

ABSTRACT

India has extensively adopted the Public-Private Partnership (PPP) model for infrastructure development in sectors such as transport, ports, airports, and energy. With the Government of India promoting PPPs in social sectors, particularly education, this model offers significant potential for addressing infrastructure gaps in higher education. Achieving the National Education Policy 2020 target of a 50% gross enrolment ratio by 2035 requires substantial expansion in higher education infrastructure, including accommodation for millions of additional students. However, limited public funding necessitates alternative financing approaches. In this context, this study evaluates the feasibility of adopting the PPP model for developing student residential housing in Indian Higher Educational Institutions (HEIs) particularly centrally funded technical institutions such as IITs and NITs.

The study first assessed the suitability of the PPP model for student housing by identifying willingness, readiness, and enabling factors through literature review and stakeholder surveys involving HEIs and private developers. Statistical analysis using descriptive methods, principal component analysis, and one-way ANOVA indicated consensus that PPPs could significantly reduce funding deficits in HEIs. At the same time, differences emerged regarding institutional financial support and the formation of the expert team.

A risk assessment framework was then developed using questionnaire data from stakeholders. An Artificial Neural Network (ANN) model was employed to predict risk severity, demonstrating strong predictive performance. Sensitivity analysis identified a lack of predevelopment studies as the most critical risk factor, followed by inadequate social support from students.

To address financial sustainability, an optimal PPP capital structure was formulated using the Ant Colony Optimization (ACO) algorithm. A multi-objective model balancing private profitability, student affordability, and public funding was validated through a case study at IIT Madras. The optimal solution was achieved at 60% Viability Gap Funding (VGF), a 5.55% loan rate, and annual rent of USD 852, equivalent to approximately INR 75000 at the assumed exchange rate of USD 1 = INR 88, resulting in an Equity Internal Rate of Return (EIRR) of 11.03%. Pareto-front analysis further identified multiple feasible alternatives for stakeholder decision-making.

Finally, the study developed a Sustainable Policy Framework (SPF) for the successful implementation of PPP-based student housing using Structural Equation Modeling (SEM). The study found that institute readiness emerged as the most significant factor, followed by financial viability and legal and regulatory support, while operational aspects did not show a statistically significant direct effect in the tested SEM model. The findings suggest that PPP-based student housing can be financially viable under specific support conditions, including appropriate VGF, affordable debt, and balanced rent structures.