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Assessments of Barriers to Implementing Cost Control and Optimal Cost Reduction Techniques in Construction Projects: A Case Study of Egypt

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Abstract

The earned value management is a leading technique in monitoring and analyzing project performance and project progress. The main objectives of this paper are 1) Identify and prioritize the main problems for lack of techniques which cause poor management of cost control with poor site organization and inadequate supervision. 2) Demonstrate the modified Activity Based Costing system as the best choices for cost accounting approach for determining construction project accurate cost. To fill the gap of limited research for studying factors inhibiting the ability of contractors to effectively control their projects, a survey was conducted on 22 construction project organizations. It was noted that most project managers and contractors in Egypt find difficulty in controlling project costs due to problems that include Change order, Changes in the design, Errors in the design, current economic situation deterioration, Delay project and Rising prices of materials. To improve capital project cost schedule and predictability using a project control system for monitoring and predicting the

construction project outcomes. The detailed scope of control systems must base on the complexity, size, and sensitivity strategy of the studied project. Control systems per project should be including: 1) Cost Management Process 2) Planning and Scheduling Management Process 3) Change Management. Finally, the study will show the application of modified Activity Based Costing approach that leads to getting better tendering price and update items costs data to save necessary information to bidders. This system is controlling all activities to take correct decisions. This study recommended that it was needed to change the traditional costing system and focus on the most accurate bidder.

Keywords: Ranking factors, Activity Based Costing, Value Engineering, Earned Value Management, Target Cost and Construction Management.

1 Overview

Construction clients were interested in obtaining time, cost, quality, and scope for the studied project, [1]. Megaprojects are large-scale, complex ventures that typically cost US$1 billion or more, take many years to develop and build [2]. Cost control techniques were of vital importance due to construction cost alarming escalation that needs to be fully controlled. In addition, this research depends on questionnaires that are designed in the construction industry to analyze several deductions. Life cycle cost analysis (LCC) is a tool allowing utility owners to make sound project decisions, considering both capital and operating costs over a long-term analysis period, [3]. Construction project cost control is very important to help construction professionals to maximize fund during project execution [4]. The government does stable policies to strengthen project expenses and to monitor land cost that affect construction cost, [5]. The construction sector had a prompt impact on their projects, investment and employment contributing at least 4.7% from total projects costs, [6] and [7]. Since the last two years ago, many sectors suffered from hesitated economic situation according to Egyptian political risks. The civil projects field had been declined by 9.4% in the first Quarter of the year 2012 and had suffered from unstable political situation impacts, [8]. The main factors are affecting Egyptian construction projects as follows: 1) government strategies, 2) construction companies, 3) institutional backing, 4) available resources and 5) supporting industries, [9]. The prices such as: materials, labor,

equipment utilization, transporting, energy use and any cost over time, [10]. [11] was defined cost control as processing raw information, which is received from the operating department, projects staff's department estimates project schedules with cost to present the results by using technical reports to client and agencies. [12], presented project cost control is involved in collecting and measuring cost record to project progress also is involved by doing a comparison between projects actual progress with the project planned progress in the construction field. The main cost control objective for the construction project is to can wen the project by greatest profit within the construction period of all work items. [13], provided a reference for theoretical study with practical application on the incentive mechanism, which is applicable to construction project cost control based in China. It was taking into consideration the incentive compensation mechanism as a theoretical basis and drawing on the composition of the incentive pool based on the responsibility matrix on cost control. [14], examined corrective measures for construction project cost control. The objectives of this study are to evaluate the procedures and the essential skills required for conducting corrective measures for project cost control. Cost control frameworks have corrective measures activity. Corrective measures are well conducted by identifying the causes of the variances of the various work activities or resources such as materials, labor, plant and equipment, and profit and overheads [15]. [16], adopted an asset management perspective on the issue of contract cost control in public-private partnership contracts and aimed to add to the understanding of asset network-level effects of important contractual parameters such as contract duration and cost control trade-off. [17], integrated more models of construction bidding to determine the minimum price of each unit quantity in the construction contract. [18], contributed the body of knowledge by analyzing project data from 47 public DB transportation projects and combining performance outcomes with two decades of published DB performance transportation literature. [19], classified two main categories: qualitative and quantitative procedures. This study reviews different computational intelligence (CI) techniques and methods conducted to develop practical cost prediction models [20].

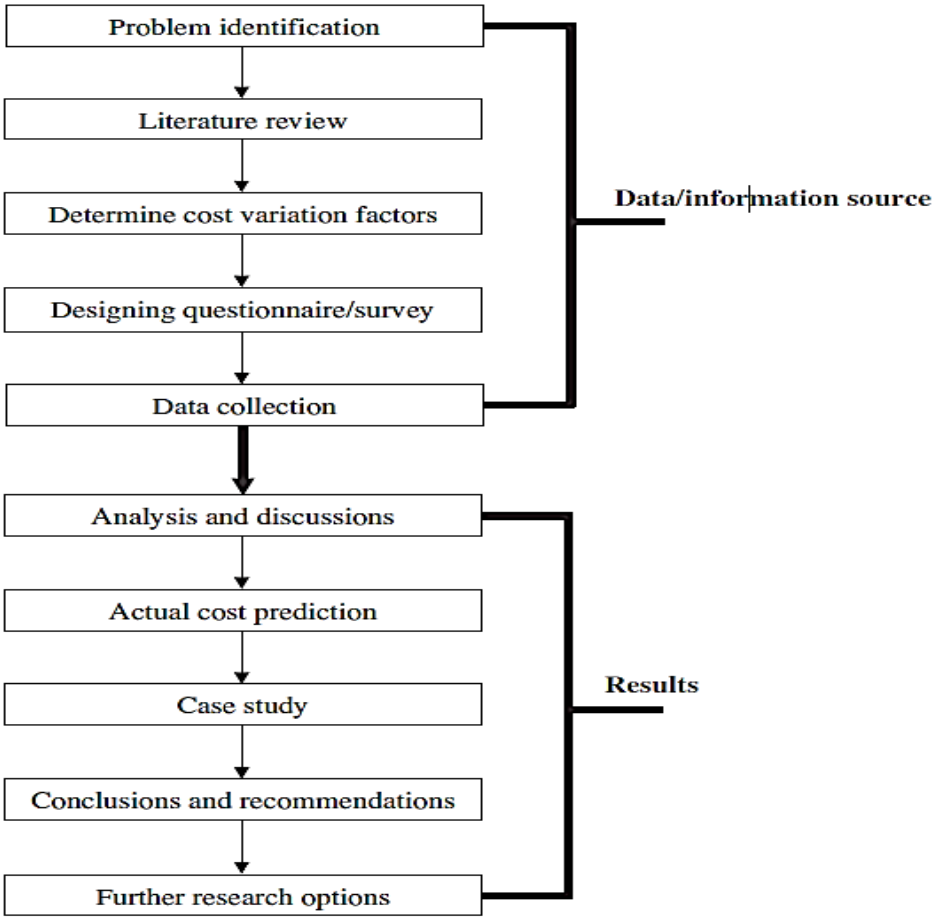

Figure 1. Research main activities/methodology

2 Research Methodology

To improve capital project cost predictability using a project control system for monitoring and predicting the construction project outcomes. The detailed control systems methodology must be done per project including Literature survey related to this topic, Earned Value Measurement, Value Engineering (VE), and designing questionnaire samples to collect feedback of construction experts, as shown in Figure 1. Also, this paper serves as a reference for contractors and construction managers for more effective management in construction projects to achieve a competitive level of cost-controlled effective project using Activity Based Costing (ABC). This paper aims to

identify the main problems for lack of cost control techniques which cause poor management with poor site organization and inadequate supervision and prove with demonstration the modified system Activity-Based Costing as the best choice for cost accounting approach for determining construction project accurate cost.

3 Experimental Program

Earned Value Management referred to cost with schedule control criteria.[8], described the 10 Fundamental principles of Earned Value Management as: 1) Define project scope, 2) Define required resources, 3) Plan and schedule, 4) Determine metrics required, 5) Estimate required resources, 6) Record direct cost, 7) Project performance baseline, 8) Managing remaining works, 9) Forecast final cost/schedule results and 10) Manage project changes. This approach reflects the true status and scope of evolving effort.

3.1 Budgeted Cost of Works Scheduled (BCWS)

[21] Defined the Budgeted Cost of Works Scheduled (BCWS) as analysis baseline and is cumulated planned costs related to occurrence time. It is also called (PV) and is calculated as scheduled quantities (Qs) product summation and estimated the cost (Cs) for assigned resources in certain data date as follows:

$$\mathrm{BCWS} = \mathrm{PV} = \mathrm{SUM}\,(\mathrm{Qs} \times \mathrm{Cs}) \tag{1}$$

The Qs is calculated as the product of the scheduled % complete for activity and budget quantity for the assigned resources for this activity.

3.2 Actual Cost of Work Performed (ACWP)

[21] Defined Actual Cost of Work Performed (ACWP) as a cumulated amount payable for works done relate to time. It is also called (AC) and is calculated as actual quantities (QA) summation and actual cost (CA) for assigned resources in certain data date as follows:

$$\mathrm{ACWP} = \mathrm{AC} = \mathrm{SUM}\,(\mathrm{QA} \times \mathrm{CA}) \tag{2}$$

3.3 Budgeted Cost of Work Performed (BCWP)

[21] Defined Budgeted Cost of Work Performed (BCWP) as the works progress physical measure and cumulated works planned cost that related to time. It is also called (EV) and is calculated as actual quantities (QA) product summation and estimated cost (Cs) for assigned resources in certain data date as follows:

$$\mathrm{BCWP} = \mathrm{EV} = \mathrm{SUM}\,(\mathrm{QA} \times \mathrm{CS}) \tag{3}$$

Note: actually, earned value management uses these data and were computed each time unit. Using "data date" is to refer to a certain date that three values were analyzed. Figure 2 shows the description of (EVM) basic elements.

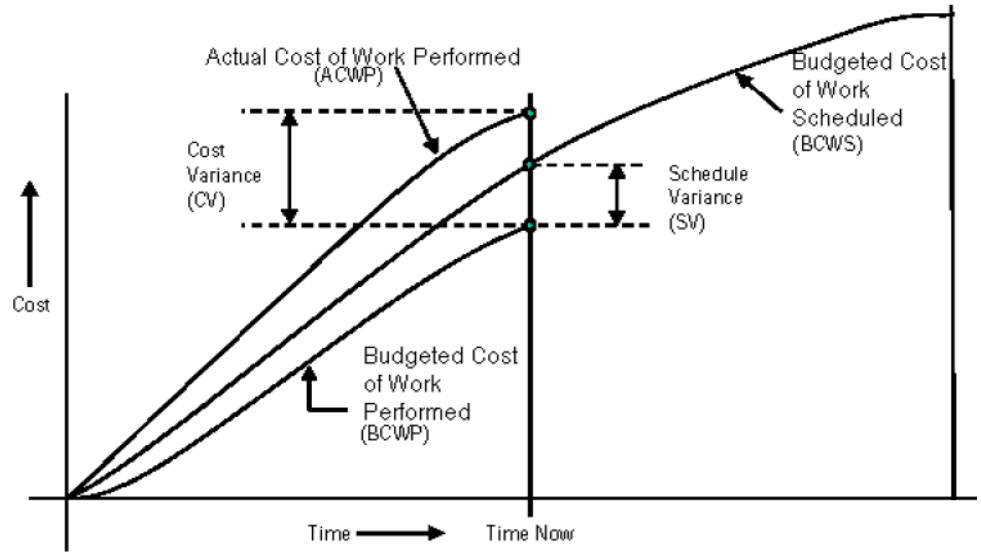

Figure 2 Description of (EVM) Basic Elements.

4 Earned Value Measurement Variances and Indices

Schedule Variance (SV)

Schedule Variance is defined as the difference between work performed values with work scheduled values. It determines time progress of a project such as behind or ahead schedule. It was calculated by using simple subtracting Project Planned Value (PV) from Project Earned Value (EV):

$$SV = EV - PV \quad (4)$$

The negative sign gives unfavorable condition indications that give behind schedule, and the positive sign gives favorable condition indications that give ahead schedule.

4.1 Schedule Performance Index

Schedule Performance Index (SPI) is work performed values against work scheduled values were used for measuring schedule efficiency. Schedule Performance Index (SPI) gives the project team efficiently, which is using its time. It was calculated by a simple formula for dividing Earned Value (EV) by Planned Value (PV):

$$SV = EV/PV \quad (5)$$

4.2 Cost Variance (CV)

Cost Variance (CV) is defined as the difference between Actual Cost (AC) Earned Value (EV). It determines time progress of a project such as under or over cost:

$$CV = EV - AC \quad (6)$$

Negative signs give unfavorable condition indications that give over cost and positive sign give favorable condition indications that give under cost.

4.3 Cost Performance Index (CPI)

Cost Performance Index (CPI) is the clearest indicators one for project cumulative cost efficiency. It is determined by simple dividing Earned Value (EV) by Actual Cost (AC) as shown in equation 6 according to any studied project:

$$CPI = EV/AC \quad (7)$$

5 Earned Value Measurement Forecasting Estimate To Complete (ETC)

[22] Defined Estimate to Complete (ETC) for any studied project as estimated future costs to complete remaining work. It shows that all remaining work will be developed by managers and workers according

to project remaining work analysis and was calculated as shown in equation 8:

$$\mathrm{ETC} = \mathrm{BAC} - \mathrm{EV} \tag{8}$$

5.1 Estimate At Completion (EAC)

[23] Mentioned that the methods of calculation of the estimated at completion with the different assumption is as the following assumptions:

Assumption 1: past e cost performance as future cost performance.

$$\mathrm{EAC} = \mathrm{BAC}/\mathrm{CPI} \tag{9}$$

Assumption 2: assume the future cost performance worse than any past cost performance.

$$\mathrm{EAC} = \mathrm{BAC}/(\mathrm{SPI} * \mathrm{CPI}) \tag{10}$$

Assumption 3: variances will be not expected to occur in future and are typical.

$$\mathrm{EAC} = \mathrm{AC} + \mathrm{ETC} \tag{11}$$

Assumption 4: assume variances will be presented and used when currents variances will be continued to be present in the future.

$$\mathrm{EAC} = \mathrm{AC} + (\mathrm{ETC}/\mathrm{CPI}) \tag{12}$$

Assumption 5: assume future cost performance will influence by past schedule performance.

$$\mathrm{EAC} = \mathrm{AC} + [\mathrm{ETC}/(\mathrm{SPI} * \mathrm{CPI})] \tag{13}$$

Assumption 6: assume future cost performance will influence by both indices.

$$\mathrm{EAC} = \mathrm{AC} + [\mathrm{ETC}/(0.2 * \mathrm{SPI} + 0.8 * \mathrm{CPI})] \tag{14}$$

5.2 Time Estimate At Completion (TEAC)

According to [22], time estimate at completion defined as expected project duration for completing project work. It is calculated as project duration over schedule performance index as shown in equation 15:

$$\mathrm{TEAC} = \mathrm{T}/\mathrm{SPI} \qquad (15)$$

5.3 Cost Performance Index (CPI)

[22] Defined it as the difference between originally expected project cost versus actual expected project cost. Manager can compute (VAC), and then can know the project finish over or under budget by subtracting (EAC) from (BAC) as shown in equation 16:

$$\mathrm{VAC} = \mathrm{BAC} - \mathrm{EAC} \qquad (16)$$

5.4 Cost Performance Index (CPI)

To Complete Performance Index (TCPI):

To Complete Performance Index (TCPI) helps to determine efficiency which should achieved on project remaining work such as Budget at Completion (BAC) or Estimate at Completion (EAC). It is calculated by simple dividing of work remaining by budget remaining as shown in equation 17, [24]:

$$\mathrm{TCPI} = (\mathrm{BAC} - \mathrm{EV}) \,/\, (\mathrm{BAC} - \mathrm{AC}) \qquad (17)$$

6 Alternative Methods for Cost Control

More cost control methods had been used for different companies in past. There are new three methods for cost, [25]: 1) Activity based cost method; 2) Target cost method and 3) Value engineering technique. A simple comparison between traditional method with all these modern methods as shown in the following table (1), [26].

Table 1. Cost control Comparison between modern and traditional methods

Modern Method	Traditional Method
Controlling cost to decrease the loss of all activities costs by using simple indicators for achieving cost reduction and increasing the standards importance such as: customer satisfaction, quality, and Space available.	Controlling cost to decrease loss of all activity's costs using indicators for achieving cost reduction only.
Application method for time in construction project.	Saving correct financial period
Application of Activity based costing is meticulous and deep going. Cost information is more accurate. Cost control is the best helpful way to improve beginning of management. It is a good way to establish cost forecasting. It is a good way to adapt future market development.	Cost elements compilation according to production stages or production orders.
Controlling cost from beginning the design stage.	Controlling cost after construction stage.
Minimize standard cost to be accessible for construction.	Corrective actions to be ensure for future results in estimated results.

7 Target Cost (TC)

It is constraining design practice and capital facility construction to maximum cost level. Much research had defined it as client's practice by financial constraints is considered successful. It is the management approach for delivering the design to customer values within project limitations, [27].

8 Value Engineering (VE)

The meaning of value engineering is a trade-off between quality and cost for achieving same function. Value Engineering is minimum and maximum approach to improve and analysis project value within same performance by process of continuous improvement. Also, it is an oriented function that used to analyze for improving construction project value. Value engineering main objective is to maximize project

value using same resources and minimizing unnecessary costs to balance between target project quality, performance, and safety, [27].

9 Activity Based Costing (ABC)

It is an analytical approach to get best identifies project costs per situation easily. [28] Considered steps for developing ABC System and assigning resources costs associated with unit cost of project activities as a significant technique to measure all outputs. Implementing steps: 1) Identify inputs and activities, 2) Assign all resources costs, 3) Identify outputs and 4) Assign activity outputs for costs.

10 Questionnaire Structure

A simplified questionnaire was carried out to gather information from construction field experts. It was gotten experienced respondents' opinions and understanding the type of project cost control as shown in the sample of the questionnaire. It was administrated and designed for leading construction sectors [29]. It was used to investigate and rank the impacting causes on construction projects which it faces contractors for controlling project costs on the construction field. Based on the literature survey and questionnaire, the problem statement and analysis were formulated. It is classified into two main groups as follows: 1) identify main factors affecting cost control performance to reduce its negative impacts. 2) Examine respondent's awareness of cost control ways related to Mega construction projects.

11 Data Analysis and Documentation

The total number of contracting companies in Egypt who have valid membership under the available seven grades for the category of integrated building works is 19,975, as of March 1, 2019. For this research, the targeted contractors are those who represent the top four grades. The first grade comprises 232 firms, the second grade comprises 157 firms, the third grade comprises 213 firms, and the fourth grade comprises 681 firms, with a total of 1,283 firms. A systematic random sample was selected to ensure a representative sample of all targeted contractors by [30] formula; it was found the

sample size of the limited population must less than 300 questionnaires. Then it was collected 322 questionnaires from experts for different categories and experiences, with the rate of response is equal to 88% from all total questionnaires to satisfy the sample size. Likert scale was used in this study analysis. All of them were analyzed using the relative Importance Indices technique (RII) as a simplified and accurate approach by [31] as shown in equation no. 18:

$$\mathrm{RII} = \sum \mathrm{W} / \mathrm{A} \times \mathrm{N} \tag{18}$$

Where W is each factor given weight, which ranged from 1 to 5; score 5 is the highest weight; N is respondent's total number. Table: 2 illustrate the result for top significant factors affecting construction projects performance. It was noticed those three most important factors according to consultant and contractor perception: 1) Average delay by materials shortage, 2) Resource's unavailability and 3) Project manager leadership skills, [32].

50% of respondents were had an awareness of cost control, and 36.5% of respondents were had scarcely awareness. 68% of respondents have experience more than 15 years, and 18% of respondents have years of experience above ten years. 13% of respondents are having experience between 5-10 years. Survey results analyses were identified the top construction project control causes and was investigated by using more experienced interviewing for bid stakeholders. This leads to mitigate these factors. The top twenty causes were selected as shown in Table 2 to show their importance for cost control. All measures that are used for defending affecting main causes factors also to control process for spotting potential problems and are utilized to mitigate project control causes effect by acting as a remedy. Organizational measures are practices wider use for the actual control process and influenced project control. The developed good practice it was developed from main three stages research process including: 1) Literature review for related topic; 2) Questionnaire survey and collecting data and 3) Interviews with construction field experts.

Table 2. Top significant factors affecting cost control and reduction for mega construction projects.

Sort	RII	Ranked main Causes
01	99.7	Change order
02	99.3	Design Changes
03	99.0	Design Errors
04	98.0	Deterioration of economic situation
05	97.0	Delay project
06	95.0	Materials Rising prices
07	90.2	Lowest bidding procurement method
08	88.6	Additional work
09	74.1	Bureaucracy in bidding/tendering method
10	68.5	Wrong method of cost estimation
11	67.6	Funding problems
12	64.8	Inaccurate cost estimation
13	58.3	Mode of financing and payment for completed work
14	56.8	Unexpected project conditions
15	56.5	Inflation
16	54.6	Prices fluctuation for raw materials
17	54.0	Inadequate planning
18	53.7	Poor contract management
19	51.9	Unstable cost of manufactured materials
20	49.9	Inadequate pre-contract study

12 Activity Based Costing using a Case Study

Faculty of Dentistry, Kafr El-Shiekh University is intended to construct new two buildings, which consists of five different floors in area 3,000 m^2 and completion date is 15/02/2018, as show in Figure 3.
Process based upon costing method assumes all related resources were assigned to significant activities to decrease wastes on activities. Traditional allocation method resources were assigned directly to pieces for projects / products, as shown in Figure 4.
Current practice characteristics for controlling cost such as overheads as follows: 1) more important than before, 2) overhead costs management, 3) nonproduction part for costs and 4) not enough attention. Costs directly were assigned to provide accurate allocation to employees cost resources. Overhead costs for any project were not allocated or distributed to different cost type. Office overhead costs were allocated to objects of projects such as work divisions or projects

to get more accurate information hardly in profit relationships between contractors and clients. Overhead reports on costs include information for each resource can be gotten by interviews with related engineers, contractors, and clients. Table 3 shows all details for two deferent projects with detailed cost elements to find final total cost.

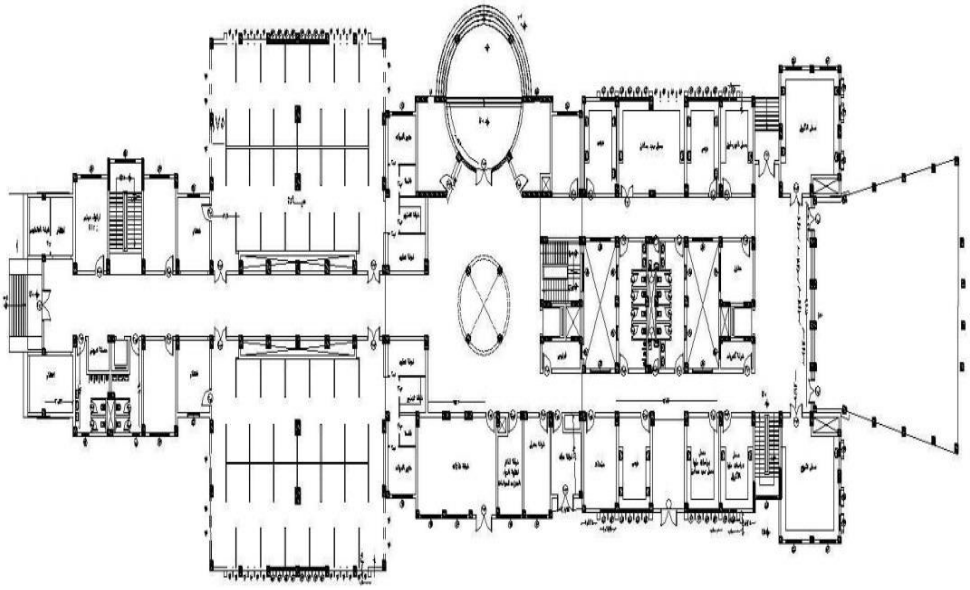

Figure 3-a: Project Plan of building (1).

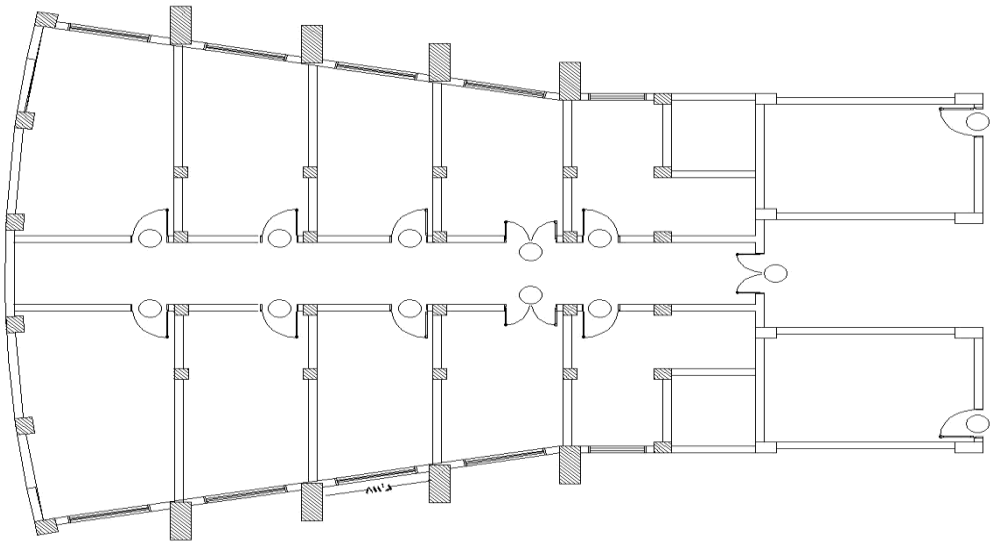

Figure 3-b: Project Plan of building (2).

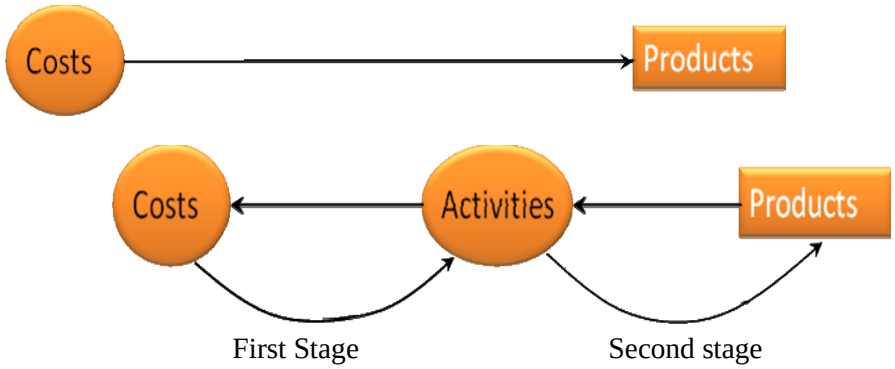

Figure 4. Activity-based allocation method.

Table 3. All cost details for Buildings 1 and 2 based on contractor study.

Direct cost	Building No. 1	Building No. 2	Total EGP
01 Materials cost	15,107,564	378,7549	18,895,113
02 Equipment cost	543,574	50,859	594,433
03 Manpower cost	4,218,910	517,282	4,736,191
04 Subcontractor cost	6,550,899	785,822	7,336,721
Sum of direct cost	**31,562,458**		
Taxes	4,227,352	822,642	5,049,994
Indirect cost	2,795,316	1,023,272	3,818,588
First + second	36,612,452	--	--
Indirect cost	3,818,588	--	--
Final total cost	**42,760,464 EGP**		

Analyze with define the resources and activities, and then decompose the organization into elemental tasks. Determine inputs resources and outputs, all activities consuming overhead by their resources and were grouped into 12 branches. The company looking for accuracy highest level from its costing accounting system to use a maximum activities number. Table 4 shows all details for two deferent projects with detailed overhead cost elements to find final indirect cost.

Table 5 develops the overhead cost that can be used to calculate all costs as shown in table 6. Establish and determine activity costs for first stage and was re-categorized according to their occurred. Determine second stage for labors then assign them. Total amount was assigned to activity by rate per activity unit.

Table 4. Categories of Overhead Expenses.

Categories of Overhead Expenses	Value (EGP)
Housing for Staff.	143,400
Quality Control.	12,000
Engineering Services.	20,000
General Site Equipment.	20,000
Mobilization & Demobilization.	20,000
Clinic Supplies.	22,300
Safety Requirements.	46,140
Site Installations	126,340
Miscellaneous Expenses.	57,300
Telephone & Communication.	19,000
Office Supplies.	28,800
Office & Surveying Equipment.	69,390
Personnel Transport.	358,368
Local Personnel (Excluding Housing).	2,875,550
Total indirect amount	**3,818,588**

Table 5. Activities Descriptions with cost details for two projects cases, based on ABC.

Activity Description	Units	Quantity		Total Quantity	Labor cost		Total Cost EGP
		Building 1	Building 2		Building 1	Building 2	
Excavation & Backfilling	M^3	16,500	2,800	19,300	0	0	0
Replacement	M^3	5,200	321	5,521	0	10,000	10,000
Concrete works	M^3	25,042	1,863	26,905	1,634,103	197,921	1,832,025
Frames works	M^3	0	244	244	0	79,097	79,097
Finishing works	M^2	49,340	7,120	56,460	1,474,317	119,257	1,593,574
Opining works	M^2	9,168	70	9,238	0	0	0
Tiles works	M^2	9,168	600	11,300	937,714	14,576	952,291
Wood cladding	M^2	10,700	4,248	8,127	105,193	57,251	162,444
Gypsum board works	M^2	3,879	800	7,500	7,546	185	7,731
Insulation	M^2	15,300	5,550	20,850	47,039	35,997	83,036
Water supplies	No.	207	150	357	110,640	80,174	190,814
Elec. Works	No.	15,210	9,132	24,342	25,037	19,997	45,034

Table 6. Indirect Costs for First Stage Labor Cost, based on ABC.

Activity Description	Labor cost	Causative work	Causative Cost		Total Cost	Loading Rate	Labor cost	
			Building 1	Building 2			Building 1	Building 2
Excavation & Backfilling	0	Soil works	16,500	2,800	19,300	0	0	0
Replacement	7,705	Replacement	5,200	321	5,521	1	7,257	448
Concrete works	1,411,558	Concrete works	25,042	1,863	26,905	52	1,313,817	97,741
Frames works	60,944	Frames	0	244	244	250	0	60,944
Finishing works	1,227,835	Finishing	49,340	7,120	56,460	22	1,072,996	154,839
Opining works	0	Doors and windows	9,168	70	9,238	0	0	0
Tiles works	733,731	Tiles	10,700	600	11,300	65	694,772	38,959
Wood cladding	125,161	cladding	3,879	4,248	8,127	15	59,739	65,422
Gypsum board works	5,956	Ceilings	6,700	800	7,500	1	5,321	635
Insulation	63,979	Isolate works	15,300	5,550	20,850	3	4,6948	17,030
Water supplies	147,020	Drainage	207	150	357	412	85,247	61,773
Elec. Works	34,698	Elec.	15,210	9,132	24,342	1,425	21,681	13,017

A final comparison between all costs for building number 1 and building number 2 under traditional costing system and activity costing method are shown in table 7.

Table 7. Comparison between building 1 and building 2 based on Traditional Cost and ABC Systems.

Type	Building 1			Building 2		
	Traditional Cost	ABC	Variance	Traditional Cost	ABC	Variance
Total cost	31,301,882	31,822,046	-520,164	11,458,582	10,938,419	520,164

13 Conclusions

Paper main objective is to improve with create construction projects performance by using the application of project management systems as contractor perspective. This objective is achieved by proposing a construction cost control framework to identify major guidelines to apply the activity-based costing system in the construction sector according to the proposed framework. It was developed based upon three steps: 1) Literature survey related to this topic, 2) Questionnaires in different construction projects, and 3) Modern cost control system. It was developed simplified calculations by Excel sheet to focus on the main effect of activity-based costing method upon costing control of the project. It was concluded that: 1) Framework results were showed all cost control thinking aspects that can be widely implemented for mega construction projects. 2) Collected data from questionnaires were analyzed then were sorted by using relative Importance Indices technique (RII) to get the top significant factors that are related to construction projects affecting cost control and reduction. 3) Application of activity-based costing system is a useful way in real Egyptian construction projects as declared in a case study to focus upon the overhead activities cost impact. Therefore, cost control techniques can be applied in the construction industry to control the costing of construction processes and to reduce overall process duration by improving management way to increase stakeholder's awareness about this approach.

References

1. Kenley, R. (2014). Productivity improvement in the construction process. Construction Management and Economics, 32(6), 489-494. https://doi.org/10.1080/01446193.2014.930500
2. Bent Flyvbjerg (2014). " What You Should Know About Megaprojects and Why: An Overview", Project Management Journal, Vol. 45, No. 2, 6 – 19.
3. Beaudet B.; Tobey B. and Harder S. (2019). "Life Cycle Cost Analysis for Decision Making in Collection System Rehabilitation". Pipelines 2019: Condition Assessment, Construction and Rehabilitation, pp. 187 – 197.
4. Dixit, S, Mandal, S. N., Thanikal, J. V, & Saurabh, K. (2019a). Evolution of studies in construction productivity: A systematic literature review (2006-2017). Ain Shams Engineering Journal. https://doi.org/10.1016/j.asej.2018.10.010

5. Reza S. and Arditi D. (2018) "Optimizing Financing Cost in Construction Projects with Fixed Project Duration" Journal of Construction Engineering and Management , Volume 144- Issue 4.
6. Adrian, J. (1987). “Construction Productivity Improvement”. Elsevier Science Publishing, Amsterdam, Netherlands.
7. Shah, M. N., Dixit, S., Kumar, R., Jain, R., & Anand, K. (2019). Causes of delays in slum reconstruction projects in India. International Journal of Construction Management, 1-16. https://doi.org/10.1080/15623599.2018.1560546
8. Abbas, M. (2012). "Improving Measurement of Project Performance in Earned Value Management" thesis submitted to the Civil Engineering Department, Alexandria University, in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering.
9. Abdel-Razek, R. (2007). “Labor productivity: Benchmarking and variability in Egyptian projects. International Journal of Project Management 25,189–197.
10. Dixit, Saurav, Mandal, S. N., Thanikal, J. V, & Saurabh, K. (2019b). Study of Significant Factors Affecting Construction Productivity Using Relative Importance Index in Indian Construction Industry. 09010.
11. Baccarini, D. (1996). “The concept of project complexity-a review”. International Journal of Project Management Vol. 14, No. 4, pp. 201-204.
12. Fayek, A. (2001) "Activity-Based Job Costing for Integrating Estimating, Scheduling, and Cost Control, Cost Engineering, Morgantown, Vol. 43, No. 8.
13. Wang Q.; Mei T.; Kong L.; and Xiao Y. (2019), "Incentive Compensation Structure for Cost Control of Construction Project Based on IPD-Ish in China", International Conference on Construction and Real Estate Management, ICCREM 2019. Innovative Construction Project Management and Construction Industrialization, pp.101-108.
14. Adjei K.; Aigbavboa C. and Thwala W. (2017). "Corrective Measures for Construction Project Cost Control ". International Conference on Construction and Real Estate Management, ICCREM 2017: Project Management and Construction Technology, pp. 31 - 37.
15. Dixit, Saurav, Sharma, K., & Singh, S. (2020). Identifying and Analysing Key Factors Associated with Risks in Construction Projects. In K. G. Babu, H. S. Rao, & Y. Amarnath (Eds.), Emerging Trends in Civil Engineering (pp. 25-32). Singapore: Springer Singapore.
16. Buiten M. and Hartmann A. (2015). "Asset Management Perspective on the Duration of Public-Private Partnership Contracts: Cost-Control Trade-off" Journal of Construction Engineering and Management, Volume 141, Issue 3.
17. Aziz R. and Aboelmagd Y. (2019). "Integration between different construction bidding models to improve profitability and reduce prices". Alexandria Engineering Journal, Vol. 58, pp. 151–162.
18. Asmar M., Ramsey D., Gibson E. and Bearup W. (2020), "Design-Build for Transportation Projects: Cost and Schedule Change Performance Analysis", Journal of Legal Affairs and Dispute Resolution in Engineering and Construction. Volume 12 -Issue 1.

19. Elmousalami H. (2020). "Artificial Intelligence and Parametric Construction Cost Estimate Modeling: State-of-the-Art Review", Journal of Construction Engineering and Management , Volume 146-Issue 1.
20. Muhwezi, L., Acai, J., & Otim, G. (2014). An assessment of the factors causing delays on building construction projects in Uganda. Construction Engineering and Management, 3(1), 13-23. https://doi.org/10.5923/j.ijcem.20140301.02
21. Burke R., (2006)," Project Management. Planning and Control Techniques", John Wiley & Sons.
22. PMI. (2017). A Guide to the Project Management Body of Knowledge (PMBOK® Guide) - Sixth Edition. PMI.
23. Liu, L. and Zhu, K. (2007). "Improving cost estimates of construction projects using phased cost factors", Journal of Construction Engineering and Management, Vol.133, No. 1, pp.91-95.
24. Shaban M., (2013), "Methods Of Cost Control" thesis submitted to the Civil Engineering Department, Alexandria University, in partial fulfillment of the requirements for the degree of Master of Engineering in Civil Engineering .
25. Guo-li, Y (2010),"Project Time and Budget Monitor and Control", Management Science and Engineering" Vol.4, No.1, PP.56-61.
26. Liang, K. (2005), "Cost Control in Construction Project of the Site" report submitted in partial fulfillment of the requirements for the award of the degree of Bachelor of civil Engineering (Construction Management) – University Technology Malaysia.
27. El-Deeb A.,(2006),"Cost Control during construction phases" thesis submitted to the Architectural Engineering Department, Alexandria University, in partial fulfillment of the requirements for the degree of Master of Science in Architectural Engineering.
28. Lyer, K. and Jha, N. (2005). "Factors affecting cost performance: evidence from Indian construction projects", International Journal of Project Management, Publisher Elsevier UK. Vol.24, No. 4, pp. 283–295.
29. Olawale, Y. and Sun, M. (2010). "Cost and Time Control of Construction Projects: Inhibiting Factors and Mitigating Measures in Practice". Construction Management and Economics, 28 (5), 509 – 526.
30. Hogg, R. V., and Tanis, E. A. (2009). Probability and statistical inference, 8th Ed., Prentice Hall, NJ.
31. Jarkas, A. M., Kadri, C. Y., & Younes, J. H. (2012). A survey of factors influencing the productivity of construction operatives in the state of Qatar. International Journal of Construction Management, 12(3), 1-23. https://doi.org/10.1080/15623599.2012.10773192.
32. Rasdorf J. and Abudayyh O. (1991), "Cost and Schedule- Control Integration Issues and Needs", Journal of the Construction Engineering and Management, ASCE, Vol. 117, No3. Page 486-502.

تقييمات العوائق التي تحول دون تنفيذ أساليب التحكم في التكلفة والتقنيات المثلى لخفض التكلفة في مشاريع البناء: دراسة حالة لمصر

الملخص

إدارة القيمة المكتسبة هي تقنية رائدة في مراقبة وتحليل أداء المشروع وتقدم المشروع. الأهداف الرئيسية لهذه الورقة هي: ١) تحديد وترتيب أولويات المشاكل الرئيسية لنقص التقنيات التي تتسبب في سوء إدارة التحكم في التكاليف مع سوء تنظيم الموقع وعدم كفاية الإشراف. ٢) إظهار نظام التكلفة المستندة إلى النشاط المعدل باعتباره أفضل الخيارات لنهج محاسبة التكاليف لتحديد التكلفة الدقيقة لمشروع البناء. لسد فجوة الأبحاث المحدودة لدراسة العوامل التي تعوق قدرة المقاولين على التحكم الفعال في مشاريعهم، تم إجراء مسح على ٢٢ مؤسسة مشاريع بناء. لوحظ أن معظم مديري المشاريع والمقاولين في مصر يجدون صعوبة في التحكم في تكاليف المشروع بسبب المشاكل التي تشمل أمر التغيير والتغييرات في التصميم وأخطاء التصميم وتدهور الوضع الاقتصادي الحالي وتأخير المشروع وارتفاع أسعار المواد. لتحسين جدول تكلفة المشروع الرأسمالي والقدرة على التنبؤ باستخدام نظام التحكم في المشروع لرصد نتائج مشروع البناء والتنبؤ بها. يجب أن يعتمد النطاق التفصيلي لأنظمة التحكم على استراتيجية التعقيد والحجم والحساسية للمشروع المدروس. يجب أن تشمل أنظمة التحكم لكل مشروع ما يلي: ١) عملية إدارة التكلفة ٢) التخطيط والجدولة عملية الإدارة ٣) إدارة التغيير. أخيرًا، ستعرض الدراسة تطبيق نهج التكلفة المستندة إلى النشاط المعدل والذي يؤدي إلى الحصول على سعر أفضل للمناقصات وتحديث بيانات تكاليف الأصناف لتوفير المعلومات الضرورية لمقدمي العطاءات. يتحكم هذا النظام في جميع الأنشطة لاتخاذ القرارات الصحيحة. أوصت هذه الدراسة بضرورة تغيير نظام تقدير التكاليف التقليدي والتركيز على أكثر مقدمي العطاءات بدقة عالية.