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INNOVATIVE FINANCIAL CRISIS MANAGEMENT IN CONSTRUCTION PROJECTS

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ABSTRACT

This paper presents an innovative approach to financial crisis management in construction projects, focusing on optimal resource allocation during economic downturns, exemplified by the COVID-19 pandemic. Utilizing a MATLAB-based mathematical model, the study provides a structured tool for decision-makers to strategically mitigate the financial impacts on project profitability. The model integrates essential economic parameters—project and yearly budgets, construction costs, expected returns, and interest rates—facilitating the maximization of profit margins and efficient unit construction across projects. Through comprehensive sensitivity analysis, the research identifies critical projects and timelines, enabling the formulation of worst-case scenarios that assess and mitigate financial risks under volatile conditions. A case study of large-scale construction projects in Jordan validates the model, revealing significant cost-saving potential and strategic resilience enhancements. Findings emphasize the importance of adaptive financial strategies in *bolstering crisis resilience and provide a framework for proactive financial planning in construction management.*

Keywords: Crisis, Financial crisis management, Optimization, COVID-19, Optimal financial solution, profit.

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1. INTRODUCTION

Many scientific research attempts to evaluate the effect of a financial crisis, but unfortunately, a few scientific researchers proposed a tool to predict a crisis or even provide decision-makers with optimal tools to minimize the negative effect of the crisis Jose & Ajayakuma (2019). This study aims to provide a sufficient, optimal solution to overcome the consequences of the financial crisis in the construction sector, which is considered a base to improve the plans to develop management capabilities, skills, and knowledge using actual feedback for more improved plans that might be a privilege to avoid any unforeseen conditions in future.

The optimal financial solution would be represented as a mathematical model using the MATLAB program, this model was built on several economic parameters, such as budgets, project budgets, costs, expected profit, estimated profit, number of constructed units, and interest rate. However, some profit values were estimated using polynomial fitting based on previously given data. Reviewing mega construction projects case study during the COVID-19 crisis offering an optimal financial solution. Sensitivity analysis was conducted on two different perspectives: Yearly perspective, and project perspective. To measure the effect of some parameters on each other, such as most affected year and project, least effect year and project to create the worst scenario case, which would be considered as risk scenario, to measure its effect on profit values and total number of constructed units.

A crisis is defined as a unique and unexpected situation faced by people, groups, organizations, and governments Roux & Vidaillet, B. (2003), Anderson, et al (2007). It cannot be solved using common regular procedures; a crisis may cause extra stress for the decision-maker due to its nature. In addition, a crisis is defined as a series of sudden uncontrolled actions in an organization's life. There are no clear pre-determined emergency plans to overcome the crisis, which may affect present stability bases and threaten future growth and developing plans. In addition, a crisis is a period of sudden changes accomplished by unpredictable incidents, risk, uncertainty, threat, conflict, and instability, but also a period that offers opportunity. According to (Loosemore, M. 2000), a crisis may have a lower probability incidence but is synchronized with a higher uncontrolled effect.

Crisis management definition is a process and management model used in an unexpected situation Samra, et al. (2019) . It involves clear, specific actions such as detecting crisis indications to minimize its negative effects on sectors, enduring minimal losses, and applying and controlling all preoperational actions for recovery Coombs, W. T., & Laufer, D. (2018). Further, crisis Management is a progressive procedure that contains both proactive and reactive actions Liu & Froese (2020). which aim to determine proper plans, control, solve, and document for the crisis phase. Crisis management involves catching and estimating direct and indirect crisis indicators Pearson & Mitroff (2019), then implementing all the required precautions.

II. LITERATURE REVIEW

A construction project is a high-value timely schedule with limited cost and resources Walker, A. (2015). Vrchota, & Rehor (2016) defined a project as a sequence of related activities with a given beginning and an end to realize a specific objective. Uncertainty can be considered a common feature and a poorly predictable phenomenon. The project's mission is to create a proper construction facility or service with minimum costs and time, considering its planned goals and quality, completion time, and other constraints or limitations.

The massive risk due to a financial crisis may affect construction projects Shibani, et al (2022), especially in the implementation phase. Recently financial issues have been increasing aggressively, especially due to (the COVID-19) pandemic. Cost and completion time are the most affecting factors that may sufficiently define a construction project's success, which may be affected remarkably by the crisis. Other parameters are scope, quality, and resources, which are considered less affected than other elements.

Recently several scientific research focused on crisis and its effect on construction projects during the planning, implantation, and maintenance phases Hällgren, M., & Wilson, T. L. (2008), especially financial crisis management. To minimize any losses or even avoid them, a system that detects any factor or evidence that results in a crisis is needed to alert decision-makers to prepare their plans to overcome or minimize the crisis's effects.

A crisis is an unusual event that deeply affects any company's basic structures, leading to high uncertainty Booth, S. A. (2015). The rapid global acceleration forces most construction companies to strengthen their strategies for unexpected events Hällgren & Wilson (2008). The long-term construction project nature, which will maximize the terms of crisis, uncertainty, and unforeseen conditions, concentrates on optimal crisis management to improve and develop its current strategies to suit those situations Sahin, S., et al (2015). In this research, crisis management is classified into four phases:

The prevention phase involves an early warning system to detect warning signals and records to forecast a crisis.

The preparation phase involves preparing the plan to suit the upcoming crisis and modifying current strategies.

The crisis phase involves working under crisis conditions to control the overall situation and mitigate its negative results in the short and long term.

The post-crisis phase involves rebuilding managerial methods and strategies to avoid unexpected or unforeseen circumstances.

III. MATHEMATICAL MODEL

As mentioned earlier the main objective is to maximize total profit for construction projects during the implementation phase, profit can be expressed as

$$\max_{X}\left\{Z=\frac{a_{j1}}{(1+i)}x_{j1}+\frac{a_{1j2}}{(1+i)^2}x_{j2}+\cdots+\frac{a_{jn}}{(1+i)^n}x_{jn}\right\} \quad j=1,2\ldots n \tag{1}$$

where:

Z is the total profit

x_{jn} is the number of the jth constructed units in the nth year

a_{ij} is the expected net profit for each

Constructed unit for each project in n year

i is the interest rate.

n is denoted for the year number

This profit function has three constraint categories, the project budget, the yearly budget, and the number of constructed unit constraints. As mentioned previously a_{jn} represent net profit for each constructed unit for each project in n year for each project, then it’s important to compare between profit values at present. A sample of available information for a mega construction project is given as will be discussed later in a case study. The mega project consists of several individual construction projects to be implemented in different years, and each project will construct several units.

To prepare the required data for modeling the problem of construction projects, three tables are needed, the first table contains detailed profit for each constructed unit/ year $A:\{a_{ij}\}$, and the second table contains the cost for each constructed unit/ year for each project $B:\{b_{ij}\}$,. These tables were organized to figure out a third table $C:\{c_{ij}\}$.

The contents of third table C represent the coefficients of the linear objective function to be minimized.

$$\max_{X}\left\{Z=\sum_{j=1}^{n}\sum_{i=1}^{n}c_{ij}x_{ij}\right\} \qquad (2)$$

where x_{ij} are the number of units constructed of the jth project using all or part of the ith yearly budget, and

$$c_{ij}=\frac{a_{ij}}{b_{ij}}, \qquad i,j=1,2\ldots n$$

These coefficients of profit/cost of unit construction are listed in a table 1. These three tables are equivalently described by matrices for programming algorithms that will be used for determining the optimal solution. The matrices' dimensions depend on the number of constructing projects (rows) and the number of implementation years (columns); both square and no square matrices are possible to consider. Table 1 shows the case of a square matrix of dimension $(n\times n)$. As is shown the yearly budget and the project budget for the ith year are denoted as S_i and D_i , respectively. It is assumed that the total budget assigned for the considered years is equal to the budget assigned for all projects to be performed; hence, a balanced linear programming model is obtained like a balanced transportation model.

Table 1 Coefficient of profit/cost

Project	P_1	P_2	P_3	….	P_n	yearly budget
Year 1	c_{11}	c_{12}	c_{13}	….	c_{1n}	S_1
Year 2	c_{21}	c_{22}	c_{23}	….	c_{2n}	S_2
Year 3	c_{31}	c_{32}	c_{33}	….	c_{3n}	S_3
….	….	….	….	….	….	….
Year n	c_{n1}	c_{n2}	c_{n3}	….	c_{mn}	S_n
project budget	D_1	D_2	D_3	D_5	D_n	

The problem could be balanced or unbalanced. For a balanced problem, the total budget assigned for the considered years is equal to the budget assigned for all projects to be performed. Mathematically, let S_i denotes the ith year budget and D_i denotes the budget for the i[th] project, then a balanced problem can be described as:

$$\sum_{i=1}^{n} S_i = \sum_{i=1}^{n} D_i$$

The yearly particularized budget represents the source and the total year budgets of the particularized project the demands of a transportation problem. However, the difference between these two problems is the additional constraints on the number of construction units to be implemented for the particularized project in all years. Therefore, the model mixed constraints will be:

$$\sum_{i=1}^{n} b_{ij} x_{ij} \leq S_i, \qquad j = 1,2 \ldots n \qquad (3)$$

$$\sum_{j=1}^{n} b_{ij} x_{ij} = D_i, \qquad i = 1,2 \ldots n \qquad (4)$$

$$\sum_{j=1}^{n} \frac{1}{b_j} x_{ij} = N_i, \qquad i = 1,2 \ldots n \qquad (5)$$

where N_j is the total number of constructed units for the jth project during all years.First, the methodology suggests solving without the third set of n constraints, then if the numbers of constructed units in all projects are as required by the company the optimal solution (maximum overall profit) is accepted. Otherwise, the pre -determined total construction units constraints (5) are included to obtain the optimal solution that satisfies the required number of constructing units. It is important to note that the inclusion of the third set of n constraints may result in an infeasible solution and hence another set of N_j values should be considered.

IV. SENSITIVITY AND CRISIS ANALYSIS

In general Sensitivity analysis can be defined as a method that determines efficacy for an independent variable with a particular dependent variable under pre-determined assumptions for any change, also studies how different sources of uncertainty can contribute to mathematical model overall uncertainty. The crisis analysis can be a part of the sensitivity analysis. Sensitivity analysis is a tool that can be used in a wide range of applications such as biology, industry, trading, economics, and engineering. For the case under consideration, sensitivity analysis includes:

1. Studying critical years to compare them with other years, in other words, where a crisis may occur as the worst-case scenario.
2. Studying critical projects to compare them with other projects, based on those analyzed data worst-case scenarios would be conducted.
3. Studying the effect of decreasing overall profit from (1 -20) % on each project to determine Maximum and Minimum profit losses.
4. Studying the effect of decreasing overall profit for each year to determine Maximum and Minimum profit losses.
5. Studying the effect of increasing the cost of construction materials from (1-20) % on each project to determine Maximum and Minimum profit losses.
6. Studying the effect of increasing the cost of construction materials for each year to determine Maximum and Minimum profit losses.
7. Studying the effect of increasing cost, and decreasing profit for the highest risky implementation year, and determining its consequences on the total number of constructed units for all projects.
8. Studying the effect of increasing cost, and decreasing profit for the riskiest implementation year, and determining its consequences on the total number of constructed units for all projects.

V. CASE STUDY

In this section, a case study was taken for one of the Jordanian Engineering construction companies that implemented mega construction projects in different districts in Jordan from 2017 to 2027 (within 10 years). Each project has a specific number of constructed units that will be implemented within a 10-year plan. For example, the second project has 35 constructed units, as their plan will be implemented within 7 years, which means 5 units/ year a long 7 years, with 1,114,988 JD constructed cost/project, table 2 shows the cost and total budget for each project.

Table 2 shows the project budget for each project, for example, the first-project budget is 7,078,896 JD, which will be used to construct 40 units during the first five years. Note that the total project budget is equal to the total number of constructed units multiplied by the cost/ constructed unit.

Using the ratio representing profit value divided by cost provides us with more reliable results without prejudice for higher profit units or, ignoring low-profit units without considering the effect of construction cost. Here, optimal tools are more robust evidence to support any proposed plan. Add to what has been discussed previously by using a ratio instead of sold figures that would represent a real effect (actual measuring tools) for either increasing or decreasing cost or profit.

Table 2 Detailed financial cost for each project

No	**Project**	**No. of units**	**Cost / constructed unit**	**Total Project Budget (JD)**
1	Project 1	40	176,972	7,078,896
2	Project 2	35	1,114,988	39,024,580
3	Project 3	50	1,712,466	85,623,340
4	Project 4	30	26,465,666	793,969,981
5	Project 5	25	3,953,246	98,831,163
6	Project 6	30	128,269	3,848,082
7	Project 7	40	273,771	10,950,862
8	Project 8	40	178,677	7,147,103
9	Project 9	40	237,925	9,517,009
10	Project 10	50	179,395	8,969,783

Since this construction project fund is a loan from an international banking institution, being restricted with this amount and proper distribution of it on each project to maximize a total profit in both normal cases and crisis conditions, will be discussed later. Since the yearly budget is fixed simultaneously, each project budget needed to be fixed, to get a balanced problem.

VI. PROFIT OPTIMIZATION

As mentioned in the previously, the optimal assignment can be computed using many techniques, such as genetic algorithms, neural networking, and simple linear programming in our case study.

Concerning solving this problem, three tables were needed, table 3 contains the profit value for each unit/project separately. Since this value differs from year to year, which has been figured out in the previous section, and table 4 contains construction cost for each unit/project, which is considered a constant in our case study, and the additional table represent coefficients (Ratio) of the linear objective function.Each table is considered as matrices (10×10), describing our case study of ten projects with ten years of implantation. Based on that, all tables and matrices will have the same size.

Table 5 shows the optimal distribution of construction units and regular distrubuation for constructed units, which are completely different from the original company plan under normal conditions, such as the first-year budget is 30,696,047 JD will be spent to implement one unit for the project4. Also, the second-year budget of 38,064,943 JD will be distributed for project 1 (construction cost is 7,078,897JD), which represents 18.59% of it, which would cover the construction cost for 40 units of the first project and the second project (construction cost is 30,986,047 JD) which represent 81.4% of it, that would cover construction cost for 28 units of project number 2, the remaining unit will be completed in the fifth year with a total construction cost of 8,038,534 JD.

It's important to highlight the fourth year budget, since it expenses 16.13% of ten years budgets, due to that many projects are considered to be implemented during it, such as 1 unit for the 4 th project, 25 units for the 5 th project, 30 units for the 6 th project, 40 units for the 7 th project 7, 40 units for the 8 th project, 40 units for the 9 th project and finally 50 units for the 10 th project as shown in the following solution (10×10)matrix

$$\begin{bmatrix} 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 40 & 28 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 25 & 30 & 40 & 40 & 40 & 50 \\ 0 & 7 & 50 & 3 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 6 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 6 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 6 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 6 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

More than 59% of all units for all projects will be implemented in the fourth year, which will lead to a reasonable explanation for considering it a critical year, where overall profit would cover all expenses for the remaining units of all projects, due to that sensitivity analysis would highlight its importance later.

Bearing in mind that the 4th project is recommended to be implemented in 8 years (starting from years number 1, 3, 4, 5, 6, 7, and ending in year 9), which is considered the longest implantation duration if it's compared with the construction duration for other projects since construction cost for 1 unit is the highest value (26,465,666 JD) take in to account that MATLAB program results table 6 are integers since it determines an integer number of construction units.

Table 3 Profit Value

Year	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Y 1	31,855	32,505	36,116	40,129	44,588	49,542	56,144	863,380	71,505	80,521
Y 2	72,820	74,306	78,217	82,333	86,667	91,228	97,097	10,332	110,196	117,661
Y 3	35,961	37,073	43,615	51,312	60,367	71,020	84,807	100,284	117,824	137,426
Y 4	42,915	43,791	52,760	63,567	76,587	92,273	112,623	135,688	161,976	191,487
Y 5	59,298	61,769	64,343	67,024	69,817	72,726	75,756	78,913	82,200	85,625
Y6	23,088	25,653	28,504	31,671	35,190	39,100	43,446	48,274	53,637	59,596
Y7	38,328	40,774	43,377	46,145	49,091	52,224	55,557	59,103	62,875	66,886
Y8	34,842	35,919	37,030	38,175	39,356	40,573	41,829	43,122	44,456	45,831
Y9	47,585	51,722	56,220	61,109	66,423	72,199	78,477	85,302	92,719	100,782
Y10	32,291	35,879	39,865	44,295	49,216	54,685	60,762	67,514	75,015	83,349
Total profit .	418,985	439,396	480,052	525,765	577,306	635,576	706,500	691,913	872,404	969,164

Table 4 Construction cost

Year	P1	P2	P3	P4	P5	P6	P7	P8	P9	P 10
Y 1	176,972	1,114,988	1,712,466	26,465,666	3,953,246	128,269	273,771	178,677	237,925	179,395
Y 2	176,972	1,114,988	1,712,466	26,465,666	3,953,246	128,269	273,771	178,677	237,925	179,395
Y 3	176,972	1,114,988	1,712,466	26,465,666	3,953,246	128,269	273,771	178,677	237,925	179,395
Y 4	176,972	1,114,988	1,712,466	26,465,666	3,953,246	128,269	273,771	178,677	237,925	179,395
Y 5	176,972	1,114,988	1,712,466	26,465,666	3,953,246	128,269	273,771	178,677	237,925	179,395
Y6	176,972	1,114,988	1,712,466	26,465,666	3,953,246	128,269	273,771	178,677	237,925	179,395
Y7	176,972	1,114,988	1,712,466	26,465,666	3,953,246	128,269	273,771	178,677	237,925	179,395
Y8	176,972	1,114,988	1,712,466	26,465,666	3,953,246	128,269	273,771	178,677	237,925	179,395
Y9	176,972	1,114,988	1,712,466	26,465,666	3,953,246	128,269	273,771	178,677	237,925	179,395
Y10	176,972	1,114,988	1,712,466	26,465,666	3,953,246	128,269	273,771	178,677	237,925	179,395

Table 5 the optimal distribution of construction units and regular distrubuation for constructed units

	P1		P2		P3		P4		P5		P6		P7		P8		P9		P 10	
Year	R	O	R	O	R	O	R	O	R	O	R	O	R	O	R	O	R	O	R	O
Y 1	8				5			1	5								4			
Y 2	8	40	5	28	5				5								4		5	
Y 3	8		5		5			1	5				5				4		5	
Y 4	8		5		5		5	1	5	25	30	40	5	40		40	4		5	
Y 5	8		5	7	5	50	5	3	5		6		5				4		5	
Y6			5		5		5	6			6		5		8		4		5	
Y7			5		5		5	6			6		5		8		4			
Y8			5		5		5	6			6		5		8		4			
Y9					5		5	6			6		5		8		4			
Y10					5								5		8		4			

profit based on the optimal plan is 4.0730×10^7 JD, the difference between the optimal plan and the company's normal plan is a round 20×10^6 JD.For example, the optimal way to distribute the specific amount of yearly budget to each project budget, for example, the fifth-year planned budget is 172,531,748 JD which is recommended for implementation of projects 2 (8,038,534 JD) to construct 7 units, 3 (85,623,340 JD) to construct 50 units once a time and 4 (78,869,875 JD) to complete 3 units, which represent 16.20% of the total budget and around 15.79% of the total number of constructed units.

The sixth-year budget as shown in table 6 is 152,779,157 JD, which represents 14.35% of the total budget. Therefore, it recommended for implementation of project number 4 to construct six units that represents 1.58% of the total number of construction units.

Table 6 MATLB assignment results

Yearly budget	Project Budget	Cost / Project	# units	Profit.
1st	P # 4	30,696,047	1	46,544
2ed	P #1	7,078,897	40	2,912,812
2ed	P # 2	30,986,047	28	4,717,760
3rd	P # 4	39,433,801	2	60,076
4th	P # 4	32,498,128	1	94,715
4th	P # 5	98,831,163	25	763,959
4th	P # 6	3,848,083	30	2,867,629
4th	P # 7	10,950,862	40	16,222,109
4th	P # 8	7,147,103	40	29,946,079
4th	P # 9	9,517,009	40	26,845,955
4th	P # 10	8,969,783	50	42,091,655
5th	P # 2	8,038,533	7	1,800,380
5th	P # 3	85,623,340	50	1,221,070
5th	P # 4	78,869,875	3	82,301
6th	P # 4	152,779,157	6	118,271
7th	P# 4	150,985,200	6	6,709
8th	P# 4	150,985,200	6	15,796
9th	P # 4	145,410,260	6	16,502
10th	P # 4	12,312,313	1	15,928

VII. SENSITIVITY ANALYSIS

In this section, sensitivity analysis would consider a tool to measure risk level, since risk management considered a primary block for efficient crisis management. Sensitivity analysis would be computed in two different perspectives: project and year perspectives, later. This analysis would help to evaluate the critical year and critical projects then a companion of that analytical information would help us to build the worst senior case, which is known as crisis or uncontrolled, unforeseen conditions.

VIII. SENSITIVITY ANALYSIS PROJECTS BASIS

Based on the available construction information, two main concerns will be considered as a measuring tool for sensitivity analysis: profit and construction costs, reffering to scientific research and some local expertise, increasing materials cost would affect more than 40% of total construction profit, which will directly affect on selling costs and expected net profit.

Add to what was mentioned previously, some common treatment marketing plans would be to add a pre-determined percent on net profit (as a buffer) to be adjusted for any unexpected upcoming actions, that may cause a delay in selling units, or reducing buying demand on this project, this percent would be removed as a solution in real state stagnation.

Table 7 Comparing the 4th and 10th projects results

(%)	Project 4		Project 10	
	Profit decreasing X 10^5	Profit decreasing due to increasing cost X 10^5	Profit decreasing X 10^5	Profit decreasing due to increasing cost X 10^5
1	0.1421	0.1406	0.9574	0.9479
2	0.2842	0.2786	1.9148	1.8773
3	0.4263	0.4138	2.8723	2.7886
4	0.5684	5.4655	3.8297	3.6824
5	0.7105	0.6766	4.7871	4.5592
6	0.8526	0.8043	5.7446	5.4194
7	0.9947	0.9296	6.702	6.2635
8	1.1368	1.0526	7.6594	7.0921
9	1.2789	1.1733	8.6169	7.9054
10	1.421	1.2918	9.5743	8.7039
11	1.5631	1.4008	10.5317	9.488
12	1.7052	1.5225	11.4892	10.2582
13	1.8473	1.6348	12.4466	11.0147
14	1.9894	1.7451	13.404	11.7579
15	2.1315	1.8535	14.3615	12.4882
16	2.2736	1.96	15.3189	13.206
17	2.4157	2.0647	16.2763	13.9114
18	2.5578	2.1676	17.2338	14.6049
19	2.6999	2.2688	18.1912	15.2867
20	2.842	2.3683	19.1486	15.9572

Table 8 describe the relationship between the percentage of decreasing profit (0-20) % for each project and its effect on net profit for all project. Figure 1 show highly affected project, for example, the 10th project (Max. profit loss) 1.9148 X $10^{6,}$ and the least affected project was the 4th project (Min. profit loss) 2.8420 X 10^5

It's clear that project ten is considered a critical project, where maximum profit loss occurs, but due to optimal assignment distribution, this project won't be implemented until the fourth year, which means that the first three years are considered a safe period without any high-risk level completion percentage is 18.42% of the total number of all construction units. On the other hand, the 4th project would consider a safe project, but table 8 shows that this project is implemented within 8 years, which gives a clear image to describe those years as a low-risk year, which will be highlighted later.

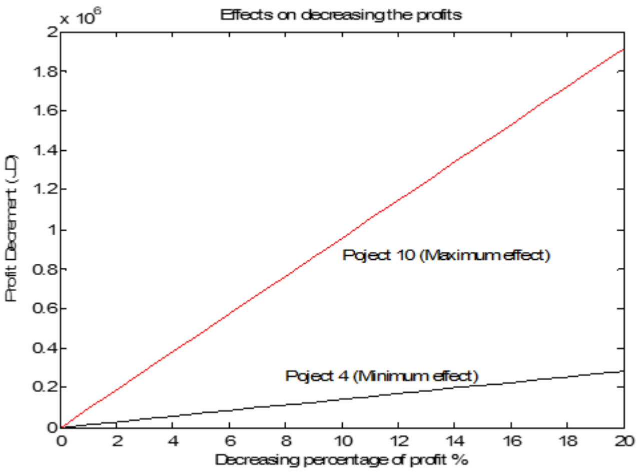

Figure 1. Effect of decreasing project profit onnet profit

Table 9 would present the second measuring tool for risk levels, which is the effect of increasing construction costs either from materials or labor costs on net profit, this table describes the relationship percent of increasing construction costs on net profit, for each project. Figure 2show a highly affected project, for example, the 10th project is (Max. profit loss) 1.5957 X 10^5 JD and the least affected project is the 4th project (Min. profit loss) 2.3683X 10^5

One important result obtained using previous analytical data is remarkable identification of Max and Min-affected projects based on a specific perspective, so further analysis was conducted on both the 4th and 10th projects as shown in table 7. Taking into consideration evaluation of the10th project losses are more than 2.7%, while losses from the 4th project are 0.42% of net profit.

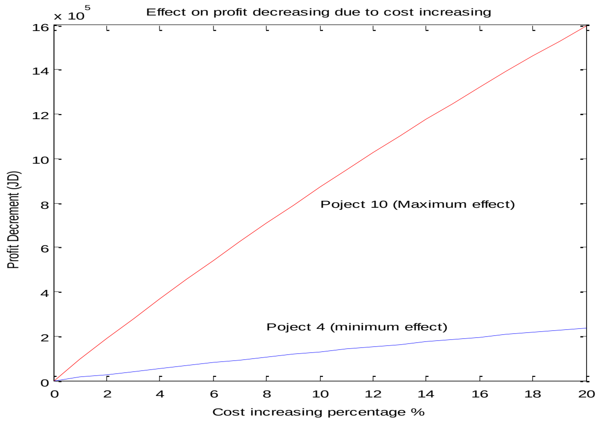

Figure 2. Effect of increasing in the cost on profit

Figure 3 describe the most affected factor for the 4th project, which is profit decreasing due to increasing construction costs, the single striking reason is that the 4th project is considered the highest construction costs compared with other projects as shown in table 6. Nevertheless, 4% increment of construction cost would consider as an out-layer value if it compared with lower and higher values.

Table 8 Profit decreasing X10^5

%	P 1	P 2	P3	P4	P 5	P 6	P7	P 8	P9	P 10
1	0.291	0.2510	0.3217	0.1421	0.1914	0.2768	0.4504	0.5427	0.6479	0.9574
2	0.5826	0.5021	0.6434	0.2842	0.3829	0.5536	0.9009	1.0855	1.2958	1.9148
3	0.8738	0.7531	0.9652	0.4263	0.5744	0.8304	1.3514	1.6282	1.9437	2.8723
4	1.6512	1.0041	1.2868	0.5684	0.7658	1.1072	1.8019	2.1710	2.5916	3.8297
5	1.4564	1.2551	1.6085	0.7105	0.9573	1.3841	2.2524	2.7137	3.2395	4.7871
6	1.7476	1.5062	1.9303	0.8526	1.1488	1.6609	2.7029	3.2565	3.8874	5.7446
7	2.0389	1.7572	2.2520	0.9947	1.3402	1.9377	3.1534	3.7992	4.5353	6.7020
8	2.3302	2.0080	2.5737	1.1368	1.5317	2.2145	3.6039	4.3420	5.1832	7.6594
9	2.6215	2.2593	2.8954	1.2789	1.7232	2.4913	4.0544	4.8847	5.8311	8.6169
10	2.9128	2.5103	3.2171	1.4210	1.9146	2.7682	4.5049	5.4275	6.4790	9.5743
11	3.2040	2.7613	3.5388	1.5631	2.1061	3.0450	4.9554	5.9702	7.1269	10.5317
12	3.4953	3.0124	3.8606	1.7052	2.2976	3.3218	5.4059	6.5130	7.7748	11.4892
13	3.7866	3.2634	4.1823	1.8473	2.4890	3.5986	5.8563	7.0557	8.4227	12.4466
14	4.0779	3.5144	4.5040	1.9894	2.6805	3.8754	6.3068	7.5985	9.0706	13.4040
15	4.3692	3.7655	4.8257	2.1315	2.8720	4.1523	6.7573	8.1412	9.7185	14.3615
16	4.6604	4.0165	5.1474	2.2736	3.0634	4.4291	7.2078	8.6840	10.3664	15.3189
17	4.9517	4.2675	5.4691	2.4157	3.2549	4.7059	7.6583	9.2267	11.0143	16.2763
18	5.2430	4.5186	5.7909	2.5578	3.4464	4.9827	8.1088	9.7695	11.6622	17.2338
19	5.5343	4.7696	6.1126	2.6999	3.6378	5.2595	8.5593	1.0312	12.3101	18.1912
20	5.8256	5.0206	6.4343	2.8420	3.8293	5.5364	9.0098	10.8550	12.9580	19.1486

Table 9 Effect on profit due to cost increasing X 10^5

(%)	P1	P 2	P 3	P4	P 5	P 6	P7	P8	P9	P 10
1	0.2883	0.2485	0.3185	0.1406	0.1895	0.2740	0.4460	0.5373	0.6414	0.9479
2	0.5711	0.4922	0.6308	0.2786	0.3754	0.5427	0.8833	1.0642	1.2704	1.8773
3	0.8483	0.7311	0.9370	0.4138	0.5576	0.8062	1.3121	1.5808	1.8870	2.7886
4	1.1203	9.6551	1.2373	5.4655	0.7364	1.0646	1.7326	2.0875	2.4919	3.6824
5	1.3970	1.1954	1.5319	0.6766	0.9117	1.3181	2.1451	2.5845	3.0852	4.5592
6	1.6487	1.4209	1.8210	0.8043	1.0837	1.5669	2.5499	3.0721	3.6673	5.4194
7	1.9055	1.6422	2.1046	0.9296	1.2525	1.8109	2.9471	3.5507	4.2386	6.2635
8	2.1576	1.8595	2.3830	1.0526	1.4182	2.0505	3.3369	4.0203	4.7992	7.0921
9	2.4050	2.0727	2.6563	1.1733	1.5809	2.2856	3.7196	4.4814	5.3496	7.9054
10	2.6480	2.2821	2.9247	1.2918	1.7406	2.5165	4.0953	4.9341	5.8900	8.7039
11	2.8865	2.4877	3.1881	1.4008	1.8974	2.7432	4.4633	5.3786	6.4206	9.4880
12	3.1208	2.6896	3.4469	1.5225	2.0514	2.9659	4.8266	5.8151	6.9418	10.2582
13	3.3510	2.8880	3.7011	1.6348	2.2027	3.1846	5.1826	6.2440	7.4537	11.0147
14	3.5771	3.0828	3.9509	1.7451	2.3513	3.3995	5.5323	6.6653	7.9567	11.7579
15	3.7993	3.2743	4.1963	1.8535	2.4974	3.6107	5.8759	7.0793	8.4509	12.4882
16	4.0176	3.4625	4.4374	1.9600	2.6409	3.8182	6.2136	7.4862	8.9366	13.2060
17	4.2322	3.6475	4.6745	2.0647	2.7820	4.0221	6.5456	7.8861	9.4139	13.9114
18	4.4432	3.8293	4.9075	2.1676	2.9206	4.2226	6.8719	8.2792	9.8832	14.6049
19	4.6507	4.0081	5.1366	2.2688	3.0570	4.4198	7.1927	8.6657	10.3446	15.2867
20	4.8546	4.1839	5.3619	2.3683	3.1911	4.6136	7.5081	9.0458	10.7984	15.9572

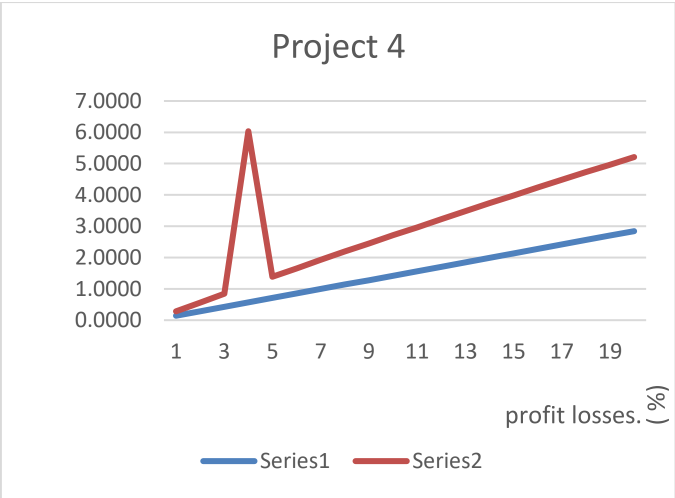

Figure 3. Sensitivity analysis for the 4th project

Figure 4 compare two factors mentioned previously, adding to what was mentioned previously and focusing on profit values, especially for the 10th project, at the beginning both losses dsue to both conditions would be considered approximately similar until 9% then the effect of profit decreases would contribute more decreasing overall profit.

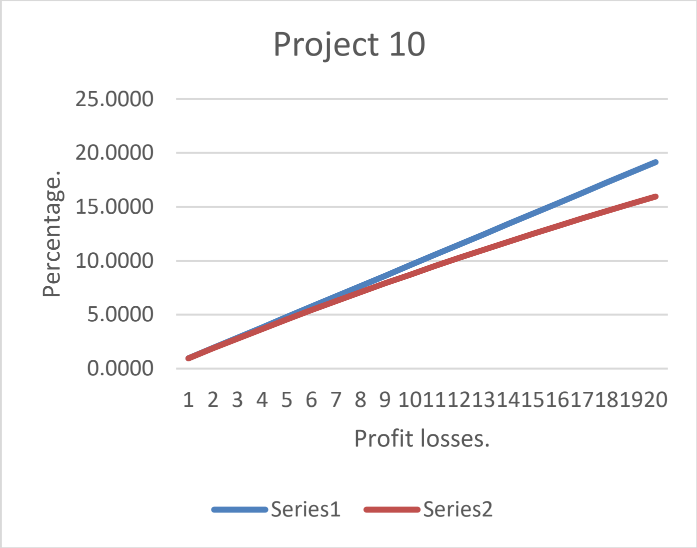

Figure 4 Sensitivity analysis for the 10th project

IX. SENSITIVITY ANALYSIS YEARLY BASIS

Since the implementation duration is ten years, which is considered a long duration to implement construction projects, so the effect of time would be obvious, this section will evaluate the effect of decreasing profit and decreasing net profit due to increasing construction costs simultaneously.

Using results from this analysis would help to complete a more accurate and represented senior, which may be considered as a possible crisis senior. This senior would be built based on two milestones, which are the critical year and critical project with the yearly budget limitation that will be discussed later.

In figure 5 it is visible that the fourth year is the most affected than the second year and fifth year and beneath it curve remaining years. Logically these results were expected since more than 69% of construction units would be accomplished in the fourth year, in other words, more than half of this mega project would be finished.

The second year is also a highly impacted year due to completing 68 units, which required more than 38 million to complete all construction activities, and finally, the fifth year where more than 55 units would be completed with more than 93 million required as project budget for this year.

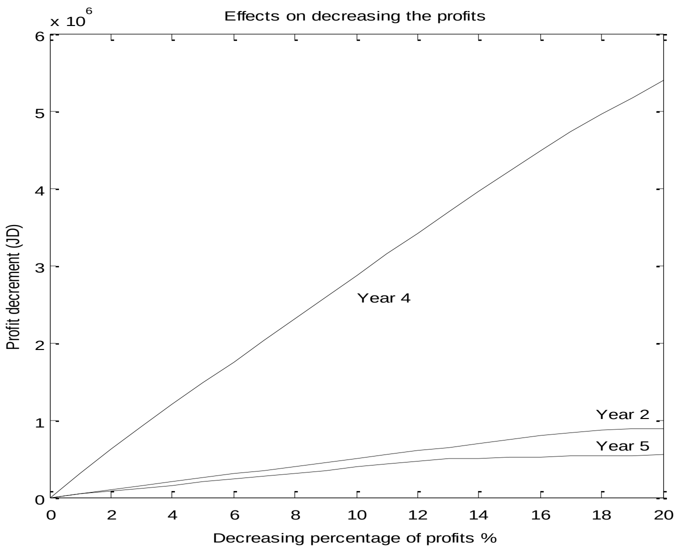

Figure 5 Sensitivity anlysis yearly basis

X. EFFECT OF INCREASING COSTS ON NUMBER OF CONSTRUCTION UNITS

Since increasing construction costs might affect the total expected, or even affect the total number of construction units, especially after the fourth year, where the expected net profit would be used to complete the remaining planned number of units. Any increment of this profit due to increasing construction costs might affect the total number of construction units, as shown in table 10; this table evaluates the consequences of the 4th year and the 4th project on overall net profit.

In the case of year 4; increasing the cost of the units of the project, and has a great effect on the optimal assignment matrix which is starting to change from an increment of 2%, which increment loses more than 8% of the total number of construction units, which may cause more than 11.43% profit losses. In case of the 4th project; decreasing the profits by (1- 20) % has a slight effect on the number of units and the optimal assignment matrix, such as decreasing five units while profit decreasing lossesis 0.58% (237.000 JD) which is considered acceptable percentage for mega construction projects.

Table 10 Effect of increasing construction costs on the total number of construction units.

Year 4			**Project 4**		
cost %	Profit “JD”	No. of units.	cost %	Profit “JD”	No. of construction units.
0	40,730,000	380	0	40,730,000	380
1	40,426,000	380	1	40,716,000	379
2	40,127,000	375	2	40,702,000	379
3	39,840,000	375	3	40,689,000	379
4	39,579,000	371	4	40,675,000	377
5	39,322,000	371	5	40,662,000	377
6	39,071,000	370	6	40,650,000	376
7	38,824,000	366	7	40,637,000	376
8	38,582,000	365	8	40,625,000	376
9	38,344,000	365	9	40,613,000	376

10	38,111,000	361	10	40,601,000	376
11	37,881,000	361	11	40,589,000	376
12	37,656,000	360	12	40,578,000	376
13	37,443,000	358	13	40,567,000	376
14	37,236,000	358	14	40,556,000	376
15	37,032,000	357	15	40,545,000	376
16	36,832,000	354	16	40,534,000	376
17	36,635,000	354	17	40,524,000	376
18	36,444,000	353	18	40,513,000	376
19	36,257,000	353	19	40,503,000	376
20	36,073,000	350	20	40,493,000	375

XI. EFFECT OF DECREASING PROFIT ON THE NUMBER OF CONSTRUCTION UNITS

Table 11 highlight the effect of decreasing profit ratio on the total number of construction units, ever after decreasing profit up to 20% total number of contrition units remains the same, which will confirm the buffer profit ratio theory.

Table 11 Effect of deacrasing profit on number of construction units

ncrease f cost	**Profit "JD"**	**No. of construction units.**	**ncrease of cost**	**Profit "JD"**	**#unit**
0	40,730,000	380	11	40,409,600	380
1	40,700,870	380	12	40,380,470	380
2	40,671,740	380	13	40,351,340	380
3	40,642,620	380	14	40,322,210	380
4	40,564,880	380	15	40,293,080	380
5	40,584,360	380	16	40,263,960	380
6	40,555,240	380	17	40,234,830	380
7	40,526,110	380	18	40,205,700	380
8	40,496,980	380	19	40,176,570	380
9	40,467,850	380	20	40,147,440	380
10	40,438,720				

XII. CONCLUSION

The current research revealed many significant conclusions, which are summarized in the following points:

- Using an optimization model will minimize overall losses during a financial crisis, by redistribution of available financial resources optimally, which is better to compare with regular plans or responding plans.
- Using an optimal model would help to avoid any financial losses created by a financial crisis

- Applying mathematical polynomial fitting to predict missing values for profit.
- Comparing present worth between the optimal plan and the company's regular plan, where optimal PW results doubled of PW for another plan.
- The effect of decreasing profit determines using sensitivity analysis for two different bases, firstly project-wise and secondly year-wise, likely in both cases it slightly affected total profit and lower effect on the total number of construction units.
- The effect of decreasing profit due to the increasing cost of construction materials would highly affect both total profit and the total number of constructed units, which represent more than a 7 % increment of the regular plan, assuming that normal conditions control the construction environment.
- To build financial crisis conditions, it is essential to determine critical years and projects, based on maximum losses for a year and a project, which was the 10th project and the fourth year.

REFERENCES

[1] Anderson, G. R., Onder, N., & Mukherjee, A. (2007, December). Expecting the unexpected, "representing, reasoning about, and assessing construction project contingencies", In 2007 winter, Simulation Conference (pp. 2041-2050). IEEE

[2] Booth, S. A. (2015). Crisis management strategy: Competition and change in modern enterprises. Routledge

[3] Coombs, W. T., & Laufer, D. (2018). Global crisis management–current research and future directions. Journal of International Management, 24(3), 199-203

[4] Hällgren, M., & Wilson, T. L. (2008). The nature and management of crises in construction projects: Projects-as-practice observations. International Journal of Project Management, 26(8), 830-838.

[5] Jose, J., & Ajayakumar, M. A. (2019). CRISIS MANAGEMENT IN CONSTRUCTION PROJECTS.

[6] Liu, Y., & Froese, F. J. (2020). Crisis management, global challenges, and sustainable development from an Asian perspective. Asian Business & Management, 19(3), 271.

[7] Loosemore, M. (2000, October). Crisis management in construction projects. American Society of Civil Engineers.

[8] Pearson, C. M., & Mitroff, I. I. (2019). From crisis prone to crisis prepared: A framework for crisis management. In Risk management (pp. 185-196). Routledge.

[9] Roux-Dufort, C., & Vidaillet, B. (2003). The difficulties of improvising in a crisis situation-a case study. International studies of management & organization, 33(1), 86-115.

[10] Sahin, S., Ulubeyli, S., & Kazaza, A. (2015). Innovative crisis management in construction: Approaches and the process. Procedia-Social and Behavioral Sciences, 195, 2298-2305.

[11] Samra, Y. M., Zhang, H., Lynn, G. S., & Reilly, R. R. (2019). Crisis management in new product development: A tale of two stories. Technovation, 88, 102038.

[12] Shibani, A., Hasan, D., Saaifan, J., Sabboubeh, H., Eltaip, M., Saidani, M., & Gherbal, N. (2022). Financial risk management in the construction projects. Journal of King Saud University-Engineering Sciences.

[13] Vrchota, J., & Řehoř, P. (2016). Project Management and the Importance of Crises in the Sectors of the National Economy. Procedia Computer Science, 100, 362-368

[14] Walker, A. (2015). Project management in construction. John Wiley & Sons.

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