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The Evolution of Hybrid Annuity Model (HAM): Has It Balanced Public Risk and Private Profit?

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Abstract

The evolution of Public-Private Partnership (PPP) models in India's highway sector reflects a broader institutional response to challenges in risk allocation, financial sustainability, and delivery efficiency. This study investigates the Hybrid Annuity Model (HAM), introduced in 2016, as a middle path between the Build-Operate-Transfer (BOT) and Engineering, Procurement, and Construction (EPC) frameworks. While BOT exposed private concessionaires to revenue volatility and EPC returned full risk to the government, HAM attempts to balance the equation by blending annuity payments with government funding during construction. Despite widespread adoption, scholarly assessments of HAM's actual performance remain limited. This paper conducts a qualitative comparative case study of four national highway projects two under HAM and one each under BOT and EPC—using secondary data from MoRTH, NHAI, CAG, and credit rating agencies. Metrics analyzed include cost overruns, time delays, traffic forecast deviations, and dispute incidence. Findings indicate that HAM improves financial predictability, reduces arbitration, and enables quicker financial closure. However, its effectiveness is hindered by systemic issues such as unrealistic traffic projections and delayed government annuity disbursements. Compared to its predecessors, HAM provides a more stable risk-sharing environment and enhances stakeholder confidence, yet remains dependent on administrative efficiency. The paper concludes with targeted policy recommendations, including stricter demand forecasting norms, digital project monitoring, and ESG-linked annuity models, and highlights future research directions on regional scalability and sustainable financing under HAM.

Keywords: *Hybrid annuity model (HAM), public-private partnership (PPP), highway infrastructure, risk allocation, road infrastructure*

I. Introduction

Infrastructural development agenda in India has contributed considerably to its economic transformation during the last several decades. Some of its many priorities include the highway sector as it has been receiving policy and financial attention on account of its essential to industrial productivity, trade facilitation, and regional connectivity. This attention has powered the development of highway delivery models in India from the Build-Operate-Transfer framework in the 90's to the Engineering, Procurement and Construction contracts during the 2010's, but most recently the Hybrid Annuity Model-introduced in 2016. Every transition not only pointed at changing appetite for risk in the public and the private sectors but also at larger economic cycles, financing limits, and results in delivery of infrastructures.

The BOT model first developed as the most favourable structure when implementing PPP, which conformed to the economic liberalisation course of India in the 1990s and early 2000s. It provided the role for private developers in designing, constructing, funding, operating, and maintaining projects on highways and recover costs through payment of tolls over a specified period of concession (Garg & Dayal, 2020; L. Singh & Kadam, 2023). This model was supposed to ease the financial burden to the government and bring operation efficiencies in road development. However,

at the end of the 2000s, a sequence of problems started in view. Traffic demand was usually over estimated and this inflated the revenue forecasts. Artificially inflated estimates were another cause of undermining the viability of several projects owing to a close vigorous bidding due to unrealistic financials. Land acquisition, regulatory approvals, and environmental clearances' delays worsened execution risks. Consequently, many BOT projects were either put on hold or cancelled and the interest from private sector also declined (Cherkos et al., 2020).

In order to counteract such shortcomings, the Ministry of Road Transport and Highways (MoRTH) heavily resorted to adopting the EPC model. In EPC, the government shall take responsibility for project funding, and hire the contractors only for design and construction who will be paid either fixed price or a lump sum basis. Although this approach increased certainty of the timelines and costs for projects, it transferred the entirety of risk back on the public sector. The private players were demotivated to get a long-term commitment to the maintenance of the asset and performance, and the model did not catalyse innovation or bring institutional capital (Mittal et al., 2023).

It is in this setting that the Hybrid Annuity Model was brought in 2016 as an effort to seek out a middle ground. HAM integrated aspects of BOT and EPC having the intention of rebalancing incentives, lessening risks to the private sector, and rejuvenating investor confidence. 40% of the project cost is disbursed by the government as money is invested in building whereas the remainder is paid by the developer and to be paid back to the developer in 15 years by paying a fixed, semi-annual annuity payment that is indexed to the rate of inflation. Developers also enjoy performance based incentives for the maintenance of quality of roads and service levels (Garg & Mahapatra, 2019; Jagannathan & Soneji, 2019). As opposed to BOT, the developer has no toll collection risk thus the model becomes more attractive for equity investors and lenders.

The timing of HAM's introduction was appropriate, especially when the infrastructure sector had witnessed high levels of non-performing assets, stalled projects and the loss of confidence of the private sector after the slowdown of 2012-2015. HAM was expected to improve cash flow certainty and reduce the market risks thus interjecting the banking sector and the institutional investors with a financial discipline and the revival of interest (Kumar & Agrawal, 2020; Mittal et al., 2023). Since rollout, HAM has represented a huge chunk of new highway project awards and its purported success has spurred debate on replicating the model in other areas of infrastructure.

Although such developments occur, there is still a lack of a thorough assessment of the practical effectiveness of HAM in the academic and policy discourse. Most of the literature has been concerned with its conceptual structure or any merits, which have been given through anecdotal examples. There is a gap of strong data-based, comparative analysis which measures HAM's performance against BOT and EPC in fundamental areas like cost-efficiency, completion schedules, stability of forecasts, and attitudes from stakeholders. In particular question has been raised whether financial structuring by HAM in reality strikes a balance between lowering the public sector liability and allowing for reasonable developer rates of returns. Moreover, one wonders whether traffic projection that is found in HAM projects – that is, not as directly tied to revenue generation as in BOT – has become more realistic and if indeed these projects are seen in a more positive light by financiers and equity partners (Sarkar & Bhatt, 2023).

This is a case analysis to address this concerns in a focused and comparative manner. It has three core objectives. First, it appraises the performances of some selected highway projects under HAM as compared to earlier key projects that were established under BOT and EPC (especially in terms of the timeliness of construction, the adherence to cost, and the incidence of disputes). Second, it investigates the reliability of traffic forecasts in HAM projects, particularly taking into account historical practise of inflating the estimates of demand. Third, it examines the views of developers and financial organisations from annual

reports, commentaries by rating agencies, and policy reviews.

The methodology for the research is entirely based on secondary sources such as official government projects records, industry publications, studies and public postulates by the stakeholders. The scope is limited to three – four national highway projects that are representative with regard to the scale, geographic spread and execution pattern. Although the sample is not representative, it is detailed enough to allow us to make sophisticated insights and evidence-based conclusions. The findings should guide policymakers, project developers, and financial institutions in fine-tuning the PPP models and in the design of infrastructure contracts that provide better risk-sharing, financial sustainability, and operation efficiency for India's road sector.

II. Literature Review

Evolution of Models of PPP in Indian Highways

PPP's are at the centre of the highway infrastructure in India, and have altered considerably in the last two decades. At the beginning, the full control and funding of the highway projects were conducted by the government; however, issues like lack of funds and inefficiencies saw the PPP models become adopted in order to access the expertise and capital of the private sector (Ashok & Kesarkar, 2022; Dagar & Ganguly, 2024). Several of the key PPP models that have taken place include the Build-Operate-Transfer (BOT), Engineering Procurement & Construction (EPC), and the Hybrid Annuity Model (HAM) (Ashok & Kesarkar, 2022; Patil & Aher, 2021). These models have been improved over time to cater for problems such as the allocation of risks, financial sustainability, and the efficiency in which projects are delivered, with the government also rolling out novel contractual structures, and policy frameworks that support this system (Ashok & Kesarkar, 2022; Prasad et al., 2024).

HAM vs BOT vs EPC's features

Risk Distribution

In BOT models, the private sector carries many risks but most particularly on traffic revenues and costs of the project. Under BOT-Toll the concessionaire carries traffic risk whereas under BOT-Annuity the revenue risk is passed on to the government and is more appealing to the private players who are not willing to bear the traffic risk (Boeing Singh & Kalidindi, 2006; Iyer & Sagheer, 2011; R. Singh, 2018). HAM is set to balance risk between the public and the private sectors. The government pays 40% of the cost of the construction with the rest being paid as annuities during the concession time, with this measure the private sector is protected from the risks of traffic and revenue (Patil & Aher, 2021; Prasad et al., 2024). The government, in the case of EPC contracts, assumes most risks finance, revenue while the private contractor is required to design and construct only (Ashok & Kesarkar, 2022; Patil & Aher, 2021).

Payment Structure

The four main highway development models in India also significantly vary as regards to their mechanisms of risk-sharing and payment. In the BOT-Toll model, private entities will finance, develop, and operate the project, where the private financiers recover their money through toll, making them vulnerable to huge traffic risk (Boeing Singh & Kalidindi, 2006; Iyer & Sagheer, 2011). The BOT-Annuity model on the other hand protects the private party from such volatility by instituting fixed payments in the form of annuity from the government irrespective of actual volumes of users witnessed (Boeing Singh & Kalidindi, 2006). The Hybrid Annuity Model (HAM) is a hybrid approach to financing wherein 60% of the construction cost is repaid through inflation-indexed annuity over the span of time, whereby, there will be no collection of toll directly by the private developer, thus mitigation of market exposure but maintaining performance accountability (Patil & Aher, 2021; Prasad et al., 2024). EPC model involves full financial responsibility for the government and private contractors are to be compensated upon milestone achievements, environment to business relations are risk-free of both revenue and usage (Ashok & Kesarkar, 2022; Patil & Aher, 2021).

Contract Terms

The concession and contract durations for highway delivery models in India are representative of their non-obvious risk and responsibility setups. In the BOT model, projects are usually characterised by long concession periods whereby the private sector is to not only build but maintain and operate the projects over extended periods, matching returns with long-term performance (Iyer & Sagheer, 2011). HAM model has moderate concession times, a bargaining tactic that balances risk by allocating roles to both public and private sectors with the government keeping the over watch while the developers take charge of construction and maintenance during a set period of annuity (Patil & Aher, 2021; Prasad et al., 2024). On the other hand, EPC model involves shorter contract duration where the private entity is only involved in construction since the government has total responsibility for activities of the post construction (Ashok & Kesarkar, 2022; Patil & Aher, 2021).

Existing Evidence on Performance Metrics

Cost

PPP initiatives, in particular BOT and HAM, typically imply increased expenses on construction as compared to the conventional bids; however, it engenders a life cycle oriented approach to expenditure management, which may raise the long term worth. HAM has prioritised favourable financial indicators (e. g., IRR, NPV) as opposed to BOT models to make it viable for investors (Prasad et al., 2024; R. Singh, 2018).

Time

Lower Time Lags and Overruns at State-Level PPP Projects than National Ones (Nayyer & Annamalai, 2024). Promptness depends on the preparations of the project, availability of resources and contractual maturity with lopsided determinants of success and failure (Garg, 2020).

Traffic

Traffic revenue risk is an essential aspect in BOT projects and which often premises the owners to financial stress when there is a realisation that the actual traffic is not up to the tune projected. The Annuity and HAM models are used to reduce this risk as they separate private returns from quantities of traffic. Sparse published evidence is on system comparisons of actual as against forecasted traffic across models (Boeing Singh & Kalidindi, 2006; Iyer & Sagheer, 2011; Prasad et al., 2024).

Legal Issues

Legal and institutional frameworks have changed to facilitate PPPs, with standardised contracts (e.g., Model Concession Agreement) meant to clarify risk-sharing and dispute resolution. FIDIC requirements as well as other international standards are more and more incorporated in PPP contracts with a view to improving legal robustness (Ashok & Kesarkar, 2022; Iyer & Sagheer, 2011; Prasad et al., 2024).

Gaps Identified

Comparative Case-Based Evaluations: There is no broad, comparative study of performance of BOT, HAM and EPC models in similar project settings (Dagar & Ganguly, 2024). Only a handful of studies attempt to read discrepancies between forecasted and the actual traffic, particularly in the dimensions of financial results, and risk-sharing mechanisms (Iyer & Sagheer, 2011).

The evolution of the PPP models of Indian highways is a continuation of efforts to optimise risks sharing, payment patterns, and contractual terms. In spite of the improvements made by HAM and annuity-based models to reduce the short falls of previous BOT methods, there are still major limitations in regards to comparative performance evaluation, Traffic flow forecasting accuracy and sentiment of stakeholders analysis. It will be essential for success in future policy and projects to fill these gaps, through strong, prioritised data-based research.

III. Research Methodology

This study adopts a qualitative comparative case study methodology, aimed at evaluating the relative performance of India's evolving PPP models specifically the Hybrid Annuity Model (HAM), Build-Operate-Transfer (BOT), and Engineering, Procurement and Construction (EPC). A qualitative design is well suited for unpacking the complex

institutional, financial, and operational dimensions of highway infrastructure delivery in India, particularly when the available data is largely textual and policy-driven (Yin, 2017). The approach relies solely on secondary data sources, enabling an in-depth comparative evaluation of selected highway projects based on publicly available documents, reports, and data dashboards.

The selection of cases is based on two criteria: prominence in national infrastructure planning and availability of reliable performance data. Two major HAM projects have been chosen for detailed examination: the *Delhi–Meerut Expressway (Package I–IV)* and the *Lucknow–Sultanpur National Highway* project. These projects are among the earliest and most extensively documented HAM initiatives and are frequently cited by the Ministry of Road Transport and Highways (MoRTH) and the National Highways Authority of India (NHAI) in their performance reports (NHAI, 2023; MoRTH, 2022). As comparators, the study includes two projects developed under earlier models: the *Kishangarh–Udaipur–Ahmedabad Highway*, a flagship BOT toll project plagued by financial stress and renegotiations, and *Phase I of NH-24 (Delhi–Hapur Expressway)*, implemented under the EPC model. These were selected for their similar scale and their availability in datasets provided by institutional stakeholders.

Data for this study has been extracted from a diverse range of authoritative secondary sources. MoRTH and NHAI annual reports and project dashboards offer granular data on project timelines, cost allocations, and financial structuring. Performance reviews and risk assessments published by leading credit rating agencies such as ICRA and CRISIL are utilised to assess project-specific execution quality, credit risks, and financial progress. Traffic performance data is derived from NHAI's FASTag-based monitoring systems, which offer vehicle count trends and toll revenue figures across national highways. Qualitative sentiment and public stakeholder discourse are analysed through published interviews, earnings calls, investor presentations, and news reports archived across financial platforms. Complementing these are audit reports by the Comptroller and Auditor General (CAG) of India, which offer legally binding insights into project delays, cost escalations, and contractual disputes.

To conduct a meaningful comparative analysis, four performance metrics have been identified. First, cost overrun percentage will be calculated as the proportion by which actual costs exceeded estimated costs, sourced from MoRTH reports and CAG audits (CAG, 2021). Second, time delay, measured in months, will provide insights into execution efficiency and responsiveness to procedural and legal bottlenecks. Third, the number and nature of disputes or renegotiations including arbitration or restructuring events will be noted using CAG findings, credit reports, and media disclosures. Finally, the study evaluates traffic forecast deviations, particularly in BOT and HAM models, by comparing initial demand forecasts (as stated in project documents) with actual traffic figures reported by NHAI and private operators through FASTag records and concessionaire disclosures (Garg & Mahapatra, 2019; Jain et al., 2019).

Despite its comprehensive scope, the study is subject to certain limitations. Most notably, the research is constrained by its exclusive reliance on secondary data. It does not incorporate primary interviews with concessionaires, financiers, or public officials, which could have enriched the contextual understanding of execution challenges. Furthermore, access to confidential legal contracts and financial restructuring documents remains unavailable, limiting the ability to analyse the nuanced risk allocation and renegotiation terms in depth. Inconsistencies in metric definitions such as variation in how delay periods or cost overruns are reported across MoRTH and CRISIL documents introduce a margin of subjectivity to the comparative analysis.

IV. Case Study Analysis

This section examines four national highway projects developed under distinct PPP frameworks two through the Hybrid Annuity Model (HAM), one through Build-Operate-Transfer (BOT), and one via the

Engineering, Procurement, and Construction (EPC) model. The analysis draws on publicly available secondary data to assess performance across cost, time, disputes, and traffic forecast reliability, thereby identifying patterns of risk-sharing and implementation success.

A. Project 1 – Delhi–Meerut Expressway Package (HAM)

The Delhi–Meerut Expressway (Package I), a high-profile HAM project, was designed to alleviate congestion in the National Capital Region. Despite its strategic importance, the project witnessed a cost overrun of approximately 10%, largely attributed to delays in land acquisition and environmental clearances (MoRTH, 2024). The project experienced a six-month delay due to litigation and utility shifting in the Mandola area of Ghaziabad (India Times, 2025). In terms of traffic forecasts, the project underperformed post-completion, with actual traffic volumes falling 15% short of projections, as per FASTag-derived data analyzed by NHAI (NHAI, 2023). However, since the HAM structure ensures fixed annuity payments indexed to inflation, the revenue shortfall had limited impact on the developer's cash flow. NHAI's public briefings and media reports praised the project's design and delivery, particularly for its elevated corridor passing through the Rajaji National Park, which demonstrated a blend of engineering efficiency and environmental sensitivity (India Times, 2025).

B. Project 2 – Lucknow–Sultanpur NH (HAM)

This HAM project aimed to connect two critical urban corridors in Uttar Pradesh. CRISIL (2024) reported a cost overrun of 12%, driven by rising input costs and irregularities in interim disbursements. Execution was delayed by eight months, primarily due to fragmented land parcels and inter-departmental coordination challenges (India Ratings, 2025). Notably, although the annuity structure protected the concessionaire from revenue risk, prolonged delays affected the internal rate of return and increased working capital requirements. Nevertheless, the project remained financially viable, with credit agencies reaffirming stable outlooks due to the project's secured cash flows (CRISIL Ratings, 2024). Delays in scheduled milestone payments were flagged as a systemic issue across multiple HAM projects during this period (CareEdge Ratings, 2025).

C. Project 3 – Kishangarh–Udaipur–Ahmedabad Expressway (BOT)

This expressway, executed under the BOT model, illustrates the challenges of revenue-linked concessions. The project suffered from a 20% shortfall in toll collections relative to forecasted traffic, stemming from inflated estimates and the availability of alternate routes. Multiple disputes arose between the concessionaire and NHAI over toll rate revisions, maintenance liabilities, and contract renegotiations, resulting in arbitration proceedings that delayed financial closure (CAG, 2021, 2022). The project was delayed by nearly a year, and lenders flagged the concession structure as a high-risk exposure due to the absence of guaranteed revenue flows. Compared to HAM, the BOT structure placed disproportionate financial risk on the private partner, contributing to stress in their balance sheets during implementation.

D. Project 4 – NH-24 Phase II (EPC)

NH-24 Phase II was implemented under the EPC model with 100% public funding and no user-fee recovery mechanism. It was completed two months ahead of schedule and stayed within budget, indicating effective execution. The fixed-price, milestone-based payment mechanism ensured cost control and timely delivery. However, the lack of long-term private participation meant that post-construction operations and maintenance remained fully with the government. The absence of performance-linked payments or annuity incentives also implied limited accountability for lifecycle asset quality (MoRTH, 2019, 2022, 2024).

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Table 1: Cross-Case Comparison (Sources: NHAI and MoRTH)

Project	Model	Cost Overrun (%)	Time Delay (Months)	Disputes	Traffic Forecast Deviation (%)
Delhi–Meerut Expressway Package	HAM	10	6	Low	-15
Lucknow–Sultanpur National Highway	HAM	12	8	Moderate	-10
Kishangarh–Udaipur–Ahmedabad Expressway	BOT	15	12	High	-20
NH-24 Phase II	EPC	0	-2 (Early)	Low	N/A

The comparative analysis indicates that HAM projects offer a more balanced risk-sharing structure, shielding private developers from traffic-linked revenue volatility. BOT projects, despite their potential for high returns, face significant exposure to demand uncertainty and regulatory disputes, making them riskier for private players. EPC models deliver timely construction outcomes but lack incentives for long-term asset upkeep. Overall, HAM appears to strike a pragmatic middle path by ensuring financial predictability and maintaining implementation accountability, although delays and institutional bottlenecks persist across all models.

V. Discussion

A comparative assessment of PPP concepts in the highways sector of India and as applied in Hybrid Annuity Model (HAM) as against Build-Operate-Transfer (BOT) and Engineering, Procurement and Construction (EPC) implies subtle patterns of achievement and lingering issues. This section critically examines performance on selected projects through thematic frames of reference such as dispute incidence, financial closure, traffic forecasting and investor sentiment, showing how infrastructure governance in India is altered in its dynamics.

Cross-case Themes: Has HAM Improved Delivery?

Based upon the case studies, it can be inferred that HAM has made fairly positive changes to project delivery mainly in regards to the enforcement of contracts and the distribution of risks. A major progress that has been credited to HAM is a decrease in the nature of the legal and contractual disagreements, a challenge that has been on long the BOT agreements. Unlike BOT whose demand and revenue risk were passed on to the concessionaires, the HAM with its structured annuity payments and government-funded construction tranches has created a more self-controlled and predictable risk setting (Garg & Mahapatra, 2019). Consequently, the prominent HAM ventures like the Delhi–Meerut Expressway had less renegotiation cases and low legal escalations, which indicated the improved project stability.

Moreover, HAM projects have been mostly easier to reach financial closure mainly because there is less revenue risk and enhanced credit ratings from institutions such as ICRA and CRISIL (ICRA, 2022). This model is preferred by lenders as it provides constant cash flows post the construction with less volatility as compared to share toll-based BOT projects. This has resulted in renewed interest in the private sector and a degree of revitalization of PPP involvement in the road sector that had languished in the early 2010s because of wide-spread BOT failures (Singh & Kadam, 2023).

HAM's Successes: Dispute Reduction and Financial Closure

The payment model of HAM has been helpful in minimising disputes, particularly, where toll collections, traffic risk, and construction delays are concerned. Unlike BOT projects such as Kishangarh–Udaipur–Ahmedabad where arbitration claims

resulted from unrealistic demand projections and delayed financial close the HAM projects are not suffering from the lack of clarity in contractual frameworks with no proper definition of the payment schedules and government obligations (CRISIL, 2021). In addition, the two-stage financing system (40% of project cost is reimbursed during the construction stage and 60% in form of fixed annuities post project completion) has brought the developer's interests closer to the long-term maintenance and quality assurance (Sarkar & Bhatt, 2023).

This financial construction also increases bankability, since banks are eager to provide financing for projects that have reliable government cash flows. As confirmed by rating agency commentaries, HAM projects for their part have continued to clinch financial closure faster than their BOT counterparts, needing less in credit enhancements thanks to lesser exposure to end-user revenue volatility (Garg & Dayal, 2020). Therefore, HAM is also usually seen as a "de-risked PPP", especially attractive in the market that has just emerged out of a series of failed toll-based projects.

Persistent Challenges: Traffic Forecasting and Payment Delays

HAM is not a perfect system, in spite of these improvements. The accuracy of traffic forecast is still one of the most important problems that affect both demand estimation for value estimation, as well as policy-level prioritization. Although, the HAM model technically shields private developers from direct traffic risk, the economics of the project, including viability gap funding and calculation of annuity, are still based on forecasted usage that is still vulnerable to overestimation (Jain et al, 2019). Mistakes that would result from these projections might cause faulty financial structuring, thereby numbing long-term fiscal liabilities to the government.

The other evolving problem within the HAM framework lies on the government payment delays especially at the time of disbursing the annuity. Despite the assumption of timely government payments indexed to inflation, some recent reports account for lapses because of budgetary problems and delay in processes at NHAI. Such delays can undermine developer confidence, particularly with smaller infrastructure companies that depend on a regular cash flow (Mittal et al., 2023). The ensuing liquidity gaps might initiate operational inefficiencies or over dependence on working capital borrowings hence project costs could increase indirectly.

Comparison with BOT and EPC: Accountability and Investor Sentiment

When compared with BOT and EPC models, HAM provides the middle ground solution to the risk allocation. Misaligned incentives and information asymmetry hampered savings BOT models, which are, theoretically, the most optimal mode of aligning the user demand and the private investment. Developers underbid to win projects, then sought renegotiations – an aspect that distorts the sanctity of contracts (Deep & Nayyer 2022). Such problems resulted in high incidence of arbitration, poor financial return, ultimately investor fatigue in the toll-based PPP market.

EPC however realized shorter execution timelines but passed the entire financial and operational burdens on to the government which crowds out the private sector capital and innovation. It also did not hold accountability in maintenance phase, whereby roads rarely took time to deteriorate after they were finished (CAG, 2021). HAM regulates both ends by equitable sharing of risk and anchoring performance-linked payments for the purpose of holding stakeholders accountable during the asset lifecycle.

It is an ambivalent position, which can be seen in investor sentiment, especially among banks and institutional investors. BOT is now considered to be a high-risk activity whilst EPC has become low-return, but HAM is seen to provide astable return with lower default risk due to its annuity structure and central government guarantee (ICRA, 2022). None the less, whatever loss of credibility by the government to honour payment commitments might threaten this perception thereby making open fiscal provisioning a critical success factor.

HAM is a major leap in India's PPP evolvement correcting critical flaws of prior models via enhanced contract arrangements, enhanced sharing of risk, and more salient financial constructions. But its success depends on continuous government performance, beliefs in the methodology used in assessing the traffic consistently, and institutional openness. As the HAM model grows, constant monitoring and periodic recalibration will be critical for the continuing sustainability and fairness that it is as a vehicle for highway infrastructure development.

VI. Conclusion and Policy Recommendations

The Hybrid Annuity Model (HAM) has come out as smart alternate to conventional highway development formats in India, especially following boondoggle of earlier ones like Build-Operate-Transfer (BOT) and Engineering, Procurement, and Construction (EPC). HAM has played a significant role in mitigating revenue risk from the private sector and securing annuity based payments indexed to inflation thereby contributing to revival of confidence amongst investors as well as enhancement of financial closure timelines. It has also been successful in minimising conflicts in contractual terms, a constant problem under the BOT model. However, this success is conditional. While the overall performance of HAM continues to be highly dependent on administrative efficiency of the public institutions especially in addressing the timeliness of land acquisition, disbursement of annuity payments and inter-agency coordination. In areas where the government machinery operates effectively, HAM has recorded tangible results. in which such administrative delays exist time and cost overruns for projects still exist. Therefore, HAM is a partial solution, i.e. efficient in terms of financial risk redistribution, but still being vulnerable to systemic inefficacy.

In order for HAM to be highly effective and long-lasting, certain policy-level interventions are necessary. To begin with, stricter traffic forecasting protocols have to be adopted. Most of the deviations identified on case studies are as result of overly optimistic projections hence downstream implications on structuring of projects and risk assessment. Forecasting should become standardised by third party validation and audited historical baselines. Second, there must be real-time project monitoring using digital dashboards based on satellite data, GPS tracking, and blockchain-based contract ledgers and so on. Such transparency will not only help enhance an administrative responsiveness, but will also align the information asymmetry of stakeholders. Third; developing HAM into a more dynamic framework with risk- based incentives embedded can be the way forward towards achieving the match of private sector performance and public interest. For example, enabling partial payments on variable annuity on the basis of actual usage or performance indices could add accountability while not completely restoring the traffic risk to the developer.

From the perspective of the academic investigation and further research, two groups of issues are worth paying additional attention to. The first issue is scalability of HAM at the tier-II and tier-III level of regional context. The existing literature and performance evaluations are focused on the national or high-volume corridors. Knowing the way HAM operates in less trafficked areas may lead to its adaptation for rural or state-level road developments. The second one is related to financing of the environmental, social, and governance (ESG) type, under the HAM structure. In the wake of India's push of its green infrastructure agenda, the feasibility of alignment of HAM with the sustainability-linked bonds or green finance is yet to be explored. Incorporating ESG benchmarks into annuity terms or construction mandates may not only provide an access to new financial sources but also enhance responsibility in the area of society and environment.

HAM is a major institutional reform as far as India's infrastructure delivery system is concerned. If specific reforms are undertaken, and increasingly improved model, it can be transformed into a livelier and more flexible structure, capable of pursuing development objectives, as well as sustainability goals.

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