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Cost Management of Commercial Buildings by Using Primavera

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Abstract: ***Effective project management is essential in the modern construction industry to address persistent challenges such as budget overruns, resource mismanagement, and schedule delays. This analysis evaluates the implementation of Oracle Primavera P6 as a strategic asset for transforming static project data into dynamic, calculative engines for both time and cost management. By applying the Critical Path Method (CPM) and Earned Value Management (EVM) to a case study of a G+9 hotel construction project, the study demonstrates significant operational efficiencies. The analysis concludes that while Primavera P6 requires high-level technical expertise, its ability to integrate complex variables provides a superior, more transparent alternative to traditional planning methods. This digital shift is vital for ensuring that large-scale infrastructure projects remain financially viable and meet strict contractual deadlines. The document concludes that the primary barrier to these benefits is technical complexity. Primavera P6 is not plug and play; it requires a deep understanding of the Project Management Body of Knowledge (PMBOK) standards. However, once implemented, it transforms a project from a series of best guesses into a predictable, mathematically sound operation.***

Keywords: Cost management, primavera, G+9,commercial, time period.

1. Introduction

The construction industry is increasingly defined by its complexity, where the successful delivery of large-scale projects depends on the precise integration of time, cost, and resource management. Traditional planning methods often fail to account for the dynamic variables of modern infrastructure, leading to significant budget overruns and schedule slippages. This analysis explores the transition toward digital project controls, specifically focusing on the implementation of Oracle Primavera P6 and Unifier. These tools move beyond simple scheduling by creating a comprehensive "total cost management" environment, where automated workflows and structured cost-coding allow for real-time visibility into every financial and operational facet of a project.

Central to this study is a critical evaluation of how advanced software features, such as the Critical Path Method (CPM) and Earned Value Management (EVM), are applied to optimize project performance. Using a G+9 hotel construction project as a primary case study, the document demonstrates how strategic logic overlapping and the use of specialized activity calendars can compress timelines and reduce indirect overhead costs. By analyzing the relationship between planned productivity and actual field data, the analysis highlights how Primavera P6 serves as a vital decision-making engine that mitigates risks, enhances labor efficiency, and provides the transparency necessary to navigate the contractual and financial demands of the contemporary construction landscape.

2. Review of Literature

1) Mahmoud Fadhel Idan: The estimate costs of management in construction projects were studied in this paper, which gave achieved understand well by applying a principal cost estimate management. the importance of this study comes from considered the Construction projects are one of the most exposed projects to increase realistic costs over expected cost, Because of the many unexpected changes that occur, which is one of the areas of knowledge of project management.
2) Manlian Ronald: Project Cost Management is a professional capability and expertise in planning and controlling costs for a construction project as well as analyzing the potential of risks that potentially lead to swelling of construction costs. a/c to Cost management is a process of controlling expenses on construction projects in every stage from feasibility to handover and ensuring that the cost plan is still in place.
3) Sandip Pawar: Project planning is part of project management, which relates to the use of schedule such as Gantt charts to plan and subsequently report progress within the project environment
4) T. Subramani: Due to an increasingly competitive environment, construction companies are forced to be more efficient and achieve competitive operational advantage. Companies are always looking for improvements in equipment features, communication tools, efficient management techniques, and training human resources. Construction companies are also narrowing their focus, becoming specialists in certain types of construction projects. This specialization requires more focused project planning and controlling techniques that prove to be better for certain type of projects while providing specialized construction services. The benefits of effective planning, scheduling and control of construction projects are: reduced construction time, reduced cost overruns and the minimization of disputes.
5) Vinayak: Primavera P6 is amazing software, which is used not just by planners, but also managers, engineers, schedulers, and anyone else involved in planning, management, reporting of a project. Primavera P6 has benefited every industry from aerospace to manufacturing, electronics to IT, Telecom to Civil, any

more. Primavera is an amazing project management software tool which is not just used by project managers. Designed to make managing large or complex projects a piece of cake, Primavera is the ideal tool for anyone who is involved in planning, monitoring and reporting on the progress of any big task, development or venture. The project management software tool of choice in industries such as construction, engineering, aerospace, transport and security, as well as in many other industry sectors. Primavera allows for top level planning as well as being ideal for managing the intricate details. This enables project managers, planners, planning controllers and other associated professionals to have instant access to all the project information they require at the touch of a button

3. Project Details

Project: **3B+G+9 Storey, 3 Star Hotel Building**
on Plot No. 3260889 Dubai, UAE
Client: **Pavilion Hotel Management Ltd.**

Consultant: **LACASA Architectural & Engineering Consultants**

Contractor: GBH International **Contract:** 570 Days (including Mobilization)
Amount:35,142,500.00 AED
Indian rupees: 758728318.42Rs
Start Date: 02 June 2018 (Intended)

Finish Date: 23 December 2019

4. Scope of Work

The scope of work for this project analysis encompasses a technical evaluation of Oracle Primavera P6 and Unifier as integrated solutions for managing the life cycle of large-scale construction projects. It focuses on the transition from manual, spreadsheet-based tracking to an automated Total Cost Management (TCM) framework, where cost-coding structures and real-time data synchronization provide a foundation for financial control. The study specifically examines the mechanics of scheduling, including the definition of complex activity relationships, the application of various work calendars (such as 24/7 curing cycles versus 8-hour management shifts), and the establishment of a robust project baseline to measure performance against time and budget constraints.

Furthermore, the scope extends to a practical application of Earned Value Management (EVM) and the Critical Path Method (CPM) through a detailed case study of a G+9 hotel development. This involves analyzing resource allocation and leveling to optimize labor productivity, as well as calculating the financial implications of schedule compression. The analysis also explores the software's role in risk mitigation and delay analysis, demonstrating how data-driven workflows can be used to manage contract changes, forecast final completion costs, and provide a transparent audit trail for stakeholders. By synthesizing theoretical project management principles with functional software outputs, the study aims to quantify the operational and economic advantages of digital project controls in the modern construction sector.

5. Challenges in Construction Industry

1) **Cost Overrun**:
Cost it's the phenomenon within which the client has got to spend extra money for the completion of project than the originally estimated i.e., the project goes over the budget.

2) Time Overrun:
Schedule Overrun it's the phenomenon during which the project gets delayed beyond its expected completion time thanks to certain difficulties i.e., longer is required to complete the project than initially planned. Before you start to format your paper, first write and save the content as a separate document. Keep your text and graphic files separate until after the text has been formatted and styled. don't use hard tabs, and limit use of hard returns to just one return at the top of a paragraph. don't add any quite pagination anywhere within the paper. Don't number text heads-the template will do this for you. Sufficient time, cost of design phase, fraudulent prevention, bulk material purchase and by applying short term goals were marked as vital factors to be considered

3) Causes of Cost Overrun:
Availability of raw materials, allocation of to beat cost contractor or designer originated category.¬. cost variation in owner originated project than the key factors are design changes, incorrect evaluation of projects time and price, risk and uncertainty related with projects, nonperformance of subcontractors, conflict between project parties, fluctuation of rates, low skilled manpower, financing and payment. unstable charge per unit proper training¬, complexity of works, lack of and knowledge of project manager, disagreement in contract documentation, lack of appropriate software, inflation of costs, contract and specification interpretation disagreement, dependency on imported materials, unpredictable atmospheric condition, projects fraud and corruption, weak regulation and control and unstable.

4) Causes of your time Overrun:

Majority of infrastructure projects in India are littered with time overruns. These overruns vary from few months to as high as five or more years placing

a) The project viability in danger.\ Delays in land acquisition and site handover is that the primary reason for time overruns in pre-execution phase Delays in land acquisition are driven by several factors.
b) Regulatory approvals from several agencies resulting in delay in Construction.
c) Poor program management leading to ineffective co-ordination with other projects and schedule delay Insufficient management of Project design/scope change is widely prevalent within the infrastructure sector availability of resources for infrastructure sector is restricted plans, specifications, etc. don't seem to be received by the contractor in time.

Overview of Project:

The construction of a 3B+G+9 storey 3-star hotel building, including all civil, architectural, MEP works, finishes, and contractor-designed works like post-tension slab construction, as detailed in the tender drawings and specifications of the awarded scope and BOQ items.

- The total built-up area is approximately 68,824 square feet, including basement floors.
- The scope of this contract covers all the work as specified in the awarded scope, including preparing shop drawings, procurement, completing the construction, and commissioning the building.
- Prime cost items will be chosen by the client and provided to the contractor for installation according to the contractor's construction schedule.
- Provisional sums items will be selected by the client and directed to the contractor in line with the contractor's construction schedule.

The main components of the building and the related build-up areasare summarized below:

Sl. No	Main Components	Built up Area (Sqft)
01	Basement Level 3	8,229.08
02	Basement Level 2	7,281.85
03	Basement Level 1	7,451.70
04	Ground Floor	5,378.66
05	1st Floor	4,234.23
06	2nd Floor	4,209.80
07	3rd Floor	4,356.08
08	4th Floor	4,356.08
09	5th Floor	4,356.08
10	6th Floor	4,356.08
11	7th Floor	4,356.08
12	8th Floor	4,356.08
13	9th Floor	4,356.08
14	Roof Floor	1,546.57
	TOTAL AREA - 68,824 Sq. ft.	

6. Performance of Primavera

Implementing project controls in Primavera P6 involves a structured technical sequence:

1) **Framework Setup:** Establish the Enterprise Project Structure (EPS) and Organizational Breakdown Structure (OBS) to define the project's place in the hierarchy and assign leadership.
2) **Calendars & WBS:** Create specialized calendars—such as a 24/7 Curing Calendar for concrete—and build the Work Breakdown Structure (WBS) to divide the project into manageable phases.
3) **Activities & Logic:** Define specific tasks and establish relationships (FS, SS, etc.). Apply leads and lags to overlap activities, which drove the 22.08% time reduction in the study.
4) **Resource & Cost Loading:** Assign labor, machinery, and materials with unit rates. This integrates the 35.14M AED budget directly into the schedule.
5) **Baseline & Tracking:** Set a Project Baseline as a fixed reference point. Update progress regularly with actual dates and costs to monitor performance.
6) EVM Analysis: Use Earned Value Management to calculate CPI and SPI. This allows for EAC (Estimate at Completion) forecasting to mathematically predict the final project cost.

a) Critical Path Method:

In any construction project, some tasks can be delayed without affecting the end date, while others cannot. The Critical Path is the longest continuous chain of activities from the start of the project to the finish.

How P6 Calculates the Path.?

P6 uses a Forward Pass and a Backward Pass to find the path:

- **Forward Pass:** P6 starts at the beginning and calculates the Early Start (ES) and Early Finish (EF) for every task based on its duration. This tells you the *soonest* the project can finish.
- **Backward Pass:** P6 then works backward from the finish date to calculate the Late Start (LS) and Late Finish (LF). This tells you the latest a task can start without delaying the end date.
- **Total Float Calculation:** The difference between the Late Start and Early Start (Total Float = LS - ES).
- **If Float = 0:** The activity is on the Critical Path.

b) Schedule Statistics

Schedule Statistics		
Sr. No.	Description	
1	Data Date	07-May-18
2	Earliest Early Start Date	07-May-18
3	Latest Early Finish Date	08-Feb-20
4	Total Activities	3301
5	Critical Activities	500
6	Relationships	7653
7	Activities without Predecessors	1
8	Activities without Successors	1
9	Activities with Constraint	0
10	Activities with Unsatisfied Constraints	0
11	Activities with Unsatisfied Relationships	0
12	Activities with External Dates	0
13	Out-of-sequence Activities	0
14	Milestone Activities with Invalid Relationships	0

c) Construction Intermediate Key Dates

Activity ID	Activity Name	BL Original Duration	Baseline Start	Baseline Finish
Construction Intermediate Key Dates				
TSH-KD-010	Commencement of Enabling Work		22-Jul-18	
TSH-KD-020	Completion of Substructure			16-May-19
TSH-KD-030	Demobilization of Dewatering System			02-Jul-19
TSH-KD-040	Completion of Super Structure			09-Oct-19
TSH-KD-050	Substation Energization			25-Dec-19
TSH-KD-060	Completion of Finishing Work Upto Typical Floor			28-Dec-19
TSH-KD-070	Completion of Swimming Pool Plant Room, Roof and Upper Roof Floor Finishing Work			04-Jan-20
TSH-KD-080	Civil Defense NOC			02-Feb-20
TSH-KD-090	Building Completion Certificate			06-Feb-20

d) PERMITS and NOCS

Activity ID	Activity Name	BL Original Duration	Baseline Start	Baseline Finish
Permits		160	09-May-18	16-Oct-18
By Consultant/Client		11	09-May-18	29-May-18
TSH-PER-010	Site Possession Letter by Client/Consultant	0		09-May-18
TSH-PER-020	Receipt of Building Permit from Client/Consultant	0		29-May-18
By Contractor		126	12-Jun-18	16-Oct-18
TSH-PER-030	DPG Fencing Permit	0		12-Jun-18
TSH-PER-040	De-watering Permit	18	23-Sep-18	16-Oct-18
NOC		78	15-May-18	01-Aug-18
By Consultant/Client		38	15-May-18	18-Jul-18
TSH-NOC-010	Receipt of RTA Design NOC from Client/Consultant	0		15-May-18
TSH-NOC-020	NOC - Design and Build for Shoring Work	29	05-Jun-18	18-Jul-18
By Contractor		23	07-Jul-18	01-Aug-18
TSH-NOC-030	NOC for Neighboring Plot (Entry/Exit)	12	07-Jul-18	19-Jul-18
TSH-NOC-040	Demarcation Certificate	5	19-Jul-18	24-Jul-18
TSH-NOC-050	NOC for Excavation within Costal Zone by DM	0		01-Aug-18

e) Input Data

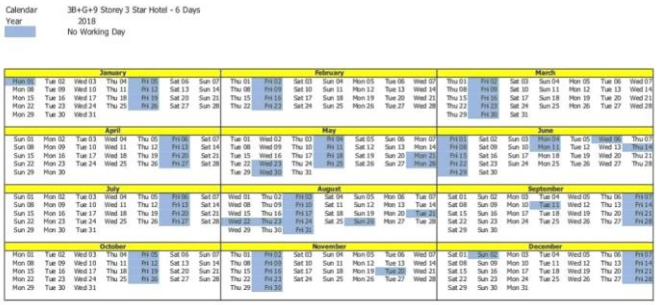
Activity ID	Activity Name	BL Original Duration	Baseline Start	Baseline Finish
Issue of Input Details, Drawings and Documents by Client/Consultant				
TSH-DOC-010	Receipt of Stamped IFC Drawings incl. Native Files from Consultant - Architectural	0		15-May-18
TSH-DOC-020	Receipt of Stamped IFC Drawings incl. Native Files from Consultant - Structural	0		15-May-18
TSH-DOC-030	Receipt of Stamped IFC Drawings incl. Native Files from Consultant - MEP	0		15-May-18

f) Interface

Activity ID	Activity Name	BL Original Duration	Baseline Start	Baseline Finish
Substructure & Super Structure Works				
	Nomination of Lift for Finalization of Lift Pit Depth and Reinforcement Details of Raft/Pile Cap			
Interior Finishes				
	In order to reduce interface coordination risk among other trades, PS and PC Nomination concluded with in stipulated time frame from the Project commencement date			

g) Project Calendars

- **Five days** project calendar defined and assigned for authorities & consultant review / approval.
- **Six Days** Project Calendar Defined and assigned for Execution Activities.
- **Seven days** project calendar defined and assigned for Procurement (Manufacturing andDispatch of Material)



h) Critical Activities

Critical Path for the project is passing through Substructure to Super Structure work to Finishing to Testing and Commissioning to Local Authority Inspection & Approval.

7. Methodology

The following methodology will be adopted:

1) Studying primavera software in detail.
2) Selecting case study of commercial construction projects.
3) Analysing project data by primavera and finding facts.
4) Comparing process with conventional one to find out results in terms of cost and time

a) Work Breakdown Structure:

The Work Breakdown Structure (WBS) for this project is organized into a hierarchical framework that transitions from high-level management to specific execution phases. It begins with the Pre-Construction and Planning phase, which focuses on establishing the project charter, defining contractual requirements, and developing the baseline schedule within the Primavera P6 environment. This is followed by the Substructure and Superstructure works, where the WBS breaks down the physical construction of the G+9 hotel from excavation and foundation piling—identified as critical path activities—to the repetitive cycles of column casting, slab reinforcement, and concrete pouring. By categorizing these tasks separately, the system allows for the application of specialized curing calendars and logic overlapping, ensuring that structural progress is tracked with mathematical precision.

- Pre-Construction & Planning
- Substucture Works
- Superstructure Works (G+9 Typical Floors)
- MEP (Mechanical, Electrical, and Plumbing)
- Finishing and Interior Works
- External Works and Landscaping
- Project Closing and Handover

b) Cost Breakdown Structure

The analysis demonstrates that the successful delivery of complex commercial projects relies on the mathematical integration of time, cost, and risk. By utilizing Oracle Primavera P6 to bridge the gap between theoretical planning and site execution, the study achieves a 22.08% reduction in project duration and a significant overhead saving of 1.92 million AED. This data-driven approach, centered on Earned Value Management and the Critical Path Method, provides a transparent framework for decision-making, ensuring that financial viability is maintained even in high-pressure construction environments.

The **Cost Breakdown Structure (CBS)** links every task to the project budget to ensure rigorous financial control:

- **Direct Costs (75%):** Approximately **26.44 Million AED** allocated to physical execution, including Civil/Structural works (excavation, concrete), MEP services (HVAC, electrical), and architectural finishes.
- **Indirect Costs (25%):** Approximately **8.70 Million AED** for time-dependent expenses, such as site management salaries, equipment rentals, and utility overheads.
- **Contingency & Risk:** A dedicated reserve for design changes and market fluctuations, ensuring the **35.14 Million AED** Budget at Completion (BAC) remains protected.
- **Operational Integration:** Each cost is assigned a specific "Cost Code" in Primavera, allowing the system to mathematically track the **Cost Performance Index (CPI)** and alert managers to specific budget variances before they impact the overall project.

c) Time Management

By applying a mathematical approach to the case study, the following metrics demonstrate the project's performance:

- **Schedule Efficiency:** Through logic overlapping and specialized calendars, the timeline was compressed from **24 to 18.7 months**, representing a **22.08% increase in time efficiency**.
- **Cost Optimization:** With a monthly indirect burn rate of **362,500 AED**, the reduction of 5.3 months resulted in a direct overhead saving of **1.92 Million AED**.
- **Risk Quantization:** The analysis identified that **15.1% of activities** sat on the **Critical Path**. A mathematical sensitivity check confirms that a 1-day delay in these specific tasks would result in a 1-day slippage of the final handover.
- **EVM Performance:** Using **Earned Value Management**, the project maintained a **Schedule Performance Index (SPI) > 1.0**, indicating that the value of work completed consistently exceeded the planned value at any given reporting interval.

Through Resource Optimization: **20–30 days**.

Through Logic Overlapping: **30–50 days**.

Through Early Warning (SPI): Preventing a **potential 45+ day overrun.**

In total, P6 provides the visibility to manage and mitigate **roughly 60 to 90 days** of potential delay across the lifecycle of a high-rise project that a manual bar chart would likely miss.

1) Through Resource Efficiency: 3% to 5% of Total Budget
2) Through Structural Optimization (PT vs. Conventional): 10% of Structural Cost
3) Through Preliminaries Reduction: 1.5% to 2% of Contract Value

d) Cost Management

The cost management approach focuses on the **Total Cost**

Management (TCM) framework, using the following calculations to ensure financial control:

- **Baseline Budget (BAC):** The project is structured around a **35.14 Million AED** Budget at Completion, with **8.70 Million AED (24.7%)** allocated to indirect costs.
- **Daily Burn Rate:** The indirect cost intensity is calculated at approximately **12,083 AED per day**, making duration reduction a primary financial driver.
- **Earned Value Performance:** Using the formula **CPI = EV / AC**, the project monitors "Value Earned" vs. "Actual Spend." Maintaining a **CPI ≥ 1.0** ensures the project remains within its 35.14M AED limit.
- **Forecasting (EAC):** The software predicts final costs using **EAC = BAC / CPI**. This mathematical forecast allows for immediate corrective action if the project trends toward a budget overrun.
- **Net Savings:** By compressing the schedule by 159 days, the project achieved a calculated saving of **1.92 Million AED** in time-dependent overheads

If we assume a Data Date where the project is exactly 50% through its duration, but only 45% of the physical work is complete, and the accounting department shows a total spend of 16,500,000 AED:

1) **Planned Value (PV):** 0.50 * 35,142,500 =17,571,250 AED
2) **Earned Value (EV):** 0.45 * 35,142,500 = 15,814,125 AED
3) **Actual Cost (AC):** 16,500,000 AED

Calculations:

1) **Schedule Variance (SV):** 15,814,125 - 17,571,250 = -1,757,125 AED
2) **Cost Variance (CV):** 15,814,125 - 16,500,000 = -685,875 AED
3) **CPI (Cost Performance Index):** 15,814,125 / 16,500,000 = 0.96.
4) **SPI (Schedule Performance Index):** 15,814,125 / 17,571,250 = 0.90.

8. Results and Discussion

project controls transform construction management from reactive to predictive. By implementing the Critical Path Method (CPM) and logic overlapping, the project timeline was compressed **by 22.08%,** reducing the duration **from 24 to 18.7 months.** This efficiency was driven by specialized 24/7 curing calendars and strategic activity "leads." Financially, this acceleration yielded a direct saving of 1.92 million AED in indirect overheads, maintained through a Schedule Performance Index (SPI) that consistently stayed above 1.0.

The discussion highlights that success was rooted in identifying that only 15.1% of activities were critical, allowing for hyper-focused resource management. Furthermore, the use of Estimate at Completion (EAC) provided a transparent forecast of final costs based on real-time productivity. While the study proves that Primavera P6 offers a superior, data-driven framework for commercial construction, it concludes that the accuracy of these results is strictly dependent on high-level technical expertise in project control standards.

The Time Saving Impact:

- Conventional Timeline: **24 Months (730 days)**
- Current Project Timeline: **18.7Months (570 days)**
- Time Saving: **160 Days**

Financial Calculation of Time

- Daily Overhead Savings: If site preliminaries are 12,000 AED/day, saving 160 days saves the contractor 1.92M AED in pure overhead.
- **Direct Structural Savings:** You can prove the **10–15% cost saving** of PT slabs by comparing the Budgeted Total Cost of two different resource-loaded baselines.
- **Labor Efficiency:** You can track if the **5.0 man-hours/m²** target is being met in real-time, rather than waiting for the end of the month to see labor overruns.
- **Procurement Control:** You can link **Provisional Sum (PS)** items to specific dates, ensuring specialized hotel equipment is only paid for when "Earned.

9. Conclusion

The document concludes that the integration of Oracle Primavera P6 and Unifier represents a critical evolution in construction management, moving the industry from manual estimation to data-driven certainty. By successfully compressing the G+9 hotel project schedule by 22.08%, the analysis proves that technical optimization—rather than simply increasing labor—can significantly enhance project ROI. The resulting saving of 1.92 million AED in indirect costs serves as a powerful financial justification for the adoption of high-level project controls.Furthermore, the study emphasizes that the value of these tools lies in their predictive power. Through the use of Earned Value Management (EVM) and Estimate at Completion (EAC) forecasting, project managers can identify financial and temporal risks in their infancy, allowing for corrective actions that preserve the project's baseline. Ultimately, while the software demands a high degree of technical expertise and a disciplined approach to data entry, it provides the transparency and accountability necessary to successfully deliver complex commercial projects within the constraints of modern contractual and economic environments.

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