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Reliability of Cost Data for Detailed Construction Cost Estimating in Egypt

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Abstract

Cost estimation of construction projects is the basis for project life cycle cost management. The accuracy of project cost estimates depends on many factors, such as: Labor and equipment prices and availability of production rates, availability of material prices, accuracy of bid documents provided by project's owner, and market conditions. The price of construction materials accounts for a large proportion of the total project cost. Therefore, the availability of material prices is one of the most important factors affecting the accuracy of project cost estimates. When estimating costs at the bidding stage, a variety of material price sources can be used, such as: Catalogs from suppliers and manufacturers, surveys, historical data, price lists, and price bulletins from government or private organizations. This paper evaluates the availability of cost data in Egypt for detailed construction cost estimates and the reliability of the available data. The paper highlighted that there are two formal references for construction material price bulletins in Egypt (CAPMAS Central Agency for Public Mobilization and Statistics, and MHUC Ministry of Housing, Utilities & Urban Communities) which are issued on a monthly basis. The evaluation of the data availability and reliability in the formal bulletins were conducted using a real contractor's tendering estimate documents as case study by comparing to the cost estimates based on these bulletins. The results show that the available material prices provided by MHUC represents about 78% of total material cost in the case study, while the CAPMAS available data represents only about 45%. This study also highlighted the high level of accuracy of both bulletins' material prices compared with actual market prices in terms of civil and architecture materials and low accuracy for electro-mechanical materials.

KEYWORDS: Bulletins in Egypt, Cost Management, Cost Overrun, Cost Estimate, and Cost Data.

1. INTRODUCTION

Unexpected factors rising from uncertainty sources, such as construction stakeholders' performance, financial difficulties, management challenges, resource unavailability, and external circumstances, have a significant impact on the construction projects. As a consequence, poor performance in terms of project delay and cost overruns may arise [1].

Poor cost performance is a common problem for most construction projects worldwide, leading to significant cost overruns [2]. Cost overruns are a common problem with construction projects that are rarely completed within the original budget. Cost overruns can be caused by a variety of factors, including poor planning, inaccurate cost estimates, rising resource costs (people, materials, and equipment), rework, wasted materials, and poor productivity.

According to [3], [4], [5], [6], etc., inaccurate cost estimates are one of the main reasons for cost overruns. Contractors must avoid bidding too low or too high; otherwise, the offer will not be awarded. Estimates should be high enough to make a profit, not low enough to secure jobs. The accuracy and reliability of cost information/availability of labor and material prices is one of the main factors affecting the accuracy of cost estimates [7], [8], [9], [10], [11], [12].

Hence, the purpose of this research is to investigate the accuracy and reliability of CAPMAS and MHUC bulletins as official references for material pricing in order to provide an accurate cost estimate for Egyptian construction projects. There are no published studies in Egypt that tested or assessed the accuracy of official bulletins like CAPMAS and MHUC as a source of cost data for accurate project detailed cost estimates during the tendering stage.

2. LITERATURE REVIEW

Cost management is the process by which the costs and expenditures that are formally spent on the project are determined, approved and paid [13]. Estimation, monitoring, and control are the cost management process, which is required for completing construction projects within budget and with minimal cost overruns.

Cost overruns in construction projects account for around 90% of the total project budget [14]. Several studies have been conducted to investigate the reasons of cost overruns in building projects. Toh et al. [15], for example, determined that cost overruns were an issue in 89 percent of Malaysian residential building projects. Other studies on infrastructure projects in Europe, North America, and Asia have been done, including roads, trains, airports, and seaports. They concluded that 28 to 100 percent of the projects analyzed had cost overruns up to 183 percent of the initial cost estimate [14], [16], [17], [18], [19]. Many prior studies showed inaccurate cost estimate as one of the major reasons of cost overruns [20],[21].

The cost estimating process is the foundation and most crucial phase in the cost management life cycle [22]. The project cost includes both direct and indirect expenditures. Direct expenses include supplies, labor, and equipment, and indirect costs include any additional expenditures associated with the project. Indirect costs include company taxes, home office expenses, and so forth. The final price includes both estimated expenditures as well as contingency and profitability.

Cost estimation applies techniques and techniques to estimate any possible cost, scale, or characteristics based on the information available at that time[23]. The most important factors influencing the accuracy of construction estimating in the detailed estimate process are the quality and reliability of cost information about materials and labor costs[24], [9], [25], [11], [26].

Inaccurate construction cost estimates may be prevented by employing accurate data, which is a critical input for construction projects and reduces the risk of opportunity loss and unanticipated costs [27]. Hatamleh and Hiyassat [25]listed the accuracy and availability of cost information, as well as the availability of bids' databases on comparable projects, as two of the top ten criteria influencing the accuracy of cost estimates.

Cost data collecting is often one of the most difficult, expensive, and time-consuming aspects of cost estimating operations. Data for cost estimates are often gathered from a variety of sources, including published price books, cost information publishing services, and trade publications [28]. Commercial cost reference estimates of real project costs, bulletins of building material prices, vendor data catalogues, and periodicals are also issued. Another major source of data that may be obtained from prior projects' real cost data is the historical database.

Bulletins of construction material prices: many organizations issued construction material prices, such as the Abu Dhabi Static Centre’s bulletin of building material prices and the Indonesian government's standard price of goods and services (SHBJ) as a cost reference.

In Egypt, there are two official building material pricing bulletins: one released by the Central Agency for Public Mobilization and Statistics (CAPMAS) and another by the Ministry of Housing, Utilities, and Urban Communities (MHUC).

When historical data is gathered, sorted, and standardized for diverse places and periods to be utilized for future projections, it may be very efficient. However, for precise cost estimate for present and future building projects, this technique involves data standardization, processing, storage, effort, and expense.

Cost information from various sources does not have the same reputation for accuracy and reliability and should be utilized with caution for new estimations. Data verification and validation should be performed to ensure the consistency and correctness of the data being utilized. Some of these sources were evaluated in order to compare cost estimate findings from various sources with actual estimates. For example, Diaz et al. [29]

assessed the usefulness and limits of RSMeans, a commercial cost reference published by Gordian, in thorough cost estimate for residential construction case studies. According to the findings, the cost estimate based on RSMeans was 206 % higher than the actual project cost. Ghuzdewan and Narindri [30] investigated the availability and reliability of the Indonesian government's Standard Price of Goods and Services (SHBJ or Standard Harga Barang dan Jasa). In a case study from Yogyakarta, they utilized a contractor's bidding sheets and the SHBJ bulletin. The analysis showed that the SHBJ cost estimate was 13% more than the contractor estimate.

This research intends to assess the accuracy of comprehensive cost estimates based on two separate official bulletins in Egypt and compare the results with contractor cost estimates to investigate the accuracy and reliability of such official bulletins for a detailed cost estimate in Egypt..

3. RESEARCH METHODOLOGY

This study proposes a simple technique for assessing the availability and accuracy of cost data introduced by the two official Egyptian bulletins, CAPMAS and MHUC for comprehensive cost estimates. The framework, as shown in Figure 1, covers the primary procedures for verifying the detailed cost estimate based on the two official bulletins and comparing their findings to cost estimating based on the contractor database.

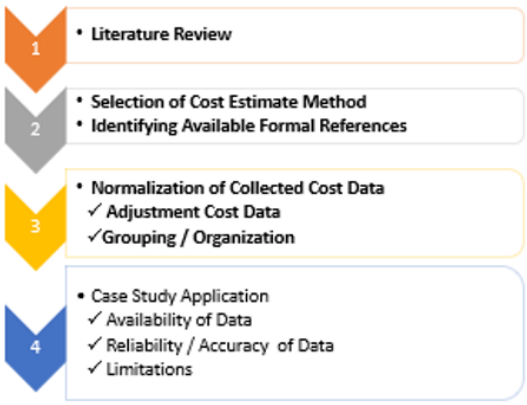

Fig 1: Research Framework

The research approach consists of four steps as shown in Figure 1, which are as follows: - The first step was a survey of the literature on cost estimation methodologies and cost data references in Egypt. Based on a review of the existing official bulletins, CAPMAS and MHUC were found and chosen for this investigation.

The Housing and Utilities Sector, under the Ministry of Housing and Urban Communities' (MHUC) Central Administration for Needs and Building Materials, publishes a monthly bulletin of average building material costs. Based on current market values, the MHUC prices include taxes in addition to sales tax. This bulletin provides a pricing list for wires and cables, conduits, and pipes that does not include deduction rates. The bulletin is divided into seven major sections and 37 subcategories [31].

The second bulletin is the CAPMAS bulletin, which is released monthly by Central Agency for Public Mobilization and Statistics and contains average retail costs for the most significant construction materials to assist estimators and decision-makers in preparing cost estimates. The price in CAPMAS bulletin is the commodities selling price to the ultimate consumer by suppliers. In addition to sales tax, these prices include all other taxes. Prices are gathered monthly from all governorates in Egypt by professional delegates in CAPMAS offices situated in the major governorate cities. The CAPMAS bulletin only lists the pricing of the most significant construction materials in 14 categories, totaling 29 products only [32].

The second step was the normalization step, in which the data received from the two bulletin sources was normalized using the two processes outlined below:

- Price adjustment: The data is adjusted before it is used for comparison / analysis or as the basis for cost estimation of the project by adding other neglected charges (taxes, shipping, etc.). It has been.
- Categorization: Reorganize the data and prepare for the cost estimation process. The data was categorized based on the BOQ department and confirm that all items were fully loaded with material prices.

The third step included using the normalized data from real case studies to generate a final cost estimate based on a detailed cost breakdown for BOQ items.

Figure 2 depicts the process of evaluating the accuracy and availability of data taken from official bulletins (CAPMAS and MHUC) as well as the contractor database, which includes purchase orders and supplier offers/quotations. The review method also shows how the data was standardized and utilized to estimate costs.

The last step includes the final research findings and outputs:

- Cost data availability
- Final detailed Cost Estimate
- Accuracy of Available Data
- Limitation of Available Data

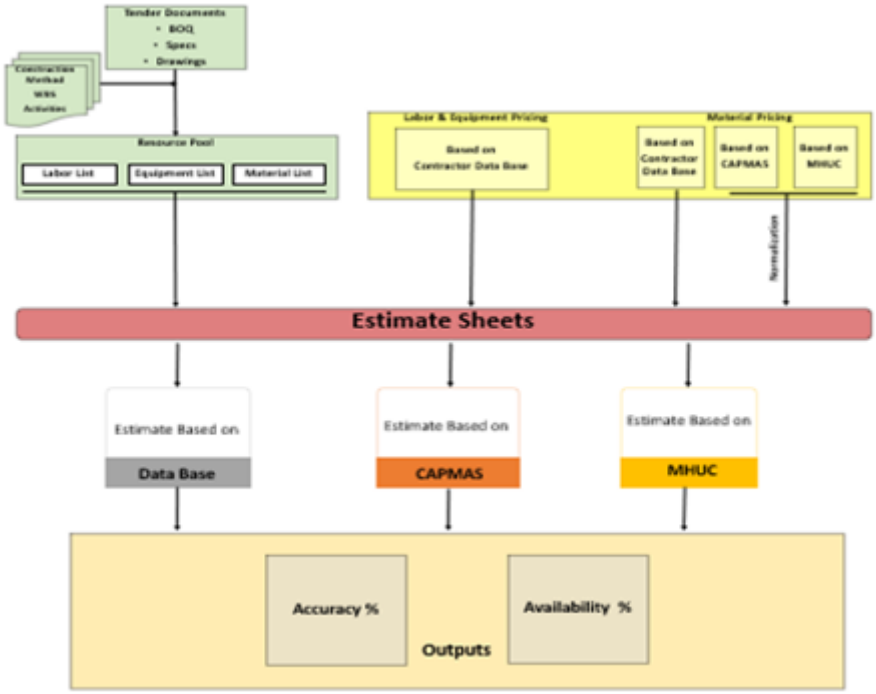

Fig 2: Process for Evaluating Data Availability and Accuracy

4. APPLICATION CASE STUDY

The research methodology used a real case study to assess the reliability and availability of the two official bulletins' material prices (CAPMAS and MHUC) in estimating the detailed cost of a residential building project.

4.1 Project Description

As a practical case study, in March 2022 a first-rate contractor was invited to submit his financial offer to execute a semi-finished residential building in Cairo. The contractor builds his detailed estimate to submit his offer based on his prices database which include the latest materials quotations from the suppliers, the actual prices from purchase orders in this time for the other in hand projects. The tender estimate sheets for this project are utilized to assess the accuracy/reliability and availability of cost data supplied by CAPMAS and MHUC bulletins for the March 2022 issues.

The detailed cost estimates procedure started by analyzing the tender document, the contractor's detailed estimate, the direct cost breakdown of materials, labor, and equipment, and then subtracting the bill of materials. The second stage was to extract and normalize the raw data from both bulletins. The raw data from the CAPMAS bulletin issued in March 2022 is shown in Figure (3), and the raw data from the MHUC March 2022 bulletin is shown in Figure (4). As previously stated, the normalization procedure was completed in two parts. The first step was to adjust the pricing. Tables 1 and 2 illustrate the raw data adjustments made by adding non-included costs (e.g., taxes, transportation, etc.). The final phase was the classification procedure, which included categorizing the updated data based on the project's BOQ divisions, as shown in Table 3

Average retail prices of the most important building materials
and monthly & annual change rates of
Republic Urban
March 2022
(Prices in L.E)

متوسط أسعار التجزئة لأهم مواد البناء
ونسب التغير الشهرية والسنوية
الحضر الجمهورية
مارس ٢٠٢٢
(الأسعار بالجنيه)

Commodity	Change rate for % نسبة التغير Mar/مارس 2021	Change rate for % نسبة التغير Feb/فبراير 2022	Mar/مارس 2021	Mar/مارس 2022	Feb/فبراير 2022	الوحدة Unit	السلعة
Iron							الحديد
Round Iron 16 mm	43.27	24.39	13354.68	19133.56	15381.34	Ton/ طن	حديد سيرو ١٦ مم
Round Iron 13 mm	43.27	24.39	13354.68	19133.56	15381.34	Ton/ طن	حديد سيرو ١٣ مم
Round Iron 10 mm	43.27	24.39	13354.68	19133.56	15381.34	Ton/ طن	حديد سيرو ١٠ مم
Cement							الأسمنت
Ordinary portland cement packed in a sack	64.41	35.33	45.99	75.61	55.87	50K.g/ كجم ٥٠	بورتلانده عادى معبأ فى شيكارة
White cement packed in a sack	4.47	3.65	122.50	127.98	123.47	50K.g/ كجم ٥٠	أبيض معبأ فى شيكارة

Fig 3: Partial Raw Data from CAPMAS (March 2022 Issue

أولاً: أسعار الخامات الأساسية خلال عام ٢٠٢٢

١- الحديد

١-١ أسعار حديد التسليح خلال ٢٠٢٢عام

النوع	الوحدة	يناير	فبراير	مارس	أبريل	مايو	يونيو	يوليو	أغسطس	سبتمبر	أكتوبر	نوفمبر	ديسمبر
صلب ٣٧ـ لفائف	طن	١٥٥٠٠	١٥١٠٠	١٩٠٠٠									
صلب ٥٢ـ اطوال		١٥٥٠٠	١٥١٠٠	١٩٠٠٠									

الأسعار للمستهلك لكميات أكثر من ٣٠ طن طبقاً لمتوسط أسعار الشركات المنتجة - شاملة الضرائب دون النولون

Fig 4: Partial Raw Data from MHUC (March 2022 Issue)

TABLE 1: Sample of Normalizing MHUC March. 2022 data (step 1 adjusting the prices)

Material	Unit	Price of raw data from MHUC	Vat Taxes	Transportation fees	Adjusted prices
Cement	Ton	1500	Included	included	1500
Steel reinforcement	Ton	19000	Included	190	19190
Ready Mix Concrete 250 kg/m2	M^3	960	134.4	9.6	1104
Plastic water pipes Diameter ½ inch	L.M	14.59	Included	0.14	16.05

TABLE 2: Sample of Normalizing CAPMAS March. 2022 data (step 1 adjusting the prices)

Material	Unit	Price of raw data from CAPMAS	Vat Taxes	Transportation fees	Adjusted prices
Cement	Ton	1512.2	Included	included	1512.2
Steel reinforcement	Ton	19133.56	Included	included	19133.56
Plastic water pipes Diameter ½ inch	L.M	39.77	Included	included	39.77

TABLE 3: Sample of Normalizing CAPMAS March. 2022 data (step 1 adjusting the prices)

Material Code	Material description	Unit	Material Prices from Contractor database	CAPMAS Normalized price	MHUC Normalized price
Soil Works					
CS01	Clean Sand	M^3	75	108.91	75
CS02	Crushed Stone	M^3	200	196.47	200
WT01	Water	M^3	10	NA	NA
Concrete Works					
RMC250	Concrete 250	M^3	1300	NA	1104
SW	Sweden wood	M^3	9000	9459	11500
WT01	Water	M^3	10	NA	NA
NA01	Nails	Kg	35	NA	NA
RFT37	Steel Reinforcement 37	Ton	19000	19133.56	19190
RFT52	Steel Reinforcement 52	Ton	19000	19133.56	19190
TW01	Tie wire	Kg	25	NA	NA
CB01	Cover Block	No	2	NA	NA
HR01	Hardened	Kg	14	NA	NA
EP01	Epoxy Paint	Kg	451	NA	147.69

4.2 Cost Estimate Calculation

The cost estimate for each bulletin was computed by entering the cost data from Table 3 into the detailed cost estimate page. When CAPMAS and MHUC material costs were unavailable, the contractor database's material prices were utilized. As a result, three estimations have been calculated: the first based on the contractor database, the second based on the CAPMAS bulletin, and the third based on the MHUC bulletin.

4.3 Data Availability Calculation

Both bulletins' data availability weight has been calculated in two phases. To assess the entire cost of the project, the first step was to eliminate the personnel and equipment expenses from the cost estimating sheets. The second stage was to remove the prices of items that not provided by the bulletin pricing items. The weight of each bulletin's data availability was then calculated using (1), and (2).

$$\text{CAPMAS (Available Materials' Weight \%)} = \frac{\text{TMC CAPMAS}}{\text{TMC CAPMAS.T}} \quad (1)$$

where:

TMC CAPMAS: The total materials cost of the project after removing costs for items not included in the CAPMAS bulletin.

TMC CAPMAS.T: the total materials cost of the project utilizing CAPMAS bulletin prices and contractor material costs for materials not accessible in the CAPMAS bulletin.

$$\text{MHUC (Available Materials Weight \%)} = \frac{\text{TMC MHUC}}{\text{TMC MHUC.T}} \quad (2)$$

where:

TMC MHUC: The total materials cost of the project after subtracting costs for items not included in the MHUC bulletin.

TMC MHUC.T: the total materials cost of the project based on MHUC bulletin prices and a contractor database for pricing of materials not accessible in the MHUC bulletin

4.4 Data Accuracy Calculation

The accuracy of the information provided in both references was checked. For example, the cost estimates for each reference were

compared individually with the contractor's cost estimates after the prices of materials not available in the bulletin were removed from all cost estimates. Next, the data accuracy of each cost estimate for the project is checked by equations (3) and (4).

CAPMAS (Data Accuracy %) =

$$1 - \left(\frac{\text{ABS(TMC CAPMAS-TMC CAPMAS.CD)}}{\text{TMC CAPMAS.CD}}\right) \quad (3)$$

where:

ABS: the Absolute Value

TMC CAPMAS: The total materials cost of the project after removing costs for items not included in the CAPMAS bulletin.

TMCCAPMAS.CD: the overall material cost of the project utilizing contractor database materials prices for available materials listed in the CAPMAS bulletin and removing other material costs.

MHUC (Data Accuracy %) =

$$1 - \left(\frac{\text{ABS(TMC MHUC-TMC CAPMAS.CD)}}{\text{TMC CAPMAS.CD}}\right) \quad (4)$$

where :
ABS: the Absolute Value
TMCMHUC: The overall materials cost of the project after subtracting prices for items not listed in the MHUC bulletin.
TMCMHUC.CD: the total materials cost of the project utilizing contractor database materials prices for available materials identified in the MHUC bulletin and removing other materials prices.

5. RESULTS

5.1 Project Cost based on contractor prices

The case study project is a 13-story reinforced concrete residential structure (basement + ground + 11 typical floors) with a 1,258-m2 footprint in Cairo, Egypt. The project is semi-finished and comprises of 14 groups of work, such as preparation, earthwork, masonry, concrete, roof works, façade, inner finishing, and so on.

The total direct cost has been computed as 18,933,266.4 LE, which is split into 16,190,277.92 LE for materials cost with about 131 main different material items, according to the contractor's precise cost estimate. The labor cost is 2,503,666 LE, while the equipment cost is 327,133 LE. During bidding preparation in March 2022, the cost estimate was determined using the contractor database for past purchase orders from other comparable projects and quotations from suppliers. Table 4 shows the material breakdown costs for the main divisions.

TABLE 4: Estimated Materials Costs for Key Divisions Based on Contractor Estimates

Division	Division Cost	% of total materials cost
Civil work materials cost	9,266,621.80	57%
Architectural work materials cost	5,175,207.34	32%
Plumbing work materials cost	316,544.79	2%
Electrical work materials cost	1,431,904.00	9%
Total materials cost	16,190,277.92	100%

Table 5 shows the distribution of the main materials to the total materials, whereas the steel reinforcement material represents 34 % of the total material cost. The ready-mix concrete was the second material in distribution of the total material cost with 19%, while the Portland cement represents about 4% of the total materials cost.

TABLE 5: The Cost of Various Materials is Dependent on the Contractor's Estimate

Item	Total item cost	% of total materials cost
Steel reinforcement	5,473,579.28	34%
Ready Mix Concrete	3,152,736.09	19%
Portland Cement	719,648.07	4%
Others	6,844,314.48	45%

5.2 Project Cost based on MHUC Bulletin

The project cost has been determined using material costs from the MHUC bulletin released in March 2022. The retrieved data was standardized and utilized to generate cost estimate sheets. Prices for items not included in the MHUC bulletin were obtained from the contractor's database. Based on the MHUC bulletin, the total material cost estimate for the project is 10,377,601.7 LE. The disparity in total material cost estimates between the MHUC bulletin and contractor data-base

estimates is seen in Table (6). Assuming that any missing or unavailable material prices in the MHUC bulletin were retrieved from the contractor database prices in order to compare total material costs for each estimate.

TABLE 6: Estimated materials costs for key divisions based on contractor pricing and MHUC bulletin prices

Major project Divisions	Based on the contractor offer	TMC MHUC.T
Civil works materials cost	9,266,621.80	9,415,033.9
Architectural works materials cost	5,175,207.34	5,239,172.9
Plumbing works materials cost	316,544.79	314,703.4
Electrical works materials cost	1,431,904.00	1,457,313.7
Total materials cost	16,190,277.92	16,426,223.9

The weight of the available materials provided by MHUC has been determined using Equation (2) for the project's main divisions, as indicated in Table 7. The MHUC bulletin provides prices of materials for most civil works with 98%. MHUC offers a fair data for material prices of both architectural and plumbing works with 63% and 66%. However, the MHUC bulletin provides a limited data for electrical works prices with 11% as it mainly provides the prices for wires, cables and conduits without any data for electric fixtures.

TABLE 7: Weight of Available Materials in MHUC Bulletin Prices

Major project Divisions	TMC MHUC.T	TMC MHUC	Weight of available materials %
Civil works materials cost	9,415,033.9	9,203,118.5	98%
Architectural works materials cost	5,239,172.9	3,289,818.3	63%
Plumbing works materials cost	314,703.4	206,480.5	66%
Electrical works materials cost	1,457,313.7	158,438.7	11%
Total cost of Available materials data	16,426,223.9	12,857,856.0	78%

For key project divisions, the accuracy of material costs reported by MHUC bulletin has been determined using Equation (4). Table 8 compares the accuracy of the MHUC-based materials cost estimate with the contractor's database estimate. The results show high accuracy and quality of the material prices provided by MHUC compared with the data received from the contractor database.

TABLE 8: Accuracy of Available Materials in CAPMAS Bulletin Prices

Major project Divisions	TMC MHUC	TMC MHUC.CD	Accuracy of MHUC prices
Civil works materials cost	9,203,118.5	9,054,706.3	98%
Architectural works materials cost	3,289,818.3	3,225,852.8	98%
Plumbing works materials cost	206,480.5	208,321.9	99%
Electrical works materials cost	158,438.7	133,029.0	84%
Total materials cost	12,857,856.0	12,621,910.0	98%

5.3 Project Cost based on CAPMAS Bulletin

For this case study, the material prices from the CAPMAS bulletin published in March 2022 were utilized to estimate costs. After the normalization procedure was completed, the normalized cost data were utilized on the cost estimate sheets. In the absence of materials in the CAPMAS bulletin, the contractor's database prices were utilized. Based on CAPMAS, the total material cost estimate for the project is 16,102,242.54LE. Table 9 shows the estimated total material cost based on the contractor offer and the CAPMAS estimate. To compute the overall project materials cost, the prices of non-available items were assumed based on the prices in the contractor database.

TABLE 10: The Weight of Available Materials in CAPMAS Bulletin Prices

Major project Divisions	TMC CAPMAS.T	TMC CAPMAS	Weight of available materials %
Civil works materials cost	9,343,721.64	6,000,112	64%
Architectural works materials cost	5,015,357.14	1,289,490.75	26%
Plumbing works materials cost	311,259.75	17,895.79	6%
Electrical works materials cost	1,431,904.00	0.00	0%
Total cost of Available materials data	16,102,242.54	4,577,359	45%

In this case study, the accuracy of materials prices given by CAPMAS was determined using Equation (3) to compare the accuracy of material cost estimate based on CAPMAS and contractor's database, as shown in Table 11. Cost data from CAPMAS have high accuracy level for civil works and quit accuracy for both architectural works and plumbing works.

TABLE 11: Accuracy of Available Materials in CAPMAS Bulletin Prices

Major project Divisions	TMC CAPMAS	TMC CAPMAS.CD	Accuracy of CAPMAS prices
Civil works materials cost	5,923,012.46	6,000,112	99%
Architectural works materials cost	1,449,340.94	1,289,490.75	89%
Plumbing works materials cost	23,180.83	17,895.79	77%
Electrical works materials cost	0.00	0.00	0%
Total materials cost	7,395,534.22	7,307,498.84	99%

6. DISCUSSION

The research introduces an evaluation of the two official bulletins in Egypt for material prices by comparing the cost estimates of these bulletins with a contractor database estimate through a real case study. According to the findings, MHUC gives material prices for about 78% of the total material cost. CAPMAS, on the other hand, only provides material prices for 45 % of the total material costs.

The results show that there are available material prices in both bulletins for civil works in the case study with availability % about 98% for MHUC and 64% for CAPMAS and lower availability level for architectural works with availability % about 63% for MHUC and 26% for CAPMAS. In Contrast, both bulletins do not provide adequate data for plumbing and electrical works. Table 7 demonstrates that the weight proportion of the available materials in the MHUC bulletin for plumbing and electrical works is 66% and 11%, respectively. Table 10 demonstrates that the weight percentage of available materials in the CAPMAS bulletin for plumping works is 6%, with no available resources for electrical works.

According to the findings, the accuracy of material prices offered by MHUC is around 98 % when compared to the contractor's pricing database. In similarity thereto, the accuracy of CAPMAS pricing is around 99 percent, as shown in Table 11. The findings also showed that plumbing and electrical materials costs had a lower degree of accuracy than civil and architectural works materials prices.

7. CONCLUSIONS

This research aims to study the availability and reliability of cost data for detailed construction cost estimating in Egypt. In this context, the research introduces the two formal references for construction material price bulletins in Egypt (CAPMAS Central Agency for Public Mobilization and Statistics, and MHUC Ministry of Housing, Utilities & Urban Communities) which are issued monthly as a source for construction material prices. In addition, this paper introduced a simplified method for assessing the accuracy of using official MHUC and CAPMAS bulletins in detailed cost estimates for Egyptian projects. Based on use case study analysis, the data provided by both bulletins has a high level of accuracy comparable to actual market prices.

However, the data of these references have many limitations, these limitations have a major impact on the accuracy of the estimates, particularly for electrical, mechanical, and plumbing items. These bulletins do not include labor and equipment prices, as well as productivity rates.

Future work might be done to automate the collecting official bulletins data by extracting data from relevant websites, normalizing data, averaging, and calculating costs to be usable for detailed cost estimates. In addition, the research process may be continued with other project types for example, fully finished building to address the availability for electrical and mechanical materials prices and infrastructure projects.

8. REFERENCES

[1] N. A. Kartam and S. A. Kartam, “Risk and its management in the Kuwaiti construction industry: A contractors’ perspective,” Int. J. Proj. Manag., vol. 19, no. 6, pp. 325–335, 2001, doi: 10.1016/S0263-7863(00)00014-4.

[2] A. Girma and M. G. Alemu, “Improving project cost management practice and profitability of domestic contractors in Vadodara,” J. Emerg. Technol. Innov. Res., vol. 5, no. 5, pp. 51–58, 2018.

[3] A. M. F. Albtoush and S. I. Doh, "A Review on Causes of Cost Overrun in the Construction Projects," Int. J. New Innov. Eng. Technol., vol. 12, no. 3, pp. 015–022, 2019.

[4] C. Ahbab, "An Investigation on Time and Cost Overrun in Construction Projects An Investigation on Time and Cost Overrun in Construction Projects.," 2019.

[5] M. Akram, T. H. Ali, N. A. Memon, and S. H. Khahro, "Causal attributes of cost overrun in construction projects of Pakistan," Int. J. Civ. Eng. Technol., vol. 8, no. 6, pp. 477–483, 2017.

[6] A. Aljohani, D. Ahiaga-Dagbui, and D. Moore, "Construction Projects Cost Overrun: What Does the Literature Tell Us?," Int. J. Innov. Manag. Technol., vol. 8, no. 2, pp. 137–143, 2017, doi: 10.18178/ijimt.2017.8.2.717.

[7] M. T. Hatamleh, M. Hiyassat, G. J. Sweis, and R. J. Sweis, "Factors affecting the accuracy of cost estimate: Case of Jordan," Eng. Constr. Archit. Manag., vol. 25, no. 1, pp. 113–131, 2018, doi: 10.1108/ECAM-10-2016-0232.

[8] A. H. Ibrahim and L. M. Elshwadfy, "Factors affecting the accuracy of construction project cost estimation in Egypt," Jordan J. Civ. Eng., vol. 15, no. 3, pp. 329–344, 2021.

[9] B. Amade, E. Okon, and P. Akpan, "Project Cost Estimation : Issues and the Possible Solutions," Int. J. Eng. Tech. Res., vol. 2, no. 5, pp. 181–188, 2014.

[10] J. Chimdi, S. Girma, A. Mosisa, and D. Mitiku, "Assessment of Factors Affecting Accuracy of Cost Estimation in Public Building Construction Projects in Western Oromia Region, Ethiopia," J. Civ. Eng. Sci. Technol., vol. 11, no. 2, pp. 111–124, 2020, doi: 10.33736/jcest.2617.2020.

[11] G. A. Bakr, "Identifying crucial factors affecting accuracy of cost estimates at the tendering phase of public construction projects in Jordan," Int. J. Civ. Eng. Technol., vol. 10, no. 01, pp. 1335–1348, 2019.

[12] H. K. Doloi, "Understanding stakeholders' perspective of cost estimation in project management," Int. J. Proj. Manag., vol. 29, no. 5, pp. 622–636, 2011, doi: 10.1016/j.ijproman.2010.06.001.

[13] V. T. G. K., "Strategic Cost Management for Construction Project Success : A Systematic Study," Civ. Eng. Urban Plan. An Int. J., vol. 4, no. 1, pp. 41–52, 2017, doi: 10.5121/civej.2017.4105.

[14] B. Flyvbjerg, M. K. Skamris Holm, and Sø. L. Buhl, "What causes cost overrun in transport infrastructure projects?," Transp. Rev., vol. 24, no. 1, pp. 3–18, 2004, doi: 10.1080/0144164032000080494a.

[15] T.-C. Toh, C. Ting, K.-N. Ali, G.-U. Aliagha, and O. Munir, "Critical Cost Factors of Building Construction Projects in Malaysia," Procedia - Soc. Behav. Sci., vol. 57, pp. 360–367, 2012, doi: 10.1016/j.sbspro.2012.09.1198.

[16] J. Odeck, "Cost overruns in road construction - what are their sizesand determinants?," Transp. Policy, vol. 11, no. 1, pp. 43–53, 2004, doi: 10.1016/S0967-070X(03)00017-9.

[17] L. Le-Hoai, Y. D. Lee, and J. Y. Lee, "Delay and cost overruns in Vietnam large construction projects: A comparison with other selected countries," KSCE J. Civ. Eng., vol. 12, no. 6, pp. 367–377, 2008, doi: 10.1007/s12205-008-0367-7.

[18] Y. I. Park and T. C. Papadopoulou, "Causes of cost overruns in transport infrastructure projects in Asia: Their significance and relationship with project size," Built Environ. Proj. Asset Manag., vol. 2, no. 2, pp. 195–203, 2012, doi: 10.1108/20441241211280873.

[19] J. M. Andrić, A. M. Mahamadu, J. Wang, P. X. W. Zou, and R. Zhong, "The cost performance and causes of overruns in infrastructure development projects in Asia," J. Civ. Eng. Manag., vol. 25, no. 3, pp. 203–214, 2019, doi: 10.3846/jcem.2019.8646.

[20] S. Durdyev, S. Ismail, and N. A. Bakar, "Factors causing cost overruns in construction of residential projects; Case study of Turkey," Int. J. Sci. Manag., vol. 1, no. 1, pp. 3–12, 2012.

[21] A. A. A. Azis, A. H. Memon, I. A. Rahman, Q. B. A. I. Latif, and S. Nagapan, "Cost management of large construction projects in South Malaysia," 2012, doi: 10.1109/ISBEIA.2012.6422964.

[22] T. F. T. F. Theodorakopoulos, "Integrated cost management system for delivering construction projects," vol. 7, no. 4, pp. 316–321, 2017, [Online]. Available: https://repository.lboro.ac.uk/articles/Integrated_cost_management_system_for_delivering_construction_projects/9453836.

[23] A. D. Britto and B. A. K. S. Perera, "Factors Affecting the Accuracy of Pre-Tender Estimation of Road Construction in Sri Lanka," Fac. Archit. Univ. Moratuwa, vol. 5, no. 1, pp. 243–254, 2013.

[24] P. O. Alumbugu, W. A. Ola-awo, I. Saidu, M. M. Abdullahi, and A. Abdulazeez, "Assessment of the Factors Affecting Accuracy of Pre-tender Cost Estimate in Assessment of the Factors Affecting Accuracy of Pre-tender Cost Estimate in Kaduna State , Nigeria," IOSR J. Environ. Sci. Toxicol. Food Technol., vol. 8, no. 5, pp. 19–27, 2014, doi: 10.9790/2402-08541927.

[25] M. T. Hatamleh and M. Hiyassat, "Factors affecting the accuracy of cost estimate : case of Jordan," Eng. Constr. Archit. Manag., vol. 25, no. 1, pp. 113–131, 2018, doi: 10.1108/ECAM-10-2016-0232.

[26] T. H. Dandan, G. Sweis, L. S. Sukkari, and R. J. Sweis, "Factors affecting the accuracy of cost estimate during various design stages," Journal of Engineering, Design and Technology, 2020. .

[27] D. A. Mislick, G.K. and Nussbaum, Cost estimation: methods and tools. John Wiley & Sons, 2015.

[28] N. Sinclair, P. , Artin, and S. Mulford, "Construction cost data workbook," in In Conference on the International Comparison Program, 2002, pp. 11–44.

[29] N. Diaz, M. Hasan, and M. Lu, "RSMeans-Guided Approach to Detailed Cost Estimating: A Residential Project Case," 2018.

[30] T. A. Ghuzdewan, B. Petra, and K. Narindri, "Project Cost Estimation Based on Standard Price of Goods and Services (SHBJ)," MATEC Web Conf., vol. 159, pp. 0–4, 2018.

[31] "Ministry of Housing and Urban Communities (MHUC), March Bulletin," 2022.

[32] "Monthly Bulletin of Average Retail Prices of Major Important Building Materials March." pp. 1–11, 2022.