success in general. On the other hand, there have also been studies to identify the CSFs of specific types of projects, such as public construction projects [8], large-scale construction projects [18] and projects undertaken by public-private partnerships [19].

On the other hand, the researchers developed conceptual frameworks in order to classify the groups of projects success factors. Chan et al. [6] stated that the success factors which may affect the project success can be grouped under the following five headings: human-related factors, project-related factors, project procedures, project management actions, and external environment. Tabish and Jha [8] concluded that the success factors can be grouped under five main categories according to the project objectives. These include schedule, cost, quality, safety and no-dispute.

According to the above review it can be noted that there is a plenty of factors with the potential to affect the project success. Success factors mean different things to different people. Furthermore, CSFs may change over time from country to country. Also, it is affected to a high degree by the project type, the project size and the project participants. Accordingly, set a fixed and unified concept for these factors is very complex issue. In spite of this, the study of these factors is still very important for all researchers who are interested in the development of construction industry.

III. Need for the Study

The construction industry in Egypt accounts for 4.7% of Egypt's Gross Domestic Product, making it one of the most important industries for the country's economic progress. For developing economies, highway construction constitutes a major component of the construction industry. Egypt's road network comprises 91,173 kilometers of roads, divided into 67,728 of main roads and 23,445 kilometers of artery roads. Furthermore, the roads network in Egypt carry out 85% of domestic freight and 60% of passenger movement, which makes it one of the most important industries affecting the GDP [20, 21]. Furthermore, the investments in infrastructure especially highway project reach to US $5.46 billion which means that much of the national budget on infrastructure development in Egypt is channelled to highway construction projects [22, 23].

However, the importance of this industry in Egypt to the national economy, most of highway projects in Egypt are no at the desired level of performance. For instance, according to a report by the World Bank, only 20 % of the roads in Egypt are in good condition and suffer from low service quality and are at risk of premature failure [24]. Furthermore, concerns are raised frequently on the poor performances of these projects in Egypt on time and cost accounts, with delay and cost overrun percentages reaches up to 66% and 7.12% respectively [25, 26]. This is in addition to the dispute records and the issues related to the safety and number of accidents due to the poor quality of the implementation of the roads network in Egypt [27].

These overruns may be a result of several causes such as inadequate design, drawings and specifications, inaccurate initial cost estimates, insufficient time to implement the project, lack of experience and qualifications to monitor the project, lack of communication and frequent meetings among project stakeholder…etc. Therefore, in order to reduce such overruns and improve the performance of these projects in Egypt, the critical success factors associated with these causes have to be identified. Review of literature on the variables/attributes that affect the outcome of a project reveals that most of the studies have been taken up in the context of developed countries and no research works have been reported for the Egyptian construction projects, specifically highway projects in Egypt.

The above reasons have been the motivating factor for the study which aims at identifying the factors which can be used for achieving the desired level of performance of construction projects in Egypt. Furthermore, enhancing the management practice of highway projects in Egypt by specifying the most important success factors that are felt to be useful for improving the performance of this industry during the project pre-construction and construction phases.

IV. Study Methodology

For the purpose of specifying the success factors which can be used for improving the performance of highway projects delivery and enhancing the management practice of such industry through the application of AHP technique, five steps have been designed to clearly illustrate the study methodology stages beginning from the review of the previous work regarding the theory of the AHP and factors of success, passing through structuring the hierarchy model and designing the questionnaire survey and ending with the analysis and discussions of the survey results. Figure 1 explains the research flowchart.

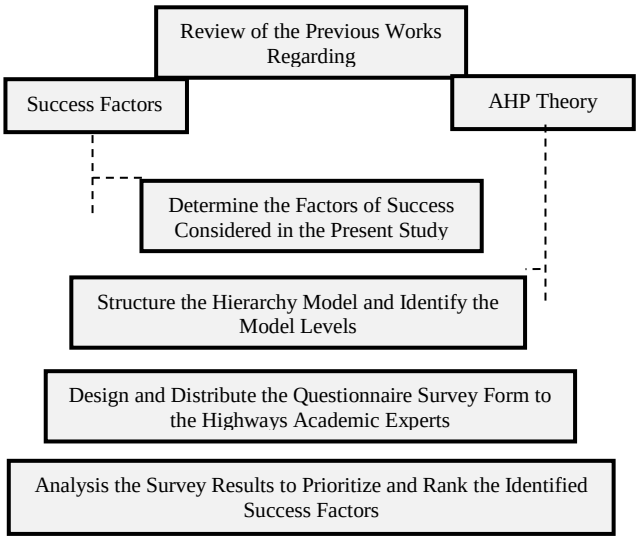

FIGURE I

METHODOLGY FLOWCHART

A. Success Factors of the Present Study

A construction project such as highway comprises two distinct phases: the preconstruction phase, (the period between the initial conception of the project and signing of the contract; and the construction phase which is the period after award of the contract when the actual construction is going on) [28]. Furthermore, a typical construction project environment, particularly under the traditional procurement method with separate consultant and contractor, can be simplified represented by many different aspects such as project management actions/interactive process, contractual arrangements, human related-factors, pre-construction related-factors, project participants, project procedures...etc [12 , 29 and 30]. The contribution of these aspects towards the project outcome/project success has been noted by many researchers such as Chan et al. [6], Chua et al. [12], Alias et al. [29], Whi, et al. [30]. Therefore, the classifications of these predetermined aspects have been considered as a base in the success model of the present study.

A careful study of the pervious literature suggested that CSFs for the pre-construction phase of the project can be grouped under two main categories namely, pre- project technical studies and contractual arrangements [12, 30]. While, CSFs for the construction phase of the project can be grouped under three main categories. These include interactive processes, monitoring and control and human related-factors [6, 12]. Totally, 35 factors have been identified to represent the success factors of these five groups. A comprehensive literature review identified 25 success factors, together with 10 project success factors developed to be matched with the aspects of the identified groups. Table 1 presents the source of the identified factors.

B. Analytic Hierarchy Process

The Analytic Hierarchy Process (AHP) introduced in the early 1970s by Thomas Saaty to be used for dealing with complex technological, economic and socio-political problems [31]. AHP helps in identifying priorities on the basis of the decision-maker's knowledge and experience of each problem. The strength of AHP lies in its ability to structure a complex, multi-person, multi-criteria problem hierarchically and then to investigate each level separately, combining the results as the analysis progresses [32].

The AHP theory depends on breaking down the decision problem into elements, according to their common characteristics and levels, which correspond to the common characteristic of the elements. The topmost level is the focus of the problem or the ultimate goal; the intermediate levels correspond to criteria and sub-criteria, while the lowest level contains the decision alternatives [33]. Furthermore, AHP depends on use the pairwise comparison in establishing the priorities for the elements at the same level i.e. criteria and alternatives [34]. The pairwise comparisons are guided by a nine-point scale as depicted in Table 2 [35]. Adopting the nine-point scale, the experts would be able to express their judgment subjectively. While, Table 3 shows the legend of the identified success related-factors and groups of the present research.

C. Structuring the Hierarchy Model of the Success Factors

As for the purpose of the present study, the hierarchy model for identifying the project success factors as shown in Figure 2 is consisted of four levels. At the top of the hierarchy is the goal of "construction projects success factors". While, level two represents the groups of project pre-construction and construction phases. On the other hand, the groups of pre-project technical studies, contractual arrangements, interactive processes, monitoring and control and human related-factors contribute to the goal occupy the third level of the hierarchy. Finally, the 35 recommended enhancement factors are inserted at level four of the hierarchy.

TABLE I
SOURCES OF THE STUDY SUCCESS FACTORS

Success Factor	P1	P2	P3	P4	P5	P6		
Reference	D	[12]	[12]	D	[7]	D		
Success Factor	C1	C2	C3	C4	C5	C6	C7	C8
Reference	[30]	D	D	[12]	[18]	[7]	D	[12]
Success Factor	I1	I2	I3	I4	I5	I6		
Reference	[6]	[30]	[18]	D	[18]	D		
Success Factor	M1	M2	M3	M4	M5	M6		
Reference	[8]	[12]	[12]	[6]	[18]	[18]		
Success Factor	H1	H2	H3	H4	H5	H6	H7	H8
Reference	[7]	[7]	D	[7]	D	[7]	[12]	[7]
Success Factor	H9							
Reference	[7]							

D: Developed Factor

TABLE II
THE FUNDEMNTAL SCALE OF ABSOLUTE NUMBERS [35]

Intensity of Importance	Definition
1	Equal importance
3	Weak importance of one over another
5	Essential or strong importance
7	Very strong or demonstrated importance
9	Absolute importance
2, 4, 6 ,8	Intermediate values between adjacent scale values

TABLE III
LEGEND OF THE SUCCESS-RELATED FACTORS AND GROUPS CONSIDERED IN THE STUDY

Legend	Factor	Legend	Factor
P	Pre-project technical studies	**I3**	Developing positive friendly relationships with the project stakeholders
P1	Allow sufficient time for feasibility studies, design, drawings and tender preparation	**I4**	Improve documentation and information systems
P2	Preparing adequate and comprehensive specifications	**I5**	Creating accountabilities, experiences, roles and responsibilities for the organization
P3	Preparing adequate designs and drawings		
P4	Preparing clear quantity take-off	**I6**	Increase awareness and understanding of quality importance among all employees
P5	Determining sufficient time to implement the desired scope of work	**M**	Monitoring and control
P6	Accurate initial cost estimates	**M1**	Implementing an effective quality control and assurance systems
C	Contractual arrangements		
C1	Precise definition of project scope and objectives in the tender to avoid the misunderstanding and contradiction	**M2**	Effective scheduling and time control system and frequency of project schedule updates
C2	Improving contract award procedure by giving less weight to price and more weight to capabilities, financial standing and past performance of contractors	**M3**	Effective cost control system and frequency of project budget updates
		M4	Implementing an effective safety program
C3	Giving applying contractors the sufficient time to study and review the tender documents accurately	**M5**	Frequent meetings among various stakeholder to evaluate the overall performance and reports updates
C4	Identified clearly the formal relationships among project parties, as well as the roles and responsibilities in the contract	**M6**	Using up to date technology and automation for construction work
		H	Human related-factors
C5	Proper dispute resolution clauses incorporated in the contract	**H1**	Availability of resources (human, financial, raw materials and facilities)
C6	Establish formal risk management system in the contract which clarifies the risk identification and allocation	**H2**	Total years of construction experience
		H3	Total years of project management experience
C7	Connect the contract price with the price index	**H4**	Perception of the role and responsibility
C8	Clearing right of way obstructions before mobilization of contracting company to the site	**H5**	Ability to make timely decision
		H6	Fast troubleshooting capabilities
I	Interactive processes	**H7**	Commitment of all parties to the project
I1	Developing an appropriate organization chart	**H8**	Competency and technical skills
I2	Adequate communication among project stakeholders	**H9**	Managerial and organizational skills

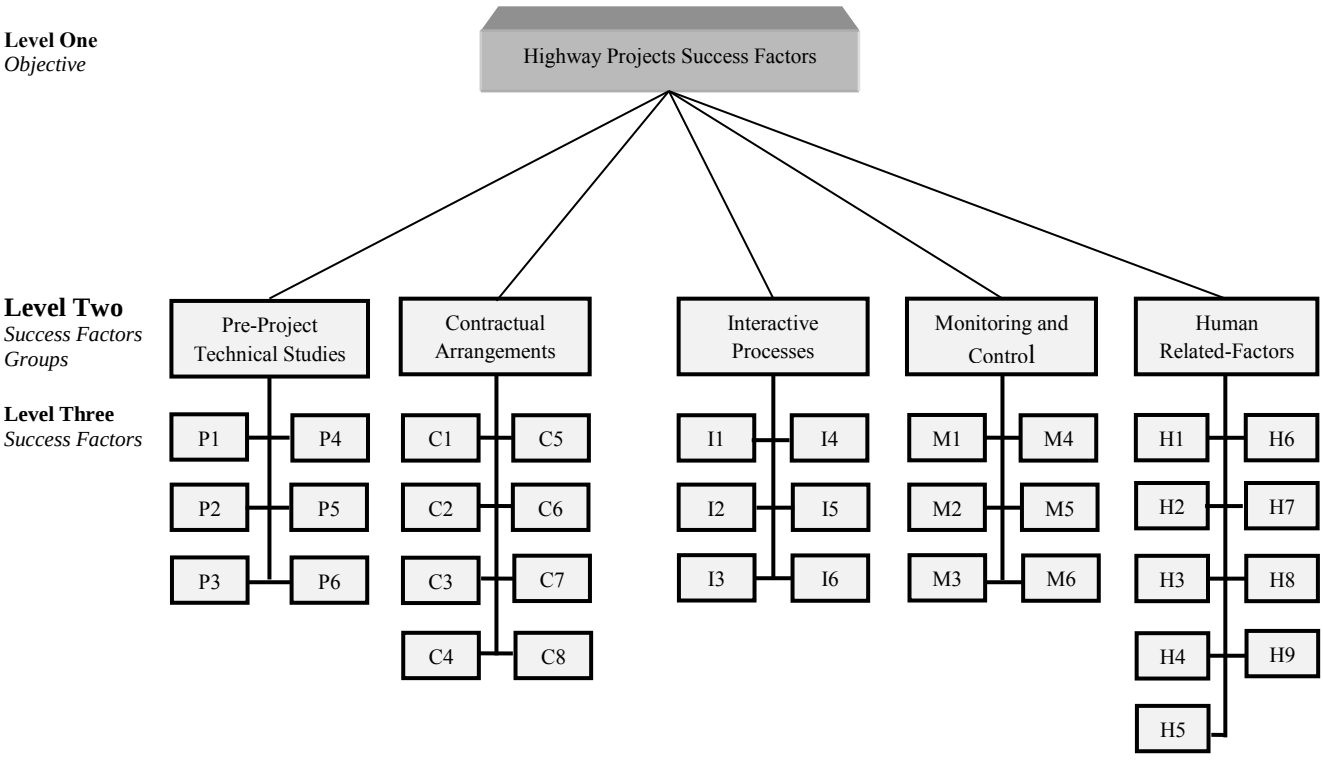

FIGURE II

THE HIERARCHY MODEL OF THE SUCCESS FACTORS

D. Questionnaire Design and Distribution

The research method of this study is mainly based on a structured questionnaire survey in order to cover the requirements of the research objectives and achieve better results. The developed questionnaire has been designed in order to specify the relative importance weight of the suggested success factors to improve the highway projects performance through the application of AHP numerical rating. The questionnaire has been divided into three sections as follows:

- Section No. 1: Personal information about the respondents: this part of the questionnaire consists of four questions which have been set to ask for information about the respondents such as his/ her name (optional) and relevant working experience.
- Section No. 2: Guideline for filling and establishing the relative importance weight: this part of the questionnaire illustrates how the participants can use the AHP in the bases of pairwise comparison to determine the importance weight of the suggested success factors in the questionnaire.
- Section No. 3: Success factors for improving the highway projects performance: this section presents the suggested factors to improve the highway projects performance during project pre-construction and construction phases.

After determining the questionnaire objectives and designing its sections, the designed questionnaire has been distributed to academic experts. To secure good quality data, a separate personal interview with every academic expert has been conducted in order to facilitate the process of filling in the questionnaires. After two months of following up with the prospected experts, only five were willing to participate in the study. It is noteworthy that all the respondents to the questionnaire have over 10 years of experience with a qualification of a PHD degree.

The relatively small sample size is mainly attributed to two reasons. First, only those with about 10 years of experience would be approached to preserve the quality of the opinions gathered in the survey. This has significantly reduced the pool size of the potential respondents. Second, some of the experienced practitioners contacted were reluctant to participate in the survey because of the commitment expected from them, noting that they have to make pairwise comparisons of 35 success-related factors.

The appropriateness of a small-sample size is not uncommon issue in the construction management studies. For instance, the results of the study which has been conducted by Gudiene et al. [7] depended on a sample-size of five experts for identifying and evaluating the critical success factors for construction projects in Lithuania using AHP approach. While, Tan et al. [36] in their study depend on a sample size of seven contractors in order to investigate how the indirect costs involved in construction works in UK are estimated.

The small sample size is a liming factor in the current study and further research can be carried out with a greater number of respondents. Nevertheless, the results of the current study should be taken into consideration due to the experience of the participants and as it is the first study conducted in Egypt for identifying and determining the critical success factors for one of the most important industries affecting the national Egyptian economy: highway construction industry.

E. Prioritizing and Ranking of Success Factors

By following AHP steps as clearly described in details by Al Wahaidi [37], the importance weight of the success factors can be easily determined. In the current study the ranking process will be determined with respect to the local and global weights of the studied factors. The local weight can be derived from judgment with respect to a single criterion. While, the global weight is derived from multiplication by the weight of the criteria.

Table 4 shows the local weights of the success factors of every identified group in the current study. The analysis of this Table shows that the most important factors which can be used in enhancing the highway construction projects delivery in Egypt are as following:

- For pre-project technical studies group: Factor No. P1"allow sufficient time for feasibility studies, design, drawing and tender preparation" with local weight=0.2396.
- For contractual arrangements group: Factor No. C1"precise definition of project scope and objectives in the tender to avoid the misunderstanding and contradiction" with local weight=0.3066.
- For interactive processes group: Factor No. I5 "creating accountabilities, expectations, roles and responsibilities for the organization" with local weight=0.2619.
- For monitoring and control group: Factor No. M1 "implementing an effective quality control and assurance systems" with local weight=0.3016.
- For human related-factors group: Factor No. H1"availability of resources (human, financial, raw materials and facilities)" with local weight=0.1985.

On the other hand, Figure 3 shows the global weights of the success factors. The analysis of this Figure presents that Factor No. M1"implementing an effective quality control and assurance systems", Factor No. P1 "allow sufficient time for feasibility studies, design, drawing and tender preparation", Factor No. M3 "effective cost control system and frequency of project budget updates", Factor No. P3 "preparing adequate designs and drawings" and Factor No. P5 "determining sufficient time to implement the desired scope of work " with global weights = 0.0898, 0.0734, 0.071, 0.0619 and 0.0577 respectively have been ranked as the most important factors which can be used for enhancing the highway projects performance in Egypt.

TABLE IV
The LOCAL WEIGHTS OF THE SUCCESS FACTORS

Group	Success Factor	Local Weight
Pre-Project Technical Studies	P1	0.2396
	P2	0.1284
	P3	0.2021
	P4	0.1208
	P5	0.1883
	P6	0.1204
Contractual Arrangements	C1	0.3066
	C2	0.0403
	C3	0.0968
	C4	0.1206
	C5	0.1905
	C6	0.0794
	C7	0.0555
	C8	0.1099
Interactive Processes	I1	0.1694
	I2	0.0953
	I3	0.1375
	I4	0.2367
	I5	0.2619
	I6	0.0988
Monitoring and Control	M1	0.3016
	M2	0.1162
	M3	0.2384
	M4	0.1186
	M5	0.1808
	M6	0.0442
Human Related-Factors	H1	0.1985
	H2	0.1149
	H3	0.1727
	H4	0.0976
	H5	0.1472
	H6	0.0870
	H7	0.1010
	H8	0.0418
	H9	0.0388

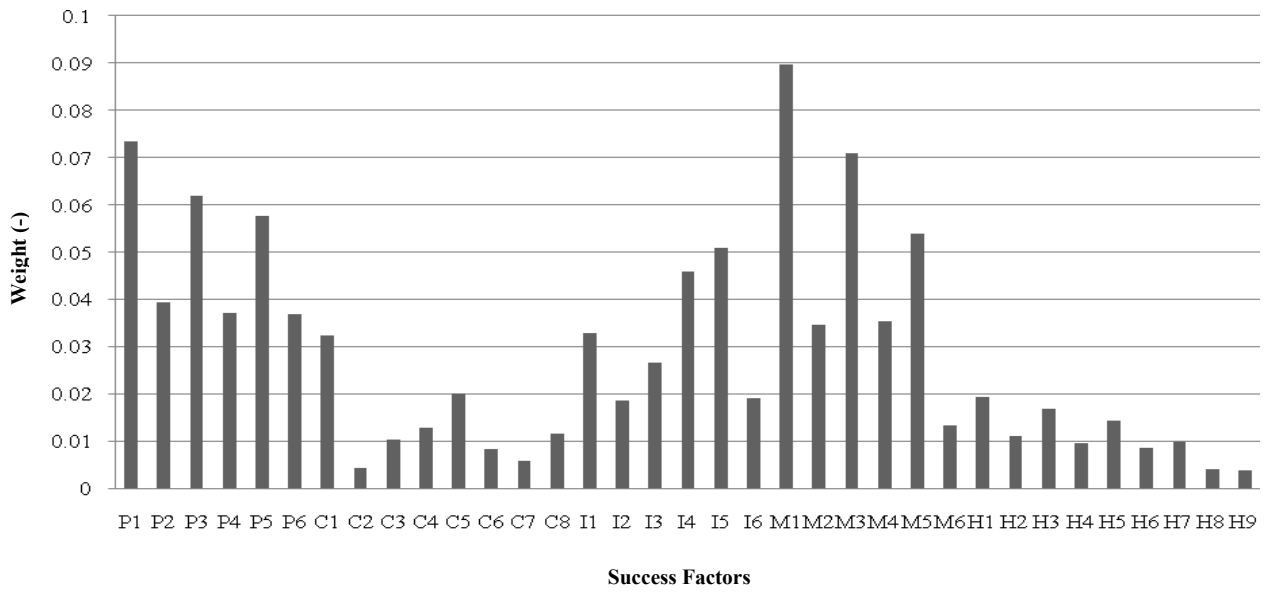

FIGURE III
THE GLOBAL WEIGHT OF THE SUCCESS FACTORS

V. DISCUSSIONS OF RESLUTS

This part discusses the results obtained in the earlier section regarding the most important success factors which can be used for enhancing the highway projects performance in Egypt. Rating of the success factors in Figure 3 reveals high-scoring factors as seen from the perspectives of the respondents are very effective to overcome the challenges that correspond to the highway construction industry in Egypt. Theses challenges are represented in improving project quality, completing project on time, completing project within budget and reducing disputes. The following points will explain how the most important identified success factors is very essential toward these challenges.

- Implementing an effective quality control and assurance systems has been ranked as the top priority factor for successful implementation of highway projects in Egypt. This result clearly reflects that quality shortfall is the most success-hindering factors in highway projects in Egypt. Therefore, imposing quality control and assurance systems during the construction process is suggested by the experts to be one of the most effective ways to avoid construction defects.
- Allow sufficient time for feasibility studies, design, drawing and tender preparation is the second CSFs. The illation of the importance of this factor toward enhance the construction projects performance is that allowing suitable time to prepare the design, drawings, tender preparation and site investigation , leading to accurately estimate the project duration and budget, clarity of project scope, complete and clear tender documents, develop a good specifications commensurate with the project objectives and clarity of roles and responsibilities....etc. Consequently, misunderstanding, conflicts and disputes between project stakeholders will be minimized and this will lead to a cooperation between the project parties in which efforts are focused on achieving the desired level of quality and completed the project according to its planned time schedule and budget.
- Effective cost control system and frequency of project budget updates is prioritized in the study as the third important success factor in the construction of Egyptian highway projects. This finding reflects that cost overrun is also one of the most success- hindering factors in highway projects in Egypt. Therefore, the experts suggested that frequency of project budget updates is essential to the project stakeholders to follow up the project cost performance during the construction phase and determine wether the project cost is over or under the estimated cost. In addition, implanting cost control system is recommended by the experts to be an effective solution to adopt plan/steps to take the necessary decision in the suitable time toward any overrun in the project cost.
- Preparing adequate designs and drawings is identified as the fourth important success factors. Inadequacy of design and mistakes in drawings have severe effects on the project objectives in terms of quality, time and cost. When mistakes in drawings or designs are discovered before the execution of the design, this certainly requires additional time to make the necessary corrections by the designer, which automatically will affect the project time schedule. While the results become more worse when the mistake discovers after the execution of the design, inasmuch as the impact of this mistake not only stops on increasing the project duration but also extends to the technical condition of the highway and the cost of the project. Therefore, preparing adequate designs and drawings is an essential factor through which project can be completed on time, within budget and in accordance with its technical specifications .
- Determining sufficient time to implement the desired scope of work is the fifth major success factor considered in the current study. This result is due to unrealistic contract time (duration) was identified by Aziz and Abdel-Hakam [25] as one of the most important factors contributing to the delay of the road projects in Egypt. Therefore, the results of the study highlighted that identifying reasonable time matching with the project requirements is an important success factor which greatly helps in reducing the delay of highway project in Egypt.

VI. SUMMARY AND CONCLUSIONS

This paper proposes the AHP approach as a tool to determine the priority of 35 success factors in order to determine the top critical success factors for improving the performance of highway construction projects in Egypt. The identified factors have been grouped under the following five headings: a) pre-project technical studies, b) contractual arrangements, c) interactive processes, d) monitoring and control and e) human related-factors. Through a questionnaire survey which has been sent to academic experts in highway construction industry in Egypt, the importance weight of the success factors has been specified.

According to the study results five success factors including implementing an effective quality control and assurance systems, allow sufficient time for feasibility studies, design, drawing and tender preparation, effective cost control system and frequency of project budget updates, preparing adequate designs and drawings and determining sufficient time to implement the desired scope of work have been ranked as the key factors for successful implementation of highway construction projects in Egypt .

Based on these findings, the study highlights that the pre-project technical studies phase is a key area for enhancing the performance of highway construction

projects in Egypt. Therefore, more investigation on the aspects of this phase toward the project success would be valuable for further studies. Furthermore, the study suggests that further research can be carried out with a greater number of respondents. With a greater number of respondents, the general credibility and wider applicability of the findings would be increased.

REFERENCES

[1] A. Chan and A. Chan, "Key performance indicators for measuring construction success", *Benchmarking: An International Journal*, vol. 11, no. 2, pp. 203-221, 2004.

[2] V. Sanvido et al., "Critical success factors for construction projects", *Journal of Construction Engineering and Management*, vol. 118, no. 1, pp. 94-111, 1992.

[3] N. Long, et al., "Large construction projects in developing countries: a case study from Vietnam", *International Journal of Project Management*, vol. 22, no. 7, pp.553-561, 2004.

[4] V. Handa and A. Adas, "Predicting the level of organizational effectiveness: a methodology for the construction firm", *Construction Management and Economics*, vol. 14, no.4, pp. 341-352,1996.

[5] T. Williams, "Risk management infrastructures", *International Journal of Project Management*, vol.11, no.1, pp.5-10, 1993.

[6] A. Chan, D. Scott, D. and A. Chan, "Factors affecting the success of construction projects" *Journal of Construction Engineering and Management* , vol. 130, no. 1, pp. 153-155, 2004.

[7] N. Gudiene, et al., "Identification and evaluation of the critical success factors for construction projects in Lithuania: AHP approach", *Journal of Civil Engineering and Management*, vol. 20, no.3, pp. 350-359, 2014.

[8] S. Tabish and K. Jha, "Important factors for success of public construction projects", *Proceedings of the 2nd International Conference on Construction and Project Management, Singapore*, vol. 15, pp. 64-68, 2011.

[9] N. Gudiene et al, "Development of a conceptual critical success factors model for construction projects: a case of Lithuania", *Procedia Engineering*, vol. 57, pp. 392-397, 2013.

[10] J. Rockart, "The changing role of the information systems executive: a critical success factors perspective", *Sloan Management Review*, vol. 24, no. 1, pp.3-13, 1982.

[11] J. Reh, "How to use benchmarking in business: who's best? how good are they? how do we get that good? about: management", [Online]. Available: http://management.about.com/cs/benchmarking/a/benchmarking.htm, [Accessed 3 April 2016].

[12] D. Chua, C. Kog, and P. Loh, "Critical success factors for different project objectives", *Journal of Construction Engineering and Management*, vol. 125, no. 3, pp. 142-150, 1999.

[13] J. Yu and H. Kwon, "Critical success factors for urban regeneration projects in Korea", *International Journal of Project Management*, vol. 29, no. 7, pp. 889–899, 2011.

[14] S. McCabe, "Benchmarking in Construction." Blackwell Science, UK, 2008.

[15] A. Chan, "Determinants of project success in the construction industry of Hong Kong", PhD Thesis, The International Centre for Management and Organisational Effectiveness, Faculty of Business and Management, University of South Australia, Australia, 1996.

[16] J. Pinto and D. Slevin, "Project success: definitions and measurement techniques", *Project Management Journal*, pp. 67-72, 1988.

[17] E. Jaselskis and D. Ashley, "Optimal allocation of project management resources for achieving success", *Journal of Construction and Engineering Management*, vol. 117, no. 2, pp. 321-340, 1991.

[18] S. Toor, S. and S. Ogunlana, "Construction professionals' perception of critical success factors for large-scale construction projects", *Construction Innovation*, vol. 9, no. 2, pp. 149-167, 2009.

[19] C. Jacobson and S. Choi, "Success factors: public works and public private partnerships", *International Journal of Public Sector Management*, vol. 21, no. 6, 637–657, 2008.

[20] Timetric, "Construction in Egypt - key trends and opportunities to 2016", [Online]. Available: http://www.marketresearch.com/Timetric-v3917/Construction-Egypt-Key-Trends-Opportunites-7084362, [Accessed 23 October 2013].

[21] I. Farag, "SWOT analysis of road transport sector in the Arab region", IRU Academy, Alexandria, Egypt, 2012.

[22] PWC's Staff Reporter, "Africa gearing up-future prospects in Africa for the transportation & logistics industry", [Online]. Available: http://www.pwc.com/africagearingup, [Accessed 13 March 2015].

[23] C. Kaliba, M. Muya, and K. Mumba, "Cost escalation and schedule delays in road construction projects in Zambia", *International Journal of Project Management*, vol. 27, no. 5, pp. 522-531, 2009.

[24] World Bank Group, "Proposed road infrastructure and transport development project", Unpublished concept note, Arab Republic of Egypt. Washington, D.C., 2007.

[25] R. Aziz and A. Abdel-Hakam, "Exploring delay causes of road construction projects in Egypt", *Alexandria Engineering Journal*,vol.35, no. 2, pp.1515-1539, 2016.

[26] A. EL-Touny, "Estimating contingency cost for highway construction projects", M.S. Thesis, Construction Engineering Department, Faculty of Engineering, Zagazig University, Egypt, 2013.

[27] A. El Dahan, et al., "High traffic fatality rate caused by faulty road and vehicle maintenance", [Online]. Available: https://academic.aucegypt.edu/caravan/story/high-traffic-fatality-rate caused-faulty-road-and-vehicle-maintenance , [Accessed 6 July 2016].

[28] Y. Frimpong, J. Oluwoye and L. Crawford, "Causes of delay and cost overruns in construction of groundwater projects in a developing countries; Ghana as a case study", *International Journal of Project Management*, vol. 21, no.5, pp.321-326, 2003.

[29] Z. Alias, et al., "Determining critical success factors of project management practice: a conceptual framework*", Procedia - Social and Behavioral Sciences*, vol. 153, pp.61 -69, 2014.

[30] S. H. Whi, et al., "Exploring success factors of social infrastructure projects in Malaysia", *International Journal of Engineering Business Management*, vol.5, no. 2, pp. 1-9, 2013.

[31] T. Saaty, "The analytic hierarchy process: planning, priority setting, resources allocation", McGraw-Hill, London, England, 1980.

[32] S. Oguztimur, "Why fuzzy analytic hierarchy process approach for transport problems?", Proceedings of the ERSA Congress, Barcelona, Spain, 2011.

[33] M. Berrittella, et al., "An analytic hierarchy process for the evaluation of transport policies to reduce climate change impacts" , Fondazione Eni Enrico Mattei Working Papers, Paper 61, 2007.

[34] C. Kaliba, "Cost escalation, schedule overruns and quality shortfalls on construction projects", M.S. Thesis, Department of Civil and Environmental Engineering, School of Engineering, University of Zambia, Lusaka, Zambia, 2010.

[35] T. Saaty, "Decision making with the analytic hierarchy process", *International Journal of Services Sciences*, vol. 1, no. 1, pp. 83-98, 2008.

[36] J. Tah, A. Thorpe and R, McCaffer, "A survey of indirect cost estimating in practice", *Construction Management and Economics*, vol.12, no.1, 1994. pp.12-36, 1994.

[37] S. Al Wahaidi, "An analytical hierarchy process (AHP) based prequalification system for Gaza strip construction contractors", M.S. Thesis, Faculty of Engineering, Islamic University, Gaza, Palestine, 2012.