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SUPREME AUDIT INSTITUTION OF INDIA
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National Academy of Audit & Accounts

MANTHAN: JOURNAL OF PUBLIC SECTOR AUDITING AND ACCOUNTING OF SAI INDIA

VOLUME 1, ISSUE 2
MAY 2026

JOURNAL OF THE INDIAN AUDIT & ACCOUNTS DEPARTMENT

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About the Journal

Manthan is a biannual academic journal that commenced publication in 2025. The journal is published both in print and online format and serves as a platform for disseminating new ideas, methodologies, and insights, covering areas such as performance audits, financial reporting reforms, data analytics in audits, climate and sustainability auditing, and global developments in public financial management. Articles published in Manthan are presented in English to promote rigorous research, informed discourse, and knowledge dissemination among academicians, practitioners, and policymakers.

Starting Year, Frequency and Format of Publication

Starting Year: 2025
Frequency: Biannual
First Issue: November 2025
Format of Publication: Print and Online

Aim

To serve as a leading platform for advancing thought, research, and discourse in public sector auditing and accounting—fostering professional excellence, integrity and innovation within the Indian Audit and Accounts Department and beyond. It will cover principles, practices and innovations in the field of Auditing and Accounting. The Primary goals include nurturing the research potential within IA&AD and ensuring rigorous peer-reviewed publications to promote high standards of scholarship.

Scope

The scope of the Journal includes, but is not limited to, the following broad areas:
1. Public Sector Auditing
2. Government Accounting and Financial Reporting
3. Public Financial Management and Fiscal Governance
4. Information Systems and Technology in Audit and Accounts
5. Sectoral Studies and Thematic Audits
6. Comparative and International Perspectives in Accounting and Auditing
7. Ethics, Governance and Institutional Capacity

Nature of Contributions

The Journal welcomes:
- Original research papers
- Policy analysis and conceptual articles
- Case studies and documented best practices
- Practitioner perspectives and field-based insights
- Review articles and thematic commentaries

Multidisciplinary Subjects

- Audit
- Commercial and Government Accounts
- Public Sector Fiscal Management
- Governance

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DESK OF THE EDITOR IN CHIEF

Shri S. Alok

Director General

National Academy of Audit and Accounts

It is with a sense of pride and continued responsibility that I present the second issue of Manthan: Journal of Public Sector Auditing and Accounting of SAI India, the academic journal of the Indian Audit and Accounts Department, published by the National Academy of Audit and Accounts, Shimla. The successful launch of the inaugural issue in November 2025 by the Comptroller & Auditor General of India marked an important milestone in our journey toward fostering a culture of scholarly engagement within the Indian Audit and Accounts Department and beyond. The encouraging response it received has strengthened our resolve to carry this initiative forward with greater depth and diversity. An important milestone for this issue of Manthan is that we have now obtained an International Standard Serial Number (ISSN) for its print version. This is also a testament to the standards that the journal follows, starting from its first edition.

In this edition, Manthan continues to uphold its commitment to advancing discourse in public sector auditing and accounting by bringing together contributions that span a wide spectrum of domains. The articles featured in this issue reflect the expanding frontiers of audit, covering areas such as the use of software in works audit, urban local bodies' accounts and audit, comparative perspectives on commercial and government auditing, and financial accountability in autonomous bodies. Contemporary themes such as sustainability reporting audit, environmental audit of the steel industry, introduction of biometric systems, gender auditing, audit analytics in India's electricity sector, and the application of Artificial Intelligence and Machine Learning techniques in IT audit for public sector auditing further underscore the journal's relevance in a rapidly evolving governance landscape.

We are delighted to feature scholarly work from Officer Trainees of the Indian Audit and Accounts Service (IA&AS), alongside contribution from C&AG of India's knowledge partner, the National Institute of Urban Affairs (NIUA), reflecting a meaningful step towards institutional collaboration, knowledge exchange and the confluence of academic insight and a meaningful engagement.

I extend my sincere appreciation for the esteemed members of the Editorial Board, who guide the journey of Manthan, at all times. I also congratulate all the authors for their thoughtful contributions and thank the reviewers for their rigorous and constructive evaluations, which continue to uphold the quality and integrity of the journal. As Manthan progresses, we remain committed to strengthening its academic standing and expanding its reach. It is our earnest hope that the journal will continue to grow as a forum for critical reflection, innovation, and excellence in public sector auditing and accounting. I convey my best wishes for the continued success of future editions and for Manthan to emerge as a respected voice in the global discourse on audit, accountability and governance.

S. Alok

S. Alok
Editor-in-Chief and Director General, National Academy of Audit and Accounts

ARTICLE 1

Use of IITPAVE Software in Works Audit

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Altamash Ghazi*

Received: 12 January 2026 **Accepted: 26 March 2026**

Abstract
Works audit conducted by the field audit offices of the Comptroller and Auditor General (CAG) plays a critical role in assessing whether Public Works Departments (PWDs) have planned, designed and executed road projects in an economical, efficient and technically sound manner. A key component of such audit is the scrutiny of pavement design, as deficiencies at the design stage often result in premature road failures or avoidable expenditure. With the adoption of Mechanistic–Empirical pavement design under IRC:37, PWDs now rely extensively on the IITPAVE software for preparation and approval of Detailed Project Reports (DPRs). This article explains the relevance and application of IITPAVE software in works audit. It outlines the audit methodology for examining pavement design adequacy, compliance with IRC guidelines, correctness of design inputs such as traffic, subgrade strength and the economic justification of pavement layer thicknesses. During 2022–23 to 2024–25, the study demonstrates how IITPAVE enables auditors to independently analyse pavement structures and evaluate alternative design scenarios. Audit application of IITPAVE across four road projects identified avoidable expenditure of approximately ₹7.67 crore arising from excess granular layer thickness, non-economical subgrade improvement measures and failure to account for existing pavement layers during strengthening works.

Keywords
Indian Roads Congress, CBR, Million Standard Axles (MSA), DPR, Pavement Design, IITPAVE, Flexible Pavement, Works Audit and Civil Audit.

1.1 Introduction

In accordance with Para 4.1.11 of the Manual of Standing Orders (Audit), an essential element of works audit is the scrutiny of sanctions, to ensure that expenditure on a work is supported by a sanctioned detailed estimate. The sanctioned estimate thus defines the approved scope, quantities, design and cost of a work and forms the primary benchmark for audit scrutiny. Further, Para 46.3.4.3 of the Civil Audit Manual, Vol-II, West Bengal requires a complete examination of selected works to verify that the estimate has been prepared to satisfy the actual technical requirements of the work. Audit is also required to compare sanctioned quantities and designs with actual execution to ensure that no material alteration or excess provision has been made.

In the case of road works, the pavement design contained in the Detailed Project Report (DPR) is a critical component of the sanctioned estimate, as the thickness and composition of pavement layers directly determine project cost and performance. With the adoption of Mechanistic–Empirical

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pavement[1] design under IRC:37, Public Works Departments (PWDs) now prepare and approve flexible pavement designs using the IITPAVE software[2]. Consequently, scrutiny of the sanctioned estimate and DPR, as envisaged in Para 4.1.11 of MSO, necessarily entails examination of IITPAVE-based flexible pavement design calculations. While Para 46.3.4.3 of the Civil Audit Manual and West Bengal PWD SoR 2018 are West Bengal specific, the IITPAVE based audit methodology is applicable wherever IRC:37 is used. Auditors in other jurisdictions may substitute their local manuals.

Use of IITPAVE in works audit enables Audit to independently verify whether the flexible pavement design underlying the sanctioned estimate is technically adequate, compliant with Indian Roads Congress (IRC)/Ministry of Road Transport & Highway (MoRTH) guidelines and is economical and to also identify cases of unsafe design, overdesign, excess layer thickness or avoidable subgrade upgradation leading to expenditure beyond the legitimate scope of sanction.

Flexible pavement consists of layers, from bottom to top, namely Earthwork (Subgrade), Granular Sub-base (sand, stone dust, moorum *etc.*), Granular Base (Wet Mixed Macadam, Water Bound Macadam), Bituminous layer (Bituminous Macadam, Dense Bituminous Macadam etc) and Bituminous wearing course (Semi-Dense Bituminous Concrete, Bituminous Concrete, Mastic Asphalt *etc*.).

1.2 Background

Pavement design in India was traditionally based on empirical methods. These methods primarily use the load-bearing capacity of the subgrade, expressed as the California Bearing Ratio (CBR) obtained from laboratory tests, along with historical and projected traffic loads measured in million standard axles (msa). While empirical designs are simple to apply, they offer limited flexibility and do not explicitly evaluate the structural behaviour of pavement layers under traffic loading.

To overcome these limitations, the Indian Roads Congress (IRC) introduced a shift towards a Mechanistic–Empirical (M–E) pavement design approach. This approach evaluates pavement performance by computing critical stresses, strains and deflections generated within pavement layers due to wheel loads. In this context, IRC:37 introduced the IITPAVE software as a standard tool for mechanistic analysis of flexible pavements. Its use was first formalised in IRC:37–2012 and subsequently strengthened in IRC:37–2018, which recommends the use of flexible pavement design using IITPAVE. The software is supplied along with the IRC:37 guidelines.

Under the earlier Design Catalogue approach (Chart 1.1), pavement compositions are selected from predefined tables corresponding to broad ranges of traffic and subgrade strength.

[1]The mechanistic-empirical method is based on the mechanical properties of the pavement materials that give a relation between the input, in the form of loading, and the output, in the form of stresses and strains in the pavement.

[2] IIT PAVE is a specialized software developed by IIT Kharagpur (under MORTH research) for analyzing and designing flexible pavements using IRC:37-2012 guidelines. It models pavements as multi-layer elastic systems, calculating critical stresses, strains, and deflections to evaluate fatigue and rutting life.

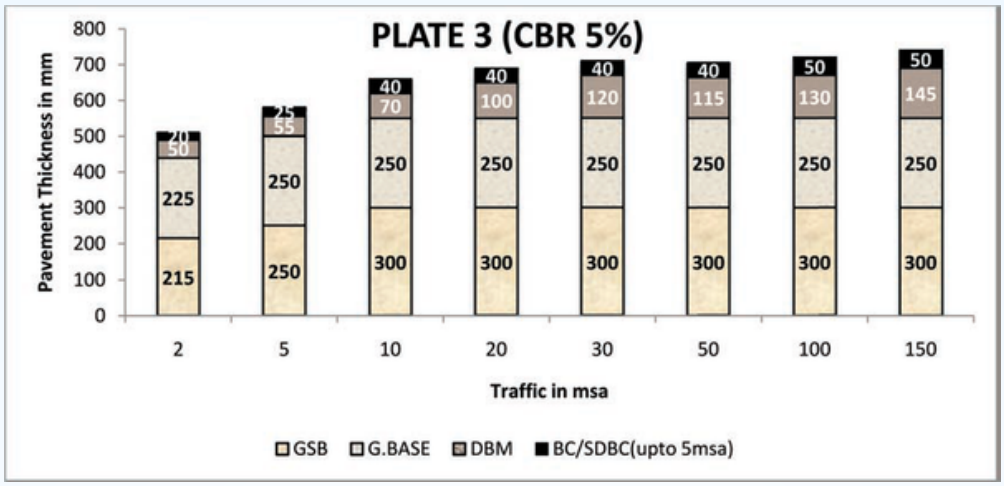

Chart 1.1: Design Catalogue (Source: IRC : 37-2018)

In contrast, IITPAVE enables project-specific pavement design by calculating critical structural responses, namely the horizontal tensile strain at the bottom of the bituminous layer (governing fatigue cracking) and the vertical compressive strain at the top of the subgrade (governing rutting). This allows designers to assess pavement safety and optimise layer thickness based on actual site conditions rather than relying solely on standardised sections.

PWDs in several States, including West Bengal, now explicitly mandate IITPAVE-based analysis in the preparation of DPRs, tender documents and technical sanctions. Consequently, for maintaining technical parity and audit credibility, Works Audit must also adopt IITPAVE wherever issues relating to pavement design adequacy, choice of materials, layer thickness or subgrade upgradation are under examination.

1.3 Understanding IITPAVE

IITPAVE software for flexible pavement design was developed by the Transportation Engineering Division at the Indian Institute of Technology (IIT) Kharagpur, as an advanced, Mechanistic-Empirical tool for analysing pavement structures based on Indian Roads Congress (IRC) guidelines, replacing older methods. It's used by engineers for accurate design by modelling layer stresses, strains and performance under traffic and environmental conditions, helping create more durable roads. The structural analysis performed by IITPAVE is fundamentally based on the Multi-Layer Elastic Theory. The software requires precise material inputs for every defined layer. These inputs include the Resilient Modulus[3] (M_R) and layer-specific Poisson's Ratio[4] (v).

The software calculates the structural responses (stresses, strains and deflection) resulting from traffic load. Fatigue crack (Figure 1.1) often initiating at the bottom of the bituminous layer and propagating upwards, is a load-related distress mechanism caused by repetitive tensile strain. The critical structural response that governs this failure is the horizontal tensile strain (ε_t) computed by IITPAVE at the bottom interface of the lowest bituminous layer.

[3]The resilient modulus is a key parameter that quantifies the elasticity and stiffness of the pavement layers under repeated loading.
[4] Poisson's Ratio is a measure of a material's deformation when subjected to stress. It is defined as the ratio of lateral strain (deformation perpendicular to the applied force) to axial strain (deformation parallel to the applied force).

Figure 1.1: Crack of pavement due to Fatigue strain

Source: https://uppwd.gov.in/site/writereaddata/siteContent/20190424201015351912.pdf

There is another kind of failure known as rutting (Figure 1.2). Rutting represents the accumulation of irrecoverable plastic deformation primarily within the unbound granular and subgrade layers, leading to depressions in the pavement surface. The structural response that dictates this failure mode is the vertical compressive strain (ε_v) computed at the critical location, the top of the subgrade layer.

Figure 1.2: Surface depression due to rutting strain

(Source:https://uppwd.gov.in/site/writereaddata/siteContent/20190424201015351912.pdf

A pavement is considered safe if IITPAVE-computed strains are below allowable limits, calculated using IRC-prescribed fatigue and rutting equations. These strains are measured at critical locations in the pavement. The locations are marked as I and II in Figure 1.3.

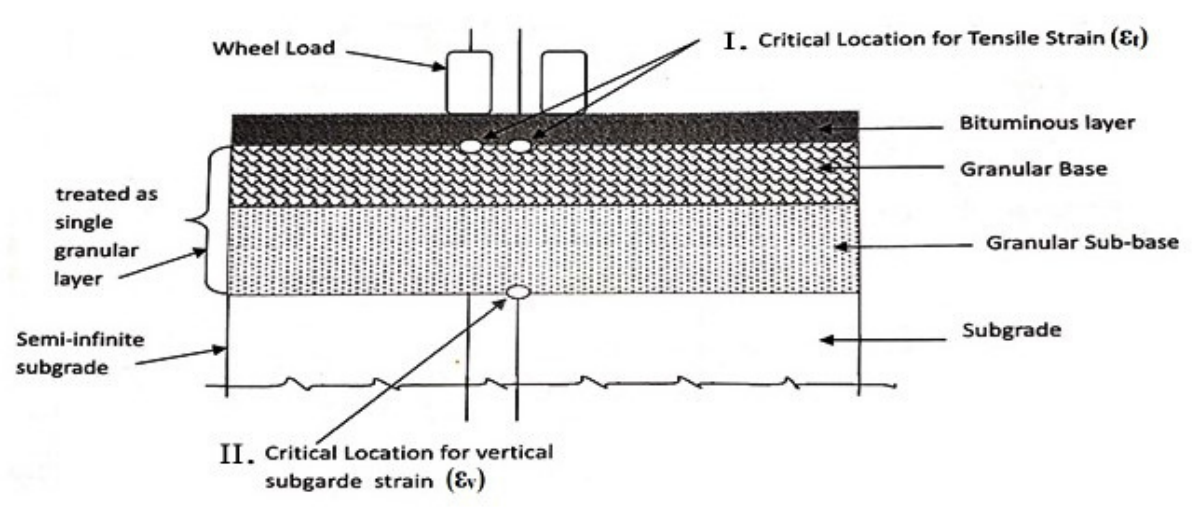

Figure 1.3: Horizontal tensile strain and vertical compressive strain

(Source: IRC: 37-2012)

Moreover, in some cases, there can be a significant difference between the CBR values of the soils used in the subgrade and in the embankment layer below the subgrade. Alternatively, the subgrade may be laid in two layers, each layer material having different CBR value. In such cases, the design should be based on the effective CBR value of a single layer subgrade which is equivalent to the combination of the subgrade layer(s) and embankment layer.

Using IITPAVE software, the maximum surface deflection (expressed as 'δ') can be determined and the effective Resilient Modulus (M_R) of the equivalent single layer and consequently the effective CBR of the combined layer is derived using the equations provided in IRC:37. These are then used to calculate ε_v and ε_t.These values are then used to determine if they are below the allowable limits prescribed by IRC.

Thus, IITPAVE provides a comprehensive framework for assessing structural adequacy, safety and economy of pavement designs, making it a powerful tool not only for designers but also for audit scrutiny of DPRs and sanctioned estimates.

1.4 Use of IITPAVE in Audit

For independent verification of pavement designs using IITPAVE, audit teams obtain the required design inputs from primary engineering records maintained by the executing department. The principal inputs include subgrade strength (CBR), projected traffic load (msa), pavement layer thickness and material properties such as resilient modulus (MR) and Poisson's ratio (ν). These parameters are typically derived from the Detailed Project Report (DPR), laboratory test reports, traffic census data and technical sanction documents.

Use of IITPAVE in works audit enables derivation of technical and financial audit observations relating to design adequacy, IRC compliance, economy of pavement composition and avoidable expenditure on subgrade improvement, as detailed below.

(i) Inadmissible / Unsafe Designs in DPR

Audit may establish:

- DPR not prepared scientifically,
- strains exceeded allowable values,
- inadequate design leading to premature distress.

(ii) Verification of Departmental Compliance with IRC Guidelines

Check whether DPR or design approval:

- followed IRC:37-2012 or 2018,
- used IITPAVE when required,
- used correct input parameters for CBR, M_R (Resilient Modulus), traffic loading and Poisson's ratio.

(iii) Excess Layer Thickness / Non-economical Pavement Design

Audit can use IITPAVE to demonstrate:

- thinner pavement structure is sufficient, or
- PWD used non-optimal combination of layer thicknesses (as detailed in Annexure -1)

(iv) Avoidable Expenditure on Subgrade Upgradation

By calculating effective CBR, Audit can verify:

- correctness of material chosen for improving subgrade,
- whether cheaper alternatives could achieve the same CBR (as detailed in Annexure-2),
- excess cost due to over-thickening of subgrade-improvement layers.

1.5 Rationale for Using IITPAVE in Audit

I. PWD itself uses IITPAVE for DPR preparation, tender conditions and technical estimates. Therefore, audit observations gain legitimacy when based on the same tool.

II. IITPAVE enables calculation of continuous values not discrete values (catalogue-based), optimisation of pavement thickness, helping identify excess layering.

III. The tool calculates effective CBR, enabling Audit to verify whether the selected material for subgrade upgradation was economical and technically justified.

1.6 IITPAVE Application

In the following cases, IITPAVE software was applied by audit to independently verify pavement design parameters and assess compliance with Indian Roads Congress (IRC) guidelines, thereby enabling identification and quantification of avoidable expenditure.

A) Reference- Audit Reports:

i) Excess thickness of non-bituminous layers (Audit Report 2023-24): Audit used IITPAVE to analyse traffic loading, sub-grade strength and design requirements as per IRC norms and compared the technically required thickness of non-bituminous layers with the thickness actually executed. The analysis revealed execution of excess thickness beyond design necessity, resulting in avoidable expenditure of ₹2.15 crore.

ii) Selection of non-economical borrowed material for sub-grade upgradation (Audit Report 2024-25): IITPAVE was applied to evaluate alternative pavement design scenarios using different sub-grade materials. The software analysis showed that the selected borrowed material led to a higher pavement cost compared to more economical options capable of meeting the same design requirements, resulting in avoidable expenditure of ₹1.79 crore.

B) Reference-Inspection Reports:

i) Non-consideration of existing pavement layer while providing Wet Mix Macadam (WMM). (Inspection Report 2023-24): Audit used IITPAVE to assess the pavement design by incorporating the existing layer strength and thickness into the design input parameters. The analysis demonstrated that failure to account for the existing layer led to unnecessary provision of additional WMM thickness, causing avoidable expenditure of ₹1.82 crore.

ii)Execution of excess thickness of granular layers (Inspection Report 2022-23): By inputting actual traffic and sub-grade parameters into IITPAVE, audit determined the optimum thickness of granular layers required as per IRC guidelines. Comparison with the executed thickness revealed excess provision of granular layers, resulting in avoidable extra expenditure of ₹1.91 crore.

1.7 Conclusion

Works audit of road projects necessarily involves technical scrutiny of pavement designs, as the DPR and sanctioned estimate are now predominantly based on IITPAVE calculations in accordance with IRC:37. By analysing critical structural responses such as fatigue and rutting strains, IITPAVE enables a more accurate assessment of pavement safety and performance than traditional reliance on empirical design tables alone. The software also facilitates optimisation of pavement layer thickness and material selection, helping to identify cases of overdesign, non-economical specifications and avoidable expenditure without compromising structural adequacy. Accordingly, use of IITPAVE in works audit strengthens the assessment of design adequacy, compliance with IRC guidelines, economy and effectiveness of flexible pavement works.

Data Availability
No new data has been introduced.

Ethics Statement
All necessary ethical and research integrity principles have been duly adhered to.

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Conflict of Interest
The authors declare no conflict of interest.

Acknowledgement

Field audit parties of the O/o Principal Accountant General (Audit-II), West Bengal.

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2. Indian Roads Congress. (2012). IRC:37-2012: Tentative guidelines for the design of flexible pavements.

3. Indian Roads Congress. (2018). IRC:37-2018: Guidelines for the design of flexible pavements.

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Annexure-1, Article 1

1. Objective

The objective of the audit examination was:

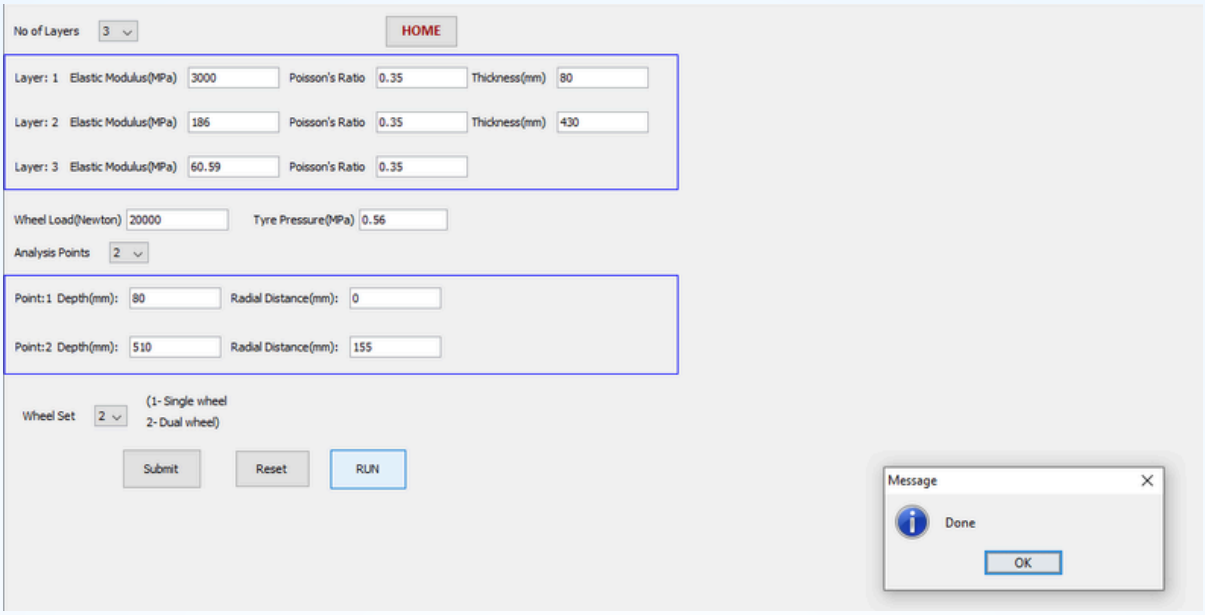
- To verify whether the pavement composition adopted in the DPR complied with **IRC:37–2018 design requirements**.
- To assess whether the **granular layer thickness provided by the department was technically necessary** for the projected traffic and subgrade strength.
- To determine whether **avoidable expenditure resulted from overdesign of pavement layers**.

1. **IITPAVE Inputs**

Following data which are required to run the IITPAVE software were collected from the DPR of the project and some standard data from IRC- 37:2018:

Category	**Value**	**Source**
CBR of subgrade soil	6.9%	DPR
msa	10 ((For design life 15 yrs of granular layers) 3.5 (For design life 5 yrs of bituminous layer)	DPR
Layers thickness (executed by the Department)	80 mm bituminous layers **480** mm Granular layers	DPR
Optimal Layers thickness arrived by audit through IITPAVE	80 mm bituminous layers **430** mm Granular layers	DPR
MR (Resilient Modulus)	3000 MPa (for Bituminous layers) 186 MPa (for Granular layers) 60.59 MPa (for Subgrade)	IRC: 37-2018
Poisson's ratio of pavement layers	0.35	IRC: 37-2018
tire pressure	0.56	IRC: 37-2018
wheel load	20000	IRC: 37-2018
Radial distance	155 mm	IRC: 37-2018

The screen shot of the IITPAVE inputs for the instant case is as follows:



2. **Computation of the allowable strains/stresses**

The allowable strains in the bituminous layer and subgrade for the projected traffic loads are estimated using the fatigue and rutting equation given in IRC-37:2018. The inputs to the equations are the design period of pavement in terms of cumulative standard axles (msa), the resilient modulus value of the bottom layer bituminous mix, and the volumetric proportions (air voids and effective binder) of the mix.

Allowable tensile strain (Fatigue),

$N_f = 1.6064*C*10^{-4}x[1/(\varepsilon_t)]^{3.89} x [1/M_{R\_Bituminous\ layer}]^{0.854}$ **(equation no. 3.3 of IRC-37:2018)**

Where,

$N_f = 3500000$

$C = 10M$, and $M = 4.84\ (Vbe/Va+Vbe-0.69)$

$Va = 4.5$, $Vb = 10.5$

ε_t = maximum horizontal tensile strain at the bottom of the bottom bituminous layer

$M_R = 3000$

Hence, ε_t (allowable tensile strain) = **0.0004117**

Allowable vertical subgrade strain (Rutting),

$N_R = 4.1656 \times 10\text{-}08\ [1/\varepsilon_v]\ 4.5337$ **(equation no. 3.1 of IRC-37:2018)**

where,

$N_R = 1000000$

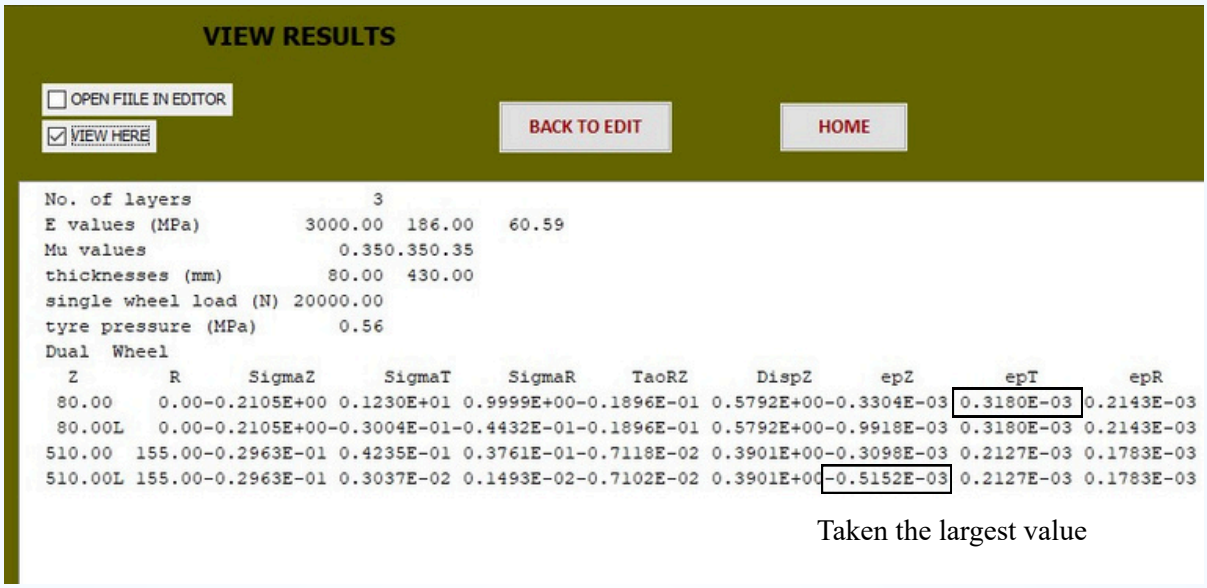
Hence, ε_v (allowable vertical subgrade strain) = **0.0005300**

3. **IITPAVE run**

The IITPAVE software is an elastic multi-layered programme which uses the inputs like the layer thicknesses, the layer moduli (MR), the layer Poisson's ratio values, the standard axle load of 80 kN distributed on four wheels (20 kN on each wheel), and a tyre pressure as 0.56 MPa. The program will output the stresses, strains and deflections at selected critical locations (at the bottom of bituminous layers and at the top of the subgrade) in the pavement from which the values of critical mechanistic parameters (epT and epZ) can be identified as permissible strains/stress for pavement design.

4. IITPAVE Outputs

The screen shot of the IITPAVE inputs for the instant case is as follows:



By running the IITPAVE software using the above-mentioned inputs, the IITPAVE outputs derived from which the largest value of epT which implies the permissible tensile strain (**εt)** and the largest value of epZ which implies the vertical subgrade strain (**εv**) derived as **0.0003180** and **0.0005152** respectively, and the IITPAVE generated strain/stress values are within the allowable limit (**0.0004117** and **0.0005300** respectively) as derived from the equation 3.3 and 3.1 of IRC-37:2018, hence, the pavement composition *i.e.* tried by audit using IITPAVE is safe for the road.

5. Comparison with Departmental Design and calculation of extra expenditure

Thus, it is observed that the Department had constructed 480 mm granular layers for the road, whereas audit by IITPAVE analysis established that 430 mm granular layers is safe for the road to withstand the projected traffic. Hence, the Department has executed 50 mm excess granular layers incurring an expenditure of ₹ 2.15 crore.

Calculation of extra expenditure

Excess Quantity executed for granular layers	9,991.75 m3
Item rate allowed including 1% cess	₹ 2,508.11 per m3
Extra expenditure	₹ 2,50,60,408
Less: Contractual rebate (14.26%)	₹ 35,73,614
Net extra expenditure	₹ **2,14,86,784**

Annexure-2, Article 1

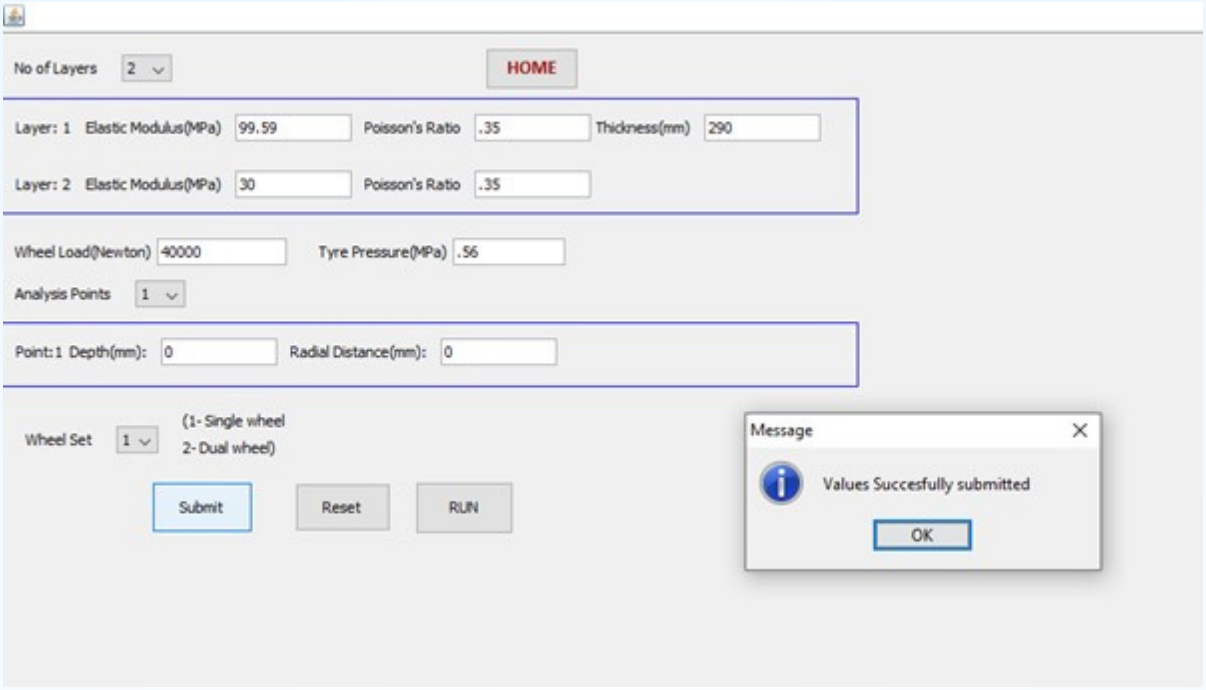
IRC : 37-2018 recommends that the subgrade CBR should be more than 5% in the year of construction of the pavement.

PWD Department executed a widening and strengthening works of a road, and it is observed that the CBR value of existing subgrade was 3% and to upgrade the CBR of the road, 500 mm medium sand layer which has a CBR value 10% was laid on the existing subgrade, resulting in effective CBR values of 6.97 % (analysed by the department through IITPAVE) for the combined subgrade.
Audit tested using IITPAVE software, a mixture of stone dust and fine sand in a 3:1 ratio (item No. 4.16 of PWD SoR-2018) as an alternative material to medium sand for subgrade upgradation. The analysis showed that the mixture of stone dust and fine sand would require lesser thickness of 290 mm to achieve the same effective CBR values obtained using 500 mm of medium sand. Furthermore, it was observed that the Department had already used the same 3:1 stone dust and fine sand mixture for sub-grade upgradation in another nearby road project.
Thus, the department has incurred an avoidable expenditure of ₹1.79 crore by selecting non-economical alternative material for the upgradation of sub-grade soil in road construction.

Use of IITPAVE by audit is detailed below:
The existing subgrade CBR-3%
CBR of stone dust and fine sand mixture-15%
Trial thickness - 290 mm
Wheel load-40000 N
Contact pressure – 0.56 MPa
Using these inputs in IITPAVE software, the maximum surface deflection ('δ') derived **2.414**, **putting this value in the formulas as stated above get the effective CBR 7.04% i.e. more than that the effective CBR achieved (6.97%) by the department using 500 mm medium sand.**

The input and corresponding output of IITPAVE are given below:
CBR of existing subgrade = 3%
CBR of a mixture of Stone Dust and Fine Sand (mixed in proportion of 3:1 by volume) = 15%.
Trial thickness 290 mm.
Resilient Modulus of existing Sub grade = 10 X 3= 30 (Eqn. 6.1 of IRC:37-2018)
Resilient Modulus of GSB(Mix of stone dust & fine sand) = 17.6 X 15^0.64 = 99.59
(Eqn. 6.2 of IRC:37-2018)

Deflection (δ)	**2.414** (Disp Z of the IIT pave reading below)
Poisson Ratio (μ)	**0.35**
Tire pressure (p)	**0.56** MPa
Radial distance (a)	**150.8 mm**
MR Subgrade = $\frac{2(1-\mu 2)\, pa}{\delta}$	2*(1-poisson ratio^2)*0.56*150.8/deflection; =148.206/2.414=61.39
CBR > 5	MR of Subgrade =17.6*(CBR)^0.64
	61.39=17.6*(CBR)^0.64
	Then CBR= 7.04% i.e. higher than design CBR.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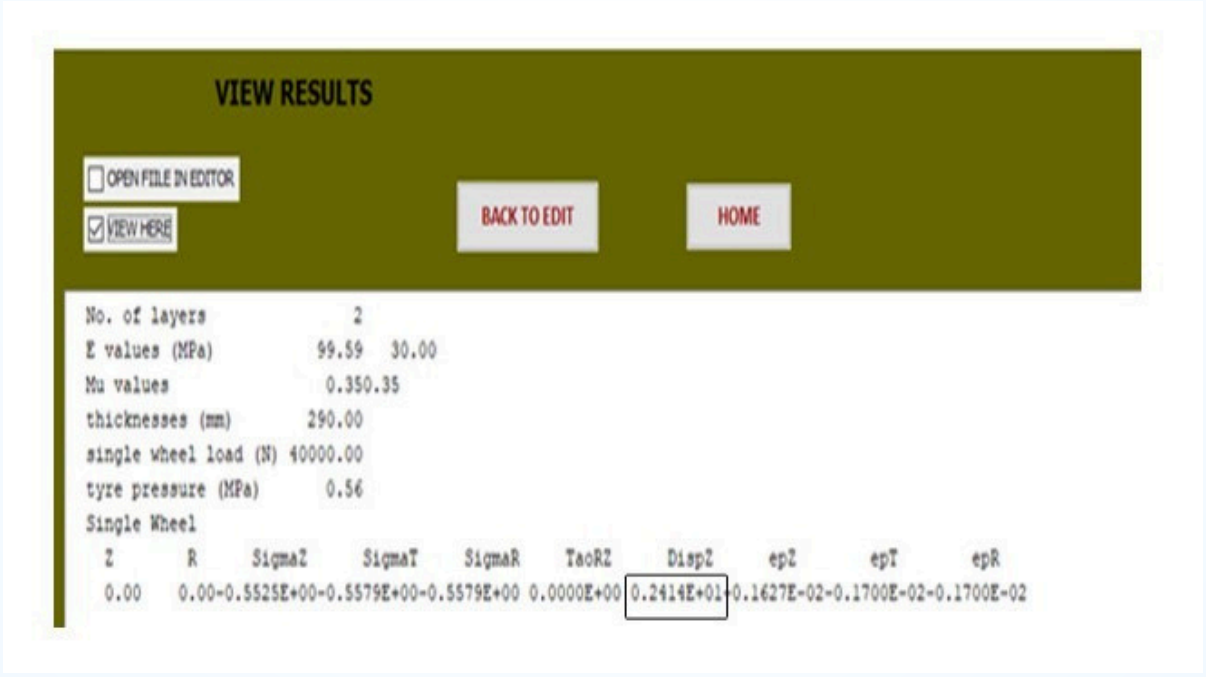
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tyre pressure (MPa) 0.56
Single Wheel
Z R SigmaZ SigmaT SigmaR TaoRZ DispZ epZ epT epR
0.00 0.00-0.5525E+00-0.5579E+00-0.5579E+00 0.0000E+00 0.2414E+01-0.1627E-02-0.1700E-02-0.1700E-02

ARTICLE 2

India's Urban Local Bodies Accounts and Audit: Challenges and Way Ahead

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Abstract

India's urbanisation trajectory has placed increasing pressure on Urban Local Bodies (ULBs) to deliver essential services efficiently and manage public finances responsibly. Cities already generate a significant share of the country's economic output, and their effective governance depends heavily on robust financial management systems. This article examines the state of accounting and audit practices in India's ULBs through a rigorous survey of the existing literature, highlighting their importance for transparency, fiscal discipline, and improved urban governance. Sound accounting systems enable municipalities to track revenues and expenditures, manage assets and liabilities, and enhance credibility with citizens, regulators, and financial institutions. They are also crucial for accessing central government grants and capital markets, including municipal bonds. Despite reforms such as the National Municipal Accounting Manual and increasing availability of audited accounts through national initiatives, significant challenges persist. These include limited professional accounting capacity within ULBs, fragmented financial management systems, inconsistent adoption of accrual accounting, weak follow-up on audit observations, and political resistance to revenue-related reforms. Smaller municipalities also face resource and scale constraints in maintaining modern financial systems. The article argues that future reforms should focus on state-wide institutional reforms, stronger fiscal incentives linked to audited accounts, integrated digital financial management systems, professionalisation of municipal finance cadres, and greater public disclosure. Embedding accounting and audit within a broader public financial management ecosystem is essential to strengthen accountability, improve service delivery, and enhance the creditworthiness of India's cities.

Keywords

Municipal accounting, Municipal Audit, Municipal Finance, Financial Management and National Municipal Accounting Manual.

2.1 Introduction

India is moving on an upward urban trajectory. The country's economic growth and development depend on its cities. About 31.2 per cent of its population lived in urban areas in 2011, which is projected to reach 39 per cent in 2036 (MoHFW GoI, 2020). About 60 per cent of India's GDP is generated in its cities (NITI Aayog, 2022). Moreover, the economic fulcrum of the country is located in urban areas.

The Census of India, distinguishes urban settlements into 'statutory towns' and 'census towns' to capture both the legal-administrative and functional dimensions of urbanisation. Urban development in India is a state subject. Accordingly, statutory towns are settlements that have been formally notified as urban by a state government under a municipal or local government law. The ULBs which constitute a Municipal Corporation, Municipal Council (Municipality), Nagar Panchayat, Cantonment Board, or Notified Area Committee, are statutory bodies with councillors who are elected for a fixed term.

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Their urban status is based on legal recognition, not on demographic or economic criteria alone. In the 2011 Census, India recorded 4,041 statutory towns, which together formed the country's municipal governance system. Census Towns[1], by contrast, are administratively rural settlements that meet specific demographic and economic thresholds prescribed by the Census by way of which these settlements are designated as urban. In 2011, the Census identified 3,892 Census Towns, a sharp increase from 1362 in 2001 (Census 2011), reflecting the rapid "in-situ" urbanisation of large villages and peri-urban areas. Together, statutory and census towns accounted for 7,933 urban settlements, highlighting the dual nature of India's urban transition: one driven by formal municipal expansion and the other by functional urban growth outside the municipal framework.

Between 2011 and now, about 1000 statutory towns, aka ULBs, have been notified. At present, there are 5006 statutory towns; of these, 264 are Municipal Corporations, 2010 are Municipal Councils, and 2400 are Nagar Panchayats (LGD Directory, Government of India, 2026). The ease of doing business and quality of life in these cities depend on how well the ULBs govern these cities and provide the basic services.

2.2 Importance of Accounting and Audit for ULBs

Accounting and Auditing are vital for Urban Local Bodies (ULBs) to ensure the efficient management of public funds and the transparent delivery of essential urban services. Robust financial systems enable ULBs to track income and expenses accurately, ensuring that financial resources are allocated to the most critical urban needs. Most ULBs across the country also own huge assets in terms of public infrastructure, land and buildings. Maintaining a proper assets register becomes very important for a credit rating. Regular accounting helps ULBs manage their vast portfolio of assets (like land and buildings) and keep track of long-term liabilities. The associated challenge is not only to strengthen the fiscal infrastructure in terms of accounts and audit mechanisms for the existing ULBs, but to create a framework that can be easily adopted by the new ULBs as they make a statutory transition from rural to urban.

Periodic financial statements and independent audits provide a credible frame of reference for citizens, regulators, and stakeholders to verify that public money is being used as intended; hence, enhancing public trust. Audits are essential for detecting and preventing fraud, corruption, and financial mismanagement by identifying deviations from established financial regulations.

Moreover, modern accounting is often a mandatory reform condition for receiving central grants, such as those from the Central Finance Commission or under the AMRUT mission. Reliable financial reporting enhances the credit ratings of ULBs, making them more attractive to institutional investors and lenders. Timely and standardised audited accounts are a prerequisite for ULBs to enter capital markets or issue municipal bonds, which are critical for funding large-scale infrastructure.

The National Municipal Accounting Manual (NMAM) was formulated in 2004 with the aim of uniform accounting practices and structure across India's ULBs. However, the same has not been achieved across India's ULBs (Sixteenth Finance Commission, 2026). Based on the data available on the cityfinance.in portal[2], 66 per cent of ULBs follow accrual accounting, 21 per cent cash accounting and 13 per cent mixed cash-accrual accounting. This lack of uniformity is primarily because a uniform municipal accounting framework is not statutorily mandated.

The conditionality requiring the publication of audited accounts for availing the 15th Finance Commission grants resulted in greater number of ULBs adopting the practice over the last five years. Audited accounts of more than 80 per cent of ULBs are available on the cityfinance portal (Janaagraha 2026).

Despite the existing efforts (Box 1), there are gaps in terms of the years for which the accounts are available for some ULBs, and in the information shared in the financial statements as data is missing for some accounting heads due to lag in recognising outstanding expenses, non-disclosure of contingent liability, lack of proper system of recognising receivables/ arrear income, irregular reconciliation of the bank book with the cash book, weakness in conducting physical verification of cash, stock and fixed assets (Agarwal 2020[3]).

[1]A place is classified as a Census Town if it satisfies all three conditions:
a. a minimum population of 5,000, b. at least 75 percent of the male main working population engaged in non-agricultural activities, and c. a population density of at least 400 persons per square kilometre. These settlements do not have an urban local body and continue to be governed as rural areas, typically by Gram Panchayats, despite exhibiting urban characteristics.
[2]The portal is said to cover 97 per cent of India's ULBs (16th Finance Commission)
[3]https://cpgfm.icai.org/wp-content/uploads/2022/10/Accounting-System-of-the-Urban-Local-Bodies-Issues-Challenges.pdf

Moreover, the usage of multiple basis of accounting (cash-based, accrual-based, mixed), sometimes even for the same ULB across the years, questions the reliability and diminishes the utility of the financial statements.

To bring about uniformity in accounting practices, the Accounting Standards for Local Bodies (ASLBs) issued by the Institute of Chartered Accountants of India comprise a comprehensive suite of 31 standards, of which 30 are accrual-based and one pertains to the cash basis (Box 2). But it is not mandatory for the ULBs across states, to follow these standards as yet.

Box 1: Efforts by the States and Union Governments in Financial Management

An important, practice-oriented dimension of municipal accounting reform has been the widespread adoption of Tally, a commercial off-the-shelf accounting software, by many states and ULBs as an interim or foundational digital platform. Beginning in the mid-2000s, several state governments—often in partnership with the Institute of Chartered Accountants of India—standardised Tally-based accounting templates aligned to their municipal accounting manuals. This approach offered a low-cost, rapidly deployable alternative to bespoke enterprise systems, particularly for small and medium ULBs with limited IT capacity. Over time some states successfully transitioned to more advanced, finance-integrated e-Governance systems typically treating Tally as a stepping stone rather than an end-state solution.

The 16th Finance Commission notes that "effort is currently underway at MoHUA to develop an Enterprise Resource Planning (ERP) solution for ULBs. It aims to facilitate the entry of financial transactions and the preparation of accounts in a manner integrated with the PFMS. MoHUA is also currently engaged in an effort to map the existing Chart of Accounts[4] (CoAs) of ULBs with the CoA of the Union Government. The Union Government has also announced an Urban Data platform for improved governance. The Commission recommends extending the digital platform's capabilities to support ULBs in preparing accounts and financial reports."

Box 2: Accounting Standard for Local Bodies (ASLBs) by Institute of Chartered Accountants of India

ASLBs establish a uniform financial reporting architecture for Urban Local Bodies (ULBs) covering presentation of the accounts (ASLB 1–3), assets such as property, plant and equipment and intangibles (e.g., ASLB 17, 31), revenue from both exchange and non-exchange transactions (ASLB 9, 23), liabilities and provisions (ASLB 19), and advanced areas such as consolidation, joint arrangements, and service concession agreements (ASLB 32–38).

A critical feature of the ASLB framework is its close alignment with the International Public Sector Accounting Standards (IPSAS) developed by the International Public Sector Accounting Standards Board. This mapping embeds globally accepted principles enabling comparability, transparency, and credibility. IPSAS alignment will enhance creditworthiness and investor confidence, particularly for instruments like municipal bonds. However, the true extent of ASLBs adoption needs to be better understood.

2.3 Challenges affecting ULB accounting and audit

Although the policy framework increasingly recognises the importance of robust financial accounting practices and high-quality audits, their impact is not optimal, as discussed in the NITI Aayog-ICAI (2023) study.

[4] It is a structured, organised list of every account in a company's general ledger, used to categorize financial transactions into assets, liabilities, equity, revenue, and expenses. It serves as a "financial roadmap" for reporting and tracking.

1. Capacity Constraints – Due to the absence of trained accounting professionals at the ULB level, ULBs rely on generalist staff for bookkeeping and on external Chartered Accountants for annual account conversion. This model undermines institutional memory and sustainability, as reforms often regress once consultants exit.

2. Fragmented Systems and Data Quality - Municipal financial management systems are frequently siloed. Property tax, water charges, payroll, procurement, and grants may be managed through separate software or manual registers, making reconciliation difficult. Weak data quality undermines both accounting accuracy and audit reliability.

3. Audit Fragmentation and Weak Follow-Up – There are parallel audit arrangements. Statutory compliance audits by statutory bodies like the CAG on one hand and financial statement auditors on the other. This creates gaps in accountability. Audit observations are rarely tracked through a formal Action Taken Report (ATR) mechanism, and there are limited sanctions for persistent non-compliance.

4. Political Economy of Revenue and Reform - Reforms that improve accounting transparency often expose inefficiencies in revenue collection, particularly in politically sensitive areas such as property taxation and user charges. Elected representatives may resist changes perceived as increasing the tax burden on constituents. This misalignment of political and administrative incentives can slow or dilute reform implementation.

5. Resource and Scale Constraints - Small and medium ULBs face acute resource limitations. Maintaining dedicated finance departments, professional staff, and modern IT systems is often financially unviable at the individual ULB level, necessitating shared or state-supported institutional arrangements.

2.4 Way Ahead

1) State-Wide Reform Models

One of the important findings of the NITI Aayog–ICAI (2023) study is that state-wide reform programmes outperform fragmented, ULB-by-ULB approaches. States that anchored reforms in Urban Development Departments or specialised municipal finance institutions achieved better scale, consistency, and sustainability. All states should adopt similar state-wide reform programmes.

Early-mover states such as Karnataka and Tamil Nadu adopted centralised project management units, standardised charts of accounts, and state-wide financial management software. These institutional arrangements enabled economies of scale in procurement, training, and audit coordination.

2) Incentives and Conditionality

The Fifteenth and Sixteenth Finance Commissions introduced a major policy shift by linking the release of basic and performance grants to the availability of audited annual accounts. The FC16 Report reinforces this approach, positioning accounting and audit compliance as core eligibility criteria for intergovernmental transfers. This has created a strong fiscal incentive for states and ULBs to prioritise financial reporting reforms.

3)Technology Adoption

Technology occupies a central place in the reform discourse, but it should be recognised as an enabler of sound accounting rather than as a panacea. Policy frameworks should prioritise finance-integrated municipal e-Governance systems that link budgeting, accounting, revenue management, procurement, payroll, and treasury functions.

Such integration enhances real-time financial control, strengthens audit trails, and enables the generation of performance dashboards that combine financial and service delivery indicators. Systems must be configured around standardised accounting principles and supported by trained personnel. From a policy perspective, this creates a bridge between financial compliance and outcome-based governance.

4) Human Resource Strategies
States need to invest in professionalisation of municipal finance cadres, including recruitment of qualified accountants, continuous training programmes, and career pathways within municipal services. External consultants should be used only strategically for system design and initial rollout, but long-term sustainability depends on building in-house expertise.

5) Citizen Interface
The ultimate beneficiaries of improved municipal accounting and audit systems are citizens. Public disclosure of audited financial statements, procurement contracts, and performance indicators transforms accounting data into a tool of democratic accountability.

Policy instruments should therefore mandate minimum standards for online publication of financial information and encourage the use of simplified, citizen-friendly formats. Participatory budgeting and social audit mechanisms can further strengthen the link between financial reporting and community oversight.

6) Continuity and Political Support
Reforms that enhance financial transparency often expose inefficiencies in revenue collection and expenditure management, generating political resistance. A realistic policy agenda must therefore incorporate stakeholder engagement strategies, including consultation with elected representatives, municipal associations, and civil society organisations.

Communication strategies that emphasise the developmental benefits of robust financial management —such as improved access to infrastructure finance and enhanced service quality—can help reframe reforms as enablers of political success rather than as administrative burdens.

2.5 Conclusion

To conclude, the overall policy challenge is no longer confined to persuading ULBs to adopt accrual accounting or to produce audited financial statements on a periodic basis. Rather, it lies in embedding accounting and audit within a broader, institutionalised public financial management ecosystem that supports strategic planning, performance management, and intergovernmental fiscal accountability on a sustained basis. These initiatives can enhance creditworthiness of ULBs to access the urban challenge fund to build Viksit Bharat by 2047.

Data Availability
None

Ethics Statement
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ARTICLE 3

A Comparative Study of Commercial and Government Auditing

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Abstract

The function of auditing is to provide an assurance to the owners of an entity that its financial statements and accounts give a true and fair view of the 'results' and the 'financial position'. This definition of auditing is very clear for the nature and scope of commercial auditing. The auditing is required because the owners of an enterprise delegate their powers to conduct the business to the 'management' or the 'administrators' of the entity, and therefore, there is information asymmetry between the management and the owners. The 'auditing system' for entities depends upon their 'objectives' and the 'accountability mechanism'. The 'objectives' and the 'accountability mechanism' of commercial enterprises and government are different. Therefore, the scope and types of audits for both entities are different. The 'accounting', 'auditing' and 'performance evaluation' help in ensuring 'accountability' of both the entities. The responsibilities of auditors of commercial enterprises and the government are different. The methodology adopted for different types of audits and the type of assurances given by auditors of both entities are different. This paper explores these differences in the audit of commercial enterprises and the government. In this process, it explores the basis of, and the need for the development of a theory, academic discipline and a profession for government auditing as distinct from those of commercial auditing.

Keywords

Commercial Auditing, Government Auditing, Profit, Market Mechanism, Legislative Control, Financial Audit, Compliance Audit and Performance Audit.

3.1 Introduction

Auditing is a function that helps ensure the accountability of 'management' to the authority responsible for 'control and supervision' of the entity, and ultimately to investors and the people (Bovens, 2007). Auditing is the collection of sufficient, appropriate evidence to prove assertions about economic actions and events, assess them with respect to the audit criteria, and report the audit findings to users (AAA, 1973). The auditor assures the readers of the 'financial statements' of an entity that all the assertions which arise on reading the financial statements are true and fair, both in form and spirit, and all the information that is material in inferring any financial assertion about the entity has been truly and fairly disclosed in the financial statements. This is an essential function of auditing for a commercial entity. However, the nature and function of auditing depend upon the objectives and the nature of the entity. Therefore, the nature and function of government auditing depend upon the objectives and the nature of the modern democratic government.

3.2 Need for Audit and Accountability Mechanism

With the development of corporate form of business organisation, there has been separation of 'ownership' and 'management' of enterprises. The ownership belongs to the investors or shareholders. The management belongs to the professional managers.

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The investors, to keep their funds invested in the organisation, should know the profitability, financial stability and liquidity management status. To know these factors for a corporate entity, the accounting profession has developed three instruments of General Purpose Financial Statements (GPFS) viz., Profit and Loss Statement, Statement of Financial Position or Balance Sheet and Cash Flow Statement.

To know about the efficient and effective performance and management of a commercial organisation, the single most important factor to be examined by the investors is the 'profitability' of the company during the year and over the years. The profitability of the company, along with its 'long term viability' and 'short term liquidity', can be examined by the analysis of its General Purpose Financial Statements if they are prepared truly and fairly. Auditing has been developed to give assurance to the investors in the capital market that the GPFS give a true and fair view of profit, financial position and liquidity of the enterprise (Hayes et al., 2005; Messier et al., 2008; GOI, 2013; Arens et al., 2017).

In the case of the modern state and government, with the transition from monarchy to democracy, there has been a separation of powers and responsibilities. The 'ownership' of the state in a democracy belongs to the 'people'. The management or 'administration' belongs to the 'executive government' elected by the citizens. The power and responsibility of 'supervision and control' over the executive government belongs to the elected 'legislative assembly'. To help the legislature and its committees, the responsibility of audit of financial and economic affairs of the state has been given to the Supreme Audit Institution, that is, the government auditors, by the Constitution of the State (INTOSAI, 1977; Pollitt et al., 2011; Mautz et al., 1961; Behn et al., 2001; Pollitt et al., 1997).

3.3 Objectives of the Study

The objectives of the study are to explore and examine (1) whether the skill sets required by the government auditors are wider and more varied than that required by the commercial auditor and, (2) whether there are sufficient justifications for development of a separate government auditing discipline to be taught in colleges and universities and a separate profession for (i) government auditors under SAIs, and (ii) other auditors doing audit of Local Government Institutions, Autonomous Public Bodies and Authorities, just like there is a separate academic discipline of commercial auditing being taught in colleges and universities and a separate, independent profession of Chartered Accountants under the Institute of Chartered Accountants of India (ICAI) for professional training, certification and management of professional conduct of commercial auditors in India.

3.4 Review of Literature

3.4.1 Commercial Auditing

American Accounting Association (1973) defined auditing as a systematic process of evidence collection and evaluation. It established auditing as an evidence-based assurance function focused on verifying assertions against criteria, forming the conceptual foundation for both commercial and government auditing.

Arens A. A. et al., (2017) explained the principles and practices of financial statement auditing. It established that commercial auditing is primarily concerned with assuring the truth and fairness of financial statements for investors.

Companies Act, Government of India (2013), regulates corporate governance and auditing. It defines a statutory audit framework for commercial enterprises in India.

Hayes R. et al., (2005) examined international auditing standards and assurance services. It demonstrated the standardisation of commercial auditing globally and its emphasis on financial reporting reliability.

Jensen M. C. et al., (1976) analysed agency theory in firms. It established that auditing mitigates agency problems arising from the separation of ownership and management.

The Mautz R. K. et al., (1961) developed a philosophical and theoretical framework for auditing. It identified auditing as an independent verification function rooted in accountability, emphasizing its role in bridging information asymmetry.

Messier W. C. Jr. et al., (2008) analysed audit risk, evidence, and audit methodology. It highlighted risk-based auditing as central to commercial audit, focusing on material misstatements and internal control evaluation.

3.4.2 Government Auditing

Behn R. D. (2001) explored performance measurement in government. It identified multiple dimensions of accountability and the complex nature of audit evaluation in the public sector. Bovens M. (2007), conceptualised public accountability in democratic governance. It defined accountability as a relationship involving information, discussion, and consequences, highlighting the complexity of government accountability compared to market-based accountability. Bozeman B. (2007) studied public values and governance. It emphasised that public sector performance must incorporate societal values beyond efficiency. Comptroller and Auditor General of India (various Reports) reports on the government finances and programs. Their reports demonstrate the extensive scope of government auditing in India, including performance and compliance audits. Funnell J. (1998) analysed the evolution of public sector auditing. It highlighted the shift from financial compliance to performance auditing in response to governance demands. Glynn J. (1991) studied accountability in public sector financial reporting. It emphasised that government auditing must address broader accountability beyond financial accuracy.

International Organisation of Supreme Audit Institutions (1977, Lima Declaration) defines principles of public sector auditing. It established the independence of Supreme Audit Institutions (SAIs) and expanded audit scope to include financial, compliance, and performance auditing. The National Institute of Public Finance and Policy (various studies) studies public finance and fiscal policy. They emphasise the importance of audit in improving public expenditure efficiency. Pollitt C. et al., (2011) examined performance auditing in modern governments. It found that government auditing plays a key role in evaluating efficiency, effectiveness, and governance outcomes. Power M. (1997) analysed the expansion of auditing in modern societies. It argued that auditing has evolved beyond financial verification into a broader governance mechanism, especially in the public sector. Reserve Bank of India (State Finance Reports) analyses the fiscal performance of states. They highlight the need for strong audit systems to ensure fiscal discipline. Schick A. (2003) analysed public expenditure management systems. It demonstrated the importance of audit in ensuring fiscal discipline and accountability in government budgeting. The Second Administrative Reforms Commission (2009) improved public administration systems. It recommended strengthening audit systems for better governance and accountability. Stiglitz J. (1999) examined the role of government in correcting market failures. It highlighted that government performance must be evaluated using welfare and equity metrics, not profit.

3.5 Synthesis of Literature and Research Gap

The literature review reveals two major insights viz., (i) Fundamental difference in objectives are that the commercial auditing focuses on profit-based accountability and government auditing focuses on multi-dimensional accountability; and (ii) The public sector auditing extend beyond financial verification and includes compliance and performance audit, policy evaluation and review of governance.

However, this reveals that the studies on commercial and government auditing have been mainly done separately. Comparative studies on two types of auditing together have not been done extensively. This study is an effort to fill this gap in the literature.

3.6 Methodology for the Study

To examine the objectives of the study, a comparative study of nature and scope of commercial and government auditing has been done along the following dimensions.
(a) Differences in their auditees, that is, a firm, and a government of State, are examined along the dimensions viz., (i) their objectives, (ii) the indicators of their performance and, (iii) their accountability institutions.

(b) The impact of differences in auditee profile for commercial and government audit on auditing profession and accountability framework has been examined along the following dimensions viz., (i) the separation of duties of three professions of accounting, auditing and financial analysis for commercial enterprises, (ii) the scope of roles of commercial auditor and government auditor, and their appointment, remuneration and independence, (iii) the methodology of audit risk assessment, (iv) the scope of audit reporting, (v) the accountability mechanism, (vi) the auditor's liability, and (vii) the skill sets required by commercial auditor and government auditor.

The research approach adopted for the study includes the following:

(i) Conceptual and Theoretical Analysis: To compare the nature and scope of commercial and government auditing, conceptual and theoretical analysis have been done based upon the concepts and theories delineated from the review of literature and case studies.

(ii) Institutional Analysis: To assess the professional and governance structure for commercial and government auditing, institutional analysis of their respective auditees and their own institutions have been done through review of institutional reports, standards, guidelines and pronouncements.

(iii) As empirical examples for comparative conceptual and theoretical analysis, a review of leading cases has been done.

3.7 Limitations of the Study

The present study does not do any empirical quantitative analysis based upon the sample reports of commercial and government audits to test the differences in skill requirements of both types of audits and to assess their respective audit impact. The present study provides a conceptual and theoretical framework of the differences between two types of audits.

3.8 Future Research Directions

Some of the areas for further research in this subject are viz., (i) Quantitative analysis of impact of both type of audits based upon samples of these reports; (ii) Skill diversity analysis or index development based upon samples of reports of both types; (iii) Comparative analysis of SAIs and Professional Audit Bodies across countries; and (iv) Study on role of artificial intelligence, big data analytics, blockchain technology in respective areas of auditing.

There is need for research in these areas with special emphasis on Indian context.

3.9 Review of Case Studies

3.9.1 Commercial Auditing

Case Study 1: Enron Scandal (USA, 2001)

The collapse of Enron Corporation represents one of the most significant failures in corporate auditing history. The company was engaged in complex accounting manipulations using Special Purpose Entities (SPEs) to hide debt.

The external auditor failed to detect off-balance sheet liabilities and aggressive revenue recognition (mark-to-market accounting). There was conflict of interest of the auditor due to consulting revenues from the same company. The key issues were that the auditor's independence was compromised; there were weak internal controls and the failure of the oversight of the board. The outcomes were the bankruptcy of Enron, the dissolution of firm of auditors and the introduction of the Sarbanes–Oxley Act (2002).

The audit lessons were the utmost importance of auditor's independence, the need for strong internal control evaluation and enhanced regulatory oversight. (U.S. Securities and Exchange Commission, 2003; Healy & Palepu, 2003; U.S. Congress, 2002).

Case Study 2: Satyam Computer Services Scam (India, 2009)

The Satyam scandal involved systematic financial statement manipulation by its chairman. The audit failures were that (i) the auditors failed to verify cash balances and fictitious revenues and assets, and (ii) the weak audit evidence procedures, especially the balance confirmations were not followed. The key issues were the collusion between management and auditors, the failure of corporate governance mechanisms and the inadequate audit scepticism. The outcomes were that there was collapse of investor confidence, the strengthening of corporate governance norms in India and the establishment of stricter oversight (e.g., NFRA). The audit lessons were the importance of substantive audit procedures (balance confirmation), the role of professional scepticism and the strengthening of audit regulation in emerging markets. (Securities and Exchange Board of India, 2009; ICAI, 2009; NFRA, MCA, 2018).

Case Study 3: IL&FS Crisis (India, 2018)

The Infrastructure Leasing & Financial Services (IL&FS) defaulted on debt obligations, triggering a financial crisis. The audit issues were the misclassification of stressed assets, delayed recognition of NPAs and the failure of auditors to flag liquidity risks. The key issues were that the rating agencies and auditors failed simultaneously and the complex corporate structure obscured financial reality. The outcomes were government intervention, reforms in Non-Banking Financial Companies (NBFC) regulation and auditing standards. The audit lessons were importance of risk-based auditing and the need for consolidated financial scrutiny. (MCA, 2019; RBI, 2019).

3.9.2 Government Auditing

Case Study 4: 2G Spectrum Allocation (India, 2010)

The allocation of telecom spectrum licenses was done at below-market prices. The Comptroller and Auditor General (CAG) of India identified non-transparent allocation process and calculated presumptive loss to exchequer. The key issues were policy vs. audit boundary debate and the valuation methodology controversies. The outcomes were cancellation of licenses by the Supreme Court and policy reforms in spectrum auctions. The audit lessons were that the government audit includes performance and policy evaluation and has significant role in public accountability and transparency. (CAG, 2010, Supreme Court of India, 2012).

Case Study 5: Coal Block Allocation (India, 2012)

The allocation of coal blocks was done without competitive bidding. The audit findings were lack of transparency and undue benefits to private entities. The key issues were discretionary allocation vs. auction-based allocation and regulatory concerns. The outcomes were that the Supreme Court cancelled allocations and the shift to auction-based allocation. The audit lessons were importance of resource governance auditing and audit as a tool for policy correction. (CAG, 2012; Supreme Court of India, 2014).

Case Study 6: Telangana Singareni Collieries Audit (India, 2026)

The audit of a state-owned coal company revealed systemic inefficiencies. The audit findings were the flawed contract design, excess expenditure due to poor planning and weak enforcement of contractual provisions.

The key issues were inefficient resource utilisation and environmental non-compliance. The outcomes were audit recommendations for improved contract governance and emphasis on cost efficiency and sustainability. The audit lessons were the continued government audit focus on efficiency (performance audit), compliance and public value creation. (CAG State Reports, 2025-26).

Case Study 7: Compliance Audit – Department of Atomic Energy (India)

The audit revealed avoidable expenditure in government projects. The audit findings were non-adherence to financial rules, weak procurement practices and avoidable expenditure of public funds. The key issues were a lack of financial discipline and weak internal controls in the public sector. The outcome was audit recommendations for better financial management. The audit lessons emphasised the importance of compliance audits and a focus on economy and efficiency in public spending (CAG Compliance Audit Reports, 2018, Scientific Departments, GOI).

Case Study 8: Local Bodies Audit – Urban Construction Violations

There was an audit of municipal construction and regulatory compliance. The audit findings were illegal construction approvals and weak enforcement of civic regulations. The key issues were governance failures at the local level and environmental and safety risks. The audit lessons were on the importance of grassroots-level auditing and its role in urban governance and sustainability. (CAG Urban Local Bodies Reports; various years).

3.10 Comparative Insights from Case Studies

(i) Nature of Audit Failure: The primary failure of the commercial audit was failure to detect and report on fraud committed by the management; the root cause for failure was auditor-client collaboration and the auditor's conflict of interest. The failures detected by the government audit were governance and compliance gaps arising from administrative inefficiency and negligence.

(ii) Accountability Mechanisms: Commercial auditing deals with market-driven accountability towards shareholders and regulators. There is legal liability for auditors. Government auditing deals with Parliamentary accountability towards PAC and the legislature. There is moral and political accountability.

(iii) Institutional Differences and Limitations: Commercial audits are constrained by client relationships, and government audits are constrained by bureaucratic complexity and political economy.

(iv) Impact of Audit Outcomes: Commercial audit failures lead to market collapse and investor loss. Government audit findings lead to policy reforms and institutional restructuring.

(v) Conclusion from Case Studies: These case studies demonstrate that the commercial audit failures (Enron, Satyam) arise primarily from conflicts of interest, weak professional scepticism and incentive misalignment. Government audit findings (2G, Coal, SCCL) highlight systemic inefficiencies, policy distortions and governance failures. The fundamental distinction lies in the fact that commercial auditing leads to assurance to investors, whereas government auditing leads to accountability to citizens.

3.11 The Nature of Commercial Enterprise and Government

There are significant differences in the objectives, indicators of performance and the accountability institutions of commercial enterprise and the government which have significant bearing on nature and scope of audit profession and framework for two entities.

3.11.1 The 'objectives' of the Auditees

The objective of a commercial enterprise is to earn 'profit' on a consistent basis through the production and delivery of goods or services to its customers. By earning profit, it aims to increase the valuation of the enterprise in general and the shareholders' equity in particular (Samuelson et al., 2009; Arens et al., 2017).

The government's objective in running the financial and economic affairs of the state is not to earn profit out of running the administration and implementation of schemes, plans and programs. The purposes of the government are viz., (i) to provide efficient, economic and effective 'administration' to all the citizens of the state, (ii) to implement 'development' schemes, plans, programs and projects effectively to achieve the objectives set by itself and approved by the legislature, and (iii) to prepare and implement plans, programs and schemes to provide 'welfare and development' of the underprivileged and needy sections of society (Pollitt et al., 2011; INTOSAI, 1977). These are shown in Table-3.1.

Table 3.1: Objectives of Auditees			
Sl. No.	**Dimension**	**Commercial Enterprise**	**Government of the States**
1	**Primary Objective**	Profit maximisation and shareholder's value enhancement	Efficient and effective general administration, public welfare and socio-economic development
2	**Nature of Output**	Goods/services sold in markets	Pure Public goods and services (non-marketable) and Merit Private Goods & Services (Marketable)

The above-mentioned differences in the objectives of auditee entities determine the nature and scope of audit of commercial enterprises and government (Mautz et al., 1961; Arens et al., 2017; AAA, 1973).

3.12. The Indicators of performance of the Auditees

For a commercial enterprise, 'profit' is the single most important indicator of its performance which is reflected in its profit and loss statement and commented upon by statutory auditor and analysed by financial analysts and management experts which affects the value of their equity in capital markets (Samuelson et al., 2009; Arens et al., 2017). For government, profit from a scheme is not an objective, hence it is not an indicator of government's performance. Efficiency, economy and effectiveness in implementation of a scheme, plan, programme are indicators of government's performance (Boynton et al., 2006; INTOSAI, 1977). In addition, the government schemes and programs are also evaluated for their outcomes and impact for society, equity and inclusiveness, legality, propriety, transparency, accountability, responsiveness, service quality, integrity and control of corruption, capacity development and sustainability (Pollitt et al., 2011; Stiglitz, 1999; Bovens, 2007, Denhardt et al., 2000; Behn, 2001). However, these are not as easy to measure in financial and quantitative terms as the profit as an indicator of performance of commercial enterprise (Boyne et al., 2006). Thus, lack of clear, transparent and simple measure of performance of government presents major challenges before the government auditor to find a touchstone to review the financial, quantitative and qualitative performance of the government. This makes the function of government auditor complex and difficult (Grossi et al., 2023; Abdulgader et al., n.d., Pollitt et al., 2011). These are shown in Table-3.2.

Table 3.2: Indicators of performance and their characteristics			
Sl. No.	**Dimension of Indicators**	**Commercial Enterprise**	**Government**
1	**Primary Performance Indicator**	Profit (net income, EPS)	3Es: Economy, Efficiency, Effectiveness
2	**Secondary Indicators**	Liquidity, solvency, growth, market value	Outcomes, impact, equity, inclusiveness
3	**Nature of Indicators**	Quantitative, financial, standardised	Mixed: quantitative + qualitative, multi-dimensional
4	**Measurement Simplicity of Indicators**	High (monetary and numerical terms)	Low (often non-monetary, proxy-based)
5	**Time Horizon**	Short–medium term (quarterly/annual)	Medium–long term (program life cycle)
6	**Benchmarking of Indicators**	Industry ratios, market comparables	Targets, norms, SDGs, policy objectives

3.13. The Accountability Ecosystems of Auditees

There are major differences in the institutions and their mechanism for ensuring accountability of commercial enterprise and the government.

3.13.1. Market Mechanism for allocation of resources to, and survival and growth of, a commercial enterprise

The effectiveness and performance of a commercial enterprise is judged by the 'market' itself. Markets are mainly of two types (i) goods and services market for evaluation of the quality of their produce and deciding their market share and, (ii) capital market for evaluation of equity of the commercial enterprise (Kotler et al., 2016).

The market does this by evaluating mainly the profits and profit earning prospects of an enterprise (Friedman, 1962). The investors invest money in commercial enterprises if they are earning profits as per their expectations. The investors withdraw money from an enterprise if it is not earning profit as per their expectations. Thus, the market itself evaluates the performance of a commercial enterprise and allocates financial, physical, human and natural resources to them depending upon their performance. Thus, the 'market mechanism' in economy decides the allocation of investment in an enterprise depending upon their profit earnings and growth potential. If it is incurring losses, the market will force the winding up of a commercial enterprise in medium and long run (Samuelson et al., 2009; Jensen et al., 1976).

However, for a government, there is no indicator like 'profit' from a scheme or program to evaluate its performance and no 'market mechanism' to allocate resources to a government for its plans, programs and schemes. If a commercial enterprise is not performing well, the market will force it to wind up. However, if the government of a state is not performing well, there is no mechanism like market to wind up the state and its government. The state is a perpetual entity. It cannot be wound up.

3.13.2 Budgetary Mechanism and Competitive Democracy

Annual budgets are presented by the government for raising tax and non-tax revenue and allocation of funds for expenditure on administration, schemes, programs and projects in the legislature. After the passing of the budget by the legislature, resources are allocated to the government (Musgrave, 1959; Wildavsky, 1964; Schick, 2003).

In a modern state, it is mostly a competitive democracy where the citizens cast their votes to elect their representatives in the legislature. The elected representatives or the citizens elect a government for a certain period to run the executive functions in a state. If that elected government is not performing well, the citizens will defeat this government after their tenure is over, elect their opposite party, and the opposition will form a new government which will implement their schemes, plans and programs (Pierre et al, 2020; Dahl, 1989). However, there is a system of periodic legislative control, supervision and accountability of executive government by the elected citizens' representatives for evaluating the performance of a democratic government (Mill, 1861/1991; Bagehot, 1876/1963; Hirschman, 1970).

3.13.3 Monopoly of Government and Near Perfect Competition in Market for Commercial Enterprise

In a competitive democracy, the executive government is elected by the people of the state for a fixed tenure (5 years in India). During this tenure, the performance of the government and its departments is regularly reviewed by financial and departmental committees of the legislature. However, once elected for a fixed tenure, the government is a monopoly institution to implement the policy, plans, programmes and schemes of the state. It is highly unlikely to recall the government before its fixed tenure is over. This is unlike the case of a corporate commercial enterprise, when its profit is less than the expectation of the investors, considering its competitors, its share prices will go down, and investors will withdraw money from this company. Hence, the existence of competitors in the market is an institutional mechanism which ensures the achievement of accountability of commercial enterprise. The function of a statutory auditor of a commercial enterprise is limited to that extent (Samuelson et al., 2009; Arens et al., 2017; Jensen et al., 1976). There is a risk of misstatement by omission or commission in financial statements and the impact of fraud by management on these statements. However, the monopoly status of government makes the duties and responsibilities of government auditors very demanding, complex, and extensive (Pollitt et al., 2011; INTOSAI, 1977; Pollitt et al., 1997; Funnell, 1998; Glynn, 1991). These are shown in Table-3.3.

Table-3.3: Accountability Ecosystem and its characteristics			
Sl. No.	**Dimension of Accountability**	**Commercial Enterprise**	**Government**
1	**Core Accountability Mechanism**	Market mechanism	Democratic(elections) + budgetary mechanism
2	**Resource Allocation**	Through capital markets based on profitability	Through legislative budget approval
3	**Disciplining Force**	Investor exit, competition, bankruptcy, winding up	Elections, legislative oversight
4	**Survival Mechanism**	Market survival: inefficient firms exit	Perpetual existence; no exit mechanism
5	**Competition**	Near perfect/oligopolistic competition	Monopoly in governance during tenure
6	**Feedback Loop for performance**	Continuous (stock prices, demand of goods/services)	Periodic (elections, parliamentary review)
7	**Accountability Institutions**	Shareholders, Board, Regulators	Legislature, Judiciary, Citizens, SAIs
8	**Consequences of Failure**	Bankruptcy, takeover, liquidation	Electoral defeat, policy change
9	**Information System for evaluation**	GPFS + market signals	Budgets, accounts, audit reports, performance reports
10	**Time Horizon of Accountability**	Continuous, real-time	Periodic (annual budget, elections after tenure)
11	**Complexity of Accountability**	Relatively simple and financial	Highly complex and multi-layered

3.14 Impact of Above Differences on respective Auditing Profession and Framework

The above differences have following significant impact on the auditing profession and framework for commercial enterprises and the government.

3.14.1 Separation of Duties of Three Professions for Commercial Enterprises

For a commercial enterprise, 'profit' and 'profitability' are the most important factors to assess its performance. Therefore, the (i) commercial accounting, (ii) auditing, and (iii) financial and market analysts' professions aim for true and fair reporting of profits and profitability of an enterprise. The financial and market analysts report upon the profitability achieved and its prospects for the commercial enterprise in comparison to its competitors in the market (Arens et al., 2017; Tricker, 2015; Hayes et al., 2005; Jensen et al., 1976).

Financial analysts require reliable and comprehensive financial and quantitative data to do a realistic financial evaluation of the company.

(i) The discipline and profession of 'accounting' has been developed to report through the General Purpose Financial Statements, the true and fair picture of the state of affairs of a corporate entity.

(ii) The profession of 'auditing' has been developed to give assurance that the GPFS and other annual reports of the company are prepared in such a way that they truly and fairly reflect the profitability, financial position and liquidity of the company. Thus, the purpose of an auditor of a commercial enterprise is to report upon the quality and adequacy of disclosure made in the GPFS of the organisation. The auditor, through its audit report, gives an assurance of the truthfulness and fairness of the profit, financial position and cash flows of the company as disclosed in its GPFS.

(iii) The financial evaluation of the company is to be done by the financial and market analysts using the accountants' financial statements and auditors' audit report thereon.

The auditors' assurance on the truthfulness and fairness of the Financial Statements, independent of the financial evaluation of the enterprise, is very important for owners (shareholders) of the commercial enterprise, as these statements are prepared by their management.

In the case of the government, there are no three separate professionals to perform the functions, viz. (i) to prepare the accounts of the government, (ii) to audit and report upon their financial statements, and (iii) to analyse and report upon their financial and managerial performance. Hence, the Supreme Audit Institution (SAI) and the government auditors thereunder perform all three functions for the government (Bovens, 2007; Glynn, 1991; Shand et al., 1996; Power et al., 1997; Guthrie, 1999). These are shown in Table-3.4.

Table 3.4: Separation of Professional Functions and its implications			
SL. No.	**Dimension of functions**	**For Commercial Enterprises**	**For Government**
1	**Accounting Function**	Performed by professional accountants	Performed by government accounting system (within executive or with SAI)
2	**Auditing Function**	Independent Statutory Auditors	Supreme Audit Institution (SAI)
3	**Financial Analysis Function**	Separate profession (analysts, rating agencies)	Largely embedded within audit institutions
4	**Institutional Separation**	Clear separation of roles	Partial or no separation
5	**Primary Output of Professionals**	GPFS (P&L, Balance Sheet, Cash Flow), Audit Report, Financial Analysis, Credit Rating	Finance Accounts, Appropriation Accounts, Audit Report, Performance Audit reports
6	**Information Flow for Professionals**	Accounting → Auditing → Financial Analysis	Accounting → Audit + Analysis combined
7	**Specialisation Level of Professionals**	High specialisation across professions	High integration and interdisciplinary roles
8	**Professional Bodies**	1. Institute of Chartered Accountants of India 2. ICMAI	Comptroller and Auditor General of India and SAIs

3.14.2 The Scope of Roles of Auditor of Commercial Entity and the Government

The scope of roles of commercial and government auditors is different in a major way.

3.14.2.1 Role of Auditor of Commercial Entity

(a) Financial Statement Attest Audit

The duties and functions of auditors of a commercial entity are limited to financial statement attest audit only. He has to express an opinion and provide an assurance on the truthfulness and fairness of the GPFS of a company by doing the procedural and substantive tests upon the transactions selected by sampling techniques adopted by him according to the Generally Accepted Auditing Standards (GAAS) and the Accounting and Auditing pronouncements issued by the Institute of Chartered Accountants of that country (Arens et al., 2017; Hayes et al., 2005; Messier et al., 2008, Tricker, 2015; Power, 1997; Lonsdale et al., 2011). The statutory auditor of a commercial entity does not prepare the accounts of the entity under audit. Another professional is responsible for preparing the accounts, and the Chief Finance Officer of the company authenticates them.

(b) Compliance Attestation

The statutory auditor can be called upon by the company to make some compliance attestations if permitted by specific Acts and Rules. Thus, a statutory auditor of a company in India is called upon to do compliance attestation for the company under the Income Tax Act and Rules, the Companies (Auditors Report) Order under the Companies Act and the SEBI Act and Rules. The report under these compliance attestations is submitted in the prescribed format covering specific points to report upon as mentioned in the Acts and Rules (GOI, 2013; MCA, 2011; GOI, 1961; SEBI, 2015; GOI, 2017).

The compliance function under the Companies Act and Rules is also being done by practising Company Secretaries as per specific statutory requirements (MCA, 2014). Under Cost Accounting Records and Rules, the practising Cost Auditor is called upon to do a compliance audit of cost accounts and records as prescribed under the said Rules and report thereon (MCA, 2011).

(c) No Performance Evaluation, Performance or Management Audit by the Statutory Auditor

The statutory auditor of a company is not called upon to do the performance, operations or management audit and evaluation of the company. If he does so, this may lead to conflict of interest and hamper independence of the statutory auditor. Thus, the audit report of auditors of a company gives an assurance to the shareholders of the company and the market that GPFS provides true and fair status subject to the exception mentioned in the audit report or does not give such an assurance.

3.14.2.2 Roles of the Government Auditor

The Government Auditor of the central and provincial governments in a country is usually its Supreme Audit Institution and the officers working under it. The government auditor usually does all three types of audits for a government, viz., (i) financial audit, (ii) compliance audit and (iii) performance audit (Broadbent et al., 1992; INTOSAI, 1977; Pollitt et al., 1977; Shand et al., 1996).

(i) **Financial Audit**

Based upon the functions performed by the SAI of India, the financial audit can be classified into the following three types: -

a. Financial Statement Attest Audit of PSUs and Government

SAI is the sole or supplementary auditor of Public Sector Corporate Undertakings (PSUs). Hence, government auditors do the corporate sector financial attest audit of their GPFSs, just like the commercial auditor does this audit for private corporate entities.

Finance Accounts and Appropriation Accounts are prepared for central and provincial governments. An audit is done of these accounts. These accounts are mainly prepared on a cash basis. Hence, instead of giving an opinion on true and fair disclosure of profit, financial position and cash management of the government, the audit certificates on these accounts by the government auditor give an opinion on truthful disclosure of receipts and disbursements, revenue surplus or deficit, fiscal deficit and sources of financing of fiscal deficit. An opinion on the truthful disclosure of the financial position of the government can also be expressed. The audit certificate on these accounts also makes mention of the auditor's comments in the State/Union Finance Audit Report, its Compliance and Performance Audit Reports (INTOSAI, 1977; Funnell,1998).

b. Financial Compliance and Appropriation Audit
The comments on quality and adequacy of disclosure in Finance and Appropriation Accounts are also made in their finance audit reports for the Union and the States. In addition, comments on 'budget management' and 'appropriation and utilisation of funds given to government in Appropriation Act are also made by government auditor in this report (INTOSAI, 1998).

c. Financial Evaluation and Financial Performance Audit
State or Union Finance Audit Report also consists of comments on the financial performance of government in respect of (i) raising of tax and non-tax revenue, (ii) incurring of capital and revenue expenditure and, (iii) debt sustainability and management of the government. As there are no separate financial analysts like commercial organisations to review the financial performance of a government, the comments on review of financial performance of governments and incurring expenditure are also made by the government auditor in its finance audit report.
Thus, in the Finance Audit Report, comments on both performance evaluation and compliance issues in management of finances by the government are made by the government auditor.

(ii) Compliance Audit of Transactions
This is a major part of the audit duties of a government auditor. Audit of transactions or a class of transactions like procurement, implementation of a project, audit of an organisation or unit, subject-specific compliance audit or thematic compliance audit are covered in this category of audit.
In a compliance audit, compliance with Acts, Rules, Standards, Guidelines and procedures prescribed by the legislature, executive, judiciary, regulatory and standard-setting bodies is examined by government auditors in the review of receipt and expenditure of the government. Receipt Audit is mainly a compliance audit as these are done to see the compliance of tax and non-tax Acts, Rules and guidelines. Audit of expenditure, which is mainly done to see the compliance with Acts, Rules, guidelines, etc., is also a compliance audit (Bovens, 2007; Pollitt, et al.,1997).

(iii) Performance Audit of Schemes, Plans and Programs and Appointment, Remuneration and Independence of Auditors
In the case of commercial enterprises, there are separate professionals called 'financial analysts' who do the quantitative and financial performance review of these enterprises and bring their analysis into the public domain. If financial and organisational performance evaluation and review are done by the statutory auditor, this will lead to a conflict of interest with the duties of financial attestation and compliance certification. For a commercial enterprise, the appointment and determination of fees of statutory auditors are done by the owners on the recommendation of the management. Hence, the financial and managerial performance review by statutory auditors will compromise their independence.

The appointments of SAI and government auditors are made under the Constitution, and their fees and budget are approved by the Legislature. Therefore, the independence of government auditors is not affected by the performance review and audit they conduct. In the case of the government, there are no separate analysts to review the performance of government policies, plans, programs, schemes and projects. Therefore, the government auditor also does the quantitative, qualitative and financial performance review of the government's policies, plans, programs and schemes mainly in areas of development and welfare administration and delivery of public goods and services.

Performance Audit is done to review the implementation of policies, plans, programs and schemes to assess the achievement of (i) their objectives and (ii) the quantitative, qualitative and financial targets envisaged in the schemes as mentioned in the performance and outcome budget of the government as placed in the legislature and in the scheme guidelines (Power, 1997; Lonsdale et al., 2011; Glynn,1991; Funnell, 1998, Shand et al., 1996). These are shown in Table-3.5.

Table-3.5: Scope of Roles of Auditors and its implications			
Sl. No.	**Dimension of Roles**	**Commercial Auditor**	**Government Auditor**
1	**Primary Role**	Financial statement attestation	Multi-dimensional audit (financial, compliance, performance)
2	**Nature of Financial Audit**	Opinion on "true and fair view" of GPFS	Opinion on receipts, expenditure, revenue, fiscal deficit & disclosures
3	**Extent of Compliance Audit**	Limited, under specific statutory requirements	Extensive compliance to laws, rules, procedures, scheme guidelines
4	**Performance Audit**	Not performed (to preserve independence)	Core function (3Es: economy, efficiency, effectiveness of programs)
5	**Audit of Budget/Appropriation**	Not applicable	Central role (Appropriation Audit)
6	**Financial Evaluation**	Done by external analysts	Done by auditors themselves e.g. Finance Audit Report
7	**Audit Scope**	Narrow and financial	Broad and multidisciplinary
8	**Independence Risk**	High, if scope expands beyond attestation	Protected Constitutionally; broader scope permissible
9	**Appointment & Remuneration**	By shareholders (via management recommendation)	Constitutional/statutory; funded by legislature
10	**Extent of Audit Output**	Audit opinion only	Audit reports + evaluation + recommendations

3.14.3 The Methodology of Audit Risk Assessment

To assess the risk involved in the audit of financial statements and compliance audit, the auditors review the internal control system of the auditee. This is done in both the commercial and the government audit while performing the financial attest audit and the compliance audit (Arens et al., 2017; Messier et al., 2019).

While assessing the risks involved in doing the performance audit, the government auditor also has to do the review of the administrative capacity and capability of the state machinery involved in planning, financial management, monitoring and control for the implementation of these policies, plans, programs and schemes of which the performance audit is being done. Many times, the schemes are taken up hastily by the government under public pressure; however, sufficient administrative machinery for their planning, management, monitoring and control is not created by the government, which has bearing upon the capacity and capability to implement those schemes effectively (Power, 1997; Bovens, 2007). These are shown in Table-3.6.

Table-3.6: Methodology of Audit Risk Assessment and its characteristics

Sl. no.	Dimension of Risk	For Commercial Auditor	For Government Auditor
1	**Primary Risk Focus**	Risk of material misstatement (financial, omission or commission)	Risk of misstatement + compliance failure + performance failure
2	**Audit Risk Model**	Audit Risk = Inherent Risk × Control Risk × Detection Risk	Extended risk model including governance risk, capacity risk, and outcome risks
3	**Internal Control Review**	Core component (financial controls)	Core component (financial + administrative + program controls)
4	**Scope of Risk Assessment**	Financial transactions and disclosures	Financial, legal, administrative, and programmatic processes
5	**Performance Risk Assessment**	Not applicable	Central to performance audit
6	**Administrative Capacity Assessment**	Not assessed	Critically assessed
7	**Policy Design Risk**	Not examined	Often examined
8	**External Environment Risk**	Limited consideration	Considered (political, institutional context)
9	**Complexity of Risk Assessment**	Relatively structured and standardised	Multi-dimensional and complex

3.15 The Scope of Audit Reporting

Economy, efficiency and effectiveness in the achievement of the objectives of the schemes are examined and reported upon by the government auditor while doing the performance audit. These performance aspects are not examined and not reported upon by the statutory auditor of a commercial enterprise. The reporting requirement of the statutory auditor is limited to express an opinion on the truthfulness and fairness of 'disclosure' in the financial statements. These are shown in Table-3.7.

Table-3.7: Scope of Audit Reporting

Sl. No.	Dimension of Reporting	For Commercial Auditor	For Government Auditor
1	**Primary Output**	Audit opinion	Multi-part audit reports
2	**Focus of Reporting**	Truth and fairness of financial statements	Economy, efficiency, effectiveness (3Es)
3	**Nature of Reporting**	Standardised (unqualified/ qualified/adverse/waiver)	Narrative, analytical, evaluative
4	**Performance Evaluation**	Not included	Core component
5	**Compliance Reporting**	Limited to prescribed areas	Extensive
6	**Policy Evaluation Reporting**	Not included	Included
7	**Recommendations in Reporting**	Limited to Accounting and Internal control	Detailed and actionable on compliance and performance
8	**Addressee of Report**	The Shareholders/ Owners	Not Specified
9	**Audience of Reports**	Shareholders, investors	Legislature, public, policymakers
10	**Impact of Reports**	Market reaction	Policy reform, legislative scrutiny

3.16 The Accountability Mechanisms of Commercial Enterprise and Government

The Annual Accounts statements of a public limited company are prepared by the company management, audited by the company auditors and adopted in the AGM of the company (Solomon, 2017; Jensen et al., 1976). These accounts are filed in the Registrar of Companies with annual company returns, with the certificate of the Company Secretary (GOI, 2013). These annual accounts are also submitted with SEBI and stock exchanges where the listing of the securities of the company has been done (Arens et al., 2017). Annual Accounts with audit reports are also published in national newspapers and company websites.

Professional financial analysts evaluate the financial and business performance of the company and publish their reviews for the benefit of investors and the public. The investors make their assessment of the performance of the company and decide whether to invest or withdraw their money from the securities of these companies. Thus, the market mechanism ensures the survival, growth or winding up of a commercial enterprise.

The performance of the government policies, plans, programs and schemes is not evaluated by the 'profits' and through any market mechanism. Therefore, special provisions for legislative review of financial and economic performance and delivery of plans, programs and schemes have been made in the Constitution (Bovens, 2007; Musgrave, 1959; Stiglitz, 2000). Finance Accounts and Appropriation Accounts, along with the government auditor's certificate and Finance Audit Report, are presented in the Legislature, which are examined by the Public Accounts Committee (PAC) (INTOSAI, 2007). Similarly, SAI's compliance audit and performance audit reports on government plans, programs and schemes are presented in the Legislature and examined by the PAC and other committees. After examination and taking evidence from the secretaries of respective departments (Pollitt et al., 2011), the PAC makes its recommendations. The departments submit Action Taken Notes (ATNs) on the recommendations of the PAC. After reviewing the ATNs of the departments on audit paras and reports, the PAC makes its final policy recommendations and presents them to the legislature. On the final recommendations of the PAC and assurances given to it, the departments of the government take policy-related corrective actions (Bovens, 2007; Power, 1997; Glynn, 1985; Funnell, 1998). These are shown in Table-3.8.

Table-3.8: Accountability Mechanisms			
Sl. no.	**Dimension of Accountability**	**For Commercial Enterprise**	**For Government**
1	**Ownership**	Shareholders/investors	Citizens ("the people")
2	**Management**	Board & professional managers	Executive government
3	**Primary Accountability Forum**	Market + shareholders (AGM)	Legislature (Parliament/Assembly)
4	**Accounts Approval**	Adopted in AGM	Laid before legislature
5	**Evaluation Mechanism**	Market forces (share price, profitability)	Legislative scrutiny + elections
6	**Feedback Loop for performance**	Investment/withdrawal decisions	PAC recommendations → Action Taken Notes (ATNs)
7	**Sanction Mechanism for non-performance**	Market exit, takeover, bankruptcy	Political accountability (elections), administrative action
8	**Transparency Channel**	Stock exchanges, disclosures, media	Legislative debates, audit reports, public domain

3.17 Auditors' Liability

There is liability under the law justiciable in courts for professional misconduct by a commercial auditor. There are liabilities of commercial auditors towards professional bodies like the Institute of Chartered Accountants of India, the National Financial Regulatory Authority, etc., under professional ethics and code of conduct.

The professional liability of the Supreme Audit Institution of India is towards the Parliament of India, like that of a judge of the Supreme Court. There are departmental liabilities, like a government servant for government auditors under SAI, for misconduct. However, there is no liability towards independent professional institutions for a government auditor, like that of a commercial auditor. These are shown in Table-3.9.

Table-3.9: Auditors' Liability			
Sl. no.	**Dimension of Liability**	**Commercial Auditor**	**Government Auditor**
1	**Legal Liability**	Civil and criminal liability under law	Limited; Institutional responsibility
2	**Professional Liability**	To professional bodies (disciplinary action)	Internal/departmental accountability
3	**Regulatory Oversight**	(i) Institute of Chartered Accountants of India (ICAI) (ii) National Financial Reporting Authority (NFRA)	Constitutional oversight (Parliament)
4	**Liability to Users**	Shareholders, investors, creditors	Legislature, indirectly to citizens
5	**Independence Risk**	Influenced by appointment/fees structure	Constitutionally protected independence
6	**Removal Mechanism**	Through shareholders/regulators	Constitutional safeguards (removal akin to judges for SAI)
7	**Penalty for Misconduct**	Fines, suspension, imprisonment	Departmental action; rarely judicial liability
8	**Nature of Responsibility**	Individual professional responsibility	Institutional responsibility (SAI)

Thus, differences in the nature and objectives of a commercial enterprise and government entity-Union, Provincial and Local Government, make it necessary to evolve different nature and structure of auditing and accountability mechanisms for them.

3.18 Additional skills required by a Government Auditor

3.18.1 Skills required for Audit of Public Sector Companies

There are instances of government owned public sector companies (PSUs) which perform commercial operations in competition with the private enterprises and the shares of many of these are listed in stock exchanges. In such situation, there are little difference in public sector companies and the commercial enterprises. The objectives of such PSUs are also profit making and these are also subject to market mechanism, besides the ultimate legislative control, for their survival and growth. Therefore, while doing the financial attest audit of these PSUs, the government auditor also performs similar functions and gives similar assurances as the auditor of a commercial enterprise (Arens et al., 2017; Boynton et al., 2006). While doing the financial attest audit of a commercial public sector undertaking registered under Companies Act and listed in stock exchange, the knowledge and skills required by government auditor are like that of the statutory auditor of a commercial enterprise.

3.18.2 Additional Skills required by Government Auditor

In addition to this, a government auditor also performs financial attest, compliance and performance audit of Union and Provincial governments. These are macro entities, different from companies, which are micro entities. Hence, performing a financial performance audit of the government requires additional knowledge and skills in macro-level financial analysis. In addition, the government auditor also performs compliance audits of public expenditure on government plans, programs and schemes and their performance audits, which do not have profit-making objectives nor the market mechanisms to allocate resources for them, but have legislative control and supervision. Therefore, some additional sets of knowledge and skills like public economics, public finance, public financial administration, public administration, welfare economics, development administration and public policy analysis etc. are required by the government auditors to perform these audits efficiently and effectively which are not required by the statutory auditor of a commercial enterprise (Power, 1997; Bovens, 2007; Lonsdale et al., 2011; Funnell, 1998; Glynn, 1991; Guthrie, 1999). The skill sets required by the commercial and government auditors are shown in Table-3.10.

Table-3.10: Skill Sets Required and their levels			
Sl. no.	**Dimension of Skills**	**For Commercial Auditor and audit of PSUs**	**Additional Skills for Government Auditor**
1	**Core Domain**	Financial accounting & Financial auditing	Multi-disciplinary (finance + policy + governance)
2	**Financial Analysis**	Micro (firm-level)	Micro + macro (fiscal analysis)
3	**Public Finance Knowledge**	Not required	Essential
4	**Public Policy Analysis**	Not required	Essential
5	**Administrative Systems Understanding**	Limited	Critical
6	**Program Evaluation**	Not required	Core skill
7	**Econometrics and Data Analytics**	Moderate	High (impact evaluation, large datasets)
8	**Legal & Regulatory Knowledge**	Corporate law	Constitutional + administrative law+ sectoral laws
9	**Sectoral Knowledge**	Industry-specific	Multi-sector (health, education, infra, welfare)
10	**Stakeholder Engagement**	Limited	High (legislature, departments, citizens)
11	**Field Audit Skills**	Limited	Extensive
12	**Communication Skills**	Standard reporting format	Policy-oriented narrative reporting

3.19 Current Status of Education and Training in Government Auditing

In India, government auditing is kept as a sub-topic of study in Public Administration and Public Financial Management programmes in universities/colleges. In the Institute of Chartered Accountants of India, there is a course on government accounts and finances for its members in which government auditing is a topic of study. In the C&AG office, there is extensive teaching and training of government auditing for various levels of officers. However, there is no academic degree program in universities and a certification program in a professional Institute in government auditing in India. (Sharma, 2015; UGC, 2020, ICAI, 2023; CAG, 2022; World Bank, 2018).

In the USA, there are government audit modules in certification programs of the American Institute of Certified Public Accountants (AICPA), Certified Government Auditing Professional (CGAP) of the Institute of Internal Auditors (IIA) and Certified Government Financial Manager (CGFM) of the Association of Government Accountants. There are internal training programs in auditing by the U.S.A. Government Accountability Office. (AICPA, 2022; IIA, 2021; AGA, 2022). In the U.K., there is a government audit module in the certification program of the Chartered Institute of Public Finance and Accountancy (CIPFA) and internal training programs of the National Audit Office. (CIPFA, 2022) China is the only country with a full-fledged audit university where degree and postgraduate degree programs in government auditing are offered. However, an independent professional certification program is not available in China (Liu, 2019; ADB, 2020).

From a review of the education and teaching of government auditing, it is revealed that university-based academic programs are available only in China but not in India, the UK and the USA. An independent professional certification program is available in the USA and UK, but not in China and India. SAI-based internal training is available in all countries. Thus, in India, both academic and professional certification programs are not available. This results in a lack of research in government accounting and auditing, and skill gaps in the use of big data analytics and econometrics in the practice of government auditing in India. Therefore, in India, the GOI, ICAI and C&AG may join hands to introduce government auditing as an academic discipline in university courses and a professional institute-level certification program, in a phased manner (World Bank, 2018; INTOSAI, 2019).

3.20 Conclusion

There are major differences in the objectives and accountability mechanisms of commercial enterprises and the government. As a result, the type and scope of audits, the methodology of performance of different types of audits, the output and nature of assurance of audit of commercial enterprises and government differ significantly. The review of literature and case studies amply demonstrates that significant additional skills are required by a government auditor to perform his or her job efficiently and effectively. Hence, there is a need for the development of a separate theory, academic discipline and a profession of government auditing in India, as there are in China and the USA, so that this becomes a field of study in colleges, universities and professional certification in professional institutions just like the discipline of commercial auditing.

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None

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ARTICLE 4

Financial Accountability in Autonomous Bodies: Audit Insights and Systemic Challenges

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Abstract

The article examines persistent irregularities and systemic control deficiencies observed during the financial audit of Autonomous Bodies (ABs) falling under the audit purview of the Comptroller and Auditor General of India (CAG). It aims to analyse non-compliance with the reporting framework, accounting standards issued by the Institute of Chartered Accountants of India (ICAI), lacunae in internal controls, coupled with a lack of documentation, which pose significant constraints during audit and also bring out the way forward to overcome these challenges.

Keywords

Accounting Standards, Uniform Format of Accounts, Opinion, Separate Audit Reports, Fixed Assets, Grants, Borrowing Costs, Internal Control and Persistent Irregularities.

4.1 Introduction

Autonomous Bodies (ABs) are Bodies or Authorities with a distinct legal existence and established by the Government through the Acts of Parliament or the State Legislature. These Bodies or Authorities are independent in their day-to-day functioning and operate at an arm's length from the Government even though the Ministries/Departments have significant control over them in matters of general direction and supervision.

4.2 Types of Autonomous Bodies:

Autonomous bodies may be classified as either Central Autonomous Bodies (CAB) or State Autonomous Bodies (SAB), depending on the funding by the respective Governments and the Acts under which they are incorporated, as detailed below:

a. **Central Autonomous Bodies:** They are enacted under an Act of Parliament and funded by various central ministries for carrying out broad objectives like education, health, culture, and others. Examples of CABs are University Grants Commission (UGC), Indian Institutes of Management (IIMs), Indian Council of Agricultural Research (ICAR), Central universities, Commodity Boards, etc. CABs are also classified as (i)Commercial (for example, port trusts)and (ii) Non-commercial (for example, educational institutions) depending on the nature of their activities.

b. **State Autonomous Bodies:** These are formed under an act of the State Legislature and are predominantly funded and operate under a specific Department of the State Government.(for example State Higher Education Department, State Health Department). The state department oversees major decisions and ensures alignment with state objectives. Examples of State Autonomous Bodies are Bangalore Development Authority, Karnataka Industrial Areas Development Board, Kerala Biodiversity Board, etc.

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4.3 Mandate for audit of Autonomous Bodies:

The mandate for Autonomous Bodies of CAG is derived from Article 149 of the Constitution of India, which stipulates the audit of Boards and Authorities by CAG. The CAG DPC Act 1971 prescribes the following mandate for audit of accounts of an AB.

CAG conducts compliance as well as performance audits of ABs under Sections 14 and 15 of the DPC Act 1971 and financial audits under Sections 19 and 20 of the DPC Act 1971 as detailed below:

a. Compliance Audit and Performance audits of an AB: The provisions of Section 14 and Section 15 of the DPC Act 1971 are as follows:

i. Section 14 (1): Where the grant or loan to a body or authority from the Consolidated Fund of India or of any State or of any Union territory having a Legislative Assembly in a financial year is (i) not less than rupees twenty five lakhs and the amount of such grant or (ii) loan is not less than seventy five per cent of the total expenditure of that body or authority, such body or authority shall be deemed to be substantially financed by such grants or loans and comes under the audit purview of CAG.

ii. Section 14 (2): The CAG may, with the previous approval of the President or the Governor of a State or the Administrator of a Union territory having a Legislative Assembly, as the case may be, audit all receipts and expenditure of any body or authority where the grant or loan to such body or authority from the Consolidated Fund of India or of any State, or of any Union territory having a Legislative Assembly, as the case may be, in a financial year is not less than rupees one crore.

iii. Section 14 (3): In the aforesaid circumstances, if any body or authority comes under the audit purview of CAG, then the receipts and expenditure of that body or authority shall continue to be audited by CAG for a further period of two years even if the conditions specified in the aforesaid sections are not fulfilled during any of the two subsequent years.

iv. Section 15 (4): Where any grant or loan is given for any specific purpose from the Consolidated Fund of India or of any State or of any Union Territory having a Legislative Assembly to any authority or body, the CAG shall scrutinise the procedures by which the sanctioning authority satisfies itself as to the fulfilment of the conditions subject to which such grants or loans were given.

b. **Financial Audit of an AB:** The mandate for audit of financial statements of an AB is described in theFigure 4.1 below:

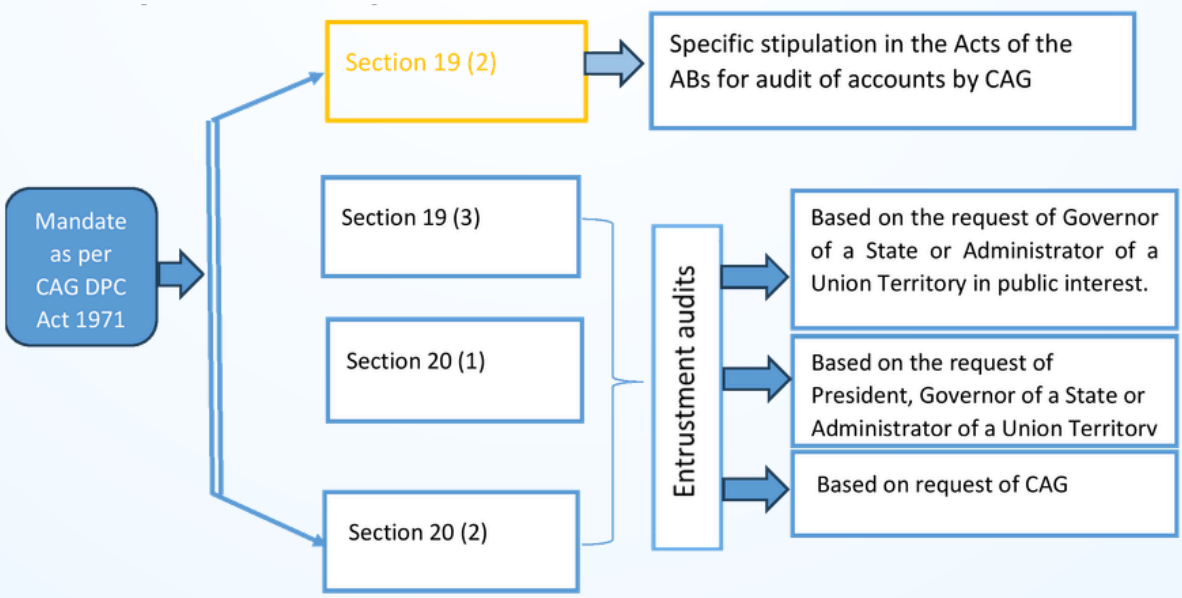

Figure 4.1: Mandate for audit of accounts of an AB.

4.4 Objectives of financial audit of Autonomous Bodies:

The main objective of the financial audit of ABs is to derive a reasonable assurance regarding the truth and fairness of the financial statements, viz. Balance Sheet, Income and Expenditure Account (for non-commercial ABs)/ Profit and Loss Account (for Commercial ABs), significant accounting policies, notes to accounts and Receipts and Payments Account at the end of a reporting period, and to ensure that the same is free from material misstatement. CAG is the sole auditor for the audit of Autonomous bodies and issues a Separate Audit Report with an opinion on the financial statements which could either be unmodified (for financial statements representing a true and fair view) or modified (either a Qualified, Adverse or Disclaimer) for financial statements not/partially representing a true and fair view, depending on the materiality and pervasiveness of issues reported upon. This underscores the critical importance of financial audit of ABs, as it provides stakeholders with assurance on the accuracy and reliability of financial statements, highlights areas of concern, and ensures accountability in the management of public funds.

4.5 Format of financial statements

To ensure transparency and consistency in accounting and presentation, the Ministry of Finance prescribed a uniform format of accounts for non-educational Central Autonomous Bodies in 2001-02, followed by a separate uniform format for educational institutions issued by the Ministry of Education in April 2015. In contrast, State Autonomous Bodies prepare their financial statements in accordance with the provisions of their respective Acts, resulting in the absence of a common standardised format comparable to that applicable to CABs.

4.6 Persistent irregularities observed during financial audits of Autonomous Bodies:

Despite a clear audit mandate and prescribed accounting frameworks, financial audits of Autonomous Bodies consistently reveal non-compliance with Accounting Standards and weaknesses in financial management and internal controls, impairing the reliability of financial statements. A few such areas depicting these irregularities and systemic lapses are as follows:

a. Non-compliance with Accounting Standards issued by ICAI:

i. Accounting Standard 1 (AS-1): Disclosure of accounting policies: The accrual concept, as prescribed under AS-1, along with transparent disclosure of accounting policies, forms the fundamental basis for the preparation of financial statements. Any lacuna in adherence to or disclosure of these principles constitutes a significant risk, as they impair the reliability, comparability, and faithful representation of financial information. Instances such as non-compliance with the accrual system of accounting, partial disclosure of accounting policies, and formulation of policies not adhering to the generally accepted accounting principles were observed in Central and State ABs.

ii. Accounting Standard 15 (AS-15): Employee Benefits: AS-15 provides for the creation of liability for long-term employee benefits, viz., pension, gratuity, and leave encashment based on actuarial valuation either using the defined contribution plan or under a defined benefit plan/self-managed trusts. However, despite repeated audit observations, this remained a persistent irregularity as 46 per cent of ABs did not comply with this stipulation. Further, discrepancies were also observed even in ABs which had created a liability based on actuarial valuation. For example, in four Port trusts, there was a shortfall of ₹ 10,074.20 crore of liability when compared to the figures provided as per the actuarial valuation reports. In one CAB, an actuary, while arriving at the valuation of leave encashment, had wrongly considered the total leave balances of 368 employees as 1,02,232 days, which should have been 96,418 days.

iii. Accounting Standard 10 (AS-10): Property, Plant and Equipment: AS-10 prescribes that a fixed asset should be recognised when it is probable that (a) future economic benefits associated with the item will flow to the enterprise; and (b) the cost of the item can be measured reliably, and the asset is ready for use. Various non-compliances were observed, such as (i) non-adjustment of advances against completed works, (ii) delayed/non-capitalisation of works for issues like want of occupancy certificate or delay in putting the asset to use, (iii) under/over-capitalising of asset, (iv) advances added to cost of asset without being utilised, (v) mis-classifications between fixed asset and capital work in progress, fixed assets and expenditure, (vi) short accountal/ over accountal of depreciation. A few interesting instances are as follows:

Instance 1: A CAB coming under the Ministry of Education had spent ₹ 7.90 crore for the construction of an underground cable passing through its premises. The same was accounted as an asset in the books of the CAB and depreciated. As per the provisions of the State Regulatory Code, the asset belonged to the state transmission utility. Since the benefit of the asset also extended to other consumers in the vicinity and the CAB did not have unrestricted control over the asset, the same should have been charged off as expenditure instead of being accounted for as an asset in the books of the CAB.

Instance 2: A port trust did not charge off ₹73.84 crore representing expenditure towards capital dredging work, which was abandoned due to the quashing of environmental clearance by the National Green Tribunal Authority.

Instance 3: A CAB accounted for ₹12.29 crore, being the cost of 28 assets which were dismantled as per the physical verification report for the year 2021-22 and were not displayed distinctly from the fixed assets, as required by the standard.

AS-10 was also revised in March 2016 to incorporate the concepts of component accounting, liability for decommissioning costs, etc., thereby expanding the scope of verification by audit. It also factors in the provision of impairment losses as per AS-28. As such, the management is required to assess the indicators of impairment every year and also provide for impairment losses, if any.

iv. Accounting Standard 16: (AS-16): Borrowing cost: As per Accounting Standard 16, interest on any loan taken for the purpose of qualifying assets is required to be capitalised, i.e. added to the cost of the asset till such time the asset is commissioned. However, during the period when the works are suspended, the capitalisation of such interest would cease, and the same would be treated as revenue expenditure. Most of the capital expenditure for Higher educational CABs is funded through Higher Education Financing Agency Loans (HEFA). The interest portion of such loans is completely funded by the Ministry of Education as grants in aid and routed through an escrow account formed for this purpose. A few instances of non-compliances to AS-16 are as follows:

Instance 1: A CAB under the Ministry of Education had taken an HEFA loan for the construction of a new campus. However, the interest of ₹1.12 crore on the same was accounted as revenue expenditure instead of capital expenditure during the period of construction of the campus. Despite being pointed out in previous years, no remedial action was taken.

Instance 2: A CAB coming under the Ministry of Education capitalised ₹ 809.84 lakh towards interest on HEFA loan during 2020-21, though the same was not utilised for capital expenditure during that year.

v. Accounting Standard 12: (AS-12): Accounting for Government Grants: AS-12 provides for two methods of accounting for grants, viz. (i) Capital approach and (ii) Deferred revenue approach. As per the Uniform format of account for CABs, when an asset is funded out of grants, on capitalisation of the asset, the corresponding amount of grant is transferred to the corpus fund. Further, any income derived from earmarked and sponsored funds was required to be ploughed back into the respective funds. Various non-compliances were pointed out, viz. (i) advances paid out of grants were transferred to the corpus fund though capital expenditure was yet to be incurred, (ii) non-adjustment of grants against assets created, (iii) partial disclosures of grant accounting, etc.

For instance, a State AB, which followed the Capital approach for accounting of grants, did not adjust ₹ 2595.32 crore against the completed assets over the years, due to which the grants remained in liabilities, though the audit repeatedly pointed out these issues during the earlier years.

It was also observed in several instances that the income earned out of the investment of unutilised grants was considered as income without ploughing it back into the concerned grant. The incidence of unutilised grants has reduced substantially in CABs on account of the introduction of the Treasury Single Accounting (TSA) system by the Ministry of Finance, due to which the unutilised grants lapse to the Government account at the end of the reporting period. However, in State Autonomous bodies, non-utilisation of the grants for the intended purpose and refund of the same to the concerned Departments remains a challenge.

vi. Accounting Standard 29 (AS-19): Provisions, contingent liabilities and contingent assets: AS-29 stipulates that a provision should be recognised when an enterprise has a present obligation as a result of a past event, and it is probable that an outflow of resources embodying economic benefits will be required to settle the obligation. However, if a loss or probable gain depends on the occurrence or non-occurrence of uncertain future events (e.g., settlement of court cases), such amounts require only a disclosure in Notes to Accounts as contingent liabilities (probable loss) or contingent assets (probable gain), as the case may be. Various non-compliances regarding non-provision of statutory liabilities, arbitration awards, known liabilities for administrative expenses, outstanding payments towards letter of credit, interest on loan and work bills remain provisioned. Probable impact of a contingent liability/asset also remained undisclosed. A few instances are as follows:

Instance 1: A CAB under the Ministry of Coal invested ₹1,390.25 crore in an entity which underwent insolvency proceedings under the Insolvency and Bankruptcy Code. The CAB could recover ₹662.58 crore, resulting in a loss of ₹727.67 crore. However, the unrecovered amount was neither written off nor provided for, which was in non-compliance with AS-29.

Instance 2: A CAB under the Ministry of Health had procured medical equipment worth ₹2.27 crore on credit. As per the Uniform format of accounts, plant, machinery, and equipment acquired and pending installation and commissioning should also be included in capital work in progress under the fixed assets schedule. In the present case, neither the asset nor the liability was brought to the books.

It is also pertinent to note that the Minutes and agenda of the governing bodies of ABs, information available on the public domain, and media clippings also serve as a valuable source of information to determine whether or not any provision or disclosure is required to be made in line with Accounting Standard 4 for any event occurring between the Balance Sheet date and the date of approval of the financial statements.

vii. Accounting Standard 13 (AS-13): Investments: AS-13 provides that any diminution in value of investments needs to be provided for. Instances were observed wherein, despite erosion of investment, no provision was made. For instance, a Central AB coming under the Ministry of Petroleum and Natural Gas had invested ₹5,034.00 lakh in an entity which incurred cumulative losses to the tune of ₹18,917.94 lakh and its negative net worth stood at ₹11,410.92 lakh. However, the Board did not assess the diminution in the value of the investment and did not provide for the same.

viii. **Accounting Standard 9 (AS-9): Revenue recognition:** Revenue recognition: As per AS-9, revenue is measured by the charges made to customers or clients for goods supplied and services rendered to them and by the charges and rewards arising from the use of resources by them. A few non-compliances are as follows:

Instance 1: Revenue from academic receipts received in CABs covering part of the subsequent year was accounted as the revenue for the year, though they constituted prepaid expenditure for the subsequent year.

Instance 2: A State AB under the Department of Housing collected EMIs from allottees of housing units. However, on account of non-reconciliation and updation of the allottee register, ₹6,694 crore collected from the allottees were accounted under current liabilities instead of income and remained under liabilities even after transfer of property to the allottees. Based on repeated audit observations, the AB is in the process of reconciling these amounts.

Similar observations related to non-compliance with AS have also been raised in SARs of State Autonomous Bodies. Unlike CABs, SABs do not have any uniform accounting as the format for financial statements is prescribed by the respective acts under which these SABs are formed. Hence, though comments are raised on non-compliance with generally accepted accounting principles, the strict enforceability of compliance with accounting standards depends on the stipulations in these respective acts, and hence, ensuring compliance with the same still remains a challenge.

b. Non-compliance to uniform format of accounts: Issues pertaining to non-compliance with the reporting requirements of uniform format of accounting for CABs were persistently observed in areas like (i) routing of income and expenses pertaining to earmarked funds through Income and expenditure account (ii) accounting of assets created out of sponsored projects where the sponsor retained ownership of the assets as asset of the CAB instead of disclosure required by the format (iii) mis-classifications between the corpus funds and various other earmarked and sponsored funds. Though these were presentation aspects, they vitiated the disclosure requirements to a large extent.

c. Lacunae in Internal controls: Persistent internal control lacunae were observed in ABs in areas, viz.(i)absence of a system for physical verification of fixed assets and inventory (ii) absence of an internal audit wing/ineffective internal audits (iii) non-segregation of duties (iv) absence of a system to periodically prepare the bank reconciliation statements/obtaining bank confirmation from banks, absence of policies for safeguarding assets. An interesting instance is as follows:

A State AB coming under the audit purview of the Department of Urban Development was entrusted with the development of sites. Given the cyclical nature of land development, the AB often held large surplus balances ranging from ₹363.57 crore to ₹1,458.26 crore held for infrastructure projects.

The AB did not have any investment policy to manage its surplus funds. A special audit by CAG in this regard observed violations of principles of financial propriety, failure to maintain financial records, failure to conduct an internal audit, and proper checks and balances through segregation of duties of staff in the finance wing. Consequently, the funds of the AB were diverted to mutual funds and transferred to other organisations by opening and operating unauthorised bank accounts, creation of fake term deposits, suppression of facts, falsification of records, preparation of misleading financial statements and destroying the trail of all transactions. The unauthorised transfer of funds for investment in Mutual Funds resulted in financial loss of ₹205.85 crore, and the unauthorised transfer of funds aggregating ₹6.17 crore to other government organisations represented cases of misappropriation of funds of the AB. Based on the observations of the audit, the AB subsequently formed a separate independent wing for bank reconciliation, compilation of monthly accounts and established an internal audit wing while segregating the job responsibilities in the finance wing.

Such systemic vulnerabilities not just render the system susceptible to fraud and misappropriation, but if left uncorrected, would impair the institutional credibility of the ABs in the long run.

d. Lacunae in documentation: Non-maintenance of basic documentation like fixed assets register, project wise records for inflow and outflow of grants, fixed deposits and investment register, operation and non-reconciliation of suspense accounts, non-production of records on time despite this being repeatedly being pointed out in the Separate audit reports of the earlier years not only posed significant constraints in conducting audit, but also impeded the ability of forming an opinion on the financial statements.

For instance: A State AB coming under the purview of the Department of Housing was entrusted with the construction of housing projects. Though cash flows from sale of housing projects constituted the main source of revenue to the AB, which on an average worked out to ₹375 crore per year, the AB failed to maintain cost records, due to which the cost of sales of housing units and sites were computed on an ad hoc basis ranging from 75 percent to 100 percent of the sales resulting in vitiation of the reporting results.

Further, with arrears in accounts in ABs' coupled with the aforementioned persistent irregularities, effective audit scrutiny is constrained, increasing the risk of financial irregularities going undetected. Despite the issuance of a Disclaimer/Adverse Opinion in line with the Circulars issued by Headquarters Office, ensuring that management takes timely corrective action on the identified discrepancies remains a challenge.

4.7 Way Forward

Various initiatives have been initiated by the Headquarters Office to attempt to address these issues and reduce the incidence of persistent irregularities:

i. **Convening of timeline/pre-accounts meetings:** Timeline/pre-accounts meetings refer to a meeting conducted between the field offices and the AB to expedite the submission of accounts.

a)Timelines for certification of accounts of ABs: As per Para 10.08 of the Manual of Instructions for audit of Autonomous Bodies, the following timelines have been prescribed for conducting the audit, finalisation and issue of SAR in respect of completion of certification process of Autonomous Bodies (Table 4.1).

Table 4.1: Timeline for Certification of Accounts

Timeline	Task	Task Completion Date
1	Approved and authenticated annual accounts to be made available by the autonomous body to the concerned audit office and commencement of audit of annual accounts	**30th June**
2	Issue of Draft SAR to the Chief Executive of the autonomous body	**31st August**
3	Receipt of reply of Draft SAR from the management (two weeks from the date of issue of Draft SAR)	**14th September**
4	Submission of Draft SAR, with or without incorporating replies of the autonomous bodies, to the Headquarters for approval.	**21st September**
5	Sending approved SAR by Headquarters to the field Office (two weeks from the date of receipt of Draft SAR by Headquarters)	**21st October**
6	Issue of the final SAR in English version with audit certificate to Autonomous Body/Government concerned	**31st October**
7	Issue of the hindi version of final SAR with a copy of the final SAR to Headquarters	**15th November**

b) Considering the aforesaid timelines, Circular dated 14.06.2022 was issued by the Autonomous Bodies Wing, emphasising the importance of timeline meetings between the field offices and the finance head of the ABs, which would serve as a forum for bringing to notice persistent irregularities while ensuring timeliness in submission of accounts.

ii. Format of Separate Audit Report: The new format of SAR issued during June 2025 renders a thrust and focus on the opinion expressed in the SAR by incorporating (a) Opinion paragraph with separate formats for unmodified and modified opinions in the beginning of the SAR (b) defining the responsibilities of management and auditors (c) lacunae on internal controls as a separate paragraph in the SAR instead of annexure as per the earlier format (d) Emphasis of Matter section, aligned with Standards on Auditing (SA 706) of the Institute of Chartered Accountants of India, to highlight significant matters appropriately disclosed and presented in the financial statements.

iii. Risk assessment of ABs: The Committee on Capacity Building of Autonomous Bodies and Urban Local Bodies proposed a weighted, risk-based scoring framework for ABs, considering key areas such as timeliness of accounts, recurring errors and irregularities, adequacy of retirement benefit provisions, compliance with double-entry accounting, asset-liability classification, and technology adoption. Based on the scores, ABs are classified as non-compliant/severely deficient, partially compliant, or compliant, with each category further graded into high, medium, or low criticality to guide monitoring priorities. Further, the implementation strategy for the same also envisages steering committees and nodal officers, duly including the heads of ABs, thereby facilitating an effective stakeholders' engagement.

iv. Collaborations with various Institutes: MoU with ICAI for capacity building initiatives of staff of IA&AD, induction of CAs in audit teams of CABs, Risk Control Matrix Scorecard (RCMS) for higher educational institutions, development of an Artificial Intelligence (AI) system for ABs in collaboration with IIT Madras, have been envisaged to strengthen the financial audit of ABs.

v. Other initiatives: Developing Guidance Notes, Standard Operating Procedures, common format of accounts for state autonomous bodies have been envisaged in the ensuing years that would go a long way in streamlining audit methodologies in ABs and reducing the persistent irregularities reported upon.

4.8 Conclusion

While audit continues to play a critical role in detecting systemic irregularities and deficiencies in the financial statements, sustainable improvement in financial reporting requires active and continuous engagement of all key stakeholders, including governing bodies, management, administrative ministries, and professional institutions. These measures, when complemented by stronger oversight by governing authorities, have the potential to significantly improve transparency and financial discipline in ABs thereby re-enforcing public trust in the audit process.

Data Availability

There is no new data associated with this article

Ethics Statement

This Article meets the ethical guidelines and legal requirements of the country in which it was performed.

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ARTICLE 5

Sustainability Reporting: Concept, Evolution and Audit Relevance

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Abstract

Sustainability reporting has evolved from voluntary environmental disclosures into a structured governance mechanism that integrates Environmental, Social and Governance (ESG) considerations into organisational accountability frameworks. This evolution reflects growing recognition that financial reporting alone is insufficient to capture long-term risks, externalities, and value creation. The paper examines the etymology and conceptual foundations of sustainability reporting, traces its global and Indian evolution, analyses major reporting frameworks and datasets, and evaluates the relevance of sustainability reporting for public sector auditing. It argues that sustainability reporting is no longer peripheral but central to assessing governance quality, fiscal sustainability, policy effectiveness, and highlights emerging challenges for audit institutions in assuring sustainability-related information.

Keywords

Sustainability Reporting, Environmental, Social and Governance (ESG), Public Sector Audit and Governance Accountability.

5.1 Introduction

Economic growth has delivered unprecedented prosperity, but at the cost of environmental degradation, social inequality, and governance fragility. The triple planetary crisis, climate change, biodiversity loss, and pollution, underscores the inadequacy of traditional financial reporting, which overlooks environmental and social externalities as well as long-term risks.

Sustainability reporting has emerged to bridge this gap, evolving from voluntary narratives to standardised, and increasingly mandatory ESG disclosures. For public audit institutions, ensuring the credibility and completeness of these disclosures is vital to strengthen accountability, inform decision-making, and address climate, social, and fiscal risks.

5.2 Etymology and Conceptual Foundations

5.2.1 Etymology of Sustainability

The word sustainability is derived from the Latin term sustinere, meaning “to hold up” or “to endure”. In its literal sense, sustainability implies the capacity of a system to continue over time without collapse or irreversible damage. The term entered modern environmental and development discourse during the late twentieth century, with concerns about ecological limits and intergenerational equity.

In 1713, Hans Carl von Carlowitz, responding to a crisis of timber shortages in Saxony, wrote Sylvicultura Oeconomica, calling for the careful, regenerative use of forests. His work introduced the

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concept of "Nachhaltigkeit" (sustainability), the idea that natural resources must be used in a way that does not compromise their availability for future generations. It linked economic activity with ecological stewardship, predating modern sustainability discourse for centuries. (Carlowitz, 1713).

The Brundtland Commission's 1987 report "Our Common Future", later offered the widely accepted definition of the term sustainable development which refers to idea of 'meeting present needs without compromising the ability of future generations to meet their own needs'. The concept of sustainable development integrates economic development, environmental protection and social equity. (WCED, 1987).

5.2.2 Concept of Sustainability Reporting

Sustainability Reporting refers to the systematic disclosure of information on an organisation's environmental, social and governance performance, and its impacts, risks, and opportunities. Unlike financial reporting, which primarily addresses shareholders and creditors; the sustainability reporting adopts a broader stakeholder orientation, encompassing employees, communities, regulators, and future generations.

Conceptually, sustainability reporting serves multiple purposes:

- Assessing environmental impacts
- Enhancing transparency regarding non-financial impacts
- Supporting risk assessment and long-term planning
- Facilitating accountability for policy and managerial decisions
- Enabling comparability across organisations and sectors

From an audit perspective, sustainability reporting represents an expansion of the accountability framework within which public and private entities operate.

5.2.3 Triple Bottom Line

The Triple Bottom Line (TBL) framework expands organisational performance measurements beyond financial profit to include:

- People (Social performance)
- Planet (Environmental performance)
- Profit (Economic performance)

Popularised by John Elkington in the mid-1990s, it underpins modern sustainability reporting by arguing that organisational performance should be assessed jointly on economic, social and environmental dimensions rather than profit alone. Instead, it should be assessed on three aspects together: economic performance (profit), social impact (people) and environmental impact (planet). Sustainability reports, therefore, include information on employee welfare, community development, environmental protection, and financial value creation.

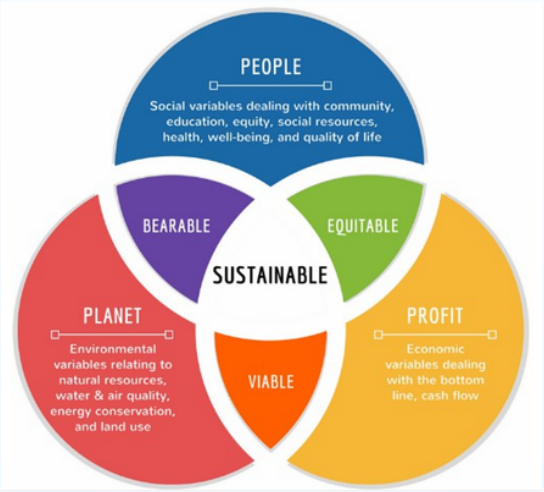

Figure 5.1: Triple Bottom Line

5.2.4 Double Materiality

Double materiality assesses sustainability from two complementary angles: how environmental and social issues affect an organisation's financial position and performance, and how the organisation's activities affect society and the environment.

For instance, climate change may damage a company's assets, and at the same time, the company's emissions may contribute to climate change. This concept is increasingly embedded in regulatory and reporting frameworks, requiring auditors to consider not only financial materiality but also impact materiality when evaluating sustainability information. It thereby deepens the link between sustainability reporting, risk assessment and public interest oversight.

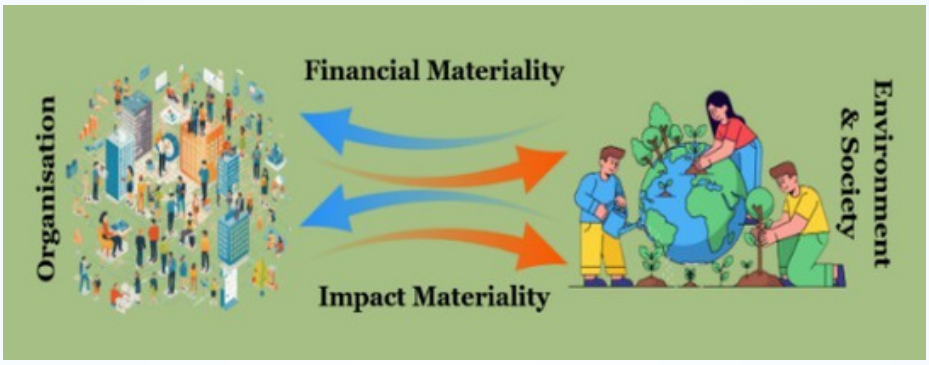

Figure 5.2: Impact & Financial Materiality

5.2.5 Assurance and Reliability

Assurance and reliability have become increasingly important as sustainability reporting moves towards mandatory disclosure. Stakeholders need confidence that the reported data is accurate and reliable. Assurance by independent professionals improves trust in sustainability information. However, sustainability data often involves estimates and non-financial measurements, making assurance more challenging. Auditors must therefore apply professional judgement and appropriate methodologies while providing assurance.

5.3 Global Evolution of Sustainability Reporting

5.3.1 Early Environmental Disclosure (1970s–1980s)

The origins of sustainability reporting can be traced to environmental disclosure practices that emerged in the 1970s. These early disclosures were compliance-oriented, focusing on pollution control measures and adherence to environmental regulations. They were typically qualitative, fragmented, and limited in scope.

Key international developments during this period included:

- The United Nations Conference on the Human Environment (1972)
- Growing recognition of environmental limits to growth
- Emergence of environmental impact assessments

These developments laid the groundwork for linking organisational accountability with environmental responsibility.

5.3.2 Institutionalisation through Reporting Frameworks (1990s–2000s)

The 1990s marked a turning point, as sustainability reporting began to be institutionalised through formal frameworks and guidelines. The establishment of the Global Reporting Initiative (GRI) in 1997 was a significant milestone. GRI provided standardised indicators covering environmental, social, and economic dimensions, enabling greater consistency and comparability in reporting.

During this period:

- Sustainability reports expanded beyond environmental issues to include labour practices, human rights, and governance.
- Multinational corporations increasingly adopted voluntary sustainability reporting.
- Stakeholder engagement emerged as a core reporting principle

By the early 2000s, sustainability reporting had become an established, though still voluntary, practice among large global corporations.

5.3.3 Integration with Climate and Financial Risk (2010s)

The 2010s witnessed a fundamental shift in how sustainability reporting was perceived. Environmental and social issues, particularly climate change, began to be recognised as sources of material financial risk. This shift was reinforced by:

- The adoption of the Paris Agreement in 2015
- The launch of the Sustainable Development Goals (SDGs)
- Growing investor demand for ESG information

The establishment of the Task Force on Climate-related Financial Disclosures (TCFD) in 2017 marked a critical development, as it explicitly linked climate risks with financial stability. Sustainability reporting has increasingly moved from a corporate responsibility exercise to a risk disclosure mechanism.

5.3.4 Transition towards Mandatory Reporting (2020 onwards)

In recent years, sustainability reporting has transitioned from a voluntary practice to a regulatory requirement in many jurisdictions. The European Union's Corporate Sustainability Reporting Directive (CSRD) and the issuance of global baseline standards by the International Sustainability Standards Board (ISSB) have accelerated this shift.

By 2024:

- A majority of G20 countries had introduced mandatory or semi-mandatory ESG disclosure regimes.
- Sustainability reporting was increasingly subject to assurance requirements.
- Public sector entities began exploring sustainability disclosures aligned with national climate and development commitments.

5.4. Evolution of Sustainability Reporting in India

5.4.1 Early Phase: CSR-Oriented Disclosure

In India, sustainability disclosure initially evolved through Corporate Social Responsibility (CSR) reporting. Before statutory intervention, CSR disclosures were voluntary and philanthropic, focusing on charitable activities rather than systemic sustainability impacts.

The enactment of the Companies Act 2013 marked a significant shift by mandating CSR spending for eligible companies. However, CSR reporting during this phase primarily emphasised financial expenditure rather than outcomes, effectiveness, or long-term sustainability.

5.4.2 Regulatory Push through Capital Markets

A more structured approach to sustainability reporting emerged with interventions by the capital market regulator. The introduction of Business Responsibility Reports (BRR) in 2012 represented India's first attempt at standardised ESG disclosure for listed entities.

This framework was strengthened in 2021 with the introduction of Business Responsibility and Sustainability Reporting (BRSR). From FY 2022–23, BRSR became mandatory for the top 1,000 listed companies by market capitalisation.

5.4.3 Scope and Data Trends under BRSR

BRSR is aligned with the National Guidelines on Responsible Business Conduct and covers environmental, social and governance indicators. Early datasets reveal mixed levels of maturity:

- High disclosure rates for energy consumption and workforce diversity
- Moderate disclosure for Scope 1 and Scope 2 emissions
- Limited disclosure for Scope 3 emissions and supply chain impacts

These trends highlight both progress and challenges in India's sustainability reporting ecosystem.

5.4.4 Public Sector Context

In the public sector, sustainability reporting remains less formalised. While ministries, departments and public sector undertakings publish outcome budgets, environmental statements and performance reports, comprehensive sustainability reports are limited. Nevertheless, sustainability dimensions are increasingly addressed through environmental audits, SDG audits and performance audits conducted by the Supreme Audit Institution.

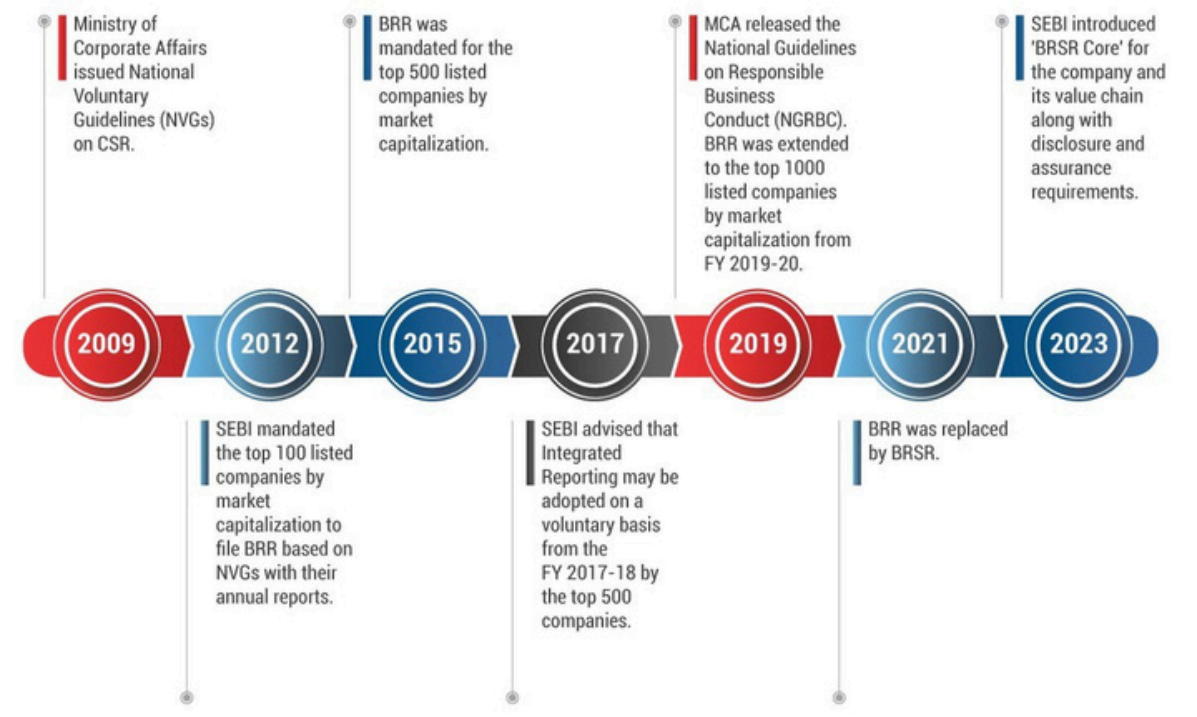

Figure 5.3: Timeline for Evolution of BRSR

5.5 Business Responsibility and Sustainability Reporting (BRSR) in India

5.5.1 Genesis and Regulatory Basis of BRSR

Business Responsibility and Sustainability Reporting (BRSR) represent India's most comprehensive attempt to institutionalise sustainability disclosures within the corporate regulatory framework. It was introduced by the Securities and Exchange Board of India (SEBI) through its circular dated 10 May 2021, replacing the earlier Business Responsibility Report (BRR) framework that had been in force since 2012.

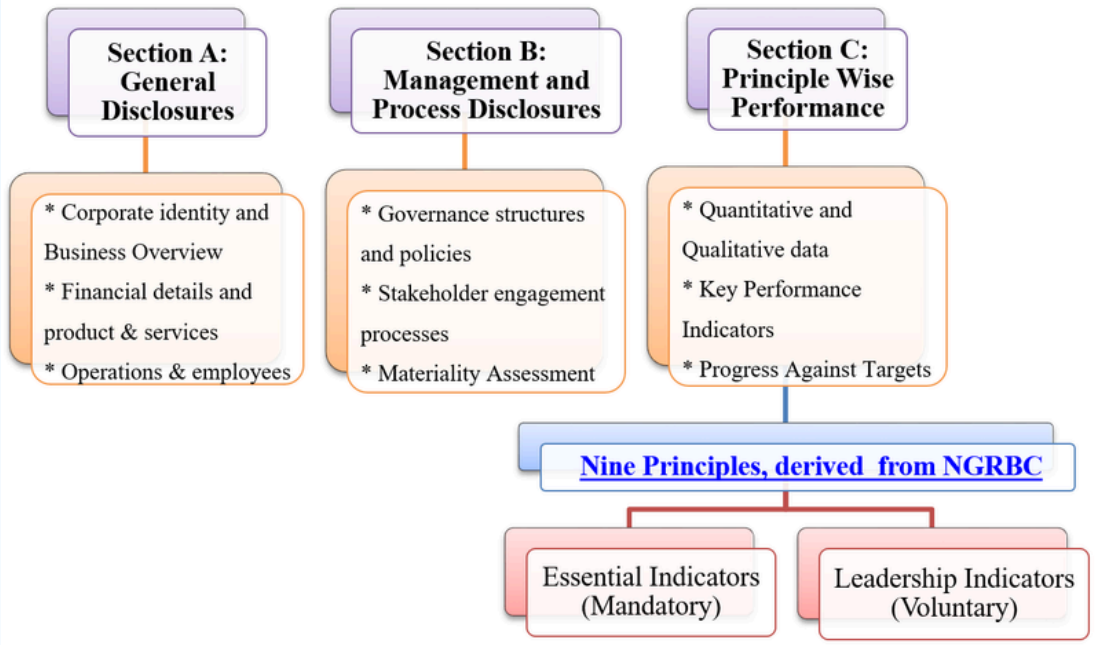

Figure 5.4: Structure & disclosure requirements in BRSR

Image Source: https://cag.gov.in/uploads/media/Green-Files-Volume-55-06993efa827dd55-76302713.pdf

The introduction of BRSR was driven by multiple, converging needs in India's evolving sustainability landscape. It sought to provide standardised, comparable and quantitative ESG disclosures in place of fragmented narratives, align corporate reporting with India's commitments under the SDGs and the Paris Agreement, and respond to growing investor demand for reliable sustainability data that could inform capital allocation and risk assessment. From FY 2022–23, BRSR became mandatory for the top 1,000 listed entities by market capitalisation, marking a major regulatory step towards mainstreaming ESG information within capital markets.

Structurally, BRSR is anchored in the National Guidelines on Responsible Business Conduct (NGRBC), which are built around nine principles spanning ethical governance, environmental stewardship, human rights, employee welfare, consumer protection and inclusive growth. These principles provide the conceptual backbone for the reporting framework, ensuring that disclosures are not ad hoc but systematically linked to a nationally endorsed vision of responsible business conduct.

From an audit perspective, this section functions as a set of environment control indicators for ESG governance, signalling whether the organisation's systems are robust enough to support credible disclosures. Principle-wise Performance Disclosures then translate each of the nine principles into quantitative and qualitative metrics, including energy consumption and intensity, Scope 1 and Scope 2 greenhouse gas emissions, water withdrawal and discharge, gender diversity and employee turnover, occupational health and safety metrics, and value chain sustainability. SEBI's 2023 analysis shows that while most companies report basic environmental metrics, data reliability and completeness, especially in relation to value chain disclosures, remain uneven, underscoring the ongoing challenge of deepening the quality of BRSR reporting.

5.6 BRSR Core and Proportional Reporting: Enhancing Credibility and Assurance

BRSR Core was introduced by SEBI through its circular dated 14 July 2023 to improve data consistency, comparability and assurance in ESG disclosure by identifying a subset of key indicators considered most critical for stakeholder decision-making. Initially applicable to the top 150 listed entities from FY 2023–24, this requirement will be progressively extended to the top 1,000 entities, signalling a phased but firm move towards more rigorous sustainability reporting.

BRSR Core narrows the focus to select quantitative ESG indicators, mandates reasonable assurance by independent assurance providers, and prescribes uniform measurement methodologies for these metrics, thereby shifting the regime from disclosure-only reporting to assured sustainability information. The Core set of indicators covers Scope 1 and Scope 2 greenhouse gas emissions, water consumption and intensity, waste generation and recycling, gender diversity in the workforce and leadership, and occupational injury frequency rates, capturing both environmental and social dimensions of performance.

BRSR has strengthened ESG transparency by introducing structured, principle-based disclosures aligned with global sustainability expectations. However, the comprehensiveness of the framework, especially with the rollout of BRSR Core and assurance-linked indicators, can pose implementation challenges for smaller entities with limited reporting capacity. In this context, BRSR Lite represents a proportional reporting pathway that enables smaller organisations to participate meaningfully in sustainability reporting without diluting the credibility of disclosures.

BRSR Lite is not a separate regulatory framework but a scaled application of BRSR principles, grounded in materiality and organisational capability. It focuses on a compact set of essential indicators covering governance, environmental stewardship, employee welfare and stakeholder responsibility, while allowing flexibility for advanced disclosures to be added gradually. This approach prioritises relevance over volume, encouraging entities to report what is materially significant to their operations rather than producing compliance-driven boilerplate narratives. The proportional model is consistent with the broader philosophy of sustainability reporting articulated in Indian thought leadership, which emphasises practicality, phased adoption and integration with enterprise strategy. (ICMAI Sustainability Journal, 2024).

A key dimension of BRSR Lite is proportional assurance. Instead of mandating uniform third-party assurance for all disclosures, assurance is calibrated to risk and stakeholder reliance. Basic disclosures may rely on management attestation, while selected quantitative indicators can undergo limited or targeted external review. This layered approach maintains trust in ESG data while keeping assurance costs manageable for smaller entities. It also encourages preparers to build internal data systems gradually, improving reporting maturity over time.

For auditors, BRSR Lite requires a risk-based mindset: focusing on controls, sampling and data governance rather than exhaustive verification. For preparers, it provides an entry point into structured sustainability reporting, fostering early adoption and continuous improvement. Importantly, proportional reporting broadens participation in ESG disclosures, supporting comparability and transparency across India's diverse corporate landscape.

In essence, BRSR Lite advances the core objective of sustainability reporting, embedding responsible business conduct into organisational practice, while ensuring inclusivity. By aligning disclosure expectations with organisational scale, it transforms sustainability reporting from a compliance exercise into a practical management tool that smaller entities can realistically adopt and sustain. (SEBI Expert Committee, 2024)

5.7 Audit Relevance and Emerging Challenges

Sustainability reporting is directly relevant to audit institutions because it intersects public expenditure, policy outcomes, and long-term fiscal risks. Auditors are increasingly required to:

- Assess the credibility of sustainability disclosures.
- Examine alignment between policy commitments and reported outcomes.
- Evaluate whether sustainability initiatives deliver value for money.

Internationally, audit institutions are expanding their mandate to include climate finance audits, SDG preparedness audits, and reviews of ESG governance mechanisms. Despite the progress, several emerging challenges hinder comprehensive auditing, most notably persistent issues with data quality and a lack of standardised reporting units for critical metrics like energy consumption and emissions. Auditors must also navigate the complexity of fragmented reporting, where data is often scattered throughout annual reports rather than consolidated, and inconsistencies in how companies define the underlying figures used for intensity calculations. Furthermore, transparency remains a significant hurdle in complex areas such as Scope 3 emissions and value chain assessments.

5.8 Conclusion

Sustainability reporting represents a significant evolution in accountability frameworks, reflecting the growing recognition that economic performance cannot be separated from environmental and social realities. Globally and in India, sustainability reporting has moved towards standardisation and regulatory enforcement, although challenges relating to data quality and assurance remain.

For audit institutions, sustainability reporting offers an opportunity to strengthen oversight of long-term risks and policy effectiveness. At the same time, it demands methodological innovation, interdisciplinary expertise, and institutional capacity building. Integrating sustainability considerations into mainstream audit processes will be essential for ensuring that sustainability reporting contributes meaningfully to transparency, accountability, and sustainable development.

Data Availability

None

Ethics Statement

This article is a conceptual and documentary analysis based on publicly available secondary sources, and it does not involve human participants, animals or primary field experiments requiring prior ethical approval. No sensitive personal data was collected, processed or reported, and no procedures with potential physical, psychological or social risk to individuals or communities were undertaken.

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ARTICLE 6

Environmental Audit of the Steel Industry: Indian Perspectives with special reference to Steel Authority of India Limited

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Abstract

The steel industry is one of the most resource-intensive and pollution-intensive industrial sectors worldwide, playing a crucial role in infrastructure development and economic growth. India, as the second-largest producer of crude steel globally (World Steel Association, 2025), faces the dual challenge of expanding production while minimising environmental degradation. Environmental auditing has emerged as an important management and regulatory tool to ensure compliance with environmental laws, improve resource efficiency and promote sustainable development.

This paper examines the concept and practice of environmental audits in the Indian steel industry, with insights from the Steel Authority of India Limited (SAIL). Using secondary data from government reports, CAG reports, corporate sustainability disclosures and published literature, the study analyses the key environmental impacts such as air emissions, water pollution, solid and hazardous waste generation and recent initiatives such as green steel, zero liquid discharge and ISO 14001 certification. The study finds that while Indian steel plants have made measurable progress in environmental performance, significant scope remains for technological modernisation, stronger regulatory compliance and integration of audit findings into strategic decision-making.

Keywords

Environmental Audit, Steel Industry, SAIL, Environmental Regulations, Green steel and Zero Liquid Discharge.

6.1 Introduction: Indian and Global Steel Industry Scenario

Globally, crude steel production exceeds 1.8 billion tonnes annually, with China accounting for more than half of total output, followed by India, Japan and the United States. India has emerged as the world's second-largest steel producer, with crude steel production exceeding 149 million tonnes in recent years. The steel sector contributes approximately 2 per cent to India's Gross Domestic Product (GDP) and provides direct and indirect employment to millions of people. Major players in the Indian steel sector include public sector enterprises such as Steel Authority of India Limited (SAIL), Rastriya Ispat Nigam Limited (RINL) and private companies such as Tata Steel, JSW Steel and Arcelo Mittal Nippon Steel India (World Steel Association, 2025).

Steel production is inherently energy-intensive and environmentally sensitive. The sector generates significant air pollutants (particulate matter, sulfur dioxide, nitrogen oxides, carbon monoxide and carbon dioxide), large volumes of wastewater with high biological oxygen demand (BOD) and chemical oxygen demand (COD) and solid wastes such as slag, sludge, fly ash and hazardous chemical wastes. In this context, environmental auditing assumes critical importance as a mechanism for ensuring regulatory compliance and promoting sustainable industrial practices.

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6.2 Concept and Scope of Environmental Audit

An environmental audit is defined as a systematic, documented, periodic and objective evaluation of how well environmental organisation, management and equipment are performing in conserving the environment and complying with statutory requirements. Environmental audit encompasses a dual dimension, comprising compliance assessment with statutory requirements and performance evaluation focused on resource efficiency and pollution mitigation. In the steel industry, environmental audits facilitate continuous improvement and proactive environmental governance, positively influencing regulatory compliance and risk management.

These audits typically assess air and water pollution control systems, solid and hazardous waste management, occupational health and safety practices, energy and water efficiency and emergency preparedness. With the increasing emphasis on Environmental, Social and Governance (ESG) performance, environmental audits have also become a strategic tool for long-term sustainability.

6.3 Global Evolution of Sustainability Reporting

Sustainability reporting refers to the disclosure of an organisation's ESG performance, enabling stakeholders to assess the organisation's commitment to sustainable development. Over time, it has evolved from voluntary disclosures to structured and increasingly mandatory frameworks.

Globally, sustainability reporting has progressed through initiatives such as the Global Reporting Initiative (GRI), United Nations Global Compact (UNGC) and Task Force on Climate-related Financial Disclosures (TCFD), leading to greater standardisation and transparency. Many countries now emphasise mandatory ESG disclosures, reflecting growing stakeholder expectations.

In India, sustainability reporting has gained importance, particularly in industries like steel. The Securities and Exchange Board of India (SEBI) mandates Business Responsibility and Sustainability Reporting (BRSR) for specified listed companies, encouraging disclosure on environmental performance, emissions and resource efficiency.

The Indian steel industry operates within a comprehensive environmental regulatory framework administered by the Ministry of Environment, Forest and Climate Change (MoEF & CC). Key legislation includes (Figure 6.1):

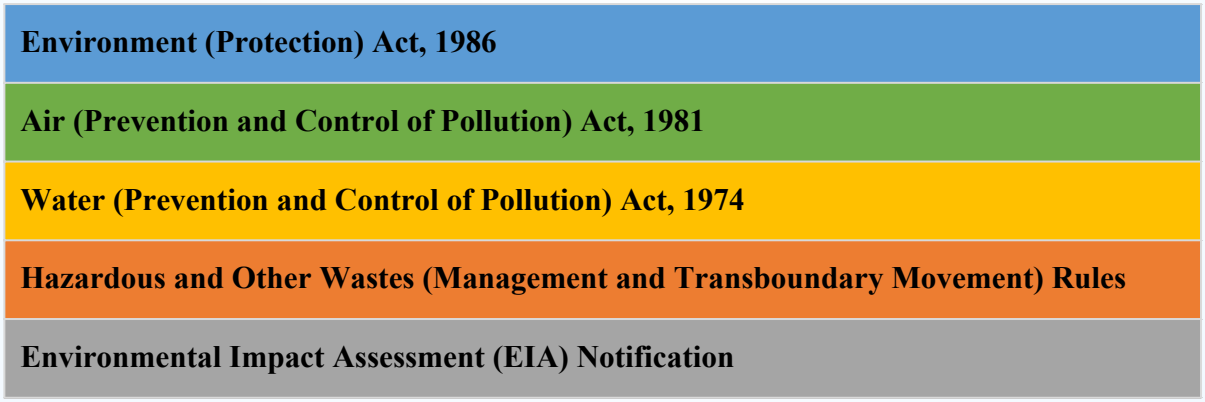

Figure 6.1: Key legislation from the comprehensive environmental regulatory framework of the Indian Steel industry

These laws and regulations are implemented and enforced by the Central Pollution Control Board (CPCB) and respective State Pollution Control Boards (SPCBs). In addition, specific rules govern hazardous and other wastes, biomedical waste, solid waste management and fly ash utilisation. The National Green Tribunal (NGT) plays an important role in adjudicating environmental disputes and ensuring compliance. Steel plants are required to obtain environmental clearances, operate pollution control equipment, submit periodic compliance reports and undergo environmental audits (Government of India, 1986).

6.4 Major Environmental Issues in the Steel Industry

6.4.1 Air Emissions and Climate Change

Steel plants are major sources of air pollutants such as dust and particulate matter, sulfur dioxide, nitrogen oxides, carbon monoxide and carbon dioxide. Carbon dioxide emissions from steelmaking significantly contribute to global greenhouse gas emissions. Environmental audits assess the efficiency of electrostatic precipitators, bag filters, gas cleaning plants and continuous emission monitoring systems, as well as initiatives for CO_2 reduction through energy efficiency and fuel substitution.

6.4.2 Water Pollution and Zero Liquid Discharge

Steel production requires large volumes of water for cooling, processing and dust suppression. Wastewater often contains suspended solids, oil and grease, heavy metals and high BOD levels. Many Indian steel plants are moving toward Zero Liquid Discharge (ZLD) by maximizing water recycling, installing Sewage Treatment Plants (STPs) and adopting rainwater harvesting systems. Environmental audits evaluate water balance, specific water consumption and compliance with discharge standards.

6.4.3 Solid, Hazardous and Other Wastes

The steel industry generates substantial quantities of solid wastes such as blast furnace slag, steel slag, fly ash and various types of sludge. Hazardous wastes include chemical residues, spent oils and contaminated sludge, while biomedical waste is generated from plant hospitals. Audits examine slag utilisation, fly ash management, ash pond safety, lagoon management and prevention of soil and groundwater contamination.

6.5 Key Environmental Metrics and Trends in SAIL

The Steel Authority of India Limited has shown progress in improving key performance indicators over the last decade (Environmental Performance of SAIL, 2025), as shown in Table 6.1.

Table 6.1: Key performance indicators over the last decade

Metric	Improvement (2015 - 2025)	Key Initiatives
Particulate Matter (PM) Emissions	31% Reduction	Electrostatic Precipitators (ESPs) → Bag Filters → Coke Dry Quenching (CDQ)
Specific Water Consumption	22% Decrease	Water Recycling → Rainwater Harvesting → Zero Liquid Discharge (ZLD)
Total Solid Waste Utilization	27% Increase	Slag Granulation → Fly Ash Utilization
CO_2 Emissions	2% Decrease	Coal Dust Injection (CDI) Usage → Energy Efficiency Projects

6.6 Environmental Audit Practices in SAIL

Steel Authority of India Limited operates several large integrated steel plants across India, including Bhilai, Bokaro, Rourkela, Durgapur and Burnpur. Given its scale of operations, SAIL has established structured environmental management systems such as the Corporate Environmental Policy of SAIL, online Continuous Emission Monitoring Systems (CEMS) etc. supported by internal audits, third-party audits and statutory inspections.

Environmental audits in SAIL plants cover air and water pollution control, solid and hazardous waste management, occupational safety, and compliance with Central Pollution Control Board and State Pollution Control Board norms. Many units have obtained ISO 14001 certification, reflecting adherence to internationally recognised environmental management standards. Initiatives such as fly ash utilisation, slag granulation, sewage treatment, rainwater harvesting and groundwater monitoring are regularly reviewed during audits. In the recent audits of environment management practices in Steel Authority of India Limited by the CAG of India, the following issues were highlighted (CAG Report no.18 of 2020 & CAG Report no.38 of 2025):

Ø Non-renewal of environment clearance certificate for the Modernisation and Expansion Plan (MEP) led to the suspension of work for installation of New Sinter plant and up-gradation of Steel Melting Shop-1 of Bokaro Steel Plant.
Ø Flaring up of gases due to delayed completion of Gas holder in Bokaro Steel Plant causing air pollution, loss of savings of energy and excess consumption of coal.
Ø Non-installation of solar power systems led to high cost of energy and emission of 3.30 lakh tonnes of CO_2 gases annually in the atmosphere.
Ø Shortfall in meeting the Renewable Energy Purchase Obligation (RPO), as notified by the Electricity Regulatory Commissions.
Ø Under-utilisation of Blast Furnace slag in Bhilai Steel Plant and Bokaro steel Plant led to the disposal of the slag in a non-eco-friendly manner.
Ø Under-utilisation of Basic oxygen finance (BOF) slag in Bokaro, Durgapur and Rourkela Steel Plant.
Ø Issues relating to other waste and hazardous waste in steel Plants in SAIL: • Under-utilisation of BOF sludge led to water pollution and soil degradation • Non-completion of hazardous pit led to disposal of hazardous waste in open area • Accumulation of hazardous Electric Arc Furnace (EAF) dust in Alloy Steel Plant led to violation of Statutory guidelines • 'Waste to Energy' Plant and solid waste processing facilities were not installed. • Due to non-installation of Effluent Treatment Plants, effluents from hospitals were drained to oxidation pond and discharged into nallah/river.
Ø Non-installation of Effluent Treatment Plants and Zero Liquid Discharge in plants led to water pollution and loss of water.
Ø Excess coke consumption led to higher emissions of Carbon Dioxide (CO_2) gas in the atmosphere.
Ø Incomplete utilisation and disposal of solid waste such as blast furnace sludge led to environmental hazards to the soil and water.

SAIL has undertaken initiatives aligned with the concept of green steel, including energy efficiency projects, increased use of by-products and gradual reduction in carbon intensity. As reflected in its recent sustainability disclosures (2024-25), the company continues to focus on cleaner technologies and resource efficiency. Compliance with NGT directions, particularly related to ash ponds, groundwater protection and occupational safety, forms an integral part of audit follow-up actions (Steel Authority of India Limited, 2025).

6.7 Challenges in Environmental Auditing of Steel Industry

Despite progress, environmental auditing in the steel industry faces several challenges like:

- Ageing production technology in older plants
- High capital costs for pollution control upgrades
- Variations in audit quality and depth
- Limited public disclosure of audit outcomes

These challenges underscore the need for strengthening audit frameworks and integrating environmental audits with strategic planning and investment decisions. Global best practices emphasise low-carbon steelmaking, hydrogen-based processes and circular economy approaches, which are gradually being explored in India.

Environmental auditing in India is evolving from a compliance-focused exercise to a more performance and improvement-oriented process, in line with global trends. This is evident from initiatives such as Business Responsibility and Sustainability Reporting (BRSR) mandated by the Securities and Exchange Board of India, which emphasises measurable ESG performance, and the adoption of Continuous Emission Monitoring Systems (CEMS) linked to the Central Pollution Control Board for real-time monitoring and data-driven audits.

Strengthening audit capacity and transparency will be critical for aligning the Indian steel sector with international sustainability benchmarks such as the Global Reporting Initiative (GRI) Standards, United Nations Global Compact (UNGC) and the Task Force on Climate-related Financial Disclosures (TCFD) framework.

6.8 Conclusion

Environmental auditing plays a vital role in promoting sustainable development in the steel industry. In India, the steel sector's economic importance necessitates a careful balance between growth and environmental protection. The experience of SAIL demonstrates that systematic environmental audits, supported by regulatory oversight and management commitment, can lead to measurable improvements in environmental performance. However, continuous technological modernisation, stronger enforcement, and integration of audit findings into strategic planning are essential to meet future environmental and climate challenges.

Data Availability
None

Ethics Statement
This document meets the ethical guidelines and legal requirements of the country.

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None

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No Conflict of Interest.

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ARTICLE 7

Biometric Systems and the Problem of Usability: A Governance-Centric Intervention in Attendance Management

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Abstract

Biometric attendance systems have improved the authenticity of attendance recording in public offices, but remain largely confined to generating static data with limited administrative usability. This article addresses this gap through an in-house, practice-based intervention developed within a large public office. The intervention introduces a role-based interpretive layer over the existing Aadhaar Enabled Biometric Attendance System without modifying the underlying biometric infrastructure. By aligning attendance data with supervisory structures, coordination groups, Branch Officers, and sections, the system enables decentralised access, reduces manual processing, and supports evidence-based administrative action. Developed and coded by the author with iterative testing support from an internal team, the system is under continuous development and demonstrates how modest, configuration-driven digital interventions can convert biometric attendance from a compliance record into an effective governance tool for the public sector.

Keywords

Biometric Attendance Systems, Public Sector Governance, Administrative Usability, Role-Based Access, Attendance Management, Digital Public Administration, E-Governance and Behavioural Nudging.

7.1 Introduction

"The most serious mistakes are not being made as a result of wrong answers, but as a result of asking the wrong questions," observed Peter Drucker. Few observations capture the challenge of contemporary digital governance better.

Imagine an office where biometric attendance is recorded flawlessly every day (BIOMETRIC ATTENDANCE, n.d.), yet a Branch Officer cannot readily answer a basic administrative question: Which employees in my section were absent today, and why? This paradox lies at the heart of many digital reforms. Data exists in abundance, but decision-ready information does not. Attendance is digitally captured, yet administrative control remains analogue. This disconnect between accurate data and usable information frames the problem that this article seeks to address.

7.2 Background and Context

Biometric attendance under the Aadhaar Enabled Biometric Attendance System (AEBAS) has standardised attendance recording in public offices by digitally capturing daily attendance data (NIC, n.d.) However, this data is typically available only as static spreadsheets and is not aligned with internal supervisory structures. As a result, although attendance data is centrally held by a nodal officer, Branch Officers who are responsible for supervision, casual leave regulation, and disciplinary control lack section-wise, usable information for timely administrative action.

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The Office of the Accountant General (A&E), West Bengal, was taken as a case study to examine this gap. The office is organised into four coordination groups Administration, Funds, Pension, and Accounts with approximately thirty-nine Branch Officers supervising multiple sections and employees. Despite this clearly defined structure, biometric attendance data is available only at a broad group level, limiting its practical usefulness for Branch Officers and senior management.

Recognising this disconnect between digital attendance data and administrative needs, an in-house initiative was undertaken in the West Bengal AG (A&E) Office to develop a role-based system that aligns attendance information with the existing administrative hierarchy. The intervention aimed to improve usability and accountability while retaining the existing biometric attendance infrastructure.

"This article presents a practice-based, in-house digital intervention implemented within a large public office to address this governance gap."

7.3 Comparison between the Existing Biometric Attendance System and the Proposed Interpretive System.

Parameter	Official AEBAS Portal	Proposed Interpretive System	Difference
Sub-Nodal Restricted	View Technically Possible but Rigid: Manuals allow "Report Viewers." However, they see a flat list of the entire organisation or specific designations (NODAL MANUAL)	Section-Specific: Automatically isolates data so a Branch Officer (BO) sees only their specific sections. Further filtering between sections allowed.	Difference: AEBAS provides a "Window" to the whole office; the new system provides a "Mirror" of just the BO's team.
Custom Messaging	Automated Only: The portal sends SMS/Email alerts based on fixed triggers (e.g., "Absent"). The Sub-Nodal cannot type a custom text to a group (BAS USER MANUAL)	Manual & Strategic: Allows the BO or Admin to send specific custom messages (e.g., "Meeting in Hall A at 10 AM for all present staff" or "Legal Cell reporting most absentees").	Difference: AEBAS is a "Robot"; the new system is a "Broadcasting Tool."
Individual Performance	Fragmented: Visible only to the Individual Employee or the Nodal Officer via manual search. (EMPLOYEE MANUAL)	Comparative: Displays an individual's performance alongside their section average and peers.	Difference: AEBAS shows a "Selfie"; the new system shows a "Team Photo" for comparison.

Dashboard	Static/Tabular: Shows raw "In/Out" logs and basic counters. (NODAL MANUAL)	Interactive/Analytical: Uses Python to show trendlines, "Punctuality heatmaps," and charts.	Difference: AEBAS is a "Logbook"; the new system is an "Analytics Suite."
Top & Worst Performers	Non-Existent: No feature in the manuals identifies "Most Regular" or "Chronic Defaulters" automatically.	Automated Ranking: Instantly generates a "Top 10" and "Bottom 10" list daily.	Difference: You save hours of manual Excel sorting to find the slackers.
Nudging (Behavioural)	None: The system is purely for record-keeping.	Core Logic: Uses "Social Proof" (visibility of performance) to drive change. (Richard H. Thaler and Professor Cass R. Sunstein, April 8, 2008)	Difference: AEBAS is "Big Brother"; the new system is "Peer Pressure."
OD/Tour Filtering	Binary: If you don't punch, you are "Absent." Requires manual reconciliation at month-end (BAS USER MANUAL)	Integrated Reconciliation: Allows the BO to mark "On Duty" status before looking at the daily defaulter list.	Difference: Reduces 90% of the "Wrongful Absence" complaints to HR.

7.4 Why a New System became Necessary

Essentially, the existing biometric attendance system functions as a data capture mechanism, not as an attendance management system. It generates accurate raw data but fails to align with:

- the hierarchical administrative structure of the office,
- the decision-making needs of Branch Officers,
- the oversight requirements of senior management, and
- the operational realities of field duties and inspections.

·It also includes a feature that allows customised messages to be issued at the branch officer or administrative level, enabling communication to be sent simultaneously to all concerned employees of a specific section.

This gap between data availability and data usability created the need for a new system one that could sit over the existing biometric infrastructure and transform static attendance logs into a role-specific, section-wise, and accountability-driven administrative tool.

7.5 Objectives of the New Attendance System

The new attendance management system was conceptualised and developed with the primary objective of bridging the gap between biometric attendance data generation and effective administrative control.

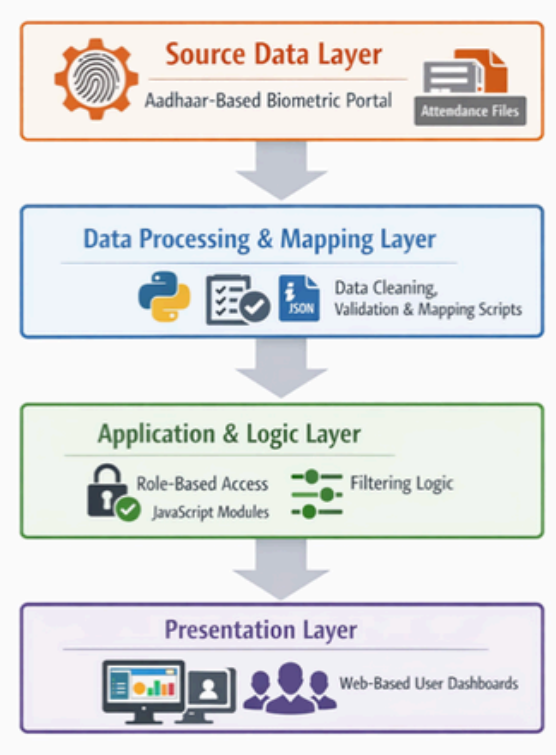
Objective Area	Concise Statement of Objective
Actionable Data Use	Transform static biometric attendance files into interactive, decision-oriented administrative information.
Administrative Alignment	Align attendance data with the actual hierarchy of coordination cells, Branch Officers, and sections.
Controlled Decentralisation	Enable role-based access that empowers Branch Officers while retaining senior-level oversight.
Accountability	Institutionalise systematic, evidence-based attendance monitoring at multiple administrative levels.
Efficiency & Accuracy	Reduce manual effort and human error through automated data processing and presentation.
Analytical Insight	Generate comparative and trend-based attendance analytics to support informed management decisions.
Operational Realism	Incorporate legitimate field duties and official engagements into attendance assessment.
Transparency & Compliance	Promote punctuality and self-compliance through transparent visibility and automated alerts.
Scalability	Create a modular, future-ready system capable of expansion without structural redesign.

7.6 Technical Architecture and Methodology

The codebase reflects a governance-first design philosophy:

- Python was used for data cleaning, validation, and master mapping
- JSON files were used to encode administrative logic transparently
- JavaScript handled role-based filtering and user interaction
- HTML/CSS provided a clean, minimal interface focused on usability

"The system was developed using an iterative, design-based methodology, with continuous validation against real administrative workflows."



7.7 Process Narrative: System Workflow and Use of Code

The attendance management system was developed as an interpretive layer over the existing biometric attendance infrastructure, using a combination of Python, JavaScript, and standard web technologies, each applied at a distinct stage of the workflow.

The process begins with the ingestion of raw biometric attendance files generated by the Aadhaar Enabled Biometric Attendance System. These files, typically in Excel format, are first analysed using Python-based data processing routines. Python was used at this stage for its strength in handling tabular data, enabling systematic parsing of attendance files, inspection of data schemas, detection of missing supervisory linkages, and identification of inconsistencies between attendance data and existing master records.

Following this diagnostic phase, the administrative structure of the office comprising coordination groups, Branch Officers, and sections was formally encoded using configuration-driven logic. This logic was expressed through structured configuration objects, generated and validated using.

Python and subsequently consumed by the application layer. Encoding the hierarchy as configuration rather than hard-coded rules ensured transparency, auditability, and ease of modification when organisational structures change.

Step	Implementation Stage	What Was Done	Logic / Code Functionality Used
Step 1	Raw Data Analysis	Examined biometric attendance outputs and master datasets to identify missing linkages and inconsistencies	Data parsing routines to read Excel inputs, schema inspection logic, mismatch and gap detection algorithms
Step 2	Administrative Hierarchy Encoding	Encoded Branch Officer–Section–Group hierarchy as system control logic	Configuration-driven mapping logic using structured data objects to define supervisory boundaries
Step 3	Employee Master Mapping	Created and normalised a permanent employee master linked to attendance ID, section, group, and Branch Officer	Entity-mapping logic ensuring one-to-one relationships; validation routines to enforce uniqueness and integrity
Step 4	Role-Based Access Design	Implemented differentiated system access for nodal, Branch Officer, and admin users	Role-based access control (RBAC) logic with permission-driven data filtering at the application layer
Step 5	Attendance Upload & Reconciliation	Enabled daily ingestion of biometric attendance files and automated reconciliation	File ingestion logic, ID-matching algorithms, and automated assignment to supervisory units
Step 6	Branch Officer Restricted Views	Presented section-specific attendance views to Branch Officers	Dynamic filtering logic rendering data based on mapped authority and user role
Step 7	Admin & Nodal Reporting	Enabled organisation-wide visibility and comparative attendance analytics	Aggregation and summarisation logic generating branch-wise and section-wise insights
Step 8	Validation & Data Hygiene	Continuously verified data integrity prior to expansion or analytics	Iterative validation routines detecting orphan records, duplicates, and classification mismatches

Sl. No.	Function Enabled	User Level	Administrative Purpose / Use
1	Role-based login authentication	All users (Nodal, BO, Admin)	Ensures secure access and prevents unauthorised viewing or manipulation of attendance data
2	Daily biometric attendance file upload	Nodal Officer	Centralised and controlled ingestion of attendance data from biometric portal
3	Automated attendance ID matching	System (Backend)	Eliminates manual reconciliation and ensures accuracy in employee identification
4	Employee–Section–BO mapping	System (Backend)	Aligns attendance data with actual supervisory and administrative hierarchy
5	Restricted attendance visibility	Branch Officers	Enables BOs to monitor only employees under their jurisdiction
6	Organisation-wide visibility	Admin / Senior Officers	Enables top-level oversight across all branches, sections, and groups
7	Daily attendance status view	BOs, Admin	Enables quick assessment of present and absent employees
8	Date-wise attendance filtering	BOs, Admin	Facilitates retrospective attendance review for specific dates
9	Absent-only filter	BOs, Admin	Enables quick identification of defaulters without scanning full lists
10	Section-wise attendance display	Branch Officers	Supports targeted supervisory action at section level
11	Branch Officer-wise aggregation	Admin	Enables comparative assessment of attendance discipline across branches
12	Dashboard-based analytics	Admin / Nodal	Supports evidence-based management and strategic oversight
13	Identification of frequent absentees	Admin / BOs	Enables focused administrative intervention and counselling
14	Identification of regular employees	Admin	Supports recognition of consistent compliance and positive behaviour
15	Monthly attendance report generation	Admin / Senior Officers	Facilitates periodic review, accountability meetings, and documentation
16	Exception handling for field duty	Authorised Officers	Prevents penalisation of employees on legitimate official duty
17	Attendance data transparency	BOs, Admin	Reduces ambiguity and informal discretion in attendance monitoring
18	Automated attendance alerts / messaging	Employees (system-triggered)	Nudges self-compliance and reduces need for supervisory follow-up
19	Reduction of manual Excel handling	All supervisory levels	Saves administrative time and reduces clerical errors
20	Configuration-driven structure updates	Admin / System	Allows easy adaptation to organisational changes without code modification
21	Scalability for future analytics	Admin / System	Enables future expansion such as trend analysis and performance metrics

A permanent employee master dataset was then created and normalised. Python validation logic was again used to enforce one-to-one mappings between employees, attendance identifiers, sections, and Branch Officers, and to eliminate duplicates or orphan records. This validated master dataset became the authoritative reference against which all daily attendance data is reconciled.

The application layer was implemented using JavaScript, which handled role-based access control and data filtering. JavaScript logic dynamically determines what portion of the attendance data is rendered to a user based on their administrative role nodal officer, Branch Officer, or senior administrator. This ensured that the same underlying dataset could be reused while enforcing strict, authority-aligned visibility.

Daily attendance uploads are initiated through a web interface built using HTML and CSS, providing a simple, role-specific user interface. Once a file is uploaded by the nodal officer, backend processing logic matches attendance identifiers with the validated employee master using automated reconciliation algorithms, assigning each record to the appropriate section and Branch Officer without manual intervention.

Finally, JavaScript-based aggregation and filtering routines generate section-wise views for Branch Officers and organisation-wide summaries for senior management. Throughout the process, iterative validation logic implemented primarily in Python is used to maintain data integrity as new attendance files are processed and as the system continues to evolve.

In combination, Python enables robust data processing and validation, JavaScript enables dynamic role-based logic and presentation, and standard web technologies provide accessible user interaction.

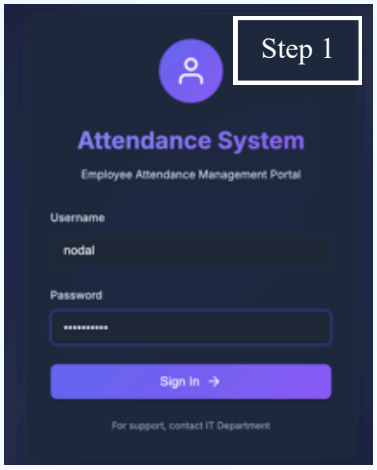
Together, these components transform static biometric attendance records into a structured, administratively usable system while leaving the underlying biometric infrastructure unchanged. Rather than replacing the biometric system, the code acts as an intelligent interpretive layer, converting raw attendance logs into administratively meaningful information.

7.8 Key Benefits throughout the Project

1. Administrative Usability of Biometric Data
    a. Example: Daily Excel attendance files downloaded from AEBAS were automatically parsed, reconciled, and displayed as section-wise attendance views, enabling supervisors to identify absentees without manual sorting.
2. Alignment with Supervisory Hierarchy
    a. Example: Attendance records were mapped to coordination groups, Branch Officers, and sections using configuration-driven hierarchy logic, ensuring that data visibility reflected actual administrative control.
3. Decentralised Accountability
    a. Example: Each Branch Officer was provided a restricted login showing attendance only for employees under their sections, while senior officers retained organisation-wide visibility through an admin interface.
4. Reduced Manual Effort and Error
    a. Example: Automated reconciliation of attendance IDs with a validated employee master eliminated repetitive spreadsheet handling and reduced errors arising from manual filtering and interpretation.
5. Timely Enforcement of Attendance Rules
    a. Example: Branch Officers could immediately identify section-level absenteeism and initiate casual leave regulation based on daily, system-generated attendance views rather than delayed manual scrutiny.
6. Evidence-Based Oversight
    a. Example: Aggregated views enabled comparison of attendance patterns across sections and Branch Officers, allowing senior management to base administrative reviews on objective trends rather than anecdotal reports.
7. Accommodation of Operational Realities
    a. Example: The system allowed authorised officers to filter attendance data to account for legitimate official duties such as inspections or meetings outside office premises, preventing misclassification due to geofencing constraints.
8. Behavioural Nudging Without Coercion
    a. Example: Clear visibility of attendance status and planned automated alerts made attendance outcomes predictable to employees, encouraging punctuality without introducing new disciplinary measures.
9. Non-Disruptive and Cost-Effective Reform
    a. Example: The intervention operated entirely over existing biometric attendance outputs, avoiding changes to AEBAS, statutory rules, or procurement of new hardware or software platforms.
10. Scalable and Replicable Design
    a. Example: The configuration-driven architecture allows additional offices or divisions to be incorporated by updating supervisory mappings without altering core system logic.

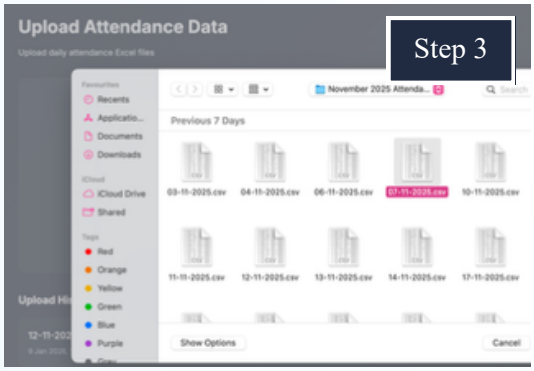
(The screenshots in the following pages depict the portal hosted on a local server; certain features of which are currently under development.)

7.9 Step-wise Visual Representation of the Developed Attendance Management Portal

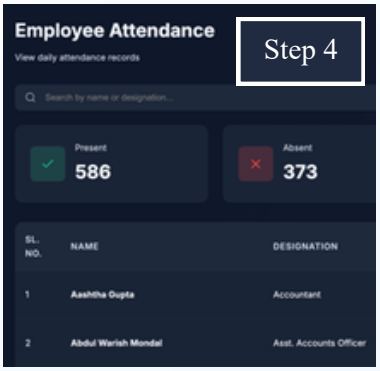


Step 1- This figure depicts the landing page of the portal, which serves as the common login interface. Designated users including the Nodal Officer, Branch Officers etc. access the system through their respective unique login credentials.

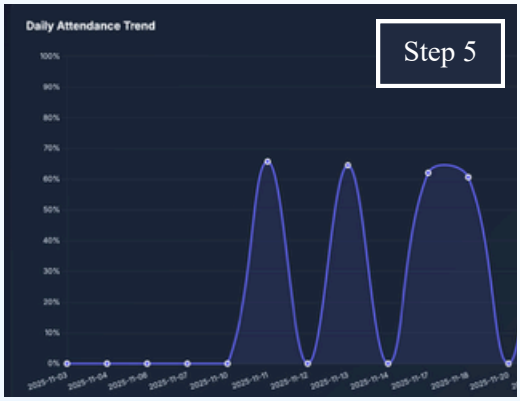
Step 2- This screen shows the nodal user interface after login, where the designated nodal officer is provided with the option to upload attendance files. At present, the system supports attendance data uploads in Excel and CSV formats.



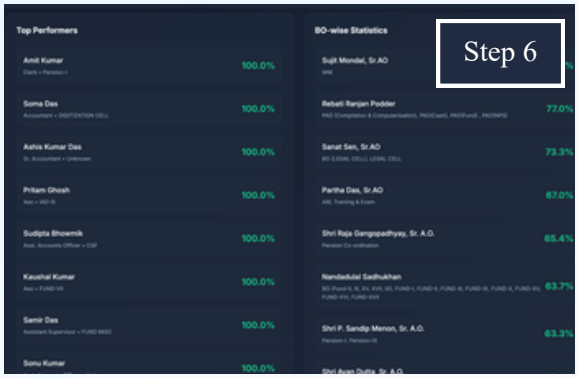
Step 3- The nodal officer can simply select and upload the daily attendance file downloaded from the biometric portal for the relevant date.



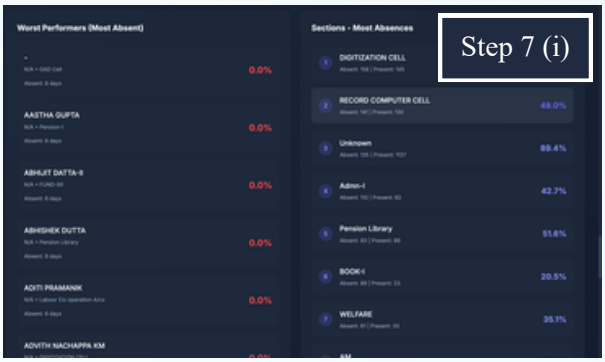
Step 4- Upon upload, the data is automatically populated, and key attendance metrics are displayed.



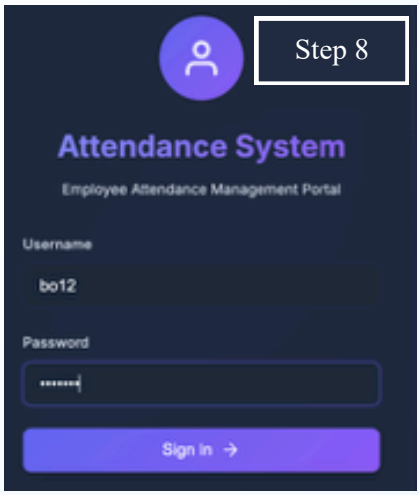
Step 5- Section-wise attendance metrics, along with additional summary indicators, are displayed on the dashboard. Attendance trends are also displayed through a trendline for analytical reference.



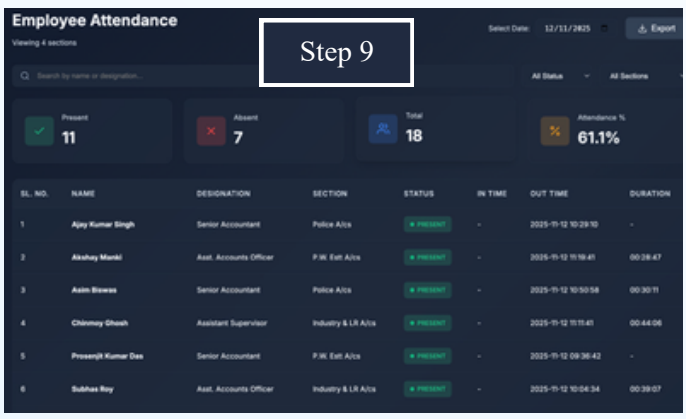
Step 6- Branch Officer–wise performance and employees identified as best performers are displayed, Section wise data is also visible.



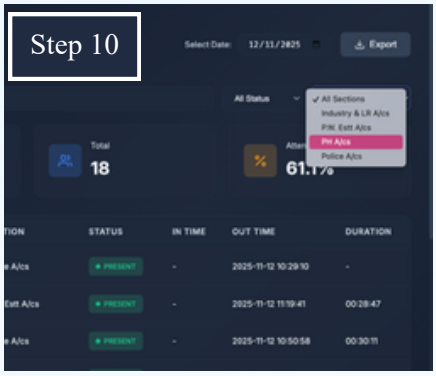
Step 7- Employees with frequent absenteeism are identified and displayed separately as defaulters.



Step 8: Each Branch Officer is provided with a unique login ID, granting restricted access limited to attendance data for employees under their respective sections.

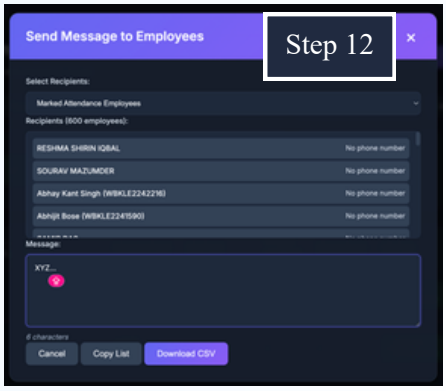


Step 9: Upon login, the Branch Officer is shown a restricted view displaying attendance data only for employees under his or her respective section.



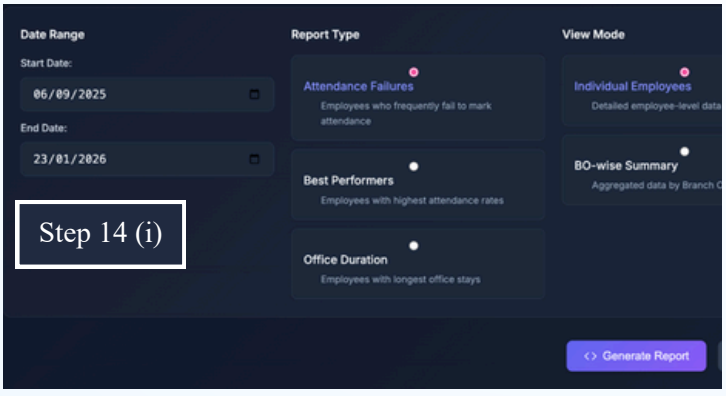
Step 10: The interface provides multiple filters, including section-wise and present/absent filters, to enable focused attendance review.

Step 11: This step illustrates the functioning of the applied filters, demonstrating how attendance data is dynamically refined based on the selected criteria.



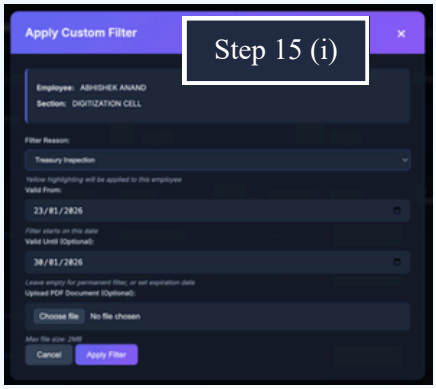
Step 12: A custom message can be sent to employees based on any appropriate filter used.

Step 13: Employee wise attendance trend is also available to be viewed.

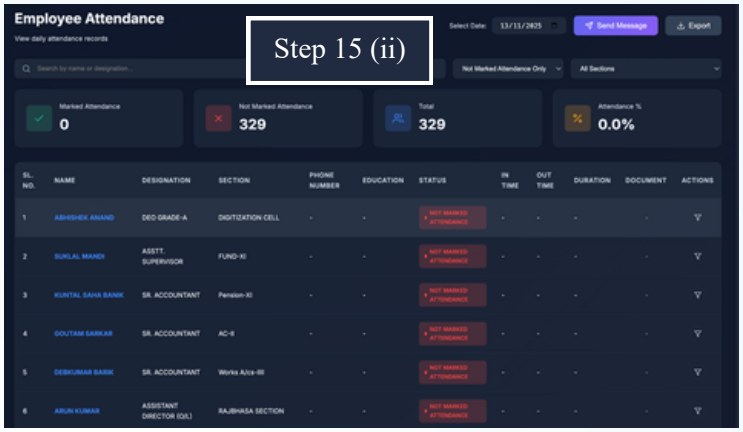


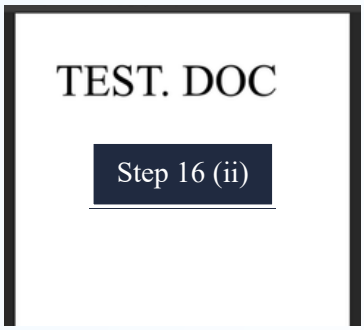
Step 14: Report generation feature – customisable

Report generated in pdf format.

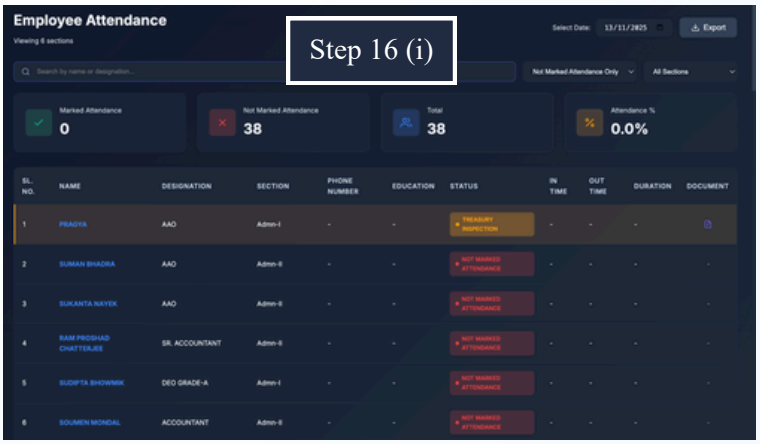


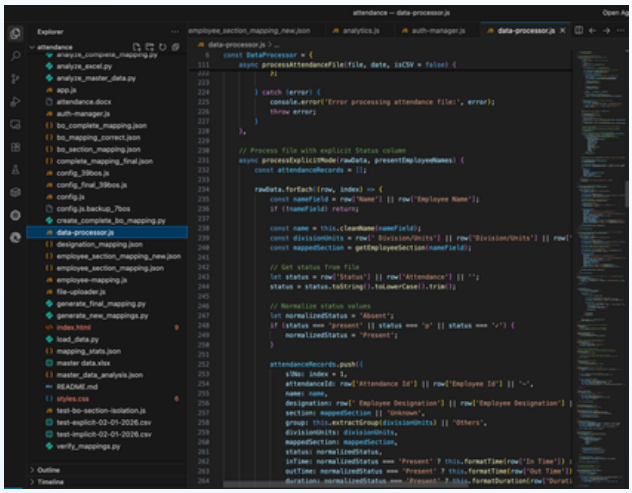
Step 15: A custom filter can be used to mark people who are not absent but either on treasury inspection, official tour etc. Office order or relevant doc can be attached.





Step 16: The filter is applied using an action option by the nodal officer, and the concerned BO will then have the particular employee visible in a different way (yellow). In this case, the concerned office order or relevant document can also be downloaded by the BO. Here 'test.doc' is the attached order.





This snapshot represents a simplified view of the extensive code logic operating in the background to support the system's functionality.

7.10 Conclusion

This project demonstrates that digital reform in public administration is effective only when technological systems are aligned with institutional authority and accountability. The behavioural impact of the system can be understood through the lens of behavioural economics. As Thaler and Sunstein argue in Nudge, a nudge is "any aspect of the choice architecture that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives." (Thaler and Sunstein, 2008) The attendance framework described in this article operates precisely in this manner: by restructuring how attendance information is presented making it timely, visible, and role-specific it encourages punctuality and compliance without introducing new sanctions or coercive controls. Behavioural change emerges not from enforcement alone, but from redesigned administrative visibility

By introducing a role-based interpretive layer, attendance data is aligned with actual supervisory responsibility, restoring the linkage between information, authority, and accountability. The transformation of static attendance logs into intelligible, section-wise views reduces manual effort, improves accuracy, and enables timely administrative action while accommodating operational realities.

More broadly, the system enables continuous, evidence-based oversight without excessive surveillance and offers a scalable, replicable model for public institutions. It thus contributes to pragmatic e-governance by demonstrating how modest, well-designed digital interventions can significantly strengthen routine administrative practice.
The system has been conceptualised and coded by the author, with active testing, validation, and iterative refinement. This in-house development approach has enabled continuous experimentation within a real administrative environment, allowing the system to evolve responsively rather than as a static technological product. Certain features remain under development, reflecting the project's incremental and adaptive design philosophy.

Data Availability

The study is based on publicly available data. All data used in this research are accessible from open sources and properly cited within the article. I confirm that any data sharing adheres to principles of privacy and confidentiality, especially for studies involving human subjects.

Ethics Statement

I confirm that the research presented in this manuscript was conducted in an ethical and responsible manner. I confirm that the data presented in this manuscript are authentic and accurate, and that no data fabrication, falsification, or manipulation has occurred. I understand that plagiarism, self-plagiarism, redundant publication, and other forms of research misconduct are strictly prohibited. I confirm that this manuscript is free from such misconduct.

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Conflict of Interest

No Conflict of Interest.

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ARTICLE 8

Gender Auditing and Public Accountability: A Structural Imperative for Inclusive Governance

Annie George*

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Abstract

Gender auditing has emerged as a critical instrument for advancing inclusive and accountable public governance. As governments worldwide commit to gender equality through constitutional mandates, international conventions, and national policies, a persistent gap between policy intent and measurable outcomes remains. This article examines the conceptual foundations, methodological frameworks, and institutional challenges associated with gender auditing in the public sector. It draws on frameworks developed by the United Nations Entity for Gender Equality and the Empowerment of Women (UN Women), the Organisation for Economic Co-operation and Development (OECD), the International Organisation of Supreme Audit Institutions (INTOSAI), and the Canadian Audit and Accountability Foundation (CAAF) to analyse how gender auditing strengthens public accountability. Central to the analysis is the role of gender-disaggregated data—data broken down by gender—in enabling auditors to move beyond compliance-based assessments toward outcome-oriented and evidence-based assurance. The article identifies recurring structural weaknesses, including weak data systems, misalignment between budgets and gender objectives, and tokenistic mainstreaming. It proposes concrete measures for institutionalising gender auditing, including capacity building, data system strengthening, and embedding quality management principles drawn from International Organisation for Standardisation (ISO) 9001. A case study from India's Self-Help Group (SHG) bank linkage programme illustrates how gender-sensitive auditing can reveal substantive governance gaps. The article concludes that gender auditing is no longer optional but essential for equitable, results-oriented public administration.

Keywords

Gender Auditing, Gender-Disaggregated Data, Public Accountability, Gender-Responsive Budgeting (GRB), Supreme Audit Institutions and Gender Mainstreaming.

8.1 Introduction: Gender Equality as a Governance Concern

Gender equality has progressively shifted from a normative social objective to a core concern of public governance and accountability. Governments have adopted constitutional guarantees, gender policies, and international commitments aimed at reducing gender disparities. Nevertheless, persistent inequalities in access to public services, employment, health, education, and decision-making indicate a continuing gap between policy intent and policy outcomes.

In this context, gender auditing emerges as a structured mechanism to assess whether public institutions, policies, and programmes effectively integrate gender considerations into planning, budgeting, and implementation. As recognised in the Gender-Responsive Budgeting (GRB), which refers to the application of gender analysis to government budgeting processes to ensure that public expenditures and revenues promote gender equality and the fulfilment of women's rights - Manual by UN Women, gender auditing strengthens public accountability by examining how state actions differentially affect various genders and whether equality commitments translate into measurable results (UN Women, 2023).

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8.2 Background: Evolution of Gender Auditing Frameworks

Despite formal commitments, gender considerations often remain inadequately operationalised. Gender auditing is necessary to address several structural gaps:

- Outcome invisibility: Aggregate reporting frequently conceals differential impacts on women and men.
- Resource misalignment: Gender objectives are not consistently supported by traceable and outcome-linked budgetary allocations.
- Institutional blind spots: Gender-neutral processes often result in gender-unequal outcomes, undermining policy effectiveness.

The relevance of gender auditing is further reinforced by policy literature on data-driven governance. Invisible Women by Caroline Criado Perez highlights how the systematic absence of sex-disaggregated data in policy formulation and implementation leads to outcomes shaped around a default male norm (Perez, 2019). Even routine aspects of urban planning can be affected when gender-disaggregated data is missing. Decisions that appear entirely gender-neutral—such as the sequencing and prioritisation of municipal services—are often based on assumptions about how people move through and use public spaces. When these assumptions are not tested against gender-differentiated patterns of work, caregiving, and mobility, planning choices can unintentionally work better for some groups than others, leading to avoidable inefficiencies and inequitable outcomes.

Such data gaps weaken programme design and service delivery. Gender auditing provides a formal mechanism to surface these blind spots and assess whether institutional decisions are informed by inclusive and comprehensive evidence.

8.3 Audit Scope and Methodology

Gender auditing may be conducted as a standalone audit or integrated within financial, compliance, or performance audits, each of which employs a distinct methodological approach. A financial gender audit examines whether public expenditures are allocated and disbursed in ways that are equitable across genders. A compliance gender audit assesses whether institutions adhere to gender-related legal obligations, policy mandates, and international commitments. A performance gender audit evaluates the effectiveness, efficiency, and economy of gender-mainstreaming efforts, focusing on outcomes and impact rather than mere process adherence. These three methodologies differ in their evidence standards, criteria, and level of assurance provided.

The availability and reliability of gender-disaggregated data form a critical determinant of audit scope, depth, and assurance level. Evidence is gathered through document review, interviews with implementing agencies, beneficiary surveys, and secondary data analysis from administrative records. Audit criteria are weighted based on their legal hierarchy, the constitutional provisions and international conventions carry the highest authority—followed by national gender policies, Sustainable Development Goal (SDG) 5, and organisational commitments. Audit conclusions are formed through systematic comparison of evidence against criteria, followed by a root cause analysis and impact assessment.

As per the Canadian Audit and Accountability Foundation's (CAAF) Practice Guide to Auditing Gender Equality, the audit scope typically encompasses:

- Policy and legislative frameworks
- Budget formulation and expenditure patterns
- Programme design, targeting, and implementation
- Institutional arrangements, staffing, and leadership representation

Audit criteria are derived from constitutional provisions, national gender policies, SDG 5, international conventions, and organisational commitments, supplemented by indicators from the UN Women Gender Equality Scorecard (Institute, 2025).

8.4 Evidence, Data, Internal Controls, and Audit Quality

A recurring concern in gender audits is the absence or poor quality of gender-disaggregated data, which significantly constrains audit analysis and weakens conclusions. In the absence of such data, auditors are often limited to assessing compliance and inputs rather than outcomes and impacts. Consequently, differential effects of public policies and programmes across genders remain obscured.

The OECD Gender Policy Framework emphasises that evidence-based policymaking depends on disaggregated and outcome-oriented data (OECD, 2025). From an audit perspective, such data is equally essential for establishing robust audit criteria, reliable audit evidence, and defensible audit conclusions. Gender-disaggregated data enables auditors to assess whether public resources are equitably allocated, whether access to services is balanced, and whether outcomes align with stated gender objectives.

The implications of data gaps have been widely documented in policy analysis. As observed by Perez (2019) in Invisible Women, the absence of gender-sensitive data renders women's experiences statistically invisible within public systems, resulting in policies and standards designed around a default male norm. In audit terms, this invisibility translates into weak internal controls, limited impact assessment, and reduced audit assurance.

From a quality management perspective under ISO 9001, reliable data is a prerequisite for process control, performance measurement, and continuous improvement. Gender-disaggregated data enhances audit quality by:

- Strengthening risk assessment and audit planning
- Enabling outcome-oriented performance audits
- Supporting cause–and–effect analysis rather than descriptive reporting
- Improving the credibility and usefulness of audit recommendations

Accordingly, gender auditing evaluates not only programme outcomes but also the adequacy of data systems, indicators, reporting arrangements, and feedback mechanisms. Strengthening gender-disaggregated data systems, therefore, directly contributes to higher-quality audits and more effective public accountability.

Evidence in gender audits is gathered through multiple complementary methods. Document review involves systematic analysis of policy frameworks, programme guidelines, budget allocations, and administrative reports to assess the presence and quality of gender provisions. Stakeholder interviews and focus group discussions with implementing agencies, frontline service providers, and intended beneficiaries—particularly women and marginalised groups—yield qualitative evidence about implementation realities that documents alone cannot capture. Beneficiary surveys provide statistically representative data on access, utilisation, and satisfaction with public services, disaggregated by gender. Secondary data analysis draws on administrative records, civil registration data, and national statistical databases to construct gender-differentiated outcome profiles. Direct observation and field visits allow auditors to verify reported outputs against on-ground conditions. The sufficiency and appropriateness of evidence is governed by International Standards of Supreme Audit Institutions 100 (ISSAI), which requires that audit evidence be relevant, reliable, and adequate to support audit conclusions.

Audit criteria in gender audits are weighted according to a hierarchy of legal and policy authority. Constitutional provisions and ratified international conventions carry the highest authority and form the primary basis for audit findings. National gender policies and legislative mandates occupy the next tier. Sectoral guidelines, institutional gender action plans, and performance frameworks constitute the operational tier against which programme-level compliance is assessed. This hierarchical weighting ensures that findings reflect the severity of deviations proportionately: a failure to meet a constitutional guarantee is weighted more critically than a shortfall against an internal target. Where criteria conflict or overlap, auditors apply professional judgement informed by ISSAI 300 to determine the most appropriate standard against which to measure evidence.

Audit conclusions are formed through a structured process of comparing evidence against criteria, identifying gaps and root causes, and assessing impact. The process begins with the formulation of audit questions—for example, "Did the programme allocate resources equitably between women and men?" Evidence gathered is then mapped to each audit question, and findings are classified as compliance, partial compliance, or non-compliance. Root cause analysis is applied to determine whether shortfalls stem from policy design, institutional capacity, data gaps, or accountability failures. The materiality of findings is assessed based on the significance of the gap, the population affected, and the resources involved. Conclusions are supported by cause-and-effect reasoning rather than descriptive narration, ensuring that recommendations are targeted, actionable, and linked to specific institutional responsibilities. This analytical rigour distinguishes a high-quality gender audit from a mere checklist exercise.

It is also important to distinguish how gender considerations are addressed across different audit types:

- Financial audits examine whether gender-related allocations are properly recorded and reported, but they typically do not assess outcomes.
- Compliance audits verify adherence to gender-related laws, policies, and guidelines.
- Performance audits provide the most substantive scope for gender analysis, as they assess economy, efficiency, and effectiveness, including whether programmes achieve intended gender outcomes.

8.5 Key Observations Emerging from Gender Audits

Gender audits conducted across jurisdictions commonly reveal:

- Gender considerations confined largely to planning and policy documents
- Weak linkage between budgets and gender-specific outcomes
- Limited monitoring of programme impacts on women and marginalised groups
- Tokenistic compliance with gender mandates
- Absence of accountability mechanisms for non-achievement of gender objectives

These findings suggest that gender mainstreaming often remains procedural rather than outcome-oriented. The following table illustrates the distinction between procedural (compliance-based) and outcome-oriented indicators commonly applied in gender audits (Table 8.1).

Table 8.1: Sample Outcome Indicators for Gender Auditing

Domain	Procedural / Compliance Indicator	Outcome / Impact Indicator
Land Rights	Existence of a gender policy in land administration	% increase in female land ownership or land titling post-intervention
Financial Inclusion	Number of Self-Help Groups (SHGs) registered	% of SHG members with active bank accounts; average credit accessed per female member
Education	Enrolment of girls in government schools	Retention rate and learning outcome scores disaggregated by gender
Health Services	Availability of maternal health schemes	% reduction in maternal mortality; % of women accessing antenatal care
Employment	Existence of an equal pay policy	Gender wage gap in public sector employment; % women in senior positions

8.6 The Alternate Perspective

Implementing agencies sometimes contend that gender objectives are adequately embedded within general welfare schemes and that dedicated gender audits increase administrative burden. Constraints related to data availability and competing priorities are also frequently cited.

However, as articulated in INTOSAI guidance, gender auditing does not create parallel accountability structures. Instead, it enhances governance quality by improving decision-making, targeting, and resource efficiency. Resistance to gender auditing often reflects institutional inertia rather than substantive limitations.

A concrete illustration of this dynamic is found in India's Self-Help Group (SHG) bank linkage programme, one of the largest financial inclusion initiatives targeting rural women. An audit by the Comptroller and Auditor General (CAG) of India identified significant gaps between reported coverage figures and actual active account utilisation. While scheme documents recorded high enrolment numbers, gender-disaggregated data revealed that a substantial proportion of accounts remained dormant, and credit accessed per member was minimal. The audit highlighted weak follow-up mechanisms and the absence of outcome-linked monitoring indicators. This case demonstrates that resistance to outcome-oriented auditing—in favour of reporting procedural compliance—obscures real governance gaps and perpetuates ineffective resource allocation.

8.7 The Way Forward

To institutionalise gender auditing and enhance its effectiveness, the following measures are essential:

- Mainstreaming gender considerations in audit planning across Supreme Audit Institutions
- Capacity building of auditors in gender analysis, data interpretation, and stakeholder engagement
- Strengthening data systems through systematic collection of sex-disaggregated and outcome-linked data
- Ensuring effective follow-up of audit recommendations through legislative and executive oversight

Gender equality should be treated as an evolving governance objective requiring regular assessment and corrective action.

8.8 Conclusion

Gender auditing represents a critical convergence of equity, efficiency, and accountability in public administration. By systematically examining how public policies, budgets, and institutions affect different genders, it strengthens governance quality and public trust. Frameworks developed by UN Women, OECD, ISO, and INTOSAI collectively affirm that gender equality is integral to effective and outcome-oriented governance.

In particular, the availability of gender-disaggregated data is central to improving audit quality, enabling auditors to move from compliance-based observations to outcome-driven and evidence-based assurance. In an era increasingly focused on results, gender auditing is no longer optional but essential for inclusive and accountable governance.

Data Availability

The data supporting this study are derived from publicly available institutional reports and academic literature cited in the references.

Ethics Statement

This article is a conceptual and documentary analysis based on publicly available secondary sources, and it does not involve human participants, animals or primary field experiments requiring prior ethical approval. No sensitive personal data was collected, processed or reported, and no procedures with potential physical, psychological or social risk to individuals or communities were undertaken.

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None

Conflict of Interest
No Conflict of Interest.

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ARTICLE 9

Audit Analytics in Practice: Evidence from India's Electricity Sector

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Abstract

This research study highlights the practical audit relevance of data analytics in strengthening risk-based audit procedures, performance evaluation and auditing. Rather than focusing solely on statistical relationships, the analysis demonstrates how indicators related to asset utilisation, financing structure, and operating efficiency can assist auditors in identifying potential pressure points in a firm's operations, cash flows, and core financial performance, as well as highlighting key audit matters. These indicators can support more focused audit planning, improved analytical review procedures, and timely identification of areas requiring deeper substantive testing.

The study illustrates how integrating structured ratio analytics into routine audit workflows can enhance professional judgement, improve anomaly detection, and contribute to more robust assurance outcomes.

Keywords

Data Analytics, Risk-Based Auditing, Electricity Sector and Outlier Identification.

9.1 Introduction

Auditing is increasingly being shaped by the need to move beyond checklist-driven verification toward risk-focused, analytics-enabled assurance. In this dynamic environment, profitability indicators derived from financial ratios offer a valuable lens for auditors to assess the underlying drivers of financial performance. Ratios capturing capital intensity, leverage exposure, and operating cost structures often signal emerging risks related to earnings quality, cost allocation practices, or financial sustainability.

Embedding ratio-based insights into audit procedures enables more efficient resource allocation and sharper identification of high-risk audit areas. For instance, sustained increases in asset-related cost burdens may warrant closer scrutiny of depreciation policies or asset valuation assumptions, while rising financing pressures may necessitate a detailed review of borrowing costs, covenant compliance, or liquidity management practices. By systematically linking financial analytics with audit judgment, practitioners can strengthen the credibility of audit findings and provide more actionable insights to management and oversight bodies.

The Bureau of Energy Efficiency (BEE) has institutionalised mandatory annual energy audits and periodic energy accounting, creating a data-driven environment that captures energy flows, losses, and operational inefficiencies across the distribution network. In particular, the BEE has established the Energy Data Management Unit to lead efforts to establish credible data on energy supply and consumption, along with a nationwide report on the National Energy Survey, which will include sectoral breakdowns. (Bureau of Energy Efficiency, 2026)

In addition, the Bureau also brought policy changes in the regulatory framework for the power sector. It released "The Bureau of Energy Efficiency (Manner and Intervals for Conduct of Energy Audit in Electricity Distribution Companies) Regulations, 2021". This regulatory framework mandates DISCOMs to undertake quarterly energy accounting procedures, as well as energy audits.

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The primary objective of the framework is to ensure accurate monitoring and evaluation mechanisms for Transmission and Distribution Losses (T&D losses). The generation of granular, periodic data and mandating third-party validations, the regulations establish a baseline to identify high-loss areas, improving operational efficiencies and financial sustainability for DISCOMs (High Court of Tripura, 2021).

At the recently held National Conference on Power Sector in New Delhi, the Comptroller & Auditor General of India also acknowledged the role of big data analytics and artificial intelligence in addressing operational inefficiencies and improving the financial sustainability of DISCOMs, amongst other inherent complexities in the power sector. (Business Standard, 2026) The CAG also took note of various data-driven initiatives in this regard, referring to the National Power Portal, the Central Electricity Authority, and NITI Aayog's India Climate & Energy Dashboard, among others (Office of the Comptroller & Auditor General of India, 2026).

9.2 Background and Context

The legislative and policy framework for the power distribution sector in India has gone through a dynamic evolution over the past two decades. Key among these changes is the initiation of the Ujwal DISCOM Assurance Yojana (UDAY), which sought to address persistent financial distress in DISCOMs through debt restructuring, operational efficiency targets such as GIS mapping of losses, compulsory feeder and Distribution Transformers (DTs) by States and loss-reduction commitments. (Ministry of Power, 2015)

Additionally, the roll-out of smart metering initiatives such as the Revamped Distribution Sector Scheme with a layout of around INR 3 Lakh Crores, a results-linked incentive scheme, with the primary objective to reduce AT&C losses to pan-India levels of 12-15% and Average Cost of Supply (ACS) - Average Revenue Realised (ARR) gap to zero, by increasing access to financial assistance under the Department's budget, particularly for Distribution Infrastructure. (Ministry of Power, 2025)

At the legislative forefront, the Energy Conservation Act of 2001 laid the foundations for the establishment of the Bureau of Energy Efficiency and enabled it to improve energy efficiency and auditing frameworks, as well as to mandate data-driven energy accounting systems. (India Code, 2001) The Energy Conservation (Amendment) Act, 2022, further expands the scope of the original Act by providing for carbon credit trading activities, and increasing the scope of regulatory oversight to sectors such as buildings, transport and industrial energy use. (The Official Gazette of India, 2022)

Despite sustained reform efforts, DISCOMs continue to face barriers to financial sustainability, primarily high Aggregate Technical and Commercial losses (AT&C losses) across the Power sector. While AT&C losses have reduced to around 15% in FY 2024-2025 from 22.62% in FY 2013-2014, the operational barriers created due to inaccurate billing, metering gaps and electricity theft still persist across DISCOMs. (Press Information Bureau, 2026)

From an audit perspective, these persistent inefficiencies highlight concerns with traditional manual and sampling-based approaches. These traditional approaches often struggle to:

a. Capture system-wide leakages across dispersed networks.
b. Detect patterns of revenue theft or billing irregularities, especially when dealing with time-series data.
c. Reconcile large volumes of operational and financial data.

Consequently, critical risk areas such as under-recovery of revenue, misreporting of losses, and inefficiencies in cost allocation are usually insufficiently addressed.

With the improvements in the policy and legislative frameworks for the sector, there has been an increase in the availability of granular operational data, driven by smart metering, energy accounting and audit mandates as well as digital billing systems. It has led to an opportunity to transform auditing practices across the sector. For practitioners, a transition towards data analytics and AI for auditing leads to several tangible improvements, such as:

a. Continuous monitoring of energy flows and billing patterns instead of periodic checks;
b. Anomaly detection using data analytics to identify irregular consumption, losses or billing gaps;
c. Predictive risk assessment, enabling early detection of high-loss feeders and revenue leakages.

By leveraging structured datasets and advanced analytical tools, auditors can move beyond compliance verification towards real-time risk assessment and performance reassurance, thereby directly contributing to the financial sustainability of DISCOMs.

9.3 Research Methodology

9.3.1 Choice of Methodology

The electricity sector (or for that matter, any sector) is structurally heterogeneous, comprising firms operating under different fuel technologies, capital intensities, regulatory regimes, and financing structures. Segment-wise regression allows the model to capture cost sensitivities specific to each operational cluster, thereby reducing coefficient bias and avoiding over-generalisation.

The segmentation was based on the primary business model of each firm and the core production of physical output or service being provided in electricity generation, supply or research & development within the sector.

A comparison of regression models with and without outliers was undertaken to examine the influence of extreme firms on segment-wide cost dynamics. Outliers in this segment were not random statistical anomalies but financially distressed or structurally atypical entities exhibiting extreme leverage, negative equity, abnormal depreciation burdens, or persistent revenue distortions. Estimating models both with and without these firms allows for a robustness check and reveals whether sectoral conclusions are representative of the average PSU or are driven by a small number of distressed entities.

Beyond regression, individual outlier analysis was conducted using ratio diagnostics, cash flow decomposition, debt service capacity assessment, and working capital cycle evaluation. Outlier firms in the Conventional Electricity segment exhibited characteristics such as negative revenues, negative debtor cycles, disproportionate depreciation relative to plant load factor, and weak interest coverage ratios.

9.3.2 Source of Data

The data for this study has been procured from Prowess, which is a comprehensive database developed by the Centre for Monitoring the Indian Economy, containing financial and non-financial information across sectors, industries and companies, including the three core financial statements.

9.3.3 Alternative Methodology

Quantile regression is another alternative, as it estimates relationships at different points along the distribution (e.g., at the median or in the lower deciles). This would allow examination of cost drivers across profitability tiers without excluding observations. However, quantile regression focuses on distributional heterogeneity rather than firm-specific structural distress.

Panel fixed-effects or random-effects models could also be employed to control for unobserved firm-level heterogeneity over time. These models are useful in accounting for persistent structural differences across firms. However, they do not directly address the issue of extreme tail influence and may still be sensitive to severe financial distortions, such as negative equity or negative revenue.

Cluster analysis or principal component analysis (PCA) could also group firms based on financial similarity, but these exploratory methods do not directly identify causal cost drivers or support regression-based inference.

Segment-wise regression acknowledges structural heterogeneity within the electricity sector, thereby producing more credible and context-specific coefficient estimates. The explicit comparison between models with and without outliers provides a clear robustness check, revealing how extreme firms influence segment-wide conclusions. This dual-estimation approach makes the impact of distressed entities analytically visible rather than statistically hidden.

Furthermore, the current approach aligns strongly with audit and governance objectives. The firm-level diagnostics directly identify Key Audit Matters, such as debt-structure opacity, plant-load-factor inefficiencies, depreciation–asset mismatches, revenue-recognition irregularities, and liquidity stress. More complex statistical techniques may improve mathematical robustness but would not necessarily enhance interpretability for financial oversight purposes.

Given the moderate sample size and the presence of highly skewed financial ratios, highly sophisticated modelling could risk overfitting without materially improving explanatory power. The selected methodology remains replicable, transparent, and economically grounded while still allowing robustness validation.

9.3.4 Identification and Analytics of an Outlier

Identification of an outlier was pursued using the median as the baseline and using (+-) 3xMean Average Deviation from the Median. Generally, the mean is utilised as a baseline; however, given the skewness of the Net Profit Margin data across segments, the mean did not reflect a true mean for any segment. The mean is susceptible to extremely high or extremely low values; in that case, the median becomes a preferred baseline.

Identified structural or financial outliers cannot be grouped for an analytical model. The primary reason is that grouped analytics require homogeneity, i.e., the observations within a group must share common characteristics for the results to be relevant and insightful.

For the identified outliers, analytics were carried out individually using the Balance Sheet, the Statement of Profit & Loss, the Statement of Cash Flow and Ratio Analysis.

9.4 Analysis and Discussion

9.4.1 Segmentation of the Sector

The electricity sector can be broken down into four separate segments, based on the primary business model of each firm and the core production of physical output or service being provided in the electricity generation, supply or research & development, which have been briefly discussed below:

1. **Conventional Electricity:** This segment includes firms working with energy sources that have been traditionally used for decades to generate power. These mainly include non-renewable energy sources such as coal, oil, natural gas, and nuclear fuel. (Tata Power, n.d.) There are 51 Central and State PSUs in this segment.
2. **Electricity Distribution:** This segment includes firms working with a variety of equipment, such as substations and distribution feeder systems, responsible for delivering electricity from substations to final consumers such as households and commercial users. (Occupational Safety and Health Administration, n.d.) There are 51 Central and State PSUs in this segment.
3. **Electricity Transmission:** This segment includes firms working within a high-voltage network regulated by central transmission utilities that help move electricity from power plants to regional substations across states. (Tata Power, n.d.)There are 35 Central and State PSUs in this segment.
4. **Renewable Electricity:** This segment consists of firms engaged in the R&D as well as generation of electricity through renewable sources such as solar, wind or hydroelectricity, etc. (National Grid Group, n.d.) There are 6 Central and State PSUs engaged in this segment.

9.4.2 Identifying Outliers

Using the median Net Profit Margin as the benchmark and a +- 3x Mean Average Deviation (MAD) standard from the set baseline, the following entities were identified as outliers in each segment:

- **Conventional Electricity:** Andhra Pradesh Development Co Ltd., Bundelkhand Saur Urja Ltd., Giral Lignite Power Ltd, K P C Gas Power Corp Ltd., Karnataka Renewable Energy Development Ltd., Rajasthan Vidyut Utpadan Ltd. and UP Jal Vidyut Nigam Ltd.
- **Electricity Distribution:** Mahatma Phule Renewable Energy & Infrastructure Technology Ltd., NTPC Renewable Energy Ltd., Bihar State Power Transmission Co. Ltd., Odisha Generation Phase-II Transmission Ltd., and Tusco Ltd.
- **Electricity Transmission:** Meghalaya Power Transmission Corporation Ltd., Odisha Power Transmission Corporation Ltd., Powergrid Unchahar Transmission Ltd., and Rajasthan Rajya Vidyut Prasaran Nigam Ltd.

9.4.3 Comparative Regression Models

9.4.3.1 Conventional Electricity

9.4.3.1.1 Including Outliers

Table 9.1: Output 1- The robust regression output (STATA) for the conventional electricity segment, including all financial outliers

Robust regression — Number of obs = 33; F(4, 28) = 95.20; Prob > F = 0.0000

NetProfitM~n	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
dep_ratio	-93.21027	12.81391	-7.27	0.000	-119.4584	-66.96217
fin_ratio	-36.70198	10.48027	-3.50	0.002	-58.16983	-15.23412
eb_ratio	-85.65294	15.41718	-5.56	0.000	-117.2336	-54.07227
cm_ratio	-66.89491	4.602552	-14.53	0.000	-76.32281	-57.46701
_cons	65.328	3.857232	16.94	0.000	57.42682	73.22919

Table 9.2: Discussion of various variables in the Regression Model, including outliers for the Conventional Electricity Segment (Full Sample Size= 33)

Variable	Nature and Type of Relationship	Overall Conclusions
Depreciation Ratio (Depreciation costs relative to Revenue from Operations)	Strongly Negative relationship	Depreciation ratio shows a substantial negative association with profitability, suggesting that firms with high capital intensity and large fixed asset bases experience significant margin compression.
Finance Cost Ratio (Financing costs/interest costs relative to Revenue from Operations)	Negative relationship	Similarly, the finance cost ratio exhibits a statistically significant negative effect, implying that leveraged capital structures and debt servicing obligations materially erode net profit margins.
Employee Benefit Expense Ratio (Employee Benefit Expenses relative to Revenue from Operations)	Negative relationship	Employee benefit expenses also demonstrate a strong adverse relationship with profitability, reflecting the relatively rigid labour cost structures prevalent in electricity utilities.
Cost of Materials Consumed Ratio (expenses relative to Revenue from Operations)	Negative relationship	Overall, the results suggest that when financially extreme firms are included, sector profitability appears heavily constrained by both operational cost pressures and capital-related financial burdens, indicating the presence of structurally stressed entities influencing aggregate financial dynamics.

9.4.3.1.2 Excluding Outliers

Table 9.3: Output 2- The robust regression output (STATA) for the conventional electricity segment, excluding all financial outliers

Robust regression — Number of obs = 23; F(4, 18) = 14.72; Prob > F = 0.0000

NetProfitM~n	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
dep_ratio	-11.64243	10.54603	-1.10	0.284	-33.79881	10.51395
fin_ratio	-15.79919	9.809534	-1.61	0.125	-36.40826	4.809874
cm_ratio	-23.75235	3.331376	-7.13	0.000	-30.75131	-16.75339
eb_ratio	-39.93873	11.23218	-3.56	0.002	-63.53666	-16.3408
_cons	25.09112	3.169269	7.92	0.000	18.43273	31.74951

Table 9.4: Discussion of various variables in the Regression Model, excluding outliers for the Conventional Electricity Segment (Full Sample Size =23)

Variable	Nature and Type of Relationship	Overall Conclusions
Depreciation Ratio (Depreciation costs relative to Revenue from Operations)	Negative relationship	Depreciation and finance cost ratios lose statistical significance, and their coefficient magnitudes decline sharply, indicating that capital intensity and leverage are not the primary determinants of profitability for the typical firm once extreme observations are excluded.
Finance Cost Ratio (Financing costs/interest costs	Negative relationship	
Employee Benefit Expense Ratio (Employee Benefit Expenses relative to Revenue from Operations)	Negative relationship	In contrast, the cost of materials ratio continues to exhibit a strong and statistically significant negative relationship with net profit margin, reinforcing the importance of operational input costs such as fuel procurement and power purchase agreements in shaping financial performance.
Cost of Materials Consumed Ratio (expense relative to Revenue from Operations)	Negative relationship	Employee benefit expenses also retain a meaningful negative effect, though at a reduced magnitude, suggesting moderate labour cost rigidity under normal operating conditions. The adjusted results, therefore, imply that the core profitability drivers for the majority of firms are linked more closely to operational efficiency rather than balance-sheet stress.

A key difference emerges in the magnitude and statistical significance of the explanatory variables. In the regression model including outliers, all four cost ratios, depreciation ratio, finance cost ratio, employee benefit expenses ratio, and cost of materials ratio, exhibit strong negative and statistically significant relationships with net profit margin. The cost of materials ratio shows the largest impact (coefficient ≈ -66.9; t = -14.53), followed by depreciation (≈ -93.2; t = -7.27), employee benefits (≈ -85.7; t = -5.56), and finance costs (≈ -36.7; t = -3.50). This indicates that, when financially extreme firms are included, sectoral profitability appears highly sensitive to both operational cost pressures and capital-structure burdens, particularly non-cash depreciation charges and employee expenses. The relatively large coefficient magnitudes suggest the presence of firms with disproportionately high fixed costs and leveraged balance sheets, which amplify sector-level cost sensitivity.

From an audit analytics perspective, these findings have significant implications. The inclusion model helps identify systemic risk signals, highlighting that certain firms may be experiencing severe balance-sheet stress that materially affects aggregate financial indicators. Conversely, the exclusion model provides a clearer benchmark for evaluating the financial performance of most firms.

9.4.3.2 Electricity Distribution

9.4.3.2.1 Including Outliers

Table 9.5: Output 3 - The robust regression output (STATA) for the electricity distribution segment, including all financial outliers

Robust regression — Number of obs = 46; F(4, 41) = 4.69; Prob > F = 0.0033

NetProfitM~n	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
dep_ratio	78.06964	19.81458	3.94	0.000	38.05327	118.086
fin_ratio	-50.38138	17.24705	-2.92	0.006	-85.2125	-15.55026
eb_ratio	-30.02097	15.92674	-1.88	0.067	-62.18567	2.14373
cm_ratio	-1.480401	2.699467	-0.55	0.586	-6.932085	3.971282
_cons	-.2703211	1.99697	-0.14	0.893	-4.303283	3.762641

Table 9.6: Discussion of various variables in the Regression Model, including outliers for the Electricity Distribution Segment (Full Sample Size = 46)

Variable	Nature and Type of Relationship	Overall Conclusions
Depreciation Ratio (Depreciation costs relative to Revenue from Operations)	Positive relationship	The results show that the depreciation ratio has a strong positive and statistically significant relationship with net profit margin (coefficient ≈ 78.07; $p < 0.01$), suggesting that firms with higher depreciation intensity appear to report relatively better margins. Although counterintuitive, this may reflect accounting effects such as regulated tariff structures, asset revaluation practices, or cost pass-through mechanisms that allow capital-intensive utilities to maintain profitability despite high fixed costs.
Finance Cost Ratio (Financing costs/interest costs relative to Revenue from Operations)	Negative relationship	In contrast, the finance cost ratio demonstrates a significant negative association with profitability (coefficient ≈ −50.38), indicating that debt servicing obligations exert downward pressure on margins.
Employee Benefit Expense Ratio (Employee Benefit Expenses relative to Revenue from Operations)	Negative relationship	Employee benefit expenses show a weak negative relationship that is marginally insignificant at conventional levels ($p \approx 0.067$), suggesting moderate labour cost rigidity.
Cost of Materials Consumed Ratio (expense relative to Revenue from Operations)	Negative relationship	The cost of materials ratio appears statistically insignificant, implying that input cost variability does not substantially explain profit variations when extreme financial observations are retained.

Table 9.7: Output 4 - The robust regression output (STATA) for the electricity distribution segment, excluding all financial outliers

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Robust regression                               Number of obs     =         45
                                                F(  4,         40) =       3.11
                                                Prob > F          =     0.0254
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NetProfitM~n	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
dep_ratio	112.4118	40.37102	2.78	0.008	30.81891	194.0047
fin_ratio	-72.80022	27.90169	-2.61	0.013	-129.1916	-16.40879
cm_ratio	-1.940712	2.839546	-0.68	0.498	-7.679649	3.798225
eb_ratio	-27.53263	16.99229	-1.62	0.113	-61.87533	6.810075
_cons	-.1069976	2.101273	-0.05	0.960	-4.353828	4.139833

Table 9.8: Discussion of various variables in the Regression Model, excluding outliers for the Electricity Distribution Segment (Full Sample Size= 45)

Variable	Nature and Type of Relationship	Overall Conclusions
Depreciation Ratio (Depreciation costs relative to Revenue from Operations)	Positive relationship	A notable change is observed in the magnitude of the depreciation coefficient, which increases substantially (≈ 112.41) while remaining statistically significant. This suggests that even within the relatively homogeneous sample, capital intensity remains an important determinant of profitability, potentially reflecting the regulated nature of electricity tariffs where asset base returns are protected. This is also backed by the Normative Return on Equity, which is explicitly guaranteed by the Central Electricity Regulatory Commission (CERC), keeping RoE for thermal and transmission projects around 15–15.5% across tariff periods. (CERC, 15th March 2024)
Finance Cost Ratio (Financing costs/interest costs relative to Revenue from Operations)	Negative relationship	The finance cost ratio also retains a statistically significant negative relationship with net profit margin (≈ −72.80), indicating persistent leverage-related financial risk across firms.
Employee Benefit Expenses Ratio (Employee Benefit Expenses relative to Revenue from Operations)	Negative relationship	In both specifications, employee benefit and material cost ratios remain statistically insignificant, suggesting that profitability variations in the sector are less sensitive to short-term operating expenses and more influenced by long-term financial and capital allocation decisions.
Cost of Materials Consumed Ratio (expense relative to Revenue from Operations)	Negative relationship	

In both models, depreciation and finance cost ratios remain the primary statistically significant determinants of net profit margin, highlighting the structural importance of capital intensity and leverage in the electricity sector. However, the increase in the depreciation coefficient after removing outliers suggests that extreme observations may have previously dampened the estimated strength of asset-related profitability effects. Similarly, the more pronounced negative coefficient for finance costs in the exclusion model indicates that once atypical firms are removed, the adverse impact of debt servicing on profitability becomes clearer and more consistent across the sample.

9.4.3.3 Electricity Transmission

9.4.3.3.1 Including Outliers

Table 9.9: Output 5- The robust regression output (STATA) for the electricity transmission segment, including all financial outliers

Robust regression — Number of obs = 23; F(3, 19) = 57.69; Prob > F = 0.0000

NetProfitM~n	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
dep_ratio	-44.00831	12.51549	-3.52	0.002	-70.20354	-17.81308
fin_ratio	-54.18798	9.136751	-5.93	0.000	-73.31142	-35.06454
eb_ratio	-78.06743	6.347834	-12.30	0.000	-91.3536	-64.78126
cm_ratio	0	(omitted)				
_cons	58.11015	4.32018	13.45	0.000	49.06791	67.15239

Table 9.10: Discussion of various variables in the Regression Model, including outliers for the Electricity Transmission Segment (Full Sample Size = 23)

Variable	Nature and Type of Relationship	Overall Conclusions
Depreciation Ratio (Depreciation costs relative to Revenue from Operations)	Negative relationship	The depreciation ratio coefficient (−44.01, p = 0.002) suggests that higher capital intensity and asset consumption reduce profitability due to increased fixed cost
Finance Cost Ratio (Financing costs/interest costs relative to Revenue from Operations)	Negative relationship	Overall, the model implies that cost structure, capital intensity, and financial obligations are critical determinants of profitability, with operating efficiency emerging as the most influential factor among the variables considered.
Employee Benefit Expense Ratio (Employee Benefit Expenses relative to Revenue from Operations)	Negative relationship	The employee benefit expense ratio shows the strongest negative effect (−78.07, p < 0.001), indicating that operating cost inefficiencies or higher expense intensity have a substantial adverse influence on bottom-line performance.

9.4.3.3.2 Excluding Outliers

Table 9.11: Output 6- The robust regression output (STATA) for the electricity transmission segment, excluding all financial outliers

Robust regression — Number of obs = 19; F(4, 14) = 23.28; Prob > F = 0.0000

NetProfitM~n	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
dep_ratio	-34.4165	11.39431	-3.02	0.009	-58.85486	-9.978136
fin_ratio	-34.43974	9.753198	-3.53	0.003	-55.35827	-13.52121
cm_ratio	90.53308	456.5151	0.20	0.846	-888.5945	1069.661
eb_ratio	-66.18139	6.976246	-9.49	0.000	-81.14395	-51.21883
_cons	50.33596	4.662039	10.80	0.000	40.33688	60.33503

Table 9.12: Discussion of various variables in the Regression Model, excluding outliers for the Electricity Transmission Segment (Full Sample Size= 19)

Variable	Nature and Type of Relationship	Overall Conclusions
Depreciation Ratio (Depreciation costs relative to Revenue from Operations)	Positive relationship	Two predictors, depreciation ratio and financial cost ratio, show statistically significant negative effects of nearly equal magnitude (~34 units each), suggesting that both depreciation burden and financial costs are meaningful suppressors of profitability.
Finance Cost Ratio (Financing costs/interest costs relative to Revenue from Operations)	Negative relationship	
Employee Benefit Expense Ratio (Employee Benefit Expenses relative to Revenue from Operations)	Negative relationship	The strongest effect comes from the employee benefit expense ratio, which exerts a highly significant negative impact of over 66 units, making it the most influential variable in the model.
Cost of Materials Consumed Ratio (expense relative to Revenue from Operations)	Negative relationship	The statistically insignificant nature of the cost of materials consumed in the sector implies that a larger erosion of profitability is coming from the labour costing and capital structure decisions. A performance audit should ideally focus on the interest and debt repayment cycles, working capital financing via bridge loans, depreciation accounting policy, and asset management, as well as valuation methodologies of the Property, Plant and Equipment blocks.

Comparing the two robust regression models reveals that the exclusion of outliers materially affects the magnitude of coefficients but not the overall directional story — all three significant predictors retain their negative sign across both specifications, lending credibility to the finding that depreciation burden, financial costs, and employee benefit expenses are genuine structural drags on net profit margin in the electricity transmission segment.

For audit and policy purposes, this comparative analysis strongly suggests a two-tier approach: a systemic review of cost management practices applicable to all transmission PSUs, and a targeted deep-dive into the outlier entities where employee benefit and depreciation pressures are demonstrably more acute and potentially indicative of governance or operational failures. The next section presents the case studies of a few outliers.

9.4.4 Analytics of an Outlier: Case Studies

9.4.4.1 K P C Gas Power Corporation Ltd. (for Financial Year ending 31st March 2024)

- As per the available data for the financial year ending 31st March 2024, the major cost burdening the PSU is the debt burden. On a scale of revenue operation, where the total revenue in the latest FY is ₹0.01 Cr., and the long-term debt burden lies at around ₹1184 Cr (including current portion of long-term borrowings) and ₹1088 Cr (excluding the current portion).

- There is a mismatch also in terms of the plants, property and land & buildings (completed) v/s the ongoing debt burden. Given the nature of the debt, a majority of the scale of operations remains stuck in Capital WIP, around ₹2644 Cr.

- A Key Audit Matter in this regard would include two elements:

a. Timeline of completion: Time-driven delays or financing structure overburdening project-related costing. A Performance/Financial Audit should conduct a detailed look into the differential timeframes for project-related payments v/s the debt repayments, the magnitude of the payments, and an analysis of the project scale, and whether enough capital is flowing towards matching the other factors, such as labour.

b. Fragmentation of Payments: The total Capital WIP of ₹2644 Cr is most likely spread out over multiple CapEx projects involving plant setup for increasing scale and production capacity. However, the liability debt repayment has significantly decreased over the period of 4 Financial Years, ~ ₹165 Cr. The fundamental gap of policy regarding deployment of capital across projects v/s debt payments forms another key matter from an auditing perspective.

- The misbalance between long-term debt repayment and project financing is also affecting day-to-day operations with negative working capital. A key audit concern is the viability of a bridge loan (short-term debt for operational capital), which is a further liability burdening the firm with its lowering debt-service coverage ratios. An audit must look into the policy disclosures about working capital financing and the project financing department, particularly into the Capital WIP policy decisions.

- Held against the industry standard, the firm's repairs and maintenance cost, expressed as a percentage of the operating expenditure, is ~ 99.16%, where the industry standard is around 4.18%.

Here is another Key Audit Matter: the distribution of the repairs and maintenance across existing plants, the Capital WIP, and whether the high level of such expenses is affecting the firm's debt servicing capacity. If yes, to what degree is the impact, and the party-by-party transactions for such repairs, contractual agreements involved, or increased contractual labour cost?

Table 9.13: Analysis of the Cash Flow Statement of K P C Gas Power Corporation Ltd. (Financial Year ending 31st March 2024)

Type of Activity	Net Cash Flow (in Cr)	Additional Remarks (if any)
Operating	7.32 Cr	- The cash flow from operating activities does not elaborate on operating expenditure, the cash flows. A deeper look into the cash and bank A/c and the various operating expenditure accounts, with a primary focus on repairs and maintenance a/c to evaluate flows. - Depreciation and Amortisation expenses have only been recorded as a meagre ~ ₹0.1 Cr; however, an audit red-flag may be the amortisation policies regarding Capital Work in Progress (WIPs). - A deeper audit sweep is required to evaluate the recording of depreciation expenses and whether they are in line with the plants and additional production facility valuations in the books.
Investing	(334.65 Cr)	- The change in Capital WIP and in the net fixed assets exceeds the total investing outflows on purchases by approximately ₹2 cr. The accounting changes for the Capital WIP and the finished WIP need to be audited for any inconsistencies in recording, as per the chosen accounting policies.
Financing	326.95 Cr	N/A

9.4.4.2 Rajasthan Rajya Vidyut Utpadan Ltd. (For Financial Year ending 31st March 2025)

- As per the available data for the financial year ending 31st March 2025, the revenues from operations lie at ~ ₹21,280 Crores. This signals no immediate distress with regard to production, plant load factors, sales channel management, as well as any contractual obligations under long-term sales contracts with Electricity Distribution/Transmission companies.

- On the other hand, the operating expenses lie at ~ ₹18368 Cr, wherein the raw materials, stores, and spares represent ~ ₹16917 Cr. These expenses, particularly when interpreted in ratio terms with respect to the Revenue from operations, are causes for concern. The operating expense ratio is 86.31%, and the major expenditure under operational expenses (raw materials/inventory) is 79.50%.

- These hint at two potential audit red flags and present a key performance indicator for an audit:

a. Inventory Management: While taking into consideration the scale of operations, a high inventory requirement may be validated from a financial standpoint, as the potential loss in sales can be quite high, in case of inadequacy in inventory for production.

However, a deeper examination of the inventory book, as well as the inventory management and valuation policy used (FIFO/LIFO/Weighted Average), will reflect a fairer picture of whether there is an overstocked demand of inventory, as well as the true cost of idle inventory.

b. Cost of Materials Consumed: Understanding the nature of overstocked inventory and/or the cost of idle inventory of raw materials, despite the scale of operations, is affecting the overall cost of materials consumed, which in turn affects the operational efficiency as well as profitability.

- Another major cost, high relative to Sales, is the Financial Services Expenses, approximately 16.71%. Even with long-term borrowings of ₹30,795 Cr at the end of FY 2024-25, the financing cost of these borrowings is not a significant burden on the company's standalone profit margin.

- As per the established SEBI standards, the usual financial fee structures are evaluated as a percentage of the Assets Under Management (AUM) or a flat rate. The applicable percentages, although varying depending on multiple factors, range from 1.5 to 2.5%. For Rajasthan Rajya Vidyut Utpadan Ltd, these charges present a major audit concern, given the high operational costs and inefficiency in inventory management.

- Another audit concern is the charges on its assets. The large charges already existent make it financially constrained, in terms of obtaining further financing, especially through debt. An evaluation of the various charges, the terms of the "Charge on Assets" agreements, is a necessity to evaluate the proficiency to finance through either informal lending agreements or extensive credit terms, which may improve working capital flow, but leave the firm highly leveraged in terms of its operational flexibility.

Table 9.14: Analysis of the Cash Flow Statement of Rajasthan Rajya Vidyut Utpadan Ltd for the Financial Year ending 31st March 2025

Type of Activity	Net Cash Flow (in Cr)	Additional Remarks (if any)
Operating	2591.68 Cr	N/A
Investing	(711.38 Cr)	- No record of any interest received against the investments made. - An audit concern is about the fee and fund-based financial service expenses. - An Audit must look into the concerns of the matching revenue standard, matching return on investments made as against the financial services fees paid.
Financing	(1871.88 Cr)	- The major concern within the financing cash flow is an emerging debt cycle. An increase in borrowing to repay the current portion of long-term borrowings. - The debt servicing and interest service coverage ratio is putting further downward pressure on an already extinguished top line. - From an audit perspective, a deeper look into the loan agreements, and any balloon payments/large settlement agreements b/w the firm and creditors needs to be evaluated.

9.5 Conclusion

From a practitioner standpoint, the key takeaway is that structured profitability analytics can significantly enhance the effectiveness of audit engagements. Indicators related to operating efficiency, financial obligations, and asset cost recovery can help auditors identify areas of heightened audit risk, prioritise substantive procedures, and support evidence-based conclusions regarding the sustainability of financial performance. Integrating such analytical signals into audit documentation and review processes also improves transparency in professional judgement and facilitates more meaningful communication with stakeholders.

Beyond supporting audit analytics, the development and deployment of AI-driven tools have significant implications for financial reporting, asset management and operational efficiency. A few use cases of such tools in the electricity sector are discussed below:

a. Revenue Protection and Theft Detection: AI-enabled analytical models trained on past billing data, smart meter readings and interval consumption patterns can be used for anomaly detection. By assigning theft-probability scores based on AI's risk assessment of metrics such as unmetered consumption, AI-enabled systems can be utilised to prioritise enforcement actions and recover lost revenue.

For an auditor, such tools provide a basis for

- Testing completeness of revenue
- Identifying high-risk consumer segments
- Validating underlying assumptions for revenue recognition and valuation of abnormal consumption/losses during distribution

b. Transformer Asset Management: AI-enabled analysis of feeder data allows real-time monitoring of Distribution Transformer (DT) loading, health and failure risk. Such analysis enables predictive maintenance models that can effectively flag overloading before breakdowns occur.

For an auditor, this supports:

- Validation of depreciation policies, disclosures regarding accounting and valuation policies, and useful asset lives.
- Assessment of impairment risks
- Review of Maintenance provisioning and capitalisation practices.

c. Payment Default Predictions: AI-driven predictive modelling based on historical billing records, payment patterns and consumer behaviour help stratify risk assessments and identify high-risk defaulters to prompt early intervention strategies.

For an auditor, this strengthens:

- Evaluation of credit risk models and assumptions
- Testing adequacy of bad/doubtful debt provisioning practices
- Assessment of going concern risks in distressed DISCOMs.

With an understanding of the above use cases of AI-enabled systems and analytical models in the area of auditing, audit procedures must incorporate underlying evaluative analytics systems, including data integrity, model reliability, governance over AI -driven decisions and alignment between operational analytics and financial reporting.

A key implication of the increasing and expanding use cases of analytical approaches in auditing is the transition from reactive to proactive auditing and governance practices. Traditional audit approaches have largely focused on identifying errors and irregularities after they have occurred, often limiting their impact to post-facto correction. In contrast, analytics-enabled auditing, supported by AI systems, smart metering data, and continuous monitoring tools, allows auditors to identify risk patterns, anomalies, and inefficiencies in near real time, enabling early intervention before financial losses materialise.

Audit Analytics further supports predictive risk assessment, such as anticipating revenue leakages, detecting emerging default risks, or identifying operational stress points in asset utilisation. This enables auditors not only to validate financial statements but also to contribute to loss prevention, improved controls, and better financial decision-making.

As audit environments become more data-intensive and performance-oriented, the routine use of ratio diagnostics and robust analytical techniques is likely to become an essential component of high-quality assurance. Practitioners who adopt these approaches can not only improve anomaly detection and risk assessment but also contribute to stronger financial governance and organisational accountability. Future audit practice will increasingly depend on the ability to translate financial data into clear risk insights that inform both assurance outcomes and strategic decision-making.

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ARTICLE 10

Integrating AI and Machine Learning Technique in IT Audit for Public Sector Auditing: Lessons from CAG Reports and Global Best Practices

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Abstract

India's public sector increasingly relies on digital systems for service delivery in defense, energy, transportation, and taxation. However, CAG audits often reveal vulnerabilities like data fragmentation and weak controls. This article examines IT Audit's role in addressing these challenges and explores how AI and ML can enhance auditing effectiveness through predictive analytics and anomaly detection, thereby strengthening the integration of IT Audit with advanced AI/ML techniques. It draws on CAG reports, including the Indian Navy's ILMS (Integrated Logistics Management System, an ERP based Inventory Management) (CAG, 2017), ONGC's SAP ERP PM Module (CAG, 2024a), GSTN (CAG, 2021a), and UIDAI (CAG, 2021b). The analysis covers service sectors such as defense logistics, energy maintenance, transportation payroll, fiscal services, and identity management. International perspectives from INTOSAI (2019; 2020a; 2023a) and ASOSAI (2023), along with peer-reviewed scholarship (Genaro-Moya et al., 2025; INTOSAI, 2025a), inform the discussion. The article addresses governance, ethics, and capacity building, advocating phased adoption to strengthen SAI India's accountability in a digital era.

Keywords

IT Audit, Artificial Intelligence, Machine Learning, Public Sector Auditing, Comptroller and Auditor General of India, Supreme Audit Institutions, INTOSAI, ASOSAI, Data Analytics, Cybersecurity and Ethical AI.

10.1 Introduction

In the contemporary landscape of public administration, the proliferation of IT systems has revolutionised service delivery across India's governmental entities. From defense logistics to energy asset management and railway payroll processing, these systems facilitate vast data handling, enabling efficiency gains and transparency (CAG, 2025a). Nevertheless, the complexity of these infrastructures introduces multifaceted risks, including cybersecurity threats, data inaccuracies, and operational inefficiencies, as evidenced in numerous CAG audits (CAG, 2024b). Traditional auditing methodologies, reliant on sampling and manual verification, are increasingly inadequate for scrutinising the scale and velocity of digital transactions.

IT Audit emerges as a critical discipline, systematically evaluating information systems to ensure asset safeguarding, data integrity, and alignment with organisational objectives (CAG, 2024c). Complementing this, AI and ML technologies offer transformative potential by automating pattern recognition, forecasting risks, and detecting anomalies in large datasets (INTOSAI, 2019). The CAG's Artificial Intelligence Strategy Framework (2025b) underscores this synergy, positioning AI/ML as tools to audit AI-driven government applications while enhancing audit efficacy.

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The term "integrating IT Audit with AI/ML" as used in this article has a dual meaning: (i) using AI/ML tools to augment IT Audit processes such as risk-based audit planning, automated anomaly detection, and continuous control monitoring within the GUID[1] 5300 framework; and (ii) applying established IT Audit methodology to audit AI/ML-powered government systems, examining algorithmic governance, training data integrity, access controls, and explainability. This dual scope distinguishes the article from a general data analytics discussion and positions it squarely within the IT Audit discipline. The Government of India's NITI Aayog Responsible AI for All framework (2021) and CAG's own AI Strategy Framework (2025b) provide the regulatory backdrop for both dimensions.

This scholarly examination synthesises insights from CAG reports to elucidate IT Audit's contributions and AI/ML's prospective applications. Case studies focus on service sectors: defence (national security services), energy (resource maintenance services), revenue (financial services) and identity management services. Global perspectives from INTOSAI (2020a) and ASOSAI (2023) enrich the discourse, highlighting cross-jurisdictional learnings. The article posits that integrating AI/ML with IT Audit not only addresses extant deficiencies but also propels SAI India toward proactive, data-centric assurance, aligning with constitutional mandates under Article 149[2].

10.2 Theoretical and Conceptual Framework of IT Audit in the Public Sector

IT Audit constitutes a specialised subset of public sector auditing, grounded in standards such as INTOSAI's International Standards of Supreme Audit Institutions (ISSAI) 5300 (INTOSAI, 2020b). It encompasses assessments of general IT controls (e.g., access management, change control) and application-specific controls, ensuring compliance with governance frameworks like India's National Cyber Security Policy (CAG, 2024c).

IT Audit operates within a risk-based paradigm, identifying vulnerabilities that could undermine public service integrity (World Bank, 2022). CAG reports consistently document challenges: for instance, fragmented databases erode data reliability, while weak validation mechanisms facilitate errors or fraud (CAG, 2017). The advent of AI/ML introduces a paradigm shift, leveraging supervised and unsupervised learning algorithms to process unstructured data and predict outcomes (INTOSAI, 2023a). ML models, such as neural networks, can classify transactions for risk scoring, while AI enables natural language processing (NLP) for contract analysis.

10.3 Expanded Case Studies from CAG Audits: IT Vulnerabilities and AI/ML Interventions

This section delves into CAG audits, expanding on AI/ML case studies to illustrate practical applications. Each case highlights systemic issues uncovered through IT Audit and proposes AI/ML solutions, drawing on real-world implementations where feasible.

10.3.1 Defence Logistics Services: Inventory Management in the Indian Navy

The Indian Navy's ILMS, operational since 1993 guided by Material Planning Manual 1995 and upgraded in 2008, automates inventory provisioning for stores and spares. CAG Report No. 20 of 2017 scrutinised expenditures totaling ₹6,731.75 crore from 2010-11 to 2015-16, revealing profound inefficiencies rooted in IT deficiencies (CAG, 2017).

10.3.1.1 Key Audit Findings:

- Data Fragmentation: ILMS lacked seamless integration with dockyards, ships, and Material Organisations (MOs), impeding real-time asset visibility. This resulted in discontinuous information flows, exacerbating procurement duplications.
- Absence of Real-Time Monitoring: Manual interventions dominated, with no centralised dashboard for inventory oversight, leading to inaccurate demand projections.
- Inadequate Controls: Multiple vendor codes and insufficient data validation at entry points permitted errors, including algebraic flaws in provisioning formulas in-built into ILMS system for providing provisional Procurement Quantity, which projected inflated requirements of 3-6 years' consumption.

[1]GUID 5300 is a "Guideline on IT Audit", it falls under INTOSAI Framework for Professional Pronouncement (IFPP), in GUID (Guidance) Series (formerly part of ISSAI 5300 Series).

[2]Article 149 of the Indian Constitution defines the Duties and Powers of the Comptroller and Auditor-General (CAG), mandating that the CAG performs functions related to the accounts of the Union, States, and other bodies as prescribed by Parliament, ensuring financial accountability and transparency, acting as the guardian of public funds, making the CAG crucial for financial oversight.

- Forecasting Deficiencies: The system failed to incorporate dynamic variables, culminating in overstocking valued at ₹7,359 crore, obsolescence costs of ₹46.92 crore, and annual carrying expenses of ₹588.75 crore.

These findings underscore IT Audit's efficacy in diagnosing systemic lapses beyond procedural anomalies, impacting national security services.

10.3.1.2 AI/ML Expansion

In a hypothetical yet feasible AI/ML application, time-series forecasting models (e.g., ARIMA or LSTM neural networks) could analyse historical consumption data to predict spare parts demand with 85-95% accuracy, as demonstrated in similar defense logistics by the U.S. Government Accountability Office (GAO, 2023). Unsupervised ML clustering (e.g., K-means) could identify stock discrepancies across depots, flagging anomalies like excess holdings. A real-world parallel is SAI Thailand's use of ML for risk based inventory audits under ASOSAI guidance (ASOSAI, 2023), reducing overstock by 20%. For ILMS, AI-driven anomaly detection could integrate with existing ERP, using graph neural networks to map inter-unit relationships and prevent duplications. Pilot studies in CAG's forensic audits have already unearthed fraud through ML pattern recognition (Murthy, 2025a), suggesting scalability to defence contexts.

A critical prerequisite for deploying ML models in defence logistics is the availability of clean, complete, and representative training data. Given that ILMS data has historically suffered from fragmented records across dockyards and Material Organisations, algebraic errors in provisioning formulas, and duplicate vendor codes, any ML model trained on this historical data risks inheriting and amplifying these flaws. From an IT Audit perspective, the IT auditor must therefore: (a) assess the quality, completeness, and lineage of training datasets before ML deployment; (b) verify that model validation protocols include cross-validation on holdout datasets drawn from diverse depots and time periods; (c) examine whether systematic biases in historical procurement records (e.g., decades of overstocking caused by the flawed ILMS formula) have been identified and corrected prior to model training; and (d) ensure that a documented and tested retraining schedule is in place to prevent model drift as consumption and procurement patterns evolve post-ILMS Version 2.0 upgrade. Without these data governance safeguards, AI/ML-generated demand forecasts may reproduce—at speed and scale—the very inefficiencies the CAG audit exposed.

10.3.1.3 The Legacy ILMS follows a Linear and Manual Flow

- Procurement Requests → Indent Processing → Material Planning → Procurement → Receipt/Issue

Transforming Navy Inventory Management with AI/ML: Figure 10.1 presents a comparative visualisation of the Indian Navy's Inventory Management System (ILMS), contrasting the legacy procurement flow with a proposed AI/ML-enhanced framework. It highlights systemic inefficiencies identified by the CAG (2017) and illustrates how artificial intelligence can address these challenges through predictive analytics and intelligent automation.

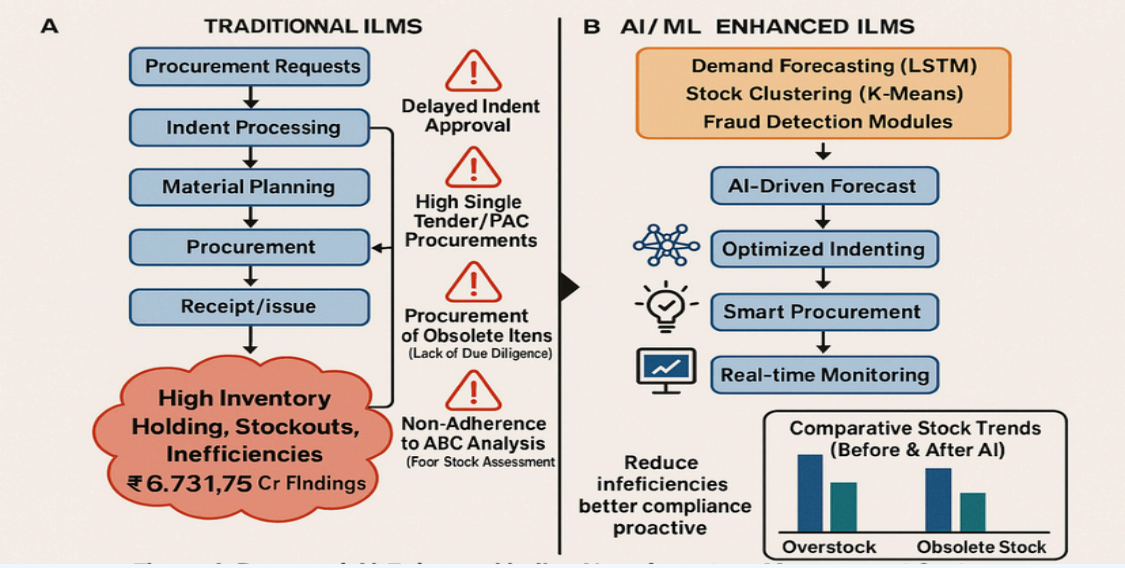

Figure 10.1: ILMS Flowchart with AI layers for Forecasting and Detection

Improved Flow: AI-Driven Forecast → Optimised Indenting → Smart Procurement → Real-Time Monitoring

Outcome: This intelligent system reduces inefficiencies, enhances compliance, and enables proactive decision-making across the supply chain.

Strategic Implication: This transformation aligns with global best practices and audit-driven reforms, offering a scalable blueprint for modernizing defense logistics. By embedding AI into ILMS, the Navy can shift from reactive procurement to predictive, data-driven inventory management.

Acceptance of Audit Recommendations by Navy: Based on the audit recommendation, the following actions have been taken in 2024-2025 by the Naval Headquarters/Ministry of Defence, which brought perceptible improvements in processes and systems:

- Revision of the Previous Material Planning Manual 1995, the Procurement Manual 1995, the Warehousing manuals 1995 and the latest version of the above manuals issued in 2025.
- Incorporation of Modified ABC/VED Classification as per Pareto's law based on audit recommendations.
- Revision of procurement formula in-built into the ILMS system with the technical assistance of IIT, Madras

Audit Impact: Performance Audit on "Inventory Management of Naval Stores, Equipment and Spare Parts in the Indian Navy" (CAG Report No. 20 of 2017) went beyond routine checks and challenged entrenched practices by identifying an inherent algebraic flaw in the provisioning formula of the Integrated Logistics Management System (ILMS), which had remained uncorrected for nearly two decades in Material Planning Manual 1995.

This pathbreaking finding not only questioned the status quo but also directly led to the development and implementation of ILMS Version 2.0, incorporating a dynamic provisioning model for accurate forecasting, minimising manual interventions, and ensuring transparency and accountability in defence logistics. Audit initiative epitomises the values of innovation, transparency, and good governance, and makes a significant contribution towards the mission of the Comptroller and Auditor General of India in promoting accountability and efficiency in public resource management, and act as a model case of how excellence in public auditing can drive systemic improvements in governance.

10.3.2 Energy Maintenance Services: SAP ERP Plant Maintenance Module in ONGC

ONGC's SAP ERP, deployed under Project ICE (Information consolidation for Efficiency) for a ₹81.50 crore investment, incorporates a Plant Maintenance (PM) Module for equipment servicing. CAG Report No. 2 of 2024 evaluated its efficacy, noting that PM orders accounted for only ₹99.22 crore against total maintenance expenses of ₹1,281.16 crore in 2020-21 (CAG, 2024a).

10.3.2.1 Key Audit Findings:

- Master Data Incompleteness: Critical fields like asset numbers (97.86% blank) and warranties (100% blank) undermined system utility and integration.
- Transactional Inefficiencies: Delays in report generation (up to 84 days), misclassified maintenance orders, and prolonged open statuses (88% exceeding 365 days) highlighted procedural gaps.
- Control Weaknesses: Absence of duty segregation (users with up to 30 roles) and non-mandatory root cause fields facilitated errors.
- Data Integrity Issues: Retired assets remained active, distorting KPIs; manual interventions rendered reports unreliable.
- Implementation Shortfalls: Logbooks were underutilised in 50 plants, and static equipment lacked mapping to maintenance plans.

These vulnerabilities risked operational disruptions in energy services, with backlogs spanning one day to two years.

10.3.2.2 AI/ML Expansion:

Predictive maintenance via AI could leverage sensor data (e.g., vibration, temperature) from integrated SCADA systems, employing ML algorithms like random forests to forecast failures with 90% precision, akin to Petrobras' AI implementations in Brazil (INTOSAI, 2023b). For fraud detection, anomaly models could scrutinise claims, identifying outliers in expense patterns—mirroring CAG's AI-driven revelations of billions in irregularities in state schemes (Times of India, 2025). ASOSAI's case study on SAI Indonesia's ML for energy audits demonstrates a 25% efficiency gain (ASOSAI, 2023). In ONGC, generative AI could automate root cause analysis from textual logs, reducing manual efforts by 40%, as per EUROSAI's generative AI guidelines (EUROSAI, 2025).

When a mature ERP like SAP PM is enhanced with AI/ML capabilities (predictive maintenance, generative root cause analysis), the IT auditor's focus must evolve beyond traditional application control testing. The following five dimensions define the changed audit approach:

(a) Audit of AI/ML Model Logic: Verify that the predictive maintenance model is trained on validated sensor data (vibration, temperature, SCADA readings), that the algorithm's outputs are explainable to maintenance engineers using techniques such as SHAP values, and that all human overrides of AI recommendations are logged, reviewed, and approved by an authorised officer. The IT auditor should review model documentation, including feature selection rationale, training data sources, and validation accuracy metrics.

(b) Shift from Sample-Based Testing to Continuous Monitoring: Traditional IT Audit tests a sample of transactions against defined controls. In an AI/ML-augmented ERP, the IT auditor should assess whether the AI system itself performs continuous control monitoring, and evaluate the reliability of AI-generated anomaly flags as audit evidence—verifying that these flags are investigated, resolved, and documented rather than silently overridden.

(c) Segregation of Duties in AI-Automated Workflows: The CAG audit already noted that users had up to 30 conflicting roles. When AI automation generates work orders or approves maintenance actions, the risk compounds: assess whether AI-generated outputs bypass segregation-of-duties controls, and whether emergency override privileges are time-bound and audit-logged.

(d) Cybersecurity Risks Specific to AI/ML: The IT auditor must assess adversarial attack risks — whether malicious inputs to sensors or data feeds could manipulate AI outputs to mask equipment failures in safety-critical energy infrastructure. Model poisoning (corruption of training data) and data exfiltration from ML pipelines are cybersecurity threats unique to AI-augmented systems that require specific audit procedures beyond standard network security testing.

(e) Compliance with GoI AI Guidelines: The IT auditor should verify that the AI/ML deployment within ONGC's SAP PM complies with NITI Aayog's Responsible AI for All (2021) framework, particularly the principles of accountability, safety and reliability, and fairness and non-discrimination, as well as CAG's own AI Strategy Framework (2025b) which mandates XAI (Explainable AI) for LLM-based audit tools.

Figure 10.2 on PM lifecycle diagram with AI interventions on the next page illustrates the transformation of ONGC's SAP Plant Maintenance (PM) lifecycle by juxtaposing legacy audit findings from CAG Report No. 2 of 2024 with targeted AI interventions. The circular lifecycle diagram maps the standard SAP PM process, while red callouts highlight systemic failures and blue overlays propose AI solutions aligned with global Supreme Audit Institution (SAI) practices.

Strategic Alignment: The proposed AI model aligns with INTOSAI's 2023b guidance and mirrors SAI Indonesia's use of big data in energy sector audits. It demonstrates how machine learning can enhance ERP systems by embedding intelligence into routine workflows — a scalable model for other public sector enterprises.

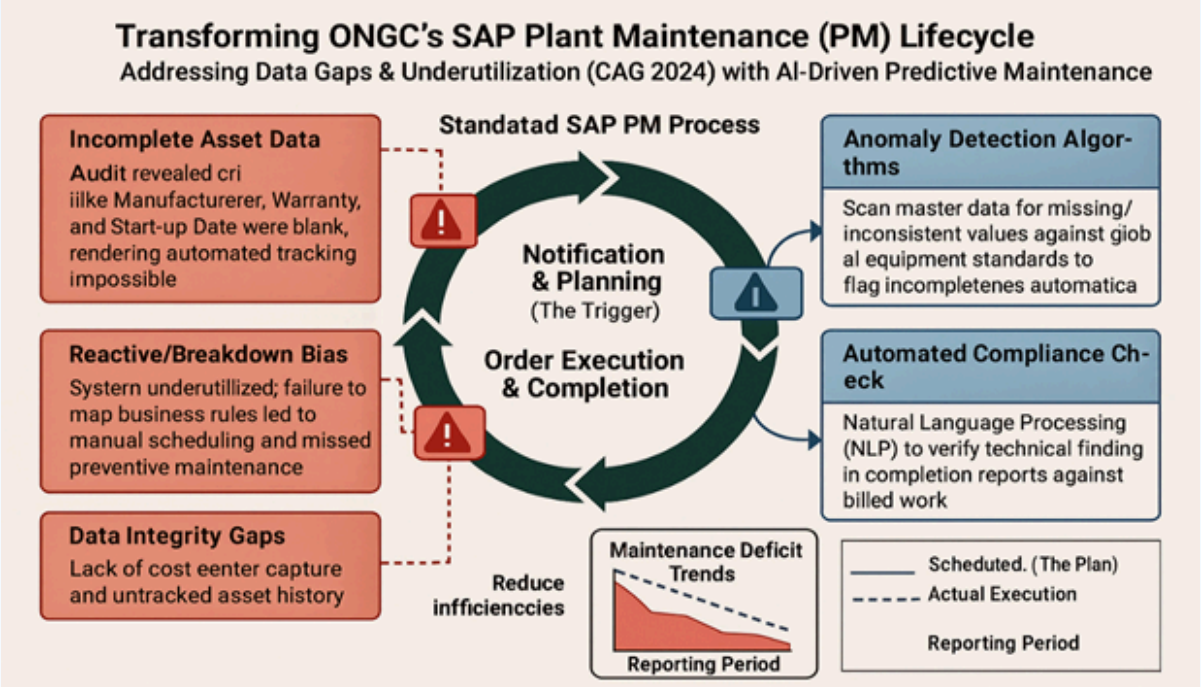

Figure 10.2: Operational Audit of ONGC's SAP ERP Plant Maintenance module

10.3.3 Identity Management Services: Functioning of Unique Identification Authority of India (UIDAI)

The 2021 CAG Performance Audit of UIDAI (CAG, 2021b) identified IT control gaps in Aadhaar issuance: biometric validation weaknesses leading to duplicate enrolments, inadequate access controls over the Central Identities Data Repository (CIDR), and insufficient audit trails for data access by enrolment agencies. From an IT Audit standpoint (GUID 5300), key focus areas are access management, segregation of duties in enrolment agency oversight, and data integrity controls. AI/ML can strengthen IT Audit of UIDAI through: ML-based deduplication combining facial recognition with fingerprint clustering, anomaly detection in grievance redressal response patterns, and NLP-based review of enrolment agency compliance documentation. Critically, any AI deployment must comply with the Aadhaar act 2016/amendment act 2019 and India's Digital Personal Data Protection Act (DPDPA) 2023, and the IT auditor must verify that privacy-by-design principles are embedded in the AI system architecture and that algorithmic decisions affecting Aadhaar status are explainable and appealable.

10.3.4 AI/ML-Enabled Remote IT Audit: Continuous Control Monitoring in Revenue, Infrastructure, and Local Government Digital Systems

Remote IT Auditing, as described in this section, is fully consistent with the IT Audit definition, which encompasses assessments of general IT controls (access management, change control, data integrity) and application-specific controls. All of these can be evaluated remotely through secure, standards-compliant data access arrangements. The AI/ML layer enhances these core IT Audit functions: ML anomaly detection replaces manual sampling in application control testing; NLP automates review of system access logs and change management records; and predictive risk models support risk-based audit planning consistent with ISSAI 3000/5300.

10.3.4.1 Fiscal Services: IT Audit of GST Network (GSTN) Phase II and the Shift towards Remote, AI-Enabled Auditing

The Comptroller and Auditor General's (CAG) Audit of the Goods and Services Tax Network (GSTN) Phase II (CAG, 2021a) underscored both the strategic importance and inherent risks of large-scale digital public financial platforms. The audit revealed significant control deficiencies, including inadequate system validations leading to erroneous GST refunds exceeding ₹1,000 crore, weak access controls exposing sensitive taxpayer data, and incomplete integration with State tax systems. These findings highlight the limitations of traditional audit approaches when applied to complex, real-time, IT-driven ecosystems.

In this context, remote auditing through IT Audit frameworks, augmented by Artificial Intelligence (AI) and Machine Learning (ML), emerges as a critical enabler for future public sector audits. Given that revenue administrations—GST, Income Tax, Customs, and Central Excise—operate almost entirely on digital platforms, remote audits allow auditors to securely access and analyse vast volumes of transactional data off-site. Data analytics and AI driven risk assessment can support audit planning by identifying high-risk taxpayers, refund claims, and systemic vulnerabilities, while virtual interactions enable continuous audit engagement without physical presence. This approach enhances audit efficiency, expands coverage of risk-prone areas, reduces cost and time overruns, and ensures audit continuity during disruptions, subject to robust safeguards for data security, legal admissibility, and auditor capacity building.

The potential of AI/ML in GST audits is particularly significant. Machine learning–based anomaly detection models can identify fraudulent Input Tax Credit (ITC) claims, circular trading, and refund manipulation, drawing parallels with the Supreme Audit Institution of the Netherlands' use of AI in tax audits (INTOSAI, 2023a). CAG's ongoing AI pilot initiatives have already demonstrated the feasibility of detecting similar fraud patterns within GST data streams (The Hindu, 2025), with international experience suggesting recovery potential of 15–20 per cent of revenue leakages.

Beyond GST, AI/ML-enabled remote auditing has broad applicability across other major audit domains. In the Railway Audit, AI tools can analyse procurement, contracts, inventory, web-based IPAS (Integrated Payroll & Accounting System), and project execution data to flag anomalies, duplicate payments, and cost escalations, while predictive analytics can identify projects at risk of delays or overruns. Natural Language Processing (NLP) can assist auditors in reviewing complex contracts, tender documents, and policy guidelines at scale, enabling more focused field verification.

Similarly, audits of Local Government Bodies can be strengthened through AI/ML-driven risk profiling of budgets, expenditures, grants-in-aid, and utilisation certificates. Anomaly detection can identify irregular payments and duplicate beneficiaries in welfare schemes, while geo-tagged data and satellite imagery can remotely verify the existence and progress of infrastructure assets such as roads, drains, and public buildings. NLP tools can further support the review of council resolutions, tenders, and compliance reports, improving audit coverage and transparency.

Overall, the integration of remote IT auditing with AI and ML represents a paradigm shift in public sector auditing, enabling CAG to move towards a continuous, risk-based, and technology-assisted audit model. While professional judgment remains central, AI/ML tools act as force multipliers—enhancing audit effectiveness, strengthening accountability, and aligning Indian public sector audits with global best practices.

10.4 International Comparative Perspectives: AI/ML Case Studies from INTOSAI and ASOSAI

The global auditing community, led by INTOSAI and ASOSAI, has actively integrated AI and ML into public sector auditing. Comparative case studies from other Supreme Audit Institutions (SAIs) offer valuable lessons, best practices, and transferable strategies for SAI India (CAG).

(i) Framework for Auditing AI/ML Systems: INTOSAI's 2020 White Paper on Auditing ML Algorithms (INTOSAI, 2020a), (co-authored by SAIs of Finland, Germany, Netherlands, Norway, and the U.K.) provides the foundational audit framework, covering risk assessment, bias evaluation, and explainability requirements. INTOSAI's INCOSAI 2025 Theme II Discussion Paper extends this to building SAI capacity to audit AI systems themselves. These documents define the global standard against which CAG's AI audit methodology should be benchmarked.

(ii) AI as an Audit Efficiency Tool – Proven Cases: Several SAIs have demonstrated significant efficiency gains viz. SAI UK (NAO) achieved a 25% reduction in fraud detection time using ML for irregular welfare payments. SAI Canada reduced manual fieldwork by 40% using ML on satellite data for environmental compliance audits. SAI Indonesia increased audit coverage by 25% using predictive models in energy audits (ASOSAI, 2023). SAI Thailand detected procurement bidding anomalies 30% faster using AI risk-based models. These results are directly transferable to CAG's defence, energy, procurement and revenue audit domains.

(iii) Governance and Ethical AI in Audit Context: SAIs have successfully addressed governance challenges in production environments. SAI Germany implemented differential privacy in ML models to anonymise audit data. SAI Brazil used NLP on procurement contracts to detect overbilling. These cases illustrate that AI governance (explainability, privacy protection, bias mitigation) is not a theoretical concern but an operational requirement.

(iv) Capacity Building – Structured Knowledge Transfer: ASOSAI's 2022–2027 strategic plan and IDI's 2025 high-level dialogue emphasise multidisciplinary teams, hybrid training, and structured knowledge sharing as prerequisites for sustainable AI adoption. SAI India's participation in INTOSAI working groups positions it to adopt these frameworks systematically rather than in isolation.

In summary, international practice validates a governance-first, phased approach to establish the audit framework for AI systems, pilot AI audit tools in high-impact areas, build explainability and bias governance, and scale through structured capacity building.

10.5 Governance, Ethical Considerations, and Risks in AI/ML Adoption

Empirically, SAI India's adoption of AI aligns with global trends; INTOSAI's Working Group on Big Data advocates for AI in enhancing auditor competencies (IDI, 2025). However, integration demands robust governance to mitigate biases and ensure explainability (ASOSAI, 2023).

AI/ML integration raises ethical dilemmas, including algorithmic bias and opacity (MDPI, 2025). The adoption of AI and ML in public sector auditing necessitates robust governance structures to address ethical dilemmas and mitigate risks. This section elaborates on these aspects, drawing from academic papers and international guidelines to provide a comprehensive analysis.

Central to governance is ensuring transparency and explainability in AI systems. Genaro-Moya et al. (2025) argue that opaque algorithms can undermine audit credibility, as decisions influenced by "black-box" models may lack justification. For instance, in SAI UK's ML pilots, explainable AI (XAI) techniques like SHAP values were employed to interpret model outputs, ensuring auditors could trace decisions back to data inputs (NAO, 2020). CAG's strategy framework mandates similar XAI for its LLM tools (CAG, 2025b).

Ethical challenges include algorithmic bias, where training data reflecting historical inequalities perpetuates discrimination. A systematic review on bias in AI auditing highlights risks in fairness and accountability (ScienceDirect, 2024a). In public auditing, biased models could skew risk assessments, disproportionately flagging certain demographics in welfare audits. The emergence of AI ethics auditing, as discussed in Schiff, D. S. and others (2024), calls for robust stakeholder involvement and external reporting to counter this.

Data privacy emerges as a critical risk, particularly under India's Data Protection Act. AI systems processing sensitive public data must comply with GDPR[3] -like standards. SAIs like SAI Germany have implemented differential privacy techniques in ML models to anonymise data during audits.

Accountability for AI-influenced decisions is another concern. Who bears responsibility if an AI-flagged anomaly leads to erroneous audit findings? ResearchGate's paper on ethical AI auditing advocates for organisational transparency and compliance mechanisms (ResearchGate, 2025). INTOSAI (2023a) stresses human oversight, with auditors retaining final judgment.

Robustness and reliability pose technical risks; adversarial attacks could manipulate ML models. ScienceDirect (2024a) notes these in auditing contexts, recommending regular model retraining. For SAI India, this means developing policies for bias audits and privacy impact assessments, aligning with ASOSAI's ethical AI guidance (ASOSAI, 2023).

In conclusion, governance must encompass legal, technical, and ethical dimensions, ensuring AI enhances rather than undermines public trust.

10.6 Capacity Building and Institutional Readiness

Capacity building is foundational to AI/ML adoption in SAIs, requiring investments in human capital, infrastructure, and knowledge ecosystems. This expanded section details strategies, programs, and challenges, informed by global and academic insights. The following competency framework is proposed, specific to IT auditors:

(a) ML Model Auditing: IT auditors should be able to review and critically assess model documentation, validation reports, performance metrics (accuracy, precision, recall), and bias test results. They do not need to code models but must understand what these metrics mean for audit reliability and whether the model is fit for purpose in a specific audit context.

[3]General Data Protection Regulation, EU 2016/679

(b) AI Governance and Regulatory Compliance Auditing: Familiarity with NITI Aayog's Responsible AI for All (2021) framework, India's Digital Personal Data Protection Act 2023, CAG's AI Strategy Framework (2025b), and INTOSAI's guidance on auditing ML algorithms (2020a). The IT auditor must be able to assess whether AI deployments in government systems comply with these frameworks, particularly regarding accountability, explainability, and human oversight requirements.

(c) Cybersecurity Audit for AI-Specific Threats: Understanding of adversarial machine learning attacks (model poisoning, data injection, evasion attacks), AI-specific data exfiltration risks, and supply chain vulnerabilities in pre-trained models. IT auditors reviewing AI-augmented ERP systems, identity platforms, or logistics systems must be able to assess these risks beyond standard cybersecurity audit checklists.

(d) Training Data and Data Pipeline Auditing: Ability to assess data lineage documentation, labelling quality and methodology, dataset representativeness, and the existence of data governance policies covering training data curation and version control. This skill is central to evaluating whether AI/ML outputs are reliable as audit evidence.

(e) Explainability Assessment Using XAI Tools: Practical familiarity with SHAP (SHapley Additive exPlanations) and LIME (Local Interpretable Model-agnostic Explanations) at the output-interpretation level, enabling the IT auditor to verify that AI model decisions in government applications are interpretable, traceable to input data, and documentable as audit evidence. CAG's AI Strategy Framework (2025b) already mandates XAI for its LLM audit tools; IT auditors must be equipped to evaluate compliance with this mandate.

(f) AI Ethical Audit Checklist for IT Auditors: The following checklist is proposed for IT auditors reviewing AI/ML deployments in government systems: (1) Is the AI system's purpose, scope, and decision logic documented and approved by a competent authority? (2) Has a bias audit been conducted on training data, and are results documented? (3) Are model outputs explainable to non-technical stakeholders and auditable? (4) Is there a documented human oversight mechanism for AI-generated decisions with significant consequences? (5) Does the system comply with India's DPDP Act 2023 and applicable sector regulations? (6) Is there a model version control register and a tested retraining/rollback protocol? (7) Have cybersecurity risks specific to the AI/ML pipeline been assessed and mitigated? (8) Is there a grievance redressal mechanism for individuals adversely affected by AI-driven decisions?

CAG's initiative to train 5,000 auditors in AI/ML exemplifies proactive readiness (Mint, 2025). Collaborations with IITs for custom LLMs further build expertise (The Hindu, 2025).

INTOSAI's high-level dialogues advocate multidisciplinary teams and emphasises competency development through hybrid training (IDI, 2025). Challenges include skill gaps and resistance to change. ScienceDirect (2024b) assesses institutional readiness in developing countries, recommending multidisciplinary teams (ScienceDirect, 2024b).

For SAIs, ASOSAI promotes knowledge sharing (ASOSAI, 2023). SAI Russia's WGITA Summit in 2025 discussed AI training (INTOSAI Russia, 2025)
.
Institutional readiness involves infrastructure; CAG's infra building for AI (Economic Times, 2025a). Overcoming barriers requires sustained funding and partnerships. In essence, capacity building is iterative, blending training, collaboration, and adaptation to ensure SAIs like CAG are AI-ready.

10.7 Pathways Forward for SAI India

A strategic roadmap for AI/ML adoption in SAI India should be phased, risk-managed, and aligned with global standards. This section outlines detailed steps.

Phase 1: Assessment and Piloting (0-12 months). Conduct readiness audits as per ScienceDirect (2024b). Pilot AI in high-impact areas like GSTN fraud detection (CAG, 2021a), using ML for anomaly spotting.

Phase 2: Integration and Scaling (12-24 months). Integrate AI into audit workflows, as in INTOSAI's Theme II (INTOSAI, 2025a). Scale to defense and energy, incorporating predictive models.

Phase 3: Governance and Evaluation (24+ months). Establish ethical oversight committees, per Genaro-Moya et al. (2025). Evaluate impacts through KPIs, refining models iteratively.

A calibrated approach involves piloting AI in high-impact areas (e.g., GSTN fraud detection), bolstering IT controls, and establishing ethical oversight. Alignment with INTOSAI's emerging technologies working group ensures global interoperability (INTOSAI, 2023b).

Addressing barriers: Secure funding, mitigate biases via diverse data, and foster cultural acceptance through training.

This pathway positions SAI India as a leader, enhancing audit relevance in a digital state.

10.8 Conclusion

The integration of IT Audit with AI/ML marks a transformative era for public sector auditing in India. CAG reports on ILMS, SAP, IPAS, GSTN, and UIDAI reveal systemic vulnerabilities amenable to AI solutions (CAG, 2017; 2024a; 2022a; 2021a; 2021b). Expanded international perspectives from INTOSAI and ASOSAI underscore global best practices, from SAI UK's fraud detection to SAI Indonesia's efficiency gains (INTOSAI, 2025a; ASOSAI, 2023).

Ethical governance is paramount, addressing biases and privacy as per academic insights (Genaro-Moya et al., 2025; ScienceDirect, 2024a). Capacity building through training and partnerships will equip auditors (IDI, 2025). The phased pathway ensures sustainable adoption, promising enhanced accountability and public trust in an AI-driven future, this integration fortifies SAI India's role in a digitised polity, ensuring accountable service delivery.

Data Availability

No new data has been introduced.

Ethics Statement

This article is a conceptual and documentary analysis based on publicly available secondary sources, and it does not involve human participants, animals or primary field experiments requiring prior ethical approval. No sensitive personal data was collected, processed or reported, and no procedures with potential physical, psychological or social risk to individuals or communities were undertaken.

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Conflict of Interest

The authors declare no conflict of interest.

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