

A Review on Cost Analysis of BOT Project

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Abstract— Traditionally public infrastructure has been delivered by the public sector using the design-bid-build procurement system. With the increased demand for new developments and for maintaining existing infrastructure, public funding resources were unable to keep pace with the demand. A BOT-type infrastructure project can be described as a project based on a concession granted to a consortium (the concessionaire) that is usually from the private sector by a client that is usually a public organization, where the concessionaire makes financial arrangements to “build” the facilities of the project, “operate” the project during the concession period to generate revenues for debt repayment and investments recovery with a certain level of profit, and “transfer” the facilities of the project in operational condition and usually at no cost to the client at the end of the concession period. In a BOT-type project, the concessionaire is responsible for financing, building, and operating the project. Even if the client is also the service user, it usually pays for the service instead of financing the infrastructure.

Study the importance of Public Private Partnership in Indian infrastructure and relevance of BOT model in the Indian Infrastructure sector. To better understand the advantages and disadvantages of BOT in brief manner. In this paper the review of relevant authors is studied and findings are summarised to understand the future scope and past work done and finally conclusions are drawn.

Index Terms—BOT, PPP.

I. INTRODUCTION

Infrastructure is vital to the nation’s economic growth. Infrastructure may be considered to be the skeleton on which the society is built. It includes highways, railways, ports, bridges, hydraulic structures, power plants, tunnels, municipal facilities like sanitation and water supply, and other facilities serving public needs. Adequate funding is required to construct and maintain the requisite infrastructure. The immediate need for such projects coupled with chronic budget shortages experienced by public agencies has encouraged the use of innovative financing.

Traditionally public infrastructure has been delivered by the public sector using the design-bid-build procurement system. With the increased demand for new developments and for maintaining existing infrastructure, public funding resources were unable to keep pace with the demand.

Public-private partnerships (PPPs) were sought as alternative delivery systems to address some of the funding problems. PPP arrangements are utilized extensively and have found considerable acceptance in several parts of the world.

A BOT-type infrastructure project can be described as a project based on a concession granted to a consortium (the concessionaire) that is usually from the private sector by a client that is usually a public organization, where the concessionaire makes financial arrangements to “build” the facilities of the project, “operate” the project during the concession period to generate revenues for debt repayment and investments recovery with a certain level of profit, and “transfer” the facilities of the project in operational condition and usually at no cost to the client at the end of the concession period. In a BOT-type project, the concessionaire is responsible for financing, building, and operating the project. Even if the client is also the service user, it usually pays for the service instead of financing the infrastructure.

1.1 TYPES OF BOT

- Build-Operate-Transfer (BOT) is a generic term taking different forms. The other major types are Build Operate Own (BOO), Build Transfer Operate (BTO), Build Lease Transfer (BLT).
- Build-Operate-Transfer (BOT): The private sector (Concession Company) is responsible for design, finance, construction, operation and maintenance of the facility. The title of ownership is retained by the concession company during the concession period. The facility is transferred to the government at the end of concession period.
- Build-Operate-Own (BOO): The private sector (concession company) is responsible for design, finance, construction, operation and maintenance of the facility. Here the title of the ownership remains with the concessionaire. There is no transfer of ownership to government.
- Build-Transfer-Operate (BTO): The private sector (concession company) constructs the facility and transfer the ownership to the government. The concessionaire operates the facility by taking a contract to operate the facility.
- Build-Lease-Transfer (BLT): The private sector (concession company) constructs the facility and leases the facility to the government. The facility will be transferred to government at the end of concession period.[8]

1.2 CHARACTERISTICS OF BOT PROJECT

BOT projects have unique characteristics that distinguish them from other project delivery methods. The following are some of the unique characteristics:

- BOT projects are financed on a project finance basis with limited recourse. Typically in limited recourse financing, the lenders provide debt to the concession company solely based upon expected cash flow/revenue generating capacity of the project. Financing is provided on the merit of the revenue generating capacity of the project rather than the assets of the concessionaire company.
- A key characteristic of BOT projects is raising of finance entirely by the private sector without the involvement of government. The private sector is fully responsible for a design, construction, finance and operation and maintenance.

- BOT projects are complex structures comprising multiple interdependent agreements among the various participants.
- BOT projects are typically large-scale infrastructure projects. Transaction costs amount on average 5 to 10% of total project cost.
- BOT projects are associated with uncertainties and high risk.
- BOT projects transfer the risk to the private sector.
- BOT formula can be applied to any sector of the economy. But it has been used widely in power plant sector, transportation and telecommunications.

1.3 SCOPE OF PAPER

Study the importance of Public Private Partnership in Indian infrastructure and relevance of BOT model in the Indian Infrastructure sector. To better understand the advantages and disadvantages of BOT in brief manner

II. LITERATURE REVIEW

S.Vaitheeswari and S.Priscil Nidhu, Over half of the world's infrastructure investment is now taking place in developing countries for which, BOT model shall be considered as a way of facilitating private provision to help meet an increasing demand for public infrastructure. BOT model can be implemented for Water treatment plants and will be more effective than EPC with O&M contracts. The private party shall incur cost of design, if included in scope, construction and recurring cost on operation and maintenance. The Private party shall get back the entire cost along with the interest through collecting from domestic and industrial users based on their intake during the agreed concession period. It may be noted that most of the project risks related to the design, financing and construction would stand transferred to the private partner. [1]

Dr. (Mrs.) Vandana Tare and Er. Raj Mohammad Khan, Road Traffic has been growing with very rapid rate, hence the traffic intensity and volume on the road is high. The present road network is necessary to improve to accommodate the future traffic and to provide the good riding quality. The development of Infrastructure has been done by the public sector through the fund collected from taxes, but huge fund are required for modernization of road network. Due to decreasing financial resources, government is not in position to invest the funds in those developments. This has brought to focus the need of attracting private investment in road in India. [2]

Murali Krishna Kuppli and Dr. A R Aryasri, The term BOT (Build-Operate-Transfer) is becoming popular in these days for many industrial segments. Few years back the term was very prevalent for infrastructure projects. Later this concept is being implemented in many sectors such as Energy, Telecom, Construction, Heavy Industries & Semiconductor etc. In general Semiconductor companies need large investments for either fab design centres or establishing foundry units. It is a challenge for few companies to setup such companies with their own funds. The best alternative is to explore feasible models such as BOT. [3]

T. Ravi Teja and B. G. Rahul A wide gap existed between the investments required and the available financial sources for road infrastructure. With the perspective of exploiting private funding agencies for implementation of public projects, Build operate transport (BOT) model burgeoned. BOT structure includes the stipend of a concession by a legitimately enabled legislative power (the grantor) to an extraordinary reason organization (the concessionaire). [4]

Chao-Chung Kang, et. al. say that the purpose of this paper is to develop new financial models of BOT projects to replace the SLR (self-liquidation ratio) since SLR cannot be used to analyze BOT projects. In this paper, we use the financial cash flow concept and mathematical analytical method to develop the PCCR (private construction cost ratio), GCCR (government construction cost ratio), ongoing royalty, and GFRR (government finance recovery ratio) for the BOT finance policy decision model. Also, we explore the relationships among the PCCR, GCCR, ongoing royalty, and GFRR models. [5]

Neda Shahrara, An objective Build-Operate-Transfer (BOT) contract evaluation at the conceptual stage, in countries facing budget constraints, will lead to undertaking projects which are anticipated to be viable in the future. An objective analysis of various risk variables and their impact on a BOT project's future outcome requires study and integration of many likely scenarios into the contract terms, which is complicated and time-consuming. If the process of examining the financial parameters and uncertainties of a BOT project could be automated, this would be a milestone in objective decision-making from various stakeholders' points of view. A soft computing model would let the user analyze many probable scenarios more accurately. [6]

Swapam Kumar Bagui and Ambarish Ghosh There are several risks in a BOT project. Major critical risks are total project cost and revenue/tollable traffic. This paper presents a sensitivity analysis for a BOT project with a real case study varying equity from 10% to 90%. Traffic and cost are varied $\pm 20\%$ and financial analysis is carried out with spread sheet, and test results are prepared in graphical forms and presented. Total Project Cost (TPC), Net Present Value (NPV) and Financial Internal Rate of Return (FIRR) are plotted with various percentages of equity. Linear and non-linear graphs are found. FIRR decreases with increasing TPC/Equity, and probability of project risk increases with increasing percentage of equity up to 30 % and decreases beyond this value. [7]

Er. Rinaj Pathan and Prof. Dr. S. S. Pimplikar opine that BOT has been one of the recent innovations in project finance. The Build-Operate-Transfer (BOT) scheme is a limited recourse financing technique. Many have adopted this approach as an alternative to traditional public financing for infrastructure development projects. This study examines the type of SOCIAL risk due to, force shutdown of toll booths due to public riots. This paper mainly represents the risk in BOT due to political & public pressure. A case study of IRDP project implemented in municipal corporation area through BOT is studied in detail. [8]

Prof. Nagarjuna P. and Dr. Pradepta Kumar Samanta The National Highway Development Programme (NHDP) - the massive road development programme was launched by the Govt. in the year 1999 with an objective to provide high speed roads there by transforming the movement of goods and people in the Country. While the project broadens its scope, funds have become a major concern. An investment of about Rs. 2 trillion is required for all projects under the programme. The first two phases of the NHDP saw more funds being pumped in from fuel surcharges and assistance from multilateral agencies. Comparatively speaking, private sector participation was low-only to the extent of Rs. 125 billion. The trend however was shifted in favour of financing through the private sector participation. From phase III onwards, all the projects of the NHDP were taken up on BOT basis, through either toll or annuity. In fact toll roads were out of favour for many years due to concerns about traffic diversions away from the paid facilities. However, there has been a revival of interest in the last 10 years, primarily because tolling makes it easier to rise off

balance- sheet financing and to encourage greater involvement of the private sectors. The paper discusses the various aspects of the highway financing system and how the toll (user fee) has become an established source of funds in India, and an update on some noteworthy highway projects which are implemented successfully on a BOT basis. [9]

K. Muni Swamy and A. Rama Krishnaiah Infrastructure can be defined as the basic physical and organizational structures needed for the operation of the society or enterprise. It is the services and facilities necessary for an economy to function. The term typically refers to the technical structures that support a society such as roads, railways, airways, water supply, power grids, and so forth. Appropriate and reliable infrastructure is essential for sustainable development and poverty reduction in developing countries. The only way to meet these multiple and ongoing demands is to create financial and managerial systems that are capable of generating and maintaining infrastructure of all kinds and at various levels i.e. regional and national. The last decade has seen a fundamental shift in the paradigm of infrastructure provision around the world with governments regretting from the role of owners and operators of infrastructure and focusing more on their roles as regulators and facilitators of infrastructure services provided by private firms. In a proper execution of the project it becomes very important to identify the possible challenges, which are due to arise during the life of the project. Although it might not be completely possible to eliminate the risk and challenges in many cases but a proper for sight can make the consortium to be properly equipped to mitigate the problems arising due to them. In this thesis, challenges encountered during various phases and its mitigation in roads and bridge projects is studied. [10]

III. REVIEW OF RESULTS

Various authors have different contribution on BOT projects in India and abroad of which primary focus is on Risk Factors on BOT, Success of BOT, Financial Management on BOT, Cost Analysis on BOT. Below mentioned table represents the results of various authors.

Table 1 Represents Review of Results

S.No.	Authors	Findings
1	S.Vaitheeswari and S.Priscil Nidhu	A BOT project is a public project utilizing private-sector benefits. Therefore, to become a BOT project, the project must, first of all, have value from a socio economic perspective. In addition, we must demonstrate that the project will be commercially profitable under the BOT model
2	Dr. (Mrs.) Vandana Tare and Er. Raj Mohammad Khan	The traffic 5545 PCU/day in the year 2006 is exceeding the capacity of single lane i.e. 2000 PCU per day. Hence there is a need to widen the road. The present traffic is also exceeding the capacity of Intermediate lane i.e. 5000 PCU/day. Hence the road is to be widened up to two lanes.
3	Murali Krishna Kuppili and Dr. A R Aryasri	Based on financial analysis & consideration of other parameters US Semi has selected to go for BOT model. Global companies have to commit at least 2 to 3 years of continuous business to selected service provider in India
4	T. Ravi Teja and B. G. Rahul	Key findings on financial analysis concerned to Net present value, IRR, Payback period, MIRR
5	Chao-Chung Kang, Szu-Chi Huang and Cheng-Min	Concept of financial cash flow of the non-BOT projects and the BOT projects is explored. Also, we use the financial engineering method to develop a new finance model in which the value of GCCR, PCCR, ongoing royalty, and GFRR were obtained to modify the drawbacks of SLR. The SLR has been used to evaluate financial project of BOT projects in Taiwan. The result indicates that, from the viewpoint of the public sector, the SLR index, that is BCA, cannot be used to evaluate financial project of the BOT project. Moreover, we find the relationship among PCCR, GCCR, ongoing royalty, and GFRR. But the SLR cannot provide the relationship of private-host utility.
6	Neda Shahrara	A BOT approach can be very successful in infrastructure development by employing private sector's innovation and business insight while bestowing overall planning, coordination and regulatory supervision of the infrastructure networks upon public Entities. This research demonstrates how effective the appraisal and risk analysis of a project at the conceptual stage can be. From reviewing many BOT projects, it was even clearer that extensive risk evaluation and risk assessment at the outset helped the success of the projects. Beside a reliable project evaluation at the conceptual stage will stop viable projects from being rejected.
7	Swapan Kumar Bagui and Ambarish Ghosh	BOT project consists of several numbers of risks. The government of a country transfers risk to the concessionaire. Major risks are country political and regulatory, force majeure, physical, financial, revenue, promoting, procurement, developmental, construction and operating

S.No.	Authors	Findings
		risks
8	Er. Rinaj Pathan and Prof. Dr. S. S. Pimplikar	Effective communication to the project to various stake holders and large public support is the key lesson Absence of support from public at large can lead to many hurdles at any stage of the project in land acquisition stage displacement of people and in operation stage oppose to collection of revenue in the form of toll tariff Public support is crucial in project sitting decisions. Public support no matter is important strong political will is also important to make the project happen Large path breaking projects are required active hand holding from government throughout the project life cycle In spite of completion of the IRDP project.
9	Prof. Nagarjuna P. and Dr. Pradeepta Kumar Samanta	The Govt, of India has been encouraging private sector participation for road projects on BOT basis and makes suggestions which could make highway venture more attractive for private entrepreneurs. However, the success of toll roads is highly dependent on public support. Public awareness need to be properly generated to make road users pay 100 percent of the cost of building and maintaining the toll road. It is to be clarified adequately to the public that the existing road is currently reaching its capacity and operating at poor level of service during peak hours of the day resulting in economic loss due to delays and high operating costs for the road user as well as high accident rates.
10	K. Muni Swamy and A. Rama Krishnaiah	Initial cost of the fly over cost is high compared to road project, and revenue is high in flyover than road, finally by internal rate of return method we can see that profits in road is more compared to flyover So it is better to work on road projects than fly over because returns are more, although maintenance of road will be more compared to fly over but still road project will get more IRR.

IV. CONCLUSION

BOT is essential along with PPP such that infrastructure, projects shall not hurdle the development of country because of finance. Various risks associated with PPP and BOT shall be nullified while starting a new project. NPV and IRR shall be thoroughly calculated such that the project shall not be under loss. New techniques of toll allocation shall be introduced which shall minimize maintenance and overhead cost of toll booth, thereby reducing duration of toll allocation.

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