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APP innovation to Control Projects Risks Management during Crises

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Abstract

The goal of this study is to build an application that can be used in difficult cases and sudden circumstances during the pandemic and post-disaster state, which can be the development of digital risk management and mitigating the difficult impact of the epidemic through the improvement of IT and IoT that can be fine by finding initial solutions and make the world like a digital city that could be managed by the network. We provide this study to gain an overview of reasons for delayed and exceeded costs in a select of thirty Iraqi case projects by controlling the time and cost. The drivers of delay have been investigated in multiple countries/contexts. however, there is little country data available under the conditions that have characterized Iraq over the previous 10-20 years.

Keywords: Statistic, Cost, Time, Building, Machine Learning, ANN.

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1. Introduction

Nowadays, it has become necessary to find quick solutions in emergencies and crises that the world may be exposed to in the event of natural or human-caused disasters such as wars or in the event of pandemics as happened in the Covid-19 pandemic, as it is one of the phases of the mutated SARS over decades [1]. Accordingly, it necessary to develop applications and software that keep pace with the modern development in the Internet of Things (IoT) and the digital management of projects in case of emergency. Then, to work on developing project risk management by improving the performance of digital management and information technology and providing the best ways to serve the user effectively through qualified results. In addition, taking into account that through the preservation on time, qualitative cost, effort and innovation of programs and applications that serve project management correctly and successfully, from the initial stages of the project and even before starting it, since the inception of the idea, feasibility studies, planning, design, preparing bills of quantities, until the stage of implementation, completion, operation and maintenance in a sequence of integrated steps. So, that we save the possible time and effort and to achieve that Time is money, and the implementation and completion of projects with the specified time and cost, without reaching the stage of cash shortfall, delay and stumbling, taking into account maintaining quality in project implementation.

Each country has its own circumstances, which play different role on delay factors. Where the focus of this case study results was the security situation as Baghdad and the whole country of Iraq are suffering from bad security situation since the end of war in 2003 (figure 1) [2] .

Many may think that project management is only concerned with schedules and budgets, but in fact, these two

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points are really important, but they are among other important things that must also be taken into account when implementing projects and required for the success of the project as explained in figure 2 Golden triangle projects management.

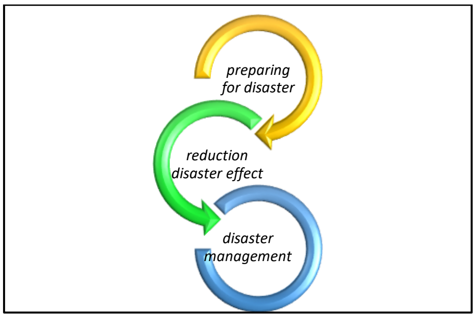

Figure 1. Disaster Management

The goal of the project and the purpose of its implementation, what benefits it will provide to individuals or organizations. Therefore, agreement on the purpose and objectives of the project is the key to the success of any project. In most cases, this step is neglected, which leads to the failure of the project in whole or in part, and confusion, delay and cost overruns may occur.

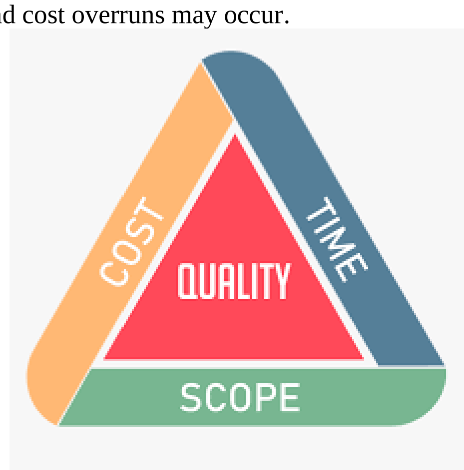

Figure 2. Golden triangle projects management

2. Related Works

In the literature numerous studies have proposed various methods to manage project[3]–[14]. Thus, in the coming paragraphs, we just detail some ones.

In 2011, **David Ellis et.al**[15] have completed a streamlined model incorporating sixteen user-controlled attributes and generating estimations of the impact of project delay on both the personal and business travel and the overall cost to the economy.

Through their research **Agarwal et al** [16], concluded that Optical Code Division Multiple Access (OCDMA) is a visual processing, a system that allows multiple users to share the same bandwidth simultaneously without interfering with each other using unique visual codes and analyze the performance of two-dimensional (2-D) visual codes by changing the intersection.

In 2014, **Elfaki et al** [17] studied construction related estimates for the previous ten years. Then, authors suggested a specific approach that is composed of two main sections. The first one is concerned with the data gathering, in which specialized journals were selected as potential resources for the surveyed study. The second one is focused on the analysis of the data and the analysis of the results. In order to evaluate each proposition, four key questions were asked. Which smart technique is employed? How were the data gathered? In what way are the outcomes confirmed? And, which building cost estimating factors were utilized? From the outcomes of this investigation, two primary contributions were identified. The first is an identification of research deficits in this domain, which had not been completely covered by earlier suggestions for estimating construction costs. The other contribution of this investigation is the suggestion and pointing out of possible guidelines for future research proposals. In addition, authors have indicated that the 2nd part of their methodology is considered as a contribution to this research.

In 2015, **El-Kholy**[18] used two models to predict the cost recovery rate in construction projects. The first one is based on regression. The factors affecting cost performance in construction projects, numbering 44, were collected from the literature. A comprehensive questionnaire study was conducted among construction entrepreneurs in Egypt in order to assess the relative importance of these causes from the perspective of the entrepreneurs. The eleven factors were identified as the most significant causes of the extra cost constitute the independent variables of the model considered. Data were collected for the occurrence of the above causes on a simple Yes or No basis and the associated percentage cost overrun (dependent variable) across thirty building projects and were split into two classes. The first set contains about twenty projects to create the model. The results showed that there exists a significant linearity relationship between the percentages of cost overrun and the above eleven factors. That affects in a significant way the projects' cost exceedance.

In 2016, **Khalsa**[19] conducted a literature review and comprehensive research to identify the relevant factors which affect the project time and subsequently to further elaborate an artificial neural network model in order to predict the project time. The suggested neural network model has been evaluated with several cases. The relationship between the true duration and the predicted duration of the project was determined in each case. A comparison was made between the obtained results and other available project management methods. The proposed neural network model was found to have the lowest variance, making it the most efficient and most reliable predictor of project duration.

Waheeb et al. [20], designed in 2020 a graphical representation of the ANN models and programs to reconstruct emergency construction projects post disaster.

In 2022, **Kumar et al** [12], [21] linked past and present in their study, they assured that the current century is witnessing a large amount of data being produced daily through different computational platforms. And this data is very large in terms of quantity compared to the past. This data appears as Big Data, and this data must be managed for processing and extraction. Big data emerges from Facebook, Instagram, and many other social and private platforms. For example, web mining has the ability to mine or extract data from a very huge set of data. Prospecting and searching for useful information is essential for optimal performance of different systems. hence we need to find more safety service when we using IoT in our emergency projects management, as

Vemprala et al [8] assured on their study The development in social media may cause an increase in misinformation and harmful information .The effects of disinformation from reputational defamation may result in loss of life. He has a long history of studying the ancestors of misinformation and how to detect when it occurred. But even so, there is limited research on how to deal with the harm caused by that misinformation. In that study, the researchers dealt with the development of a theory-based game model for balancing to improve the efforts needed by administrative bodies. To expose misinformation and to validate the model, the researchers conducted an experiment using social media associated with COVID-19.

Nerella et al [13] developed a model based on color decomposition techniques, a new way to perform visual color and encryption using wavelet technology and uses wavelet technology to convert a color image to a gray image that the important feature .

3. Methodology

Our proposed methodology was offered as a standardized way to estimate construction cost and timing proposals. In fact, our model consists of a two-stage artificial neural network, that is employed for predicting an effectiveness time & cost multiplier according to user-identified entry parameters (delay factors). This multiplier is subsequently used to fine tune an approximate average implementation time/cost gradient (ΔT and ΔC) that should be applied on a given project. The resulting time and cost estimates derived from this new scheme are matched to the actual project implementation time and cost values.

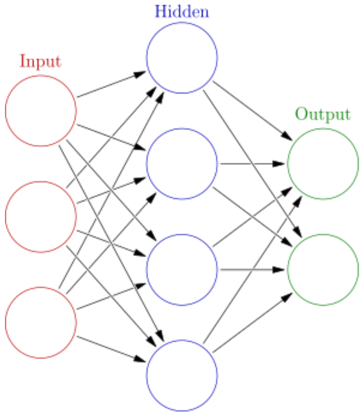

Figure 3. ANN graphical representation

An ANN is made up of a series of connected nodes or units, known as artificial neurons that approximately resemble naturally occurring brain neurons [10], [22]–[27]. The proposed model comprises an input layer, an output layer and hidden layers, as shown in Figure 3 and 4. For instance, in the input layer, we have twelve neurons to input the values of factors X_i (i=1,2..12). The decision to focus on ANN analysis was based on the fact that this technique is rarely used in the field of project management and problem solving in the construction sector. In addition, this type of methodology can be used to solve difficult tasks for which no solution can be found. Initially, a statistical study was conducted and in a few cases the relationship did not correspond to a linear equation or the correlation was weak. Therefore, we decided to use ANN analysis since it is used for non-linear problems to discover the link between the input and output elements.

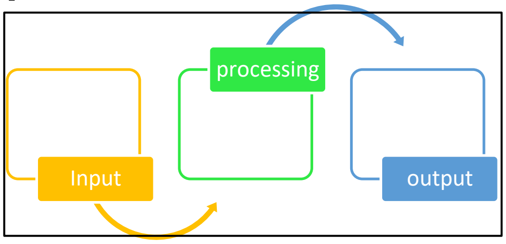

Figure 4. ANN's work steps

The steps of our model are:

(i) In this step we starting with overlaying an input weighting for the twelve factors (n=12) (table 1, 2) to be used for the next step.

(ii) The weights were ranged from 0-1 in a way to using rating process in each factor and lessen differences when this model is being under construction. This involved assigning a constant of (1/2) for adding to every balanced factor, ensuring that there was no zero or negative values once the calculation process was applied in this model. The selection of this constant value was done empirically through trial and error.

Such factors have been entered as X_i as:

$$X_1 = Cont.F + 1/2$$
$$X_2 = H.O + 1/2$$
$$X_3 = R.D + 1/2$$
$$X_4 = C.S.P + 1/2$$
$$X_5 = O.F + 1/2$$
$$X_6 = S.S + 1/2$$
$$X_7 = Cons.F + 1/2$$
$$X_8 = D.P.P + 1/2$$
$$X_9 = L.T.D + 1/2$$
$$X_{10} = L.P + 1/2$$
$$X_{11} = E.F + 1/2$$
$$X_{12} = W.F + 1/2$$

Table 1. Important data related to the project

information
Project title
Foundation
Construction project type
Starting date
Contracting date
Project implementation period
Project cost
Expected implementation date
Actual implementation date
Actual project cost
Working stop causes
Warnings against contractor
Additional periods
Reasons to grant additional periods
Delay penalties
Poor implementation
Notes

(iii) Determine the mean (X_i') and standard deviation SDi of those factors by employing straightforward narrative statistics (see table 2).

X_i' and SD_iwere used to calculate the new value of X_i^* as shown in eq (1)

$$X_i^* = X_i - X_i'/SD_i \quad \text{for } i = (1, 2, \ldots, 12) \qquad (1)$$

where

X_i : Factors

X_i' : Average of X_i

SD_i : Standard deviation in X_i

(iv) Identify the difference between the actual cost and the expected cost of implementation, similar to Δt and Δc where find.

$$Y_1^* = \frac{\Delta t}{t} \quad and \quad Y_2^* = \frac{\Delta C}{C}$$

Where:

- Δt = Variance between the real and expected duration of the execution
- t = expected date of execution
- Δc = Variance between real and expected cost of execution
- c= expected cost of execution

4. Results and discussions

From the previous results, security situation is the second most main parameter that causes delay in construction project in Iraq. Nonetheless, low price came in the first place, and that is in fact a reflection to the lack of funds in the first place. In addition to the fact that in public sector which belongs to governmental institutions might reject the idea of accepting higher bidding price for tender referral to any contractor because of the lack of funds that is affected in the first place by the security situation. We can see different scenarios in different countries, but they are mostly similar in underdeveloped countries.

Table 2. Means and typical deviations of time delay indicators

i	***delay factors***	X_i'	SD_i
1	Security status (S.S)	0,7037	0,26816
2	Contractors failures (Cont. F)	0,5963	0,17863
3	Newly holiday (H.O)	0,7222	0,28600
4	Owner failures (O.F)	0,5667	0,20569
5	Reshaping (R.D)	0,5481	0,14243
6	Altering place (C.S.P)	0,6296	0,20346
7	Delay training position (D.P.P)	0,6407	0,18030
8	Delay preparation position (D.P.P)	0,5074	0,03849
9	Little values (L.P)	0,5259	0,10225
10	Laboratory examinations delay (L.T.D)	0,5370	0,11145
11	Climate issues (W.F)	0,5296	0,08689
12	Outside Parameters (E.F)	0,6148	0,16572

As the previous studies findings were focusing on different factors of delay, this study came to focus on other factors, some of them are common and some of them have different effect on works in construction project management. In Iraq, disasters are most likely mean the anthropogenic hazards or manmade ones. Where they are found under human beings action or. In our case study, these actions are chaos, violence, or even worse, it could pass up to kill and death, the matter that leads to a disorder in the society behavior and here we can recognize the difference between natural and human disasters [28], [29]. In some cases, natural and manmade disasters might be represented by invading diseases or outbreaks and what consequences of public health might be caused later [30], [31]. Ryan and Franklin [32] listed more details of disasters kinds, where they put them in four categories, natural, technological, biological, or social, and the war of 2003 was listed under the social kinds of disasters that are considered as a human action in a society[33], [34]. These disasters could create crisis where they happen, and they can change the demographic distribution of a settled society, and that what exactly occurred through the sectarian conflict that occurred after the war of 2003 against Iraq [35]. Beyond these major factors, some problems will float when construction projects planned to be conducted as one of the continuity of societies and disaster resilience [36]. As the factors been studied here, we focused on some of those that could affect the construction projects workflow. Under the review of literatures, it was found that the lack in cash flow and working capitals were the main cause of delay in project management and construction industry. This factor was followed by other factors such as the owner, the contractor, team experience, designs and redesigns, team spirit and communication skills, applied technology, then change orders that occurred due to unexpected problems such as in emergency status. These were the findings of other studies, and each of them were based on the general circumstances of the country under study, while in Iraq (Baghdad case study) findings were somehow different, where the main rolling factor was the security issue. Because Iraq was and still suffering from bad security issues after the war of 2003, thus this factor became the major affecting factor in cost and time delay of construction projects. Moreover, beyond this factor, the other affecting factor as the results showed was low prices, where most bids would not be assigned to a higher price bidder and that could be related to the matter that the contractor wants to make more money, as the owner is a public sector (governmental facility). The managers are only employees in the government, and their concerns are more to make benefits through commissions from contractors. Hence, that would even lead to worse results in implementation due to using bad materials or working with some kind of fraud to reveal the personal benefits from the public sector. Although this is not a base to our findings, but they are just reasons seen in the scene of construction projects. The main reason that leads us to expect that is because most contractors in this industry in Iraq are from a private sector and the public or governmental companies after war mostly were assigning giant bids and works to subcontractors to finish their jobs, and here it became even more complicated in the final cost and time calculations. Where each contractor has his own capability to conduct the assigned work, thus there will be different work qualities, and here the role of quality control comes to unify the final outcomes in construction projects. Therefore, some penalties will be forced on contractors, and these penalties are negotiable depending on the compromising sides, and they are always trying to make more gains. This wasn't happening in emergency status projects, and the reason is that the owner is accepting the reasonable fixed prices, without any worry about funds runouts, because these projects are funded by different international relief organization. It is more likely that a fixed price was assigned to the contract before starting it with a competition in submitting better offers and qualities to get the bid hauled to them. These results are not generalized to all projects of this study, as we can see that there was no big deal delay in cost and time of some projects (see table 3). In addition, some delays were caused because of different other factors like those shown in discrimination analysis, where weather conditions and team spirit has nothing to deal with contractor or owner deals.

Table 3. Difference in Costs and Times, and Delay Weights parameters

N°	***delay factors***	Weights	$Y_c = \frac{\Delta C}{C_1}$	$Y_t = \frac{\Delta t}{t_1}$
1	Cont. F.	0.7	-22%	-300%
	HO.	0.3		
	L.P	0.2		
	S.S	0.1		
2	R.D.	0.5	-10%	-19%
	C.S.P	0.5		
	S.S	0.2		
3	R.D	0.3	-10%	-16%
	D.P.P	0.5		
	LP	0.5		
	SS	0.1		
4	R.D	0.7	-20%	-57%
	D.P.P	0.3		
	O.F	0.5		
5	S.S.	0.7	-22%	-32%
	Cont. F.	0.3		
	R.D	0.2		
6	R.D	0.6	-55%	-811%
	S.S.	0.3		
	L.P	0.4		
7	D.P.P	0.5	-2.7%	-16%
	L.P	0.4		
8	R.D	0.8	-0.9%	-13%
	S.S	0.3		
9	R.D	0.6	-25%	-24%
	L.P	0.5		
	S.S	0.1		
10	C.S.P.	0.9	-1.6%	-30%
11	O.F	0.4	-17%	-25%
	R.D	0.8		
12	HO.	0.5	-5.2%	-100%
	E.F	0.3		
	O.F	0.3		
	CONT.F.	0.5		
	L.P	0.2		
	S.S	0.2		
13	O.F	0.5	-56%	-230%
	CONT.F	0.5		
	S.S	0.1		
14	L.T.D	0.2	0	-166%
	R.D	0.3		
	O.F	0.2		
	L.P	0.2		
	CONS.F	0.2		
	HO.	0.5		
	S.S	0.1		
15	W.F	0.4	0%	-6%
16	O.F	0.6	-10%	-33%
	S.S	0.3		
17	R.D	0.6	-12%	-129%
	O.F	0.5		
18	L.T.D	0.5	-7%	-40%
	W.F	0.2		
	HO.	0.4		
19	CONT.F	0.4	-23%	-50%
	O.F	0.3		
	HO.	0.3		

	L.P	0.2		
20	R.D.	0.5	-3%	-75%
	H.O.	0.3		
	W.F.	0.4		
21	R.D.	0.4	-7%	-200%
	CONT.F	0.5		
	E.F	0.2		
	S.S	0.4		
	L.P	0.1		
22	R.D	0.6	-19%	-155%
	CONT.F	0.3		
	E.F	0.3		
	S.S	0.3		
	L.P	0.2		
23	CONT.F	0.6	-19%	-150%
	R.D	0.3		
	C.S.P	0.4		
	S.S	0.2		
24	CONT.F	0.6	-1.5%	-600%
	D.P.P	0.3		
	S.S	0.1		
25	CONT.F	0.6	-7%	-600%
	E.F	0.2		
	RD	0.2		
	S.S	0.2		
26	CONT.F	0.4	-7%	-200%
	S.S	0.5		
	L.P	0.2		
27	CONT.F	0.8	-6.5%	-200%
	L.P	0.4		
	S.S	0.2		
28	O.F	0.2	0%	-10%
29	0	0	0%	0%
30	0	0	%0	0%

Table 4 displays the standardized significance of every delay parameter by way of it impacts time, cost or both. Each delay factor was averaged by importance of its status and type within the particular project. Accordingly, those weightings were further investigated for their emphasis (IBM.SPSS Lab 2014) and the manner in which they impact the execution processes in the building and construction related projects. The significance analysis suggested placing those weights by means of a reliant on factor, which affects the variable of period, charge, and both of them.

The displayed outcomes from tables 3 and 4 demonstrate the way in which the delay components influenced charge and period delay. Therefore, the statistical approach provided a score to classify the delay items based on how they were found to impact cost and delivery time. By looking at the template that was constructed for this research, one can clearly understand that the delay factors could potentially cause a direct impact on cost and schedule.

The application may be used in building projects for predicting the delay rate and extra costs beforehand the closing date of the project and beforehand getting close to the monetary squeeze. In such situation, there would be dual shots to be taken into account before beginning the actual project. The first is to move the total cost of the project to be close to that predicted by this model, so that there are no or fewer cost variances, and to readjust the specified time for the project, thereby avoiding the delay. The second is controlling the causative elements of the project delay, such as the implementer might be able to do. In this case, the cost and schedule will be improved. The design framework is suitable for use by both the beneficiary and the contractors. the last ones may use it to forecast the extra charge and time they will have to endure when they are awarded the contract. If so, they will include all options in the design prior to bidding, and they may also be able to negotiate with the recipient for a more favorable outcome. This template is primarily intended for the recipient prior to awarding the bid to a vendor and listing the terms of the agreements, which includes the appropriate cost and time estimation for a successfully completed project.

Table 4. Standardized significance of time and cost analysis

Time			Cost			Time & Cost		
factor	Significance	Normalized Importance	factor	Significance	Normalized Importance	factor	Significance	Normalized Importance
Cont.F	0,161	100,00%	O.F	0,147	100,00%	S.S	0,15	100,00%
R.D	0,154	95,50%	S.S	0,139	94,60%	Cont.F	0,14	93,60%
S.S	0,11	68,20%	R.D	0,137	92,80%	R.D	0,139	92,90%
L.P	0,108	67,20%	Cont.F	0,132	90,00%	L.P	0,133	88,70%
W.F	0,09	55,60%	L.P	0,13	88,30%	O.F	0,112	75,20%
O.F	0,076	47,40%	H.O	0,065	43,90%	C.S.P	0,073	48,90%
C.S.P	0,072	44,50%	E.F	0,057	38,40%	H.O	0,064	42,70%
L.T.D	0,063	38,90%	Cons.F	0,052	35,00%	L.T.D	0,054	36,10%
H.O	0,056	34,60%	W.F	0,045	30,70%	E.F	0,05	33,20%
Cons.F	0,055	34,20%	D.P.P	0,038	25,70%	W.F	0,044	29,60%
D.P.P	0,029	18,10%	C.S.P	0,031	21,00%	D.P.P	0,041	27,40%
E.F	0,026	16,30%	L.T.D	0,028	19,20%	Cons.F	0,00	0,00%

5. Conclusion and future work

We recommend that consideration should be given to future work in developing digital management, information technology, software and engineering applications in projects management and working to encourage innovations in solving any problem facing projects in normal cases, emergencies and disasters to reduce the impact on the daily lives of people and this is done Executing and conducting the necessary examination and analysis on the results of the programming and compatibility of those results with the requirements of the user based on the required problem and the establishment of the program system in the correct and desired way and making a feedback for that to ensure the safety of work in those programs.

In applied scientific research, researchers must obtain, after completing their research, scientific, reliable, accurate and logical research results because the applied research results must be stable, reliable, and related to the recommendations and proposals for research that have been taken into account and studied before starting the applied research. The recommendations and suggestions for applied research are one of the important factors. Which causes the start of the applied scientific study, the main purpose of applied scientific research is to obtain the results of research and practical experiments, to identify the results that result from a particular phenomenon, and to record it and show it to the scientific community and those interested in scientific research.

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