CrossMark

Analysis of traffic revenue risk factors in BOT road projects in developing countries

Solomon Olusola Babatunde[a,*], Srinath Perera[b]

[a] Department of Quantity Surveying, Obafemi Awolowo University Ile-Ife, Nigeria
[b] School of Computing Engineering & Mathematics Western Sydney University, Kingswood Campus, Australia

ARTICLE INFO

ABSTRACT

The use of Build-Operate-Transfer (BOT) model for transport infrastructure projects delivery, most especially road projects has increased over the past decades. However, the growing concern is how the concessionaires will recoup their money at operation phase in BOT road projects, due to the traffic revenue risk that is highly unpredictable, particularly in developing countries. Yet effort at investigating traffic revenue risk factors in BOT road projects through an empirical method in developing countries received scant attention. It is against this backdrop that this study identified and critically assessed the traffic revenue risk factors in BOT road projects in Nigeria. This study further identified and assessed the mitigation strategies to traffic revenue risk in BOT road projects. In achieving this, the study adopted three different data gathering phases to include literature review, a preliminary survey, and questionnaire survey. The questionnaires were administered to three different primary stakeholder groups comprised public sector authorities (i.e. ministries, department, agencies), concessionaires, and lenders/banks involved from conception to operation phase of BOT transport projects in Nigeria. Data collected were analysed using mean score, Kruskal-Wallis test, and factor analysis. The study, through factor analysis, grouped the 25 identified traffic revenue risk factors into 3 principal factors. Similarly, the factor analysis classified the 19 identified mitigation strategies into 4 key factors. It is believed that this study will benefit the policymakers and other stakeholders to draw policy recommendations that will positively influence the development of BOT road projects in Nigeria and developing countries at large.

1. Introduction

In Nigeria, the state of infrastructure challenge is huge. This becomes acute with the transport infrastructure comprising roads, rails, airports, and seaports, and the country requires US$10 billion annually for the next ten years to achieve the infrastructure requirements (Ahmed, 2011). This is corroborated by Roumboutsos (2015) that the need to deliver transport infrastructure to foster economic requirements and address societal challenges has placed a strain on governmental budgets internationally. In recognition of the massive investment required for infrastructure provision and upgrading, most especially in transport sector necessitated the Nigerian government to put in place an enabling environment to drive the private sector participation in infrastructure provision. For instance, in 2005, the Nigerian government established the Infrastructure Concession Regulatory Commission (ICRC) law (World Bank, 2011). The ICRC law provided the legal and institutional framework for PPPs to operate successfully in the country (Ahmed, 2011). Thus, the recent government agenda indicates that infrastructure development is gaining

momentum with up to 51 infrastructure projects were undertaken through PPPs between 1990 and 2009 (Vetiva, 2011). Most of these PPP projects started in the year 2006 with the transport sector being the primary beneficiary, where about 24 PPP projects using Build-Operate-Transfer (BOT) model were undertaken within the sector between 2005 and 2009.

Thus, a key issue in BOT transport projects is how the concessionaires are to be paid and who is to bear the traffic revenue risk. Therefore, the identification and allocation of traffic revenue risk are of paramount importance for the successful implementation of the BOT transport infrastructure projects (Roumboutsos and Pantelias, 2015), particularly in developing countries with poor risk management practices (Ameyaw and Chan, 2015). Against this backdrop, triggered a number of earlier researchers toward the identification and allocation of risks in transport PPP projects. For instance, AECOM (2007) analyse the case studies of implemented transportation PPP projects around the world and several major types of risks are identified. Nicolini-Llosa (2002) summarises the experience with toll road concessions in Argentina and underlines five main risks in the concession contracts

in a developing country. Trujillo et al. (2002) explore the demand forecasting games in transport privatization. Thomas et al. (2003a) identify risk factors and risk management strategies for BOT road projects in India. Thomas et al. (2003b) analyse the risk perception of BOT road project participants in India. Phang (2007) conducts a risk assessment in urban rail transit PPPs. Pellegrino et al. (2013) conduct the real options theory for risk mitigation in transport PPPs. Carbonara et al. (2015) assess the risk management in motorway PPP projects. Roumboutsos and Pantelias (2015) allocate revenue risk in transport infrastructure PPP projects. In spite of these previous studies, very few attempted to pay attention to traffic revenue risk factors in BOT road projects using an empirical approach.

Existing significant studies on PPPs in Nigeria (see Ibrahim et al., 2006; Awodele, 2012; Babatunde et al., 2012; Babatunde et al., 2015; Babatunde et al., 2016a; Babatunde et al., 2016b) have focused on its critical success factors, barriers, risks, as well as capability maturity levels. Few of these studies examined risk factors associated with PPP projects in Nigeria (e.g. Ibrahim et al., 2006; Awodele, 2012) failed to pay attention to traffic revenue risk in BOT transport infrastructure projects. Also, studies on traffic revenue risk using an empirical approach can be hardly found in Nigeria. It is against this backdrop that necessitated this study to fill the identified gap(s). In this respect, this study was guided by the following derived objectives:

- Identify and assess the associated traffic revenue risk factors in BOT road projects with a view to determining their criticality.
- Identify and evaluate the mitigation strategies to traffic revenue risk factors in BOT road projects at operation phase.

It is believed that this study will be highly beneficial to both the potential and current BOT stakeholders, most especially the private investors within and outside Nigeria that planning towards BOT road projects implementation in developing countries at large.

2. Risks identification, classification and mitigation in PPP projects

The proper identification and allocation of risks are a key to the successful PPP project implementation. OECD (2008) reports that achieving value for money in PPP project depends on the ability of the major participant to adequately identify, analyse, and allocate risks appropriately. This is corroborated by Thomas et al. (2006) that the success recorded in PPP projects, particularly in BOT projects are due to proper risks identification, assessment, and allocation. Unfortunately, PPP projects are susceptible to many risks emanating from the complex nature of PPPs itself that involve various participants with diverse interests, market conditions, a huge amount of investments and long concession periods (Grimsey and Lewis, 2002). For instance, UNIDO (1996) identify the various stakeholders in BOT projects, which is illustrated in Fig. 1 as follows:

The importance of various stakeholders in BOT projects (see Fig. 1) justifies the development of several studies on risk identification and allocation in BOT projects. For instance, Pellegrino et al. (2013) state that studies on risk identification and categorisation in PPPs can be divided into two groups: the first group contains studies that focus on the nature of risks (see Grimsey and Lewis, 2004; Li et al., 2005; Ng and Loosemore, 2007) among others. Also, the second group of studies on the phase of PPP projects (Pellegrino et al., 2013; Carbonara et al., 2015) to a mention a few.

Based on the foregoing, the traffic revenue risk factors in BOT road projects identified by Thomas et al. (2006) were adapted in this study. Since their work was relevant to developing economies such as that in Nigeria. These identified traffic revenue risk factors were filtered to avoid duplication, and presented in Table 1 as follows:

Similarly, a major issue in BOT road projects is how the concessionaire is to be paid and who is to bear revenue risk comprising traffic

volumes risk, toll rates risk, collection risk, and enforcement risk (see Table 1 for details). It is on this premise that selected literature on the mitigation strategies that could be used to address the identified traffic revenue risk in BOT road projects are sourced from significant previous studies and presented in Table 2 as follows:

3. Methodology

The study adopted three distinct approaches; these include a literature review, a preliminary survey, and questionnaire survey culminating in data analysis. The three approaches are detailed as follows:

3.1. Review

A comprehensive literature review was carried out to identify the various traffic revenue risk factors and identify the mitigation strategies that could be used to address the traffic revenue risk in BOT road projects. These were identified from the significant literature (see Tables 1 and 2 for details). The identified traffic revenue risk factors and mitigation strategies were subjected to desk review. Thus, the outcome of comprehensive literature review produced 25 traffic revenue risk factors (see Table 1) and 19 mitigation strategies (see Table 2). These were used to design the questionnaire survey. This is, therefore, form the basis of inquiry for the data collection and analysis.

3.2. Preliminary survey

Prior to data collection, a preliminary survey was carried out to get the list of primary stakeholder organisations, which are the target population for this study comprised the public sector authorities (i.e. ministries, department, and agencies), concessionaires, and lenders/banks that involved in the execution and operation stage of various BOT transport projects in Nigeria. Several lists were obtained from the Infrastructure Concession Regulatory Commission (ICRC) and the Lagos State Public-Private Partnership (PPP) office. The ICRC is the national body responsible for developing and issuing guidelines on PPP policies, processes and procedures, and maintains PPP projects database in Nigeria (ICRC, 2012). Similarly, the Lagos State PPP office being the first ever regional state to develop their own PPP and have executed various PPP infrastructure projects successful, most especially BOT road projects, and it has served as a model state for both the federal and other states government in Nigeria. Thus, a total list of 31 public sector authorities, 28 concessionaires, and 22 lenders/banks, resulting in 81 primary stakeholder organisations were obtained from both the ICRC and Lagos State PPP office.

3.3. Questionnaire survey

The data for the study were collected through the administration of questionnaires to the identified 81 primary stakeholder organisations, which served as respondents for this study. Thus, the study adopted questionnaire survey with a view to capturing a broad lived experience from the respondents. The questionnaire designed for the study was structured and multiple-choice type. The questionnaire was divided into two sections. Section 'A'' comprised the background information of the respondents, this include the category of respondent organisation, academic qualification, and years of industrial/professional experience. Section 'B' was designed in relating to the purpose of the study. The questions were asked on a five-point Likert scale rating with 5 being the highest of the rating.

Further, a reliability test using Statistical Package for the Social Sciences (SPSS) was conducted on the questionnaire. The result indicated the reliability coefficient values of Cronbach's alpha 0.847 and 0.860 for the revenue risk factors and mitigation measures respectively. These values signifying that the questionnaire including