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Diagnosing internal control failures in India's petroleum subsidy programs: A COSO-COBIT Governance Analysis

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Abstract

This study investigates systemic internal control failures within India's petroleum subsidy programs, particularly Liquefied Petroleum Gas (LPG) and Public Distribution System (PDS) kerosene schemes. Using the COSO Internal Control Framework (2013) and COBIT (2019) governance principles, alongside forensic data analytics and selected case studies, this paper identifies recurring issues in beneficiary verification, delivery validation, invoice oversight, and IT governance. Despite reforms like Aadhaar-based deduplication and Direct Benefit Transfer for LPG (DBTL), vulnerabilities in real-time monitoring, audit trail consistency, and inter-agency data integration persist. Notably, over 35 million fraudulent LPG accounts were removed, highlighting both progress and past systemic flaws. This research proposes a robust governance model leveraging artificial intelligence, geo-mapping, and control matrices to enhance transparency and accountability. The model is designed to be replicable for other developing nations reforming public welfare distribution systems.

Keywords: Internal Control Failures; Petroleum Subsidy Governance; COSO And COBIT Frameworks

1. Introduction

India's petroleum subsidy architecture has historically aimed to ensure affordable fuel access for economically weaker populations. Programs like PAHAL, DBTL, and PMUY have digitized benefit transfers and introduced Aadhaar-based Know Your Customer (KYC) measures. However, control breakdowns remain, including identity misuse, fraudulent disbursements, and black-market diversion. The complex multi-agency network comprising Oil Marketing Companies (OMCs), banks, distributors, and ministries makes effective internal control challenging. This paper maps key failure points against the COSO and COBIT frameworks, supported by data-driven fraud detection and audit insights.

2. Literature review

Numerous studies underscore persistent inefficiencies. Barnwal (2014) highlights leakages due to manual systems and inadequate oversight. Shenoy (2016) critiques the fiscal savings under DBTL, pointing to exclusion errors. Mittal et al. (2017) acknowledge Aadhaar's role in removing bogus accounts but stress unresolved issues in delivery verification and data synchronization. The Ministry of Petroleum and Natural Gas (2023) notes that despite AI-based controls, real-time dashboard integration remains insufficient. NITI Aayog (2024) advocates for centralized data governance and blockchain-backed transaction records to enhance traceability. Global studies (Nozick et al., 2018) caution that without integrated audit systems, subsidy programs risk rent-seeking behaviors.

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3. Methodology

The study employs a hybrid methodology encompassing internal control evaluations, IT governance assessment, and forensic analytics

3.1. COSO Framework Assessment

- *Control Environment:* Assessed leadership commitment within MoPNG and state agencies.
- *Risk Assessment:* Identified risks such as duplicate beneficiaries and refill fraud.
- *Control Activities:* Reviewed Aadhaar-KYC checks and invoice validation procedures.
- *Information & Communication:* Evaluated data sharing across DBTL, OMCs, and banks.
- *Monitoring:* Analyzed real-time alerts and audit depth.

3.2. COBIT 2019 Framework

- *APO (Align, Plan, Organize):* Evaluated strategic IT alignment and database ownership.
- *DSS (Deliver, Service, Support):* Investigated transaction logging and service delivery mechanisms.
- *MEA (Monitor, Evaluate, Assess):* Analyzed KPIs, dashboard functions, and anomaly detection tools.

3.3. Forensic Data Analytics Tools

- Used fuzzy logic and KYC matching to detect ghost accounts.
- Applied time-series analysis for refill anomalies.
- Conducted ML-based three-way invoice validations.

3.4. Case Mapping

- Specific case studies (e.g., Odisha LPG fraud) were mapped against COSO and COBIT components to identify control gaps.

4. Results

4.1. COSO Framework Findings

- *Control Environment:* Reform intent was evident at the policy level (e.g., PAHAL), but operational enforcement was weak.
- *Risk Assessment:* Reactive rather than predictive risk identification dominated the landscape.
- *Control Activities*: While Aadhaar improved identity checks, delivery confirmation remained inconsistent.
- *Information & Communication:* Systems lacked real-time integration and had latency in beneficiary confirmation.
- *Monitoring:* Over-reliance on retrospective audits undermined proactive fraud control.

4.2. COBIT 2019 Findings

- *APO:* Fragmented ownership of databases between UIDAI, NPCI, and OMCs led to data inconsistency.
- *DSS:* Operational logs were incomplete, with weak transaction traceability.
- *MEA:* Macro KPIs existed, but failed to capture beneficiary-level irregularities.

4.3. Forensic Analytics Results

- *Ghost Accounts:* Over 35 million fake accounts eliminated via Aadhaar deduplication (PRS, 2022).
- *Refill Pattern Outliers:* Sharp refill surges in May and October 2024 signaled hoarding.
- *Invoice Irregularities:* ML-based analysis flagged delivery-payment mismatches.

Table 1 Case Mapping – Example: Odisha LPG Fraud (2019)

Case Element	Mapped COSO Component	Mapped COBIT Domain	Identified Control Gap
Ghost beneficiaries registered by dealers	Control Environment, Risk Assessment	APO, DSS	Weak beneficiary onboarding control and poor agent oversight
Refill booking through proxy phone numbers	Control Activities	DSS	Lack of two-factor or Aadhaar-authenticated refill booking
Delivery confirmation not enforced	Monitoring	MEA	Absence of GPS-tagged delivery verification
Subsidy disbursed pre-delivery	Info & Communication, Monitoring	DSS, MEA	Dashboard sync delays; subsidy triggers not dependent on delivery

4.4. Visuals and Tables

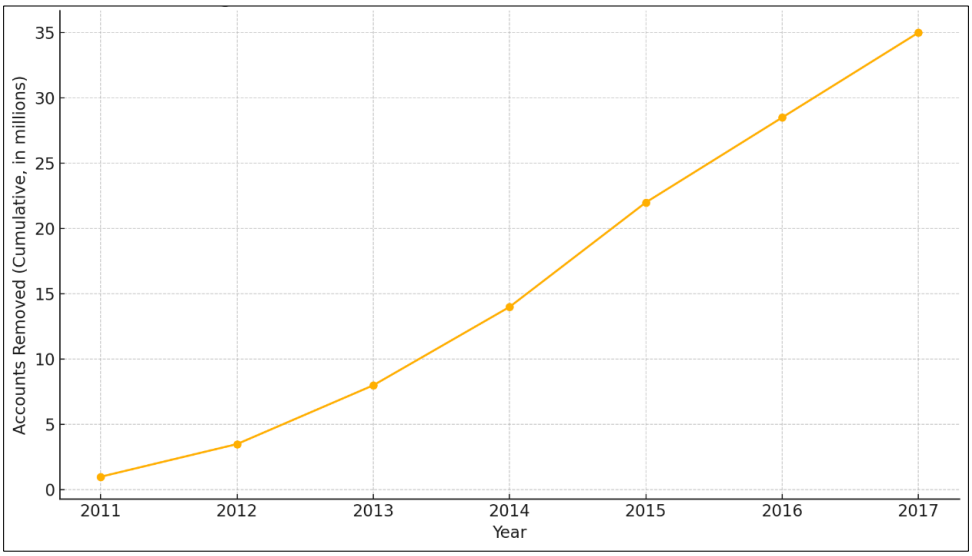

Figure 1 Ghost LPG Accounts Removed (2011–2017)

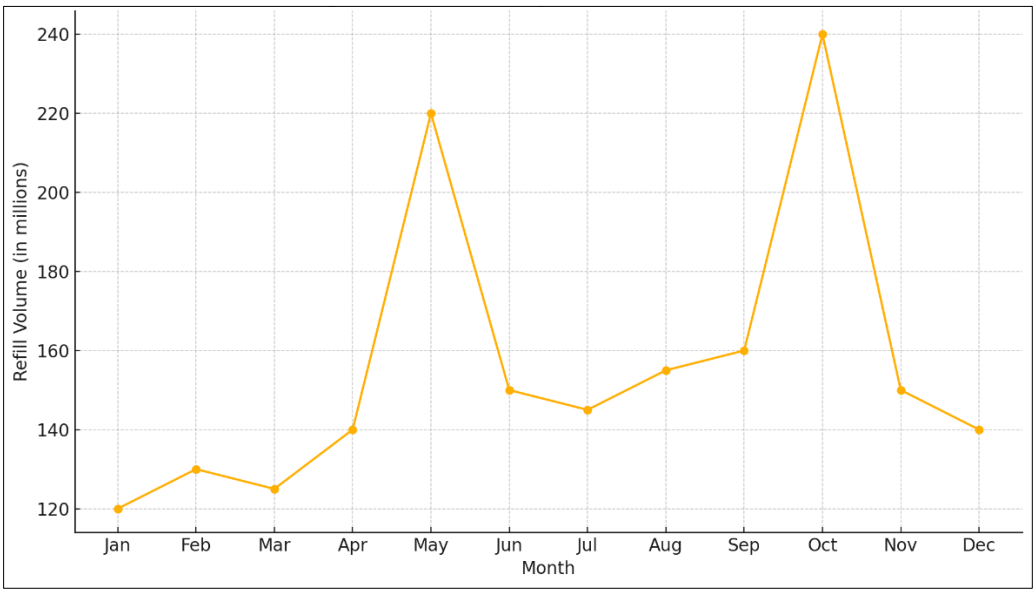

Figure 2 Monthly Refill Pattern - May & October 2024

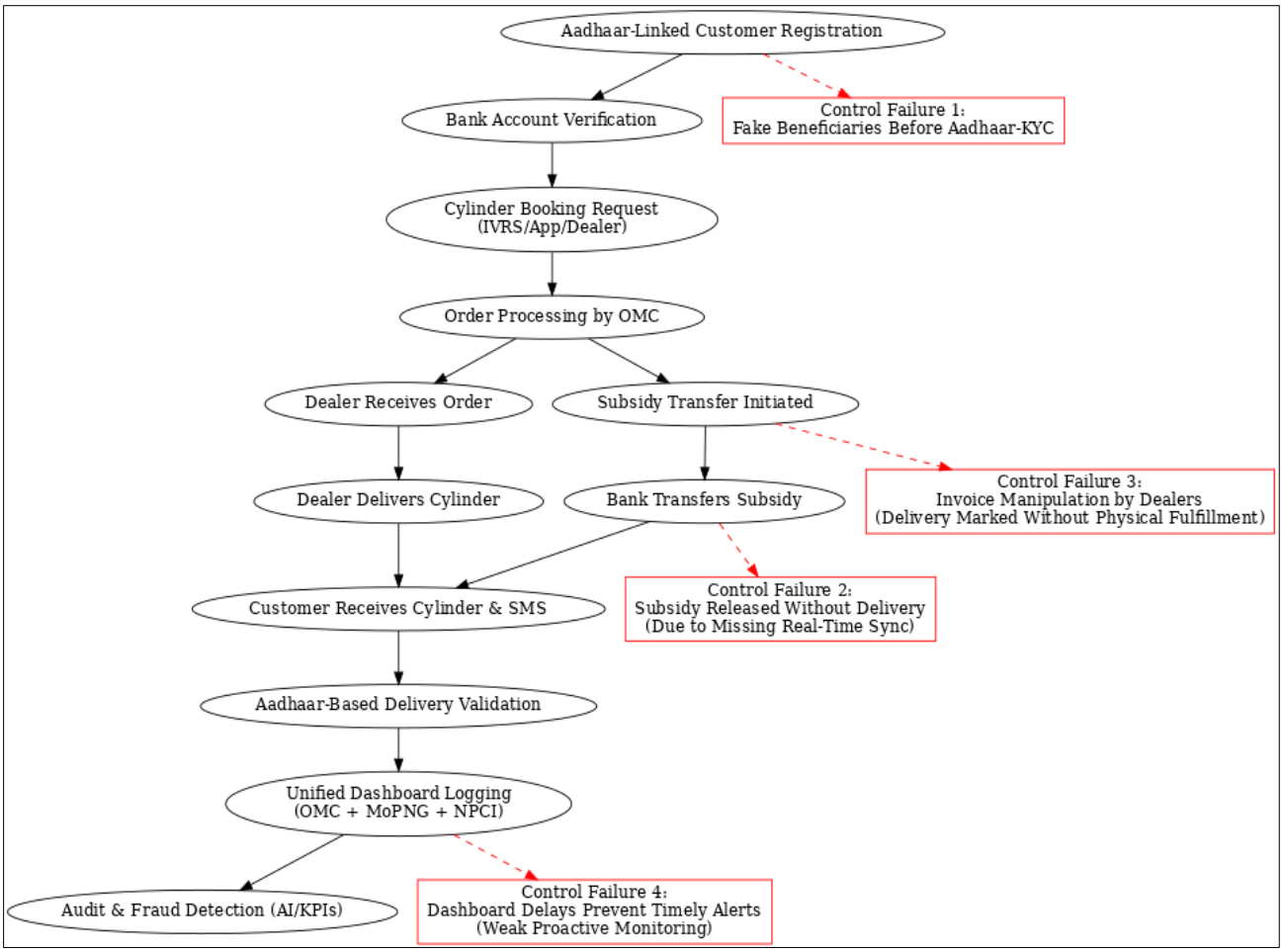

Figure 3 LPG Subsidy Delivery Flowchart

Table 2 Mapping of Control Failures to COSO, COBIT, and Analytic Techniques

Control Failure	**COSO Component(s)**	**COBIT 2019 Domain(s)**	**Forensic Technique**	**Impact Severity**
Fake Beneficiary IDs	Control Env., Risk Assess.	APO, DSS	Fuzzy Matching, KYC Deduplication	High
Undelivered Cylinders	Control Activities, Monitoring	DSS, MEA	GPS Verification, Beneficiary SMS Alerts	High
Invoice Manipulation	Control Activities, InfoComm	DSS, APO	Invoice-Payment Analysis, ML Outlier Flags	Medium
Subsidy Paid Without Delivery	Monitoring, InfoComm	DSS, MEA	Pattern Deviation Detection, KPI Dashboards	High
Fragmented Database Ownership	Information & Communication	APO	Data Integration Gaps Detected Through Audit Log Analysis	Medium
Refill Pattern Outliers	Risk Assessment, Monitoring	MEA	Time-Series Analysis of Monthly Refill Volumes (Anomaly Detection)	Medium

Lack of Real-Time Alerts	Monitoring	MEA	Audit Trail Monitoring, Dashboard Latency Reviews	High

5. Conclusion

India's petroleum subsidy initiatives have shown significant advancement through technology-driven reforms like Aadhaar-enabled DBTL and PAHAL. However, persistent weaknesses in IT governance, real-time monitoring, and cross platform integration continue to enable fraud and operational inefficiencies. This study identifies structural and systemic vulnerabilities including

- Removal of over 35 million illegitimate LPG accounts.
- Lack of real-time delivery validation.
- Incomplete audit trails and fragmented database ownership.

To address these, the following policy and control interventions are proposed:

- Real-time anomaly detection dashboards with proactive alerting.
- COSO-compliant end-to-end Risk and Control Matrices.
- COBIT-driven IT governance enforcement with centralized data ownership.
- Deployment of AI/ML algorithms for transaction monitoring.
- Geo-mapping of consumption data to identify fraud clusters.
- Nationally synchronized, dynamically updated beneficiary registries.

Such a multifaceted strategy integrating governance, analytics, and automation can not only strengthen India’s subsidy delivery mechanisms but also offer a global template for subsidy reform in other emerging economies.

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