CHAPTER 45

Cost Overrun Analysis of Irrigation Projects

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ABSTRACT

The number of irrigation projects is expected to grow rapidly in upcoming years due to the rise in population, industrialization, urbanization, and agriculture. The aim of this paper is to study irrigation projects in view of cost overruns of dam projects in Konkan region. Cost overruns and performance results of selected dam projects in the basin of west-flowing rivers in Maharashtra state. Based on available data, cost overruns and underperformance are exhibited. The completion of a project within stipulated budget, not causing a burden on the state exchequer has become the most crucial and challenging task for clients and contracting agencies. The overall objective is to identify reasons responsible for cost overruns in-water construction projects and recommend remedial solutions for land acquisition methods, execution of excess quantity and change in scope of work. The most important factors causing overruns in project cost are determined using Garrett's ranking technique, in order to rank the factors. A questionnaire was prepared and circulated to contracting agencies and irrigation departments. The most crucial factors of cost overrun were identified as: Paucity of funds; Excess due to higher tender rates; Delay in land acquisition; Increase in the cost of land acquisition; Claims for extra work of boulders. This study uses the Earned Value Method to assess an ongoing dam construction project's performance.

Keywords: Cost over run; Irrigation projects.

1.0 Introduction

There is a need for prioritising the backlog of ongoing irrigation projects in Maharashtra. The cost escalation of irrigation projects has been a major issue for the state government. Irrigation projects are essentially long-term projects involving huge investment of financial resources. For any major project involving public funds, keeping the expenditure within the stipulated budget amount is one of the major challenges before project management. Lack of financial autonomy, absence of long-term plan and prioritization of project execution, problems of land acquisition, rehabilitation of PAP's, resulting in delay and stoppage of work, clearances, resulting in abnormal delays and consequent increase in cost.

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In a complex irrigation project, inadequacies in planning or efficiency in execution can lead to manifold increase in project cost which in turn affects speed of completion. The gap between project creation and actual creation of Irrigation potential keeps increasing. The explanations for cost overruns and delays for water projects are largely on account of inflation being not considered in the initial cost estimates to get project pass through, geological difficulties, frequent design changes, increase in irrigation potential and construction of additional work. The achievement of intended outcomes of such important projects gets adversely affected by cost overruns. There is a significant shortfall in irrigation of the targeted areas. Cultivation in the command area of the projects is not up to its full potential as estimated in the DPRs.

1.1 Cost overrun in infrastructure projects

Cost overrun in infrastructure projects arises when the final cost of a project exceeds its initially estimated or budgeted cost. This is a common issue that has attracted a lot of interest from project managers and associated staff. In essence, a cost overrun in infrastructure projects represents a variation from the initial financial plan, which frequently has a negative impact on the project's success and the stakeholders involved. It's crucial to remember that cost overruns in infrastructure projects, which entail spending more than anticipated to get the same intended output, are frequently perceived as a failure in planning and a wasteful use of public resources. To reduce the chance of cost overruns, efficient control systems are required from the very beginning of the design process.

2.0 Literature Review

Cost overruns remain one of the most persistent and challenging issues in the construction industry worldwide. Defined as the excess of actual project costs over initial estimates, they significantly affect project viability, public confidence, and economic efficiency. Numerous studies have examined the root causes and proposed mitigation strategies, with findings highlighting both common and region-specific issues. One of the most frequently cited causes of cost overruns is poor project planning and design. Studies conducted in Jordan, India, and Denmark emphasize that inadequate initial estimates, incomplete drawings, and delayed designs play a significant role in escalating project costs (Al-Hazim *et al.*, 2017; Subramani *et al.*, 2014; Larsen *et al.*, 2015).

In Qatar, similar issues were observed, where inconsistencies between design and execution stages contributed to increased expenditure (Senouci *et al.*, 2016). Another critical factor is ineffective project management. Research from Denmark found that errors and omissions in consultant materials were among the most influential contributors to cost overruns (Larsen *et al.*, 2015). In both India and Portugal, lack of coordination, poor schedule control, and mismanagement of project processes were identified as key issues (Catalão *et al.*, 2020;

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Shinde & Minde, 2018). External and political factors also contribute significantly to cost overruns. In Portugal, a large empirical study revealed that electoral cycles, institutional weaknesses, and economic conditions had a measurable impact on cost deviations in public projects (Catalão *et al.*, 2020). Political interference, poor governance, and corruption, especially in developing countries, further compound the issue. These influences not only disrupt planning but also lead to deliberate underestimation of project costs for political gain, as noted by several researchers (Flyvbjerg *et al.*, 2004; Love & Ahiaga-Dagbui, 2018).

Environmental and site-specific conditions were also noted as contributing factors. Terrain difficulties and adverse weather were particularly problematic in infrastructure projects in the Middle East, notably Jordan and Saudi Arabia (Al-Hazim *et al.*, 2017). Moreover, unanticipated ground conditions due to inadequate site investigations further complicated construction efforts. Alongside these, market-driven variables such as inflation and rising material costs also influence overall project budgets. These are especially prevalent in countries like India and Qatar, where fluctuating prices and labor shortages have direct implications for project financials (Senouci *et al.*, 2016; Subramani *et al.*, 2014).

Geographically, certain regional patterns emerge. In the Middle East, particularly Jordan and Qatar, poor planning, payment delays, and environmental challenges are dominant causes (Al-Hazim *et al.*, 2017; Senouci *et al.*, 2016). Indian construction projects frequently suffer from land acquisition issues, regulatory delays, and price escalations (Subramani *et al.*, 2014; Shinde & Minde, 2018). In Europe, Denmark's research highlights the differentiated impact of various factors on time, cost, and quality, while Portugal's large-scale data analysis emphasizes the role of governance and political stability (Larsen *et al.*, 2015; Catalão *et al.*, 2020). The consequences of cost overruns extend beyond financial loss. They delay the delivery of essential services, erode public trust in governance, and compromise project sustainability. Large-scale public infrastructure projects often become unviable, and their economic and social returns diminish significantly due to prolonged timelines and budget inflation (Adam *et al.*, 2014). In response, scholars and practitioners suggest several mitigation measures. These include enhancing early-stage planning, increasing transparency in procurement, adopting data-driven cost forecasting models, and implementing continuous monitoring mechanisms (Senouci *et al.*, 2016; Shinde & Minde, 2018). Additionally, political insulation of project decisions and institutional reforms are crucial to ensure long-term efficiency (Catalão *et al.*, 2020).

3.0 Objectives

- To study various ongoing irrigation projects in view of cost overruns.
- Determine the percentage of overrun in minor, medium and major projects in a particular basin.
- Examine and conduct a questionnaire survey among contractors and department officials to rank the factors leading to cost escalation in water sector projects, using Garrett ranking.

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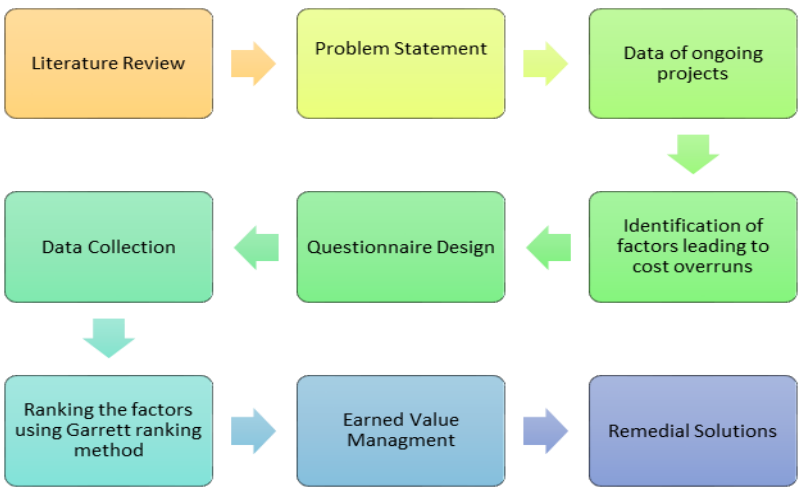
- To identify which critical factors affecting cost overrun need the most attention.
- Performing the earned value analysis for better understanding of project performance.
- To recommend corrective solutions to overcome or make protocols for those critical factors in future projects.

4.0 Research Methodology



4.1 Garrett ranking

The Garrett Ranking Technique is a method used to prioritize factors based on the perception of respondents in a survey. It's especially useful when multiple respondents rank several factors, and you want to convert these ranks into a standardized score to identify the most significant ones.

Table 1: Identified Cost Overrun Factors as per Data Obtained from Irrigation Development Corporation and CAG Report

Factor No	Factors
1	Excess due to change in D.S. R
2	Excess due to higher tender rates
3	Excess due to structural modification
4	Price escalation
5	Increase in cost of land acquisition rates
6	Increase in cost of land acquisition due to increase in command area
7	Increase in royalty rates
8	Implementation of clause 38

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9	Paucity of funds
10	Delay in land acquisition
11	Delay in approval of revised estimate
12	Claims for extra lead
13	Claims for extra work of boulders during excavation
14	Idle charges claim
15	Expenditure on Arbitration Awards
16	Payment for compensation on rehabilitated villagers
17	Conversion of open canals to PDN
18	Increase in dam height/length
19	Rework due to faulty design
20	Increase in scope of work
21	Stoppage of work due to pandemic
22	New tender process for balance work (incomplete work by previous contractor)

Table 2: Ranking of Factors based on Response of Respondents

Sr.No	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21	F22
1	1	3	8	12	3	4	9	7	5	1	13	10	4	10	16	18	14	4	20	4	22	19
2	1	2	9	14	7	6	10	6	9	4	15	12	7	12	18	19	17	6	18	4	21	22
3	1	2	10	11	4	6	10	6	7	2	14	14	6	9	17	17	19	9	21	5	22	20
4	2	3	12	14	5	3	11	9	4	3	16	12	4	11	14	19	19	7	19	7	22	21
5	4	3	7	13	5	7	8	8	6	5	16	14	5	8	18	20	18	5	22	7	21	19
6	4	3	11	11	3	3	8	10	1	1	12	13	8	13	15	17	15	8	19	7	21	21
7	2	4	12	12	3	5	9	10	5	4	15	12	8	10	19	19	18	9	21	8	21	22
8	3	6	10	12	6	5	9	11	3	2	15	10	5	10	15	18	16	6	20	8	21	18
9	2	5	10	14	5	4	11	7	7	1	16	12	4	12	18	20	17	4	18	6	21	20
10	2	5	7	12	5	6	10	9	1	1	14	10	6	11	17	19	14	5	22	6	21	22
11	5	8	12	14	4	6	11	6	4	2	11	14	7	11	14	18	18	8	18	9	22	22
12	7	9	11	13	7	7	10	9	5	3	13	12	4	9	16	17	19	7	21	7	20	21
13	2	4	9	11	3	4	10	8	2	4	13	14	7	10	15	20	16	10	20	7	21	22
14	2	4	10	11	3	5	12	6	2	1	12	13	6	9	16	17	16	8	22	7	19	22
15	4	3	8	13	5	8	11	6	1	2	15	13	4	9	17	19	17	11	19	4	22	19
16	1	6	8	14	6	7	9	7	5	1	15	14	5	13	18	20	17	7	19	4	21	19
17	1	6	10	14	6	4	11	6	2	4	16	11	8	8	14	18	18	4	22	8	21	18
18	5	3	11	12	7	7	12	9	6	3	13	14	5	10	15	20	17	9	20	6	19	19
19	3	2	12	12	7	7	9	8	8	1	14	12	8	12	19	17	16	6	21	5	22	22
20	2	2	12	12	3	5	8	10	4	2	12	14	8	9	15	19	15	8	18	4	21	21
21	2	3	11	13	3	5	9	11	3	4	15	14	6	11	19	18	13	5	21	6	20	21
22	7	4	8	13	5	6	12	10	1	1	16	11	4	10	18	19	16	10	19	7	19	22
23	4	5	8	12	4	6	10	6	1	2	13	13	7	8	14	20	17	11	18	8	19	20
24	6	5	12	11	6	3	10	9	3	2	13	13	7	13	17	17	17	11	21	8	20	18
25	6	6	7	13	6	7	9	7	6	3	15	10	4	10	15	18	18	9	20	7	20	21
26	2	2	7	11	7	3	11	6	7	1	14	12	6	12	16	18	19	4	18	9	22	22
27	2	2	11	14	3	4	11	8	7	4	15	13	5	12	16	19	16	7	22	9	21	22
28	1	3	10	15	6	4	10	9	2	1	16	12	4	10	14	20	16	6	21	10	22	20
29	1	4	9	14	7	6	12	11	3	2	13	11	8	9	17	19	14	6	22	4	22	22
30	3	4	9	12	6	5	9	10	6	3	11	14	6	11	16	19	14	10	20	4	20	21

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Table 3: Count of Number of Ranks Assigned to Each Factor

Factors	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th	17th	18th	19th	20th	21st	22nd
F1	7	10	3	4	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F2	0	6	8	6	4	4	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
F3	0	0	0	0	0	0	4	5	4	6	5	6	0	0	0	0	0	0	0	0	0	0
F4	0	0	0	0	0	0	0	0	0	0	6	9	6	8	1	0	0	0	0	0	0	0
F5	0	0	8	3	6	7	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F6	0	0	4	6	6	7	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F7	0	0	0	0	0	0	0	3	8	8	7	4	0	0	0	0	0	0	0	0	0	0
F8	0	0	0	0	0	8	4	4	6	5	3	0	0	0	0	0	0	0	0	0	0	0
F9	5	4	4	3	4	4	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
F10	10	8	5	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F11	0	0	0	0	0	0	0	0	0	0	2	3	7	4	8	6	0	0	0	0	0	0
F12	0	0	0	0	0	0	0	0	0	4	3	8	6	9	0	0	0	0	0	0	0	0
F13	0	0	0	8	5	6	5	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F14	0	0	0	0	0	0	0	3	6	8	5	5	3	0	0	0	0	0	0	0	0	0
F15	0	0	0	0	0	0	0	0	0	0	0	0	0	5	6	6	5	5	3	0	0	0
F16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	7	10	7	0	0
F17	0	0	0	0	0	0	0	0	0	0	0	0	1	4	2	7	7	5	4	0	0	0
F18	0	0	0	4	3	5	4	4	4	3	3	0	0	0	0	0	0	0	0	0	0	0
F19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	5	6	7	6
F20	0	0	0	7	2	4	8	5	3	1	0	0	0	0	0	0	0	0	0	0	0	0
F21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	5	12	9
F22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	5	4	7	11

Table 4: Calculation of Percent Position and Garrett score

Rank	100(Rij-0.5)/Nj	Percent Position	Garrett Value
1st	100(1-0.5)/22	2.272727273	88
2nd	100(2-0.5)/22	6.818181818	79
3rd	100(3-0.5)/22	11.36363636	73
4th	100(4-0.5)/22	15.90909091	69
5th	100(5-0.5)/22	20.45454545	66
6th	100(6-0.5)/22	25	63
7th	100(7-0.5)/22	29.54545455	60
8th	100(7-0.5)/22	34.09090909	58
9th	100(9-0.5)/22	38.63636364	56
10th	100(10-0.5)/22	43.18181818	53
11th	100(11-0.5)/22	47.72727273	51
12th	100(12-0.5)/22	52.27272727	49
13th	100(13-0.5)/22	56.81818182	47
14th	100(14-0.5)/22	61.36363636	44
15th	100(15-0.5)/22	65.90909091	42
16th	100(16-0.5)/22	70.45454545	39
17th	100(17-0.5)/22	75	36
18th	100(18-0.5)/22	79.54545455	34
19th	100(19-0.5)/22	84.09090909	30
20th	100(20-0.5)/22	88.63636364	26
21st	100(21-0.5)/22	93.18181818	21
22nd	100(12-0.5)/22	97.72727273	12

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5.0 Conclusion

Cost overruns continue to pose a major challenge in the construction industry, especially in public infrastructure projects. The literature reveals that these overruns are primarily caused by a combination of technical, managerial, economic, and political factors. Across various countries and case studies, the most recurring issues include inaccurate cost estimation, delays in payments from clients, poor planning and scheduling, and fluctuations in material prices. Additionally, factors such as design changes during execution, inefficient contract management, and inadequate site supervision also contribute significantly.

Table 5: Conversion of Percent Position to Scores based on Garrett Table and Ranking of Strategies based on Mean Score Values

Sr.No	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21	F22
1	88	73	58	49	73	69	56	60	66	88	47	53	69	53	39	34	44	69	26	69	12	30
2	88	79	56	44	60	63	53	63	56	69	42	49	60	49	34	30	36	63	34	69	21	12
3	88	79	53	51	69	63	53	63	60	79	44	44	63	56	36	36	30	56	21	66	12	26
4	79	73	49	44	66	73	51	56	69	73	39	49	69	51	44	30	30	60	30	60	12	21
5	69	73	60	47	66	60	58	58	63	66	39	44	66	58	34	20	34	66	12	60	21	30
6	69	73	51	51	73	73	58	53	88	88	49	47	58	47	42	36	42	58	30	60	21	21
7	79	69	49	49	73	66	56	53	66	69	42	49	58	53	30	30	34	56	21	58	21	12
8	73	63	53	49	63	66	56	51	73	79	42	53	66	53	42	34	39	63	20	58	21	34
9	79	66	53	44	66	69	51	60	60	88	39	49	69	49	34	20	36	69	34	63	21	26
10	79	66	60	49	66	63	53	56	88	88	44	53	63	51	36	30	44	66	12	63	21	12
11	66	58	49	44	69	63	51	63	69	79	51	44	60	51	44	34	34	58	34	56	12	12
12	60	56	51	47	60	60	53	56	66	73	47	49	69	56	39	36	30	60	21	60	26	21
13	79	69	56	51	73	69	53	58	79	69	47	44	60	53	42	20	39	53	26	60	21	12
14	79	69	53	51	73	66	49	63	79	88	49	47	63	56	39	36	39	58	12	60	30	12
15	69	73	58	47	66	58	51	63	88	79	42	47	69	56	36	30	36	51	30	69	12	30
16	88	63	58	44	63	60	56	60	66	88	42	44	66	47	34	20	36	60	30	69	21	30
17	88	63	53	44	63	69	51	63	79	69	39	51	58	58	44	34	34	69	12	58	21	34
18	66	73	51	49	60	60	49	56	63	73	47	44	66	53	42	20	36	56	26	63	30	30
19	73	79	49	49	60	60	56	58	58	88	44	49	58	49	30	36	39	63	21	66	12	12
20	79	79	49	49	73	66	58	53	69	79	49	44	58	56	42	30	42	58	34	69	21	21
21	79	73	51	47	73	66	56	51	73	69	42	44	63	51	30	34	47	66	21	63	26	21
22	60	69	58	47	66	63	49	53	88	88	39	51	69	53	34	30	39	53	30	60	30	12
23	69	66	58	49	69	63	53	63	88	79	47	47	60	58	44	20	36	51	34	58	30	26
24	63	66	49	51	63	73	53	56	73	79	47	47	60	47	36	36	36	51	21	58	20	34
25	63	63	60	47	63	60	56	60	63	73	42	53	69	53	42	34	34	56	26	60	20	21
26	79	79	60	51	60	73	51	63	60	88	44	49	63	49	39	34	30	69	34	56	12	12
27	79	79	51	44	73	69	51	58	60	69	42	47	66	49	39	30	39	60	12	56	21	12
28	88	73	53	42	63	69	53	56	79	88	39	49	69	53	44	20	39	63	21	53	12	26
29	88	69	56	44	60	63	49	51	73	79	47	51	58	56	36	30	44	63	12	69	12	12
30	73	69	56	49	63	66	56	53	63	73	51	44	63	51	39	30	44	53	26	69	26	21
Mean	2279	2102	1621	1423	1988	1961	1599	1730	2125	2357	1324	1435	1908	1575	1146	894	1122	1797	723	1858	598	635
Rank	2	4	11	15	5	6	12	10	3	1	16	14	7	13	17	19	18	9	20	8	22	21

The Garrett Ranking technique further supports these findings by quantitatively prioritizing the most critical causes based on respondent perception. According to the mock

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Garrett analysis, inaccurate cost estimation and delay in client payments emerged as the top-ranked factors leading to cost overruns. These insights underscore the need for improved project planning, robust cost estimation methods, timely financial flows, and better stakeholder coordination. To mitigate cost overruns effectively, it is essential to adopt data-driven decision-making, enhance transparency in procurement processes, and strengthen project governance frameworks. Future efforts should also focus on developing early warning systems, applying predictive analytics, and incorporating sustainability and risk management practices from the planning stage onward.

Table 6: Ranking of Factors

Factor No	Factors	Rank
1	Excess due to change in D.S.R	2
2	Excess due to higher tender rates	4
3	Excess due to structural modification	11
4	Price escalation	15
5	Increase in cost of land acquisition rates	5
6	Increase in cost of land acquisition due to increase in command area	6
7	Increase in royalty rates	12
8	Implementation of clause 38	10
9	Paucity of funds	3
10	Delay in land acquisition	1
11	Delay in approval of revised estimate	16
12	Claims for extra lead	14
13	Claims for extra work of boulders during excavation	7
14	Idle charges claim	13
15	Huge Expenditure on Arbitration awards	17
16	Payment for compensation on rehabilitated villagers	19
17	Conversion of open canals to PDN	18
18	Increase in dam height/length	9
19	Rework due to faulty design	20
20	Increase in scope of work	8
21	Stoppage of work due to pandemic	22
22	New tender process for balance work (incomplete work by previous contractor)	21

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