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Few Ways to Succeed, Many Ways toFail: Asymmetrical Performance of Indian Highway PPP Projects

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Abstract

We study the performance of public-private partnership (PPP) recognizing that it is associated with causal complexity, equi-finality, and vagueness of both the outcome and predictor conditions. fs/QCA, a set-theoretic configurational approach, is deployed to carry out within-case analysis and a formalized cross-case comparison of 29 large highway PPP projects. Surveys, interviews and archival data collected over seven years were employed to develop a deep contextual understanding, enabling a qualitative comparison. The projects that we study cost over $ 4 billion. They are located in India which is one of the largest PPP markets in the world, with the maximum number of highway PPPs.

In contrast to prior studies that look at performance as unidirectional, we identify asymmetrical conditions and recipes for PPP success and failure. Further, guided by detailed contextual knowledge, the study conditions founded in different disciplines, and make an effort to integrate the diverse literature. A projects timely completion / failing in timely completion is found to be asymmetrically caused by project preparation, resource availability, and contractual maturity (key attributes identified in policy and economics literature); construction experience of private sector (key aspects identified in construction and project management literature); and emphasis on social relationships (located in management and trust literature).

Introduction

Globally, Public-private Partnerships (PPP) have emerged as an innovative model for delivering public services and assets, especially in the infrastructure domain (Hodge, Greve, & Boardman, 2010; Klijn, & Teisman, 2003; Kwak, Chih, & Ibbs, 2009). In emerging economies, PPPs are salient on account of significant infrastructure gaps, pressing development targets, and emerging sources private finance (Livemint, October 4, 2017; Trebilcock & Rosenstock, 2015; PPIAF, 2016; Ruiz-Nunez et al. 2016). They are a complex managerial context, with complexity arising out of the large size of the infrastructure project undertaken, inherent technology complexity,of contrasting institutional logic, exposure to uncertainty over long periods and involving multiple actors (ven den hurk& Verhoest, 2015;Pache

& Santos, 2013).With social welfare implications and large political significance, successful delivery of PPPs is an important and a fertile ground for both theoretical and empirical examination across a number of disciplines (Hodge, Greve, & Boardman, 2010; Roehrich, Lewis, & George, 2014).

Research in different disciplines has led to a fragmented literature (Kivleniece and Quelin, 2012). For instance, the public policy literature seeks to identify the conditions under which PPPs are an optimal development option, the optimal allocation of risks between public and private agents, and the ability of PPPs to maximize the value for money (Hodge & Greve, 2016; Grimsey & Lewis, 2002). This literature seeks to identify the most appropriate macro environment in which PPP scan flourish, and how to design PPPs. Hence, it attempts to answer: Why PPPs exist? Under what conditions they are an optimal choice? How to design PPPs? In contrast, the economics and management literature focuses on sources of PPP performance. Rather than inquire into the reasons for the existence of PPPs, this literature seeks to identify ways and means to make PPPs successful. Alternately, the project/construction management literature seeks to identify tools and techniques leading to better performance in PPPs. Similarly, in public administration literature, aspects such as contract management, process management, management strategies, organizational form, and political support have been identified to lead to superior PPP performance (Wang, Xiong, Wu, & Zhu, 2017). In this review of 186 articles published in public administration journals, Wang et al. (2017) propose, "Various factors may affect PPP performance. It is necessary to construct a comprehensive framework to show which factors may impact PPP performance in given conditions" Pg 18. Similarly, Osie-Kie & Chan (2015) review of twenty seven PPP studies in project and construction management journals. They identify political support, appropriate risk sharing and allocations, strong private consortium, transparent procurement, and public community support to be some of the most widely studied critical success factors(CSF) of PPPs.Across the literature streams, a large number of factors have been identified impacting performance, some of them unique to the discipline, while others arecommon.

With the dismal performance of PPPs, the study of factors leading to PPP performance remains salient (The Economist, 2012; PPIAF, 2016). In a study of 894 infrastructure projects in India (many of which were PPPs), 40.72% of the projects experienced 15.17% cost over-run on an average, and the mean time over-run was 79.25% in82.33% of the projects (Ramakrishna & Raghu ram, 2012). Failures of PPPs in both conception and implementation find routine mention in the press,[*]and need for deepening our understanding of the working of PPPs has been felt (Garg, 2012). In a cross-disciplinary review of more than 1400 PPP publications over two decades, Roerich, Lewis, & George (2014) observe, *"Problematically, there is no consistency or cumulative development with regard to,* for instance, methodology, units of analysis, key findings and sample." Hence, the abundant PPP research is splintered across disciplines, lacking a consensual view of what are the key aspects of PPP success, while suffering from severe methodological issues.

Although India has emerged as one of the largest markets of PPPs in the world (PPIAF, 2016), there are few studies of Indian PPPs, with the review studies failing to identifyand include them. When Osie-Kyier & Chan (2015) studied the critical success factors(CSF) of PPP, they did not identify any study using Indian PPPdata. Similarly, only two studies on Indian context were found by Wang et al. (2015) when they reviewed PPP studies in public administration literature. Further, less than 20 studies (in over 1400 studies) were founding focusing on India by Roehrich, Lewis, & George (2014) in theircross-disciplinary review.

Furthermore, the PPP literature primarily constitutes case studies of successes or failures, identifying the causal factors of performance. These case studies typically emphasize the remedies for success/failureby carrying out an in-depth contextual elaboration of a case context. Such remedies are deeply contextually rooted in delivery modes (like traditional contracting and different kinds of PPPs), kind of public infrastructure delivered (like roads, ports, airports, prisons, hospitals) and the regional/local context. More broadly, this literature conjectures that success and failure are symmetric. That is, the presence of some factors(A) leads to success, and the presence of others (B) leads to failures, and reciprocally, the absence of other factors (A) would lead failure, while the absence of (B) factors

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[*]For example, Financial Express (October 17, 2015). Indian PPP story, a glass half full. http://www.financialexpress.com/opinion/indias-ppp-story-a-glass-half-full/152596/
The Economic Times (June 05, 2015) PPPs are good in theory but in India they are a failure in practice. https://economictimes.indiatimes.com/news/politics-and-nation/ppps-are-good-in-theory-but-in-india-they-are-a-failure-in-practice-shailesh-pathak-ed-bhartiya-group/articleshow/47940584.cms

would lead to success.

This study aims to simultaneously address the theoretical and methodological issues that plague the PPP literature, and we identify above. The study is motivated and guided by Fiss (2011), who empirically investigated the effects of alternate configurations on organizational outcomes in high technology firms.

Recognizing the dispersed identification of factors impacting PPP performance across disciplines, with the simultaneous need for recognition of contextual aspects, we identify a cross disciplinary list of factors impacting the performance of Indian highway PPPs. Taking into cognizance the inherent complexity of PPPs on account of causal complexity and equi-finality, we seek to identify configurational recipes for success (and failure). More specifically, we put to the test the assumption of symmetricity of performance antecedents. Like Fiss (2011), we rely on set-theoretic fuzzy Qualitative Comparative Analysis (fsQCA) for analysis. The choice of QCA is appropriate as, "*comparative case-based approach is the most suitable way to study the relationship between context and outcomes in projects*" (Verweij & Gerrits, 2012, pg 40). In contrast to quantitative methods that seek to identify the independent effects of variables, and their moderating/ mediating conditions, fsQCA is most suitable to identify the recipes for performance (Ragin, 2008). By these choices, this study is similar to the complexity informed framework to evaluate the performance of transport infrastructure projects in the Netherlands by Verweij & Gerrits (2012). Differently, we study the asymmetrical nature of performance determinants in transport infrastructure projects in India, hence carry out the first such study in the context of emerging economies.

This study tracks 29 highway up gradation PPPs in India from their inception to the year 2017 (approximately seven years), covering the most significant portion of their life cycle – construction phase. The road sector, from where our sample is derived, has been the hallmark of the Indian PPP story. The highway sector has adopted PPPs as the primary mode for project delivery in the years 2008-2015, and during this period the PPP environment in India significantly matured (Economist Intelligence, 2014). Based on data and information from surveys, archival records, and personal interviews with key informants, we carry out a qualitative case comparative analysis of the projects. We identify and discuss causal recipes leading to success/failure of PPP projects, with the choice of conditions determining performance identified from substantive knowledge of the studied context.

We find the timely delivery of projects to be a symmetrical with failing to deliver timely. Three logically consistent conditions were found to lead to project's timely delivery, and these were consistent with what the policy-makers and practitioners often argue, i.e., higher land availability and a mature contracting regimeare important for timely project delivery. We also found low project complexity to be a core condition, and numerous alternate recipes for success even if theland was not available as peripheral conditions. We also find six distinct recipes for a project failing to deliver in time. Except, for one condition that is partially symmetrical, the other recipes vary considerably, reflecting a symmetricity in performance antecedents. Hence, we find different causal recipes for success and failure of PPP projects in India. In a way, this also reflects on the fragile Indian PPP environment as of 2010, something that we did find evidence of in the later years when a major rethink of the PPP structure was taken up.

We next provide a review of the PPP performance literature, followed by the method section where we highlight the appropriateness of our choice of fsQCA for the study. After providing details of the conditions examined, the results are next presented and discussed. The paper concludes identifying the broad implications of our findings and the contributions to literature.

Table 1. Selected empirical studies identifying project performance antecedents

Paper	Method and Sample	Argument and Finding
Klijn & Teisman (2003)	Comparative case studies of three Railway Stations	Netherland: PPP idea gets diluted during execution. In the face of difficulties in decision making and organizational coordination, partners revert to the traditional forms of contracting out and separating responsibilities.
Jha & Iyer (2006)	Survey of 114 and 90 responses of project managers	India: *Commitment*, *Coordination*, and *Competence* are the key factors for the achievement of schedule, cost, and quality objectives, respectively.
Jha & Iyer (2007)	Survey of Construction project managers, CEA	India: Six activities key to project coordination: *preparation of a project quality plan in line with contract specification* is the main contributor when the coordination rating of the project is high.
Klijn, et.al. Twist, (2008)	Survey of 32 managers in 18 complex projects	Netherlands: PPP managers face managerial dilemmas, but these are not either/or choices. They need to be managed simultaneously.

Paper	Method and Sample	Argument and Finding
Jones & Noble (2008)	Comparative case study of 7 cross-sector PPP projects in UK and Australia	UK and Australia: PPP Managers (in the role of boundary spanners) use informal and flexible personal-level agreements to progress PPPs
Edelenbos & Klijn (2009)	Survey interviews with 32 PPP managers of 18 large infrastructure projects	Netherlands: Two types of management strategies: process (openness, support, joint fact-finding, relation orientation, flexibility) and project (outcome) (Closeness, Decisiveness, Stand-alone processes, result orientation, Persistence) management. Process management correlates with outcomes.
Mahalingam, Devkar & Kalidindi, (2011)	Comparative case study of 3 projects in Sanitation sector	India: Administrative experience in handling project structuring and bid process, PPP specific expertise, understanding of PPP risks, are necessary but not sufficient condition for project success. Coordination agencies involvement is required over the full life cycle of the project.
Koppenjan et al. (2011)	Case study of a rail project	Netherlands: The simultaneous requirements of project control and complexity have to be addressed for PPP project success
Steijn, Klijn, & Edelenbos, (2011)	Survey of 323 environmental project managers	Netherlands: The degree of PPP correlates with the project outcomes but is mediated by the management strategies (16 strategies -- communication, involving external people, leadership style of consulting, relationship emphasis, continuous negotiations, and discussion, etc.)
Mistarihi, Hutchings, & Shacklock. (2013)	Comparative Case Studies: Two case studies of Airports based on interviews	Jordan: Identify key issues like lack of experienced workforce, the existence of interplay of internal and external factors. Important management strategies: Human resource practices, monitoring, and management of institutional differences.
Kort & Klijn (2013)	68 surveys of project managers	Netherlands: Why PPPs? How PPPs impact democratic accountability in projects
Verweij & Gerrits (2014)	QCA of a large tunnel project	Netherlands: Manager's response to unplanned events examined. What managerial studies work in what context. Externally oriented management leads to higher satisfaction compared to internally oriented private management. Internal oriented management was found to lead to satisfaction contingent upon the cooperation levels between the public and private partners.
van den Hurk, & Verhoest, (2015).	Case study of a large sports project	Belgium: PPP complexity (technical, political, and multi-actor) affects PPP performance, and the complexity of PPP governance (by bundling and mandating are not a solution for addressing this complexity.
Liyanage & Villalba-Romero (2015)	Cross-case analysis of 4 transport cases.	European Union: There is a need for measuring success from different perspectives – project management, stakeholder, and contract management
Verweij (2015)	mQCA of events in a single road project.	Netherland: There is a need of an externally oriented managerial response.
Verweij (2015)	fsQCA of 27 road construction projects	Netherland: Contract, project scope, and internally or externally oriented management. Externally oriented (stakeholder management) approach and close public-private interactions lead to satisfaction. As complexity (functional and size) decreases, there is less reliance on interactive forms of cooperation (with a reduction in contract focus).
Osei-Kyei & Chan (2015)	Review of 27 studies (1990-2013) on PPP CSF.	Review: The main CSFs: Risk allocation and sharing, strong private consortium, political support, community/public support, and transparent procurement. Studies were from construction and project management discipline.
Kort, Verweij & Klijn (2016)	QCA of 50 manager's responses	Netherland: Institutional arrangement. Organizational form and aspects of management coexist to impact the outcome.
Klijn & Koppenjan (2016)	144 survey respondents from 68 PPP projects	Netherland: Contractual complexity, flexibility, sanctioning and length may affect PPP performance. Only support for sanctioning ability found.

Economic View: The economic theories of property rights theory and contract theory, have often been used to argue PPP performance. These theories take an ex-ante view and argue that ex-ante decisions and conditions determine PPP performance. Property rights lower transaction costs by providing an efficient resolution for conflicts over scarce resources (Alchian, & Demsetz, 1973). In PPP delivery context, the scarce resources are the base assets that need to be upgraded (like the road requiring upgradation), or on which public assets need to be created (like land for the hospital). Optimal allocation of the property rights over these scarce resources during the project's conception enables efficient resolution of conflicts and hence superior performance. Similarly, the contract theory

utilizes the notion of a complete contract that specifies the legal consequences of every possible state of the world (Arrow, 1960). By writing completecontracts during project conception, the uncertainties that the project faces over the contracting horizon can be addressed by rigid contractual adherence. However, contracts are inherently incomplete, and exposure over long terms (10-99 years in PPPs) to environmental and behavioural uncertainties makes the contracts more incomplete, adversely impacting performance (Hart, 2003).

Empirical studies linking contractual aspects with PPP performance have been inconclusive. Increased maturity in contracting and institutional frameworks that can ensure mature contracts and improved contract compliance have been found to lead to an increase in the number of PPPs (Economic Intelligence, 2014; PPIAF, 2016). For instance, Singh (2010) found cost and time over-runs to be economically and statistically associated with contractual failures while studying 894 Indian infrastructure projects. In contrast, Klijn & Koppenjan (2016) in a survey of PPP managers in the Netherlands found little impact of contract characteristics (clauses addressing complexity, flexibility, and renegotiations) on the performance of PPPs. Only the provision of sanctioning (disciplining provisions) were found to have performance implications. Hence, besides the optimal allocation of property rights through contracts and their rigid adherence, there seem to other determinants of PPP performance.

Construction management: Deployment of systematic project management tools and techniques can address the complexity inherent to PPP projects (Project Management Institute, 2004). Disciplined planning, execution and scope management, by professionally trained engineers and managers enables projects to deliver on time, cost and quality targets. With more experience, and with more resources at their disposal, large private construction firms are more likely to have routines and procedures for carrying out project management of PPPs and deliver superior performance.

In a review of twenty-seven studies in the project management discipline, a significantlylarge number of studies (twelve) identified strong private consortium as a CSF for PPPs (Osei-Kye & Chan, 2015). Likewise, in a study of a light rail project in the Netherlands, Koppenjanet al., (2011) find the need for simultaneously addressing project control and flexibility in project management, to achieve success. Similarly, in a series of surveys of managers working in the Indian construction industry, it was found that the estimation of the optimum resource requirements and preparation of project quality plan in line with contract specifications has performance implications (Iyer & Jha, 2005; Jha &Iyer, 2006, 2007).

However, PPP projects involve multiple actors and are different from conventional infrastructure projects, such that their management does not lie exclusively in the domain of project management (Shenhar & Dvir, 1996). In a survey of 32 managers from 18 large complex infrastructure projects in the Netherlands, Edelenbos & Klijn (2009) do not find project management to be associated withproject outcomes.

Management Strategies: Management practice plays an important role in PPPs (Steijn, Klijn, & Edelenbos, 2011). PPPs manager's face dilemmas in managing strategic orientation, styles to be adopted, process dynamics and processes of interactions (Klijn, Edelenbos, Kort, & van Twist, 2008). However, these dilemmas are not either/or choices, but ratherrequire simultaneous management.In a study of seven cross-sectoral PPPs in UK and Australia, Jones and Noble (2008) find that PPP manager's use informal and flexible personal- level agreements to progress PPPs. In a comparative case study of three Indian projects, Mahalingam, Devkar & Kalidindi(2011) find that coordination and involvement between the public and private partners areimportant over the life cycle of the project. Similarly, Steijn, Klijn, & Edelenbos's (2011) survey of about 200 Dutch managers finds that the degree of PPP(structuring of risks and rewards between the public and private parties) correlated with the project outcomes. However, this relation was fully mediated by the managerial strategies deployed, underscoring the role of management.In the Indian context, the commitment of project participants; and resolution of conflict among project participants have been found to contribute significantly in enhancing project performance levels (Jha & Iyer, 2005; 2006; Iyer & Jha, 2006).

The literature finds performance implications of managerial practices. Efficient managerial choices, or more importantly managing multiple dilemmas simultaneously (Klijn, Edelenbos, Kort, & van Twist, 2008; Mistarihi, Hutchings, & Shacklock, 2013); maintaining synergistic momentum and informal flexibility by the boundary spanners in PPPs (Jones & Noble, 2008); use of coordination modes (Garg, 2012); maturity and involvement of client agencies (Mahalingam, Devkar & Kalidindi, 2011); and internal verses external orientation or autonomous, cooperation or intermediating roles of the actors (Verweij, 2015), have performance implications.

Summarizing: In the review above we identify the oblique views on PPP performance determinants. A few prior attempts at integrating them exist. For instance, Klijn & Koppenjan (2016) contrast the economic and managerial view. In their study of performance implications of contractual clauses, they argued that some contract clauses

emphasize contract compliance (sanctioning), while other serve to manage complexity and bring flexibility. But they find only sanctioning clauses to be significant. In contrast, comparing the performance implications of organizational form and managerial strategies, Kort & Klijn (2011) surveyed 68 managers in the Netherlands and reported that organizationalform is not relevant to performance, but management strategies are. The same data was reanalyzed in 2016using QCA, to report that aspects of organizational form (arm's length structure, allocation of discretionary powers, and tightness/closeness of activities) and the aspects of management (use of consultation to organize, exploratory focus, committing, connecting and coordinating) have to coexist for superior performance (Kort, Verweij, & Klijn, 2016).

Research question: This study attempts a reconciliation of the different views, broadly investigating the antecedents of PPP performance? More specifically, recognizing both the alternate views in different disciplines and the lack of methodological consistency in PPP literature (Roehrich, Lewis, & George, 2014), we seek to identify the configuration recipes that lead to superior performancein the complex context of PPP projects**.**

Table 2A. Descriptive details of the outcome and predictor conditions in analysis

				Sample: 29 Observations	
	Maximum	**Minimum**	**Missing**	**Mean**	**SD**
Land Availability (LA)	1	0	0	0.393	0.314
Project Preparation (PP)	0.8	0	0	0.476	0.269
Contracting Maturity (CM)	1	0	0	0.448	0.506
Project Complexity (PC)	1	0	0	0.497	0.323
Concessionaire's Experience (CE)	1	0	0	0.648	0.276
Social Interaction (SI)	1	0	1	0.536	0.379
Timely Completion (TO)	1	0	0	0.538	0.321

Table 2B. Consistency and Coverage scores of the different conditions.

					Sample: 29 Observations	
Consistency / (Coverage) *	**LA**	**PP**	**CM**	**PC**	**CE**	**SI**
Land Availability (LA)	1					
Project Preparation (PP)	0.536 (0.649)	1				
Contracting Maturity (CM)	0.415 (0.473)	0.446 (0.420)	1			
Project Complexity (PC)	0.486 (0.614)	0.680 (0.710)	0.597 (0.661)	1		
Concessionaire's Experience (CE)	0.468 (0.771)	0.574 (0.782)	0.500 (0.723)	0.627 (0.819)	1	
Social Interaction (SI)	0.453 (0.629)	0.714 (0.788)	0.400 (0.461)	0.662 (0.689)	0.710 (0.578)	1
Timely Completion (TO)	0.589 (0.807)	0.628 (0.710)	0.384 (0.461)	0.551 (0.597)	0.769 (0.638)	0.606 (0.590)

Predictor conditions

Guided by the literature review, and supplemented with our deep contextual knowledge, we identified the salient aspect that determines project performance. For instance, Hwang et al. (2013) had identified eight CSF from a survey of 49 practitioners working with ten PPP projects in Singapore. In a comprehensive review of 27 PPP studies between 1990 and 2013, Osei-Kyei & Chan (2015) identify the CSF as risk allocation and sharing, strong private consortium, political support, community/public support and transparent procurement. Management literature identifies project complexity (Verweij, 2015), project preparation, use of management strategies(Kort, Verweij, & Klijn, 2016), stakeholder alignment (Liyanage & Villalba-Romero, 2015; Verweij & Grerits, 2015) and inter-organizational governance mechanism (for instance see Roehrich, Lewis, & George, 2014; Klijn & Teisman, 2003; Kort & Klijn, 2011; Kivleniece & Quelin, 2012).

By selecting projects coming from a single country (i.e., India), taken up by a single agency (i.e., federal agency NHAI), and under construction during a specific period (i.e., our sampling period of November – December 2010), we control for the variations in some of the above factors, like maturity of client, political support, macroeconomic

factors, and policy regimes. The factors that are likely to vary in our context, like private consortium's experience, risk allocation among partners, governance mechanism used, project complexity, project preparation and maturity of the contract, are included as predictor conditions. Here we also guided by our knowledge of the context.

The identifiedpredictor conditions coverthe three alternative views on PPP performance antecedents.Contract maturity, project preparation,and land availability take the economic view arguing that if contract maturity is high, if project preparation is good, and if there is a high level of land availability at the start of the project, the PPP is likely to complete in time (and within the prescribed cost). As per the project management view, if the project complexity is low and the firm undertaking the project has high construction experience, the PPP is likely to complete in time (and within the prescribed cost). Lastly, if social interactions among the project actors are high, relational governance and trust would get employed to negotiate the project uncertainties, and the project is likely to complete in time (and within the prescribed cost).

Land Availability (LA). The availability of land is one of the biggest hurdles to the upgradation of highways in India (Bandyopadhyay, Swaminathan, & Rohatgi, 2008). The linear nature of roads requires that in both, green-field road construction and brown-field road up gradation, small portions of land be acquired from multiple (often hundreds or thousands) of landowners (Davidson, 2010). A large number of people are required to be convinced to part with their land, and the number of transactions involving land notification, acquisition, and compensation is large in road construction context. With poor land records, a weak legal framework for land acquisition, and dense population, this problem is salient to the Indian highway up gradation program (Livemint, 2015; The Economic Time, 2016). The extent to which land is acquired and made available at the start of the project determines the degree of interdependence among the different project agencies and hence impacts how the project progresses, and finally the project outcome. The survey conducted in 2010, captured the extent of land availability at the start of the project as a single item survey measure. For analysis, we converted the survey response to fuzzy scores. Full provision of land is obligatory on the part of the public body. However, it is practically impossible. We considered land availability above 70% as "fully in" the set of projects having land availability at the start of the project, while projects with less than 20% land availability as "fully out" of the set. The cross-over point was kept at 60% land availability, with the intermediate values accordingly allocated.

Project Preparation (PP*).*The quality of DPR, based upon which the project is bid, signifies the degree to which the project's uncertainties have been identified and documented ex-ante. It enables the project managers to plan. Bad project preparation is often blamed for the poor performance of PPPs in India (Livemint, 2017). A DPR of poor quality leaves too many technical and project issues unaddressed, increasing the interdependence between the project agencies, which need to addressed during project execution by working together. The survey used a single item perceptual measure to capture the quality of the DPR, using a five-point Likert scale with "1" as bad and "5" as high quality. Higher the quality of DPR, fewer challenges the project would face. Projects either have poor DPRs (which increases their complexity and risks on-time and on-cost delivery of the projects) or good DPRs (where the project preparation is good,andthe risks of the project identified, and mitigation strategies for the same plan before one get into the project).

While DPR's are required to be high quality, in the face of the changes during execution, the engineers/ consultants/ client carrying out the construction work are seldom satisfied with the quality of the DPR (hindsight bias/ external attributions/outward locus of control). Hence, the coding was done considering other substantiated project evidence. Projects that scored "4" out of "5"were considered as "fully in" the set of projects with good project preparation, while projects with a score of "1"were considered"fully out."

Contracting Maturity (CM). The studied sample of projects iscontractually governed alliances between the public sector and the private sector. When the first PPP projects were taken up in India in 1996, the government agencies drafted the concession agreements guided by their individual experiences and voluntarily sharing information by others. NHAI also shared a draft concession agreement on its website, which was invariably adopted, but modifications were liberally allowed.

As the government sought more projects to be undertaken through the PPP route, the need for standardization was felt (Haldea, 2011; Ramakrishna & Raguhram, 2012). Consequently, after a detailed study of prevalent local and global practices in contracting, a Model Concession Agreement (MCA) was proposed in 2006 for adoption across all highway PPPs in the country. Adoption of this become compulsory from 2009. The contractual clauses in the MCA were a significant improvement over the earlier formats, and this aspect has been widely recognized in numerous studies on the institutional maturity of the PPP regime (Economic Intelligence, ADB, 2014). This was used as a template for drafting project-specific contracts. Consequently, while the project-specific contracts differ in

the technical parameters arising out of highway alignment and geographic location, the commercial contracts are very similar and possess "boilerplate" or common clauses for arbitration, role, and responsibilities (Reuer & Arino, 2007).

The projects that we studied had been bid between the years 2006-2010, and we have an almost equal distribution of projects using the older drafts (16) and those using the MCA (13). Hence, our sample captures a natural experiment where some projects were being executed as per an older contracting regime, while others were undertaken in a new contracting regime, incorporating over a decade of PPP contracting experience. Due to the binary nature, we used crisp sets to construct the set for contract maturity, the coding projects "1" if they were taken up in the new contracting regime, and as "0" if they were contracted out in the older contracting regime.

*ConcessionaireExperience (CE).*Private firms possess different abilities, with the strength of private consortium a CSF for PPP success (Hwangetal.2013; Osei-Kyei & Chan, 2015). With experience in a particular domain, firms build routines to carry out work, possess a dictionary of suppliers, vendors, consultants, and experts who can help them carry out the work, and they have the correct mindset for the focal work. Hence, strong prior experience in the domain is likely to be key to a project's timely delivery.

For highway construction projects, a private firm's prior construction experience becomes most salient. A formal evaluation of private firms was taken up by the government to decide upon technical capabilities of firms for highway construction. Based upon this data set we have extensive data on the experience profile of the private sector firms on the value and number of highway projects that these firms had completed in the previous five years, both as PPP projects or through traditional contracting.

The firm's experience was coded taking into account both the number and value of projects that it had undertaken. Using a six-value fuzzy set, the firms experience was calibrated as a firm with very low experience (0, fully out of the set), low but not very low (0.2, mostly but not fully out), moderately low (0.4, more or less out), moderately high experience (0.6, more or less in) , high experience (0.8, mostly but not fully in), and a very high experience (1, fully in the set) (Ragin, 2008). In the case of projects undertaken by joint venture firms, we parsimoniously added the experience profile to code the sets.

Project Complexity (PC). The size of a project increases its complexity level, increasing the involvement and number of project actors, and requiring more time and effort to coordinate (Klijn & Tesiman, 2003; Verweij, 2015; Verweij & Gerrits, 2015; White & Lui, 2005). Though our sample constitutes of only large infrastructure road projects, within them there is a large variation. The projects in the sample vary from Rs 195 cr ($30 Million) to Rs 2747 cr ($400 Million) (when they were bid and without revisions). The average project cost in the sample is Rs 745 cr ($100 Million). These projects vary significantly in their complexity levels, evident from the per km cost of construction that varies from Rs 4.39 cr to Rs 130 Cr/Km ($0.5 million to $20 million/km). We include project complexity in our analysis by studying the projects technical characteristics (number of flyovers, major and minor bridges, rail over/under crossings, number of toll plazas, culverts, and any special features) and allocating them to a six value fuzzy set.

Social Interaction (SI).Motivated by the extensive literature on strategic alliances we compiled the list of mechanisms that capture the social interaction in the project. As per the standard procedure for survey-based research, this list of mechanisms was converted into a pilot questionnaire, and after testing it with a subset of project managers and experts for face and context validity, we administered the survey to project participants in 2010. The five survey items required the respondents to mark on a five-point Likert scale, the extent to which the agencies (Client, Concessionaire & Consultant) a) have a shared understanding)? b) have cultural similarities? c) have shared identity (feeling of oneness or team spirit)? d) have shared informal norm(s)? And e) treat problems as joint rather than an indivi dual? The five items had a high reliability in a larger sample of 52 respondents (5 items Cronbach alpha 0.90). To code the fuzzy set, we adopted the four value scheme as it, "*is especially useful in situations where* researchers have a substantial amount of information about cases, but the evidence is not systematic or strictly comparable from case to case." (Ragin, 2008, pg 31).

fsQCA Analysis. Our final sample had data from 29 projects, with some missing values on social interactions for one project (13). This got excluded from the analysis. We used the latest version of fsQCA 3.0 for the analysis (Ragin & Davey, 2007). With 28 cases and seven conditions (6 predictors+ 1 outcome), we are within the limit of conditions to cases stipulated by Marx (2010). In other words, with seven conditions there is near zero probability of finding a fitting model from random data with 29 or more cases (Marx, 2010, pg 152, Table 5).

An innovative description of the outcome and predictor aspects is provided in Table 2A and 2B below. With consistency and coverage being reciprocally indicating necessity, we provide all the possible combinations between

the conditions and outcomes. Firstly, this allows us to test for the necessity of conditions for the outcome. There is no necessary condition in our sample, as all values are significantly below 0.9 (Greckhamer, 2011; Young & park, 2013). Secondly, like the VIF (Variance Inflation Factor) in regression analysis, this table helps us identify if any of the conditions are similar: necessary for one another. We find none in our sample, indicating that all the conditions are independently varying in the sample. Table 3 provides the truth table that was analysed.

Table 3. Truth Table Analysis

S No.	LA	PP	CM	PC	CE	SI	Number	TO	Raw Consist.	PRI consist.	SYM consist
1	0	1	0	1	0	1	1	1	1.000	1.000	1.000
2	1	0	0	0	0	0	1	1	1.000	1.000	1.000
3	1	1	0	0	0	0	1	1	1.000	1.000	1.000
4	0	1	0	0	1	1	2	1	0.962	0.877	0.877
5	1	0	0	0	1	1	1	1	0.935	0.837	0.837
6	0	0	1	0	1	0	2	1	0.933	0.800	0.800
7	1	1	1	1	1	1	1	1	0.930	0.800	0.800
8	1	0	1	0	1	0	1	1	0.921	0.750	0.750
9	0	1	0	0	1	0	2	1	0.914	0.833	0.833
10	1	0	1	0	1	1	1	1	0.912	0.500	0.500
11	0	1	1	0	1	0	1	1	0.909	0.667	0.667
12	1	1	0	0	0	1	1	1	0.857	0.000	0.000
13	1	0	1	1	1	0	1	1	0.844	0.637	0.637
14	0	1	0	0	0	1	1	1	0.833	0.333	0.500
15	0	1	0	1	1	1	2	1	0.831	0.430	0.430
16	0	0	0	1	1	1	1	0	0.800	0.400	0.400
17	0	1	1	1	1	0	1	0	0.761	0.421	0.421
18	0	0	1	1	1	0	1	0	0.759	0.440	0.440
19	0	0	0	1	1	0	1	0	0.687	0.354	0.354
20	0	1	1	1	1	1	4	0	0.667	0.311	0.311
21	1	1	0	1	1	0	1	0	0.600	0.333	0.333

We used the standard consistency cut off of >= 0.80 and included all rows with more than one cases for constructing the truth table (Ragin, 2008; Fiss, 2011). In line with Andrewset al. (2016), we compare complex and parsimonious solutions to arrive at feasible configurations. To analyse asymmetrical configurations leading to timely project delivery and failing in timely project delivery, we run two separate analysis. Tables 4A and 4Bpresent the results.

Timely Completion: We find eight configurational recipes for timely project completion, with an overall solution consistency of 0.813 and a solution coverage 0.795. Better than the threshold level of 0.8, this indicates a feasible solution. These six conditions are grouped into three core configurational recipes.
The first set of core condition (1A-1C. consistency 0.809, raw coverage 0.753) indicates that low complexity level of the project invariably leads to good project outcomes. The four peripheral conditions to this (as per the complex model) provide different possible recipes. Each of these possesses high consistency scores and contribute some element of unique coverage. As per the first peripheral configuration (1A: consistency 1.000 and raw coverage 0.132), if land availability is high at the start of the project, project preparation emerges as a no care conditions, with the absenceof contractual maturity, concessionaire's contracting experience and social interaction (each absent). As per the second condition (1B: consistency 0.875 and raw coverage 0.027), if contracting is mature with a high concessionaire's experience, land availability and social integration have to be low. More generally, we find that if land availability at project start is less, two of the other conditions have to be present: either high concessionaire's construction experience and high contracting maturity, or high concessionaire's construction experience and high

project preparation. And, both need to have poor social interaction levels. Less complexity alone and also coupled with high land availability for construction reflects a logically consistent and intuitive scenario. It is important to note that in such configurations, the project preparation (DPR), construction experience, or social interactions take up don't care values.

Table 4 A: Configurations for Achieving Timely Completion (TO)　　4B: Failing in timely completion (~TO)

	1A	1B	1C	1D	2A	2B	3A	3B	1A	1B	1C	1D	2	3	4	5	6
Land Availability (LA)	•	⊗	⊗	•	⊗	⊗	•	•	⊗	⊗	⊗	⊗		•	⊗	⊗	•
Project Preparation (PP)		•	⊗		•		⊗		⊗	•	•	⊗	•	•	•	•	⊗
Contracting Maturity (CM)	⊗	•			⊗ (L)	⊗ (L)	● (L)	● (L)		⊗		⊗	⊗	⊗ (L)	● (L)	● (L)	● (L)
Project Complexity (PC)	⊗ (L)	⊗ (L)	⊗ (L)	⊗ (L)		•			● (L)	● (L)	● (L)	● (L)	⊗	● (L)			⊗
Concessionaire's Experience (CE)	⊗	•	•	•		•	•		•		•	•	⊗ (L)	•	•		•
Social Interaction (SI)	⊗	⊗	⊗	•	● (L)	● (L)	⊗		⊗	•	•		● (L)	⊗	⊗ (L)		● (L)
Complex Cases	8,15	3, 18, 20	3, 9, 27	14, 43	19,2,10,11,21, 24	17, 2, 10	12, 40	22	5,7	2, 10, 11	1, 2, 6, 10, 23, 25	17, 5	19, 42	4	3, 41	3, 41	43
Consistency	1.000	0.875	0.912	0.922	0.821	0.722	0.807	0.930	0.817	0.773	0.860	0.900	0.867	0.800	0.837	0.837	0.911
Raw Coverage	0.132	0.027	0.283	0.269	0.292	0.178	0.210	0.182	0.378	0.203	0.457	0.269	0.194	0.060	0.204	0.204	0.154
Unique Coverage	0.110	0.191	0.037	0.037	0.041	0.000	0.027	0.032	0.060	0.000	0.800	0.035	0.105	0.015	0.030	0.030	0.030

	Solution (TO)	Solution (~TO)
Solution Consistency	0.813	0.848
Solution Coverage	0.795	0.836

Parsimonious cases	8, 19, 9, 14, 15, 18, 21, 27, 42, 3, 12, 20, 24, 43	2, 10, 11, 19, 24, 42, 14, 17, 21	22, 43, 12, 40	1, 2, 5, 17, 41, 7, 23, 11, 6, 10, 25	19, 42,	2, 17, 4, 5, 10, 11	3, 41	1, 3, 6, 23, 25, 41	43
Consistency	0.809	0.592	0.778	0.842	0.773	0.793	0.805	0.846	0.869
Raw Coverage	0.753	0.365	0.288	0.716	0.407	0.343	0.204	0.328	0.233
Unique Coverage	0.251	0.054	0.096	0.800	0.090	0.015	0.000	0.000	0.015

	Solution (TO)	Solution (~TO)
Solution Consistency	0.692	0.793
Solution Coverage	0.904	0.881

Full Circle indicate the presence of a condition.　　● 　Large circles - conditions part of parsimonious solutions.　　● ⊗

Crossed-out circles indicate the absence of a condition　　⊗ 　Small circles - conditions part of both complex and　　• ⊗

The second core condition (2) has a low consistency score of 0.592 in the parsimonious solution. It stipulates the need for high social interaction in the older contracting era, for the project to be successful. This configuration reflects that in the older contracting regime, social interaction had a significant role to play and more clear demarcation of roles and responsibilities have practically crowded out the need for social interactions, an argument often made in relational governance and trust literature (refer to Cao & Lumineau, 2015 for a review of this literature). Due to the low consistency score, we do not discuss this further.

As per the third core condition (3A and 3B: consistency 0.788 and raw coverage 0.288), the recipe of high land availability in the new contracting era (mature contracts) make projects successful. Coupled with our contextual knowledge that the new contracting regime stipulates that 80% land should be handed over at the time of project

start, our findings echo the often argued recipe by policymakers – with the maturity in the contracting regime and high level of land acquisition, projects are likely to deliver in time invariably. Notably, project complexity is the only no-care condition in both the peripheral conditions here.

A peripheral condition (3A: consistency 0.807 and raw coverage 0.210), stipulates that this has to be coupled up with poor project preparation, low social interaction and high concessionaire's contracting experience for timely project delivery. As per peripheral condition (3B: consistency 0.930 and raw coverage 0.182), the recipe with the two core conditions is good enough for success.

These findings reflect on some important aspects. Firstly, there are no necessary conditions. Poor land availability, good project preparation, and low contracting experience can all be managed by alternative combination mechanisms. Secondly, high level of social interaction does not always lead to good project outcomes. In the older contracting regime, social interactions did lead to positive results (core configuration 2), however in the new contracting regime (use of a Model Concession Agreement with improved and clearer risk and responsibility allocations), contract maturity is often associated with low values of social interactions for successful outcomes (configurations 1B and 3A).With three core conditions, there are few ways to succeed.

*Failing in Timely Completion:*In the nine sets of configurational recipes for a project failing to deliver in time (solution consistency 0.848 and coverage 0.836), there exist six core conditions. As tabulated in Table 4B, each of these core conditions have a high consistency score (four of the six reasonably above 0.8) and also significant levels of raw coverage.

Four of the peripheral conditions combine to give the first core condition (1A-1D: Solution consistency 0.842, raw coverage 0.716). As per this core condition, if theland is not available at thestart of a complex project, the project is likely to fail to deliver in time. The four peripheral conditions differ in adding peripheralconditions to this core, for instance as per configuration 1A (consistency 0.817, coverage 0.378) the complex project with low land availability at project start should also have low levels of social interactions and poor preparation, with high construction experience to fail to deliver. Similarly, as per configuration 1C (consistency 0.860, coverage 0.457), the complex project with less land availability would also fail under conditions of high project preparation, high concessionniare experience, and high social interactions. Contrasting with our observations about timely project completion (configuration 1A-1D), this indicates that if project complexity gets combined with poor land availability, the projects uncertainities cannot get resolved by alternative means. A classic case is a 555 km highway project (outside our sample) that got abandoned recently (i.e., Kishangarh, Udaipur Ahmedabad expressway, Raghuram & Udayakumar, 2016).[†] It had a high level of project complexity, but poor land availability. Despite being taken up in a highly mature contracting environment, by a firm with high construction experience and very high level of project preparation, the project failed even to start.

We also find five other core configurations for the project failing to deliver in time, each of which is very different from one another. As per configuration 2 (consistency 0.867, coverage 0.194), a recipe of poor construction experience with high social interactions, provides a recipe for failure. This recipe indicates that attempts of addressing shortfalls in a professional approach by leveraging social interactions are not in the interest of the project. Configuration 3 (consistency 0.800, coverage 0.060) identifies high project complexity in the old contracting environment as a recipe for failure. Configurations 4,5, and 6, identify conditions for projects taken up in the new contracting environment, indicating that combined with high social interactions and good project preparation the project is unlikley to have a positive outcome (4:consistency 0.837, coverage 0.204), combined with good project preparation but low land availability the project would fail to deliver in time (5:consistency 0.837, coverage 0.204), and combined with poor project preparation and high social interactions, the project would not deliver in time (6:consistency 0.911, coverage 0.154).

The second core condition (consistency 0.869, raw coverage 0.233), and the third conditions (consistency 0.813, raw coverage 0.194), both possess high levels of social interactions as a part of the recipe of success. While condition 2 has a poor project preparation in a mature contracting environment, condition 3 is about a poor construction

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[†]The Economic Times (January 8, 2013) GMR quits Rs 7200 crore Kishangarh, Udaipur, Ahmedabad Expressway
https://economictimes.indiatimes.com/news/economy/infrastructure/gmr-quits-rs-7200-crore-kishangarh-udaipur-ahmedabad-highway-project/articleshow/17932377.cms

experience of concessionaire coupled with low project complexity (as core) and a mature contracting environment as aperipheral condition. Hence, under certain conditions, social interactions can delay project completion. Anecdotally, we can argue that under conditions of poor fundamentals (poor project preparation or poor construction experience), social interactions would dilute issue resolution and delay the project.

Hence, we find multiplerecipes for project delay to lie in poor land availability, poor project preparation, poor concessioner's construction experience and/or high social interaction. That is, there are more many ways to fail. Asymmetric conditions: Ideally, one should witness reciprocity in conditions in Table 4A and 4B. However, we find only partial reciprocity in the first core configurations. While less project complexity leads to timely project delivery, high complexity is required to be coupled up with poor land availability for the project to fail to deliver in time. Further, while there exist a few and focused conditions which lead to a successful outcome in projects (three core conditions), there exist many different ways in which projects can fail to delivery in time (six core conditions). This finding reflects upon the complexity of PPPs, emphasizing that as PPPs need extensive coordination across technologies, politics, and actors (van den Hurk, & Verhoest, 2015), they can fail due to a large number of varied reasons if the resultant complexity does not get addressed. However, for success, a larger number of conditions need to be aligned together.

LITERATURE REVIEW ON PPP PERFORMANCE

PPPs face a definitional challenge (Garg & Garg, 2012; European Commission, 2004; Hodge, Greve, & Boardman, 2010; World Bank, 2014). To avoid getting trapped in the debate about what are PPPs, we adopt one on the most recognized definitions of PPP offered by Kwak, Chih & Ibbs (2009), "a cooperative arrangement between the public and private sectors that involve the sharing of resources, risks, responsibilities, and rewards with others for the achievement of joint objectives."(Page 52). This definition is similar to how Klijn & Teisman, (2003) define PPP as, "a cooperation between public and private actors in which actors develop mutual products and/or services and in which risk, costs, and benefits are shared*."*

An innovation in the delivery of public infrastructure and services, PPPs have emerged in various forms to reflect different objectives and requirements (Kwak, Chih & Ibbs, 2009). With a focus on the differences in risk allocations between the public and the private, the practice literature classifies PPPs as Build Operate Transfer, Design Build Finance Operate Transfer, Build Own Operate, and the like. Further, depending on the focal sector, we have Hospital PPP, Road PPP, Port PPP, Prison PPP and the like. However, theoretically, two distinct types of PPP have been identified – contractual and institutional (Marques and Berg, 2009; Klijn, Edelenbos, Kort & Twist, 2008; and Kivleniece and Quelin, 2012). These two types have very different formation and performance antecedents. Here we study contractual PPPs (also called concessions), alternately referred to as Long Term Infrastructure Concessions (LTIC), focusing on infrastructure construction/ up gradation projects (in contrast to service delivery). They involve significant risk transfer from the government to the private firms while channelizing private financial investments into the infrastructure sector. User service charges (like highway tolls) or government pay-outs (annuities) are used to compensate the private sector is for the risks that it shoulders in the projects.

PPPs in the infrastructure sector witness extensive bundling of activities (design, construction, operations, maintenance, and financing), with the transfer of the risk bundle to the private sector for exploiting efficiency. However, this increases the value of the project, requiring an increase in the length of the contracts (hence, long-term concessions), such that the private investments get recovered over the life cycle of the project. Altogether, it allows large value infrastructure projects to be undertaken, which could not be possible otherwise, due to the government'sfinancial constraints. This makes PPPs especially attractive to the developing world.

PPP complexity: Three kinds of complexities exist in PPPs, i.e., multi-actor complexity, technical complexity, and political complexity (Van den Hurk & Verhoest, 2015).Bundling increases the number of diverse activities that are performed by different actors ,and the need for optimal ex-ante allocation of risks among the multiple actors (Klijn, & Teisman, 2003). The involvement of multi-actors increases the number of possible communication and interaction channels, increasing coordination challenges, increasing complexity (Steijn, Klijn, & Edelenbos, 2011). The absence of a single central authority in PPPs, as in the case of hierarchies, brings ambiguity in decisions making adding to complexity (Klijn, 2007). Further, problems are contested due to the absence of clear problem definitions and applicable knowledge; decisions in different arenas require the use of a variety of strategies; and decision-making is embedded in complex and contested institutional settings (Koppenjan & Klijn, 2004).

Infrastructure PPPs aim to deliver high-value public assets like roads, airports, ports, etc., which are often taken up for the first time. This makes PPPs technically complex and brings in a larged diversity in the functions being undertaken, with large costs involvements (Verweij, 2015). The contractual governance structure of PPPs, with the use of incomplete contracts, aims ex-ante risk allocations to address macroeconomic and political uncertainties over the long life of the projects, bringing in political complexity (Klijn and Teisman, 2003).

PPP Performance: Diverse views and perspectives exist on PPP performance (Hodge & Greve, 2010; Liyanage, & Villalba-Romero, 2015). The outcomes of PPP can be measures narrowly (project delivery) or broadly (encouraging private finances into public infrastructure) (Hodge & Greve, 2010). Performance can be measuredat the project level, at the program level, or at the national policy level, each with different sets of antecedents.

At the national policy level, the development economics literature seeks to examine why PPP (private financing of public infrastructure) is required, and under what conditions they are likely to be more appropriate (e.g., Trebilcock & Rosenstock, 2015). The economics literature examines the role of contracting and organizational structures for efficient and optimal risk allocations, with performance implications. Practice and project/construction management literature seeks to identify the CSF of PPPs, and the effectiveness of different project management philosophies, tools, and techniques. In contrast, management literature examines the role of management strategies in bringing about PPP performance. With diverse focus, the different disciplines remain oblique in their treatment of factors leading to superior performance, giving us different views which need reconciliation across disciplines and also in the scholarly and practitioners understanding (Roehrich, Lewis, & George, 2014).

An attempt at integration: Essentially, three theoretically different views emerge in the literature. Firstly, the ex-ante *economic view,* as per which contract maturity and pre-project preparation determine the project's performance. Secondly, the *construction management view,* which offers an internal and project focused approach determining performance. Thirdly, the use of *management strategies* that emphasize coordination, commitment and stakeholder management has been identified to lead to superior performance. Table 1 summarizes some of the studies that we identified reflecting the management views. We discuss each of these theoretical views next.

SAMPLE AND METHODOLOGY

PPPs in the Indian Highway sector

India has a vast road network of over 3.3 million km; the second largest in the world after the road network of the United States of America. Traditionally, roads have been constructed, managed, and operated by the government. In the last three decades, the private sector has been playing an increasing role in both highway construction and operation. Not only has construction activity moved from the public to the private sector, but the private sector has also been financing the construction of highways, with the emergence of PPPs (Bult-Spiering & Dewulf, 2006; Davidson, 2010). After experimenting with different kinds of PPPs, the highway sector has adopted the BOT (Build, Operate, and Transfer) kind of PPP (India Infrastructure Research, 2010).

In the five-year period (2002-2007), about 5% of the investment in roads and bridges came from the private sector (i.e., INR 7,004 crore or about 1.5 billion USD). This was expected to increase more than six-fold (33.99%) (i.e., INR 106,792 crore or about 23.5 billion USD) in the next five years (2007-2012). However, this target could only be partially achieved. While the awarding of contracts soared 10x, the projects did not get delivered. Project execution faced multiple issues, and construction activities in the sector got stalled. This provides us with an interesting context and a fertile ground for an empirical examination of the determinants of PPP performance.

In the Indian Highway sector, project responsibilities are assigned to the private firm after a competitive procurement process. Government floats bids after carrying out a preliminary project preparation, which reflects its cost estimates and technical requirements, contained in the Detailed Project Report (DPR). Private firms competing in the bids evaluate the available information to value their price bid, and the contract is awarded to the most competitive price bid.

The private sector takes over from here, with a major share of the project risks being borne by the private sector, here on. However, some key resources still need to be transferred from the government to the private party like land for construction, design approvals, compensation for scope changes, notifications for toll collections, or regular government annuities. This resource transfer requires frequent interaction and coordination between the private and public parties. During this period multiple actors need to work together, the resources (owned by different actors) are deployed on the project, the maximum amount of managerial time and effort is spent, and maximum need for

coordination exists. Subsequently, in the operational phase, the PPP projects works like a financial arrangement, with the toll revenues or annuities used to cover the finance charges, with the project itself requiring minimal financial or managerial investments. Hence, for this study, we focus on the performance of the construction stage, which is very complex.

Sample space

As part of a larger study, we have been tracking highway PPP projects in India since 2010. For this study, we focus on twenty-nine PPP projects were taken up by NHAI (the federal agency responsible for highway up gradation). These projects come from a larger sample space of 126 NHAI projects that were under construction in late 2010 (September – December) when we first started tracking them.[‡]The choice of sample space - PPP projects in India taken up by a single federal agency - enabled us to control for many of the factors that the literature identifies as critical to the PPP performance.

The projects constituting the sample were those where we could contact senior project personnel and those who agreed to fill up a survey instrument studying the nature of coordination between the public agency, private concessionaire and the Independent consultant. They had been identified by snowballing of contacts of one of the authors who had worked closely with the infrastructure sector. The survey aimed to study project coordination as prior research in this context had found coordination to be important for time and cost performance (Jha &Iyer, 2006, 2007). Further, on most projects, the authors interviewed the survey respondents and their teams (directly or over the phone) to gather a deep understanding of the projects.

Seven years later, in 2017, the projects were revisited to observe how they had progressed. Detailed case studies were made for each project, and where required project personnel were contacted to seek additional information. The information across the cases was tabulated and calibrated by the author and two research assistants. For the calibration, we followed the procedures stipulated by Ragin (2008).

The study focuses on the construction phase of PPPs, and the predictor conditions identified from the aspects salient to the context. The outcome condition was captured at a later stage in time, making it a longitudinal study, the need for which has been identified by Verweij & Gerrits (2012). Hence, the study seeks to make a unique contribution to the PPP literature, which has predominantly investigated the optimal conceptualization of risks and CSF of PPPs.

Choice of fsQCA for analysis

The core features of the context guided the choice of fuzzy qualitative comparative analysis (fsQCA) for analysis, i.e., causal complexity, ambiguity, medium N, and combinatorial logic.

Causal Complexity. QCA is a powerful and productive alternative to the quantitative research design that focuses on calculating the net effects of "independent" variables in properly specified linear models (Ragin, 2008). A configurational approach, QCA enables identification of a combination of factors(recipes) that lead to a particular outcome of interest and hence addresses causal complexity (Ragin, 2008). The complex nature of PPPs, as discussed above, and the oblique views in the different disciplines reflect that numerous antecedents to PPP performance could exist concurrently. Hence, PPPs possess causal complexity (Verweij, 2015; Koppenjan & Enserink, 2009; Verweij & Gerrits, 2015).

Ambiguity. Many aspects of PPP are inherently ambiguous. For instance, a casual observation about timely completion of the project (the outcome measure in this study) is disputed. The multiple actors working together in a PPP are governed by formal commercial contracts, where failures have to be punished or excused, with due financial considerations.

Consider a case where a project gets delayed by X days. Typically in our context, the private firm attributes the partial/ full delay to unavailability of land or delay in decision making by the government agency (both of which can often be extremely political and socially sensitive). Simultaneously, the government is required to penalize the firm for default of contractual promise of timely project completion. To the extent that the government accepts the delay

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[‡]The complete sample space comprises of 709 Indian PPP projects (as of September 1, 2010). Of these 376 were highway PPP projects. Focusing on projects that were at any stage between financial closure and one year past the date of commercial operation as of September 1, 2010 – the important construction and immediate post construction period - we identified 126 projects at the national level that we could sample from.

(and punishes its agents) the delay on firm's account is condoned, and it is not penalized. In such a case, it is difficult to ascertain whether the project was timely completed or delayed. Fuzzy set requires comparisons to be done across the sampled projects, and not in absolute terms. Contextual knowledge allows easy ranking of projects on the extent of timely delivery, by comparison with others in the set. Hence, fuzzy set calibration is appropriate for the context.

Medium *N*.QCA is a powerful and productive alternative to the conventional large –N quantitative research design (Ragin, 2008). It is most suitable for carrying out cross-case analysis where the number of cases is small (20-50), but large for cross analysis to be cumber some and unmanageable (Young and Park, 2013). The recent emergence of PPPs, and the paucity of data about them, significantly reduces the size of our sampling space. QCA provides an empirical tool which can work with small sample sizes while moving beyond single cases and comparative studies of a few cases (Ragin, 2008).

Combinatorial Logic. Qualitative studies like detailed case studies of PPP projects, or the extensive case comparisons (many of both kinds exist), while identifying the likely primates that matter for performance and being indispensable for building theory, do not allow us to analyse the combination logic (Ragin, 2008). The complexity of PPP requires a tool that can exploit combinatorial logic, and QCA allows for the same (Verweij & Gerrits, 2012).

Contextualization: An analysis of transport infrastructure projects requires a consideration of the context, and QCA as an analytical approach allows for the same (Verweij & Gerrits, 2012).

Calibrations of sets: QCA requires the conditions to be coded as 0 or 1 (in crisp QCA) or assigned any value between 0 and 1 (in fuzzy QCA) (Ragin, 2008). The crisp sets define conditions as "fully in" (1) or "fully out" (0). Besides these extreme, extreme anchors (0 and 1), fuzzy sets also require an anchor of the mid-point, the point of maximum ambiguity, to be identified contextually. At this mid-point, a condition is neither "in" or nor "out, "however, it is not necessarily the centre point of a categorical ranking. Calibration of sets, or assigning set membership scores is a qualitative exercise where rich case data is examined to assign a score. We used crisp, four-value and six value fuzzy sets to code the different sets, as appropriate. To calibrate contracting maturity, we used crisp-setas only two values were possible. For the perceptual survey measures, we used a four-value fuzzy set, while for the outcome variable (where we had maximum information available) and others we used a six-value fuzzy set.

Outcome Condition

PPP performance. In the studied context, timely completion is a key deliverable, with the contract providing for incentives for completion before time and penalties for delays (NHAI, 2006). Even the performance of the operational phase is contingent on timely completion. It is only after project construction completion that the private concessionaire starts collecting toll revenues or annuity payments, which are the source of funds for the investments made in the project.

Besides time, the iron triangle of project management has two other constituents - cost and quality (Jha & Iyer, 2006; PMBPK, 2004). In PPP projects, the construction cost risk is borne by the private firm. Hence the completion cost of the project is a commercial secret and not routinely shared. At the same time, projects that constituted our sample space had a significantly higher cost of financial closure compared to the bid cost, hence cost overruns during project execution were not evident as there was a significant cushion available.[§]

Quality is monitored by a third party agent (Independent Consultant) and subject to well-established standards of delivery (formed by Central Road Research Institute of India in our case). Due to the inherent bundling of construction and operations, the quality risk is borne exclusively by the private firm, in an outcome determined regime (Hart, 2003). Hence, the timely completion of the project emerges as the only salient outcome of a project.

Timely Completion (TC). India has a history of time overruns in infrastructure projects. Undertaken between 2005 and 2011 (similar time-period to this study), 44 road construction projects were found to have an average time overrun of 6.48 months (Ramakrishna &Raghuram,2012).We used this contextual knowledge for calibrating timely completion. Projects completed as per scheduled time or within 3-4 months (with approved extensions) were kept "fully in" the set of projects with *timely completion*. Projects were coded "fully out" of the set of *timely completed* projects if they were inordinately delayed (3-5 years) or terminated. Fuzzy categorizationwas adopted due to the

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[§] (Haldea, 2011): Planning Commission of India had analyzed the higher financial closure costs and attributed them to tunneling of funds by private firms. As this is not a subject of our study, we do not get deep into them.

high level of ambiguity in attributing delays. Projects were coded "more in" the set of *timely completed* projects if there was clear evidence of external reasons for the delay, such as land not being provided in time, or law and order issues. In contrast, if there was evidence of project delays due to reasons attributable to the firm failures or project dynamics, we coded them "less in" the set of *timely completed* projects. The crossover point was kept at projects that got reasonably completed in time.

Cost Compliance (CC*).*For the sake of completeness, we also model the project's *cost compliance*, where available. Projects that provided significant evidence of cost overruns, evident from the requirement of higher debt funds, refinancing of projects for cost overruns, or clear evidence of excessive costs incurred, were kept partially or fully out of the set of projects that witnessed *cost compliance*. In contrast, projects with evidence of a marginal cost overrun were kept fully/partially in the set of projects demonstrating cost compliance. Where the actual cost of construction was not explicitly mentioned, the cost of financial closure was considered, and the project kept at the cross over point, as there was maximum ambiguity about its true cost compliance. Hence, almost 50% of the projects in the sample had a score of 0.5. The paucity of space restricts us from presenting and discussing these findings.

RESULTS AND DISCUSSIONS

Before analyzing for the sufficiency configurational recipes, we tested for the necessity of the conditions. We found none of the conditions to be necessary for timely project delivery. That is, as per Table 2B none of the conditions have high consistency or coverage values (above 0.9) for them to be necessary for the project outcome. Moreover, none of the identified conditions emerge as necessary for others, confirming that we are studying the impact of distinctive conditions.

CONCLUSIONS

This study tracks twenty-nine highway PPP projects in India, in the construction phase in the year 2010, till 2017when they were in their operational phase. The casual recipes that led to their timely completion/ failing in timely completion were identified from longitudinal information on the projects. We found asymmetric antecedents of performance, with a few ways leading to the projects timely delivery, and multiple different recipes for failure. Our findings identify a few key aspects about highway PPPs in India, some of which have significant managerial and policy implications. Firstly, we find that whereas extensive bundling has made PPP projects complex, the Indian Highway PPP sector (as of 2010) had not been able to address this complexity. While low complexity led to the timely completionof projects (configuration 1 in Table 4A), high project complexity is a core condition for the project failing to deliver (configurations 1A-1D and 3 in Table 4B). Thiswas confirmed half a decade later when many complex projects failed to deliver, and a rethink of the Indian Highway PPP space was done. The major changes during this rethink were aimed at reducing complexity in PPP project's structure.**Secondly, we consistently find high levels of social interactions not getting associated with good outcomes, through stakeholder connect, flexibility, adaptability, and relational working is getting increasingly argued in the management literature (Configuration 1A, 1B, 1C, and 3A in Table 4A and configurations 1B, 1C, 2, 3, and 6 in Table 4B). In complex and professional work, like highway construction, social interactions have a rightful place. With the recent recognition of the dark side of trust in inter-organizational relationships (Poppo, Zhou, & Ryu, 2008; Skinner, Dietz, & Weibel, 2014), this study adds to this stream of literature. Thirdly, across the different configurations, we find concessionaire's experience to be negatively associated with social interactions. Though this may appear counter-intuitive, during field observations we found that larger construction firms (with more experience) tend to build rigid processes and procedures, such that they have problems in negotiating low land availability, which is not contractually a part of their responsibilities. They tend to pursue legal and contractual modes to secure land, which delays the project. Fourthly, land availability has consistently emerged as a core condition, lending support to the Indian policy makers recognizing it to impede highway construction projects and their repeated attempts at addressing this issue. Our findings, however, identify that projects timely completion is also possible even if land availability is low. In conditions of low project complexity and high social interactions in the old contracting environment, even low land availability projects achieved timely completion. Together, these findings indicate the crowding of trust and social relationships in a mature contracting environment (Lumineau, 2017).We find high (low)

** http://www.thehindubusinessline.com/opinion/columns/slate/what-is-ham-in-india/article9773587.ece
http://www.careratings.com/upload/NewsFiles/SplAnalysis/Hybrid%20Annuity.pdf

social interactions to be associated with positive outcomes in the old(new) contracting environment (configurations 1B, 2, and 3A in Table 4A), and while high(low) social interactions in the new(old) contracting environment associating with negative outcomes (configurations 1B, 2, and 4 in Table 4B).

Contributions: The study makes numerous theoretical and empirical contributions. Firstly, it contributes to the performance management literature. Repeatedly, reviews of PPP literature have identified the need for empirical studies focusing on PPP studies (e.g., Roehrich, Lewis, & George, 2014).Contributing to the PPP literature, this study builds on the empirical observations by Hwang, Zhao, & Gay (2013). While studying PPP projects in Singapore, they had identified asymmetrical nature of CSFs. In a survey, 48 practitioners were asked to rate seven positive, and seven negative CSFs on a Likert scale and the data analysed using mean scoring. Herein, the positive and negative factors included in the survey were different. Hencethe asymmetry found could have been on account of the survey design. In contrast, using QCA,we study the impact of the same factors on both positive and negative project outcomes. Hence, the identification of asymmetrical behaviour in this study is more robust. Our findings of asymmetrical performance echo with those of Fiss(2011), who found the same in high technology firms and Andrews, Beynon, & Dermott (2015), who found asymmetrical structural antecedents of organizational capabilities in UK's public sector organizations.Hence, the study contributes by extending the logic of a symmetricity of performance antecedents to PPPs. Hence, using fsQCA, we contribute to mid-range theories (Fiss, 2011).

Verweij & Gerrits (2012) had argued that while QCA is most suitable for studying transport infrastructure project, one of the keyshortcomings of the approach is the ability to incorporate time dynamics in the analysis. Addressing this concern, in this study the outcome conditions are captured at a later stage than the predictor conditions. Hence, with the limits of causal complexity, we claim that our results can be interpretedas causal conditions, rather than simple associations.

Empirically contributing to the PPP literature, this is the second study (the other study is Verweij (2015) that employs QCA, an emerging analytical approach (Fiss, 2011), with projects as the level of analysis.[††]The study by Verweij (2015) carries out comparative case analysis of 27 road projects in the Netherlands. The two alternate management approaches - internal project management approach and stakeholder approach- were compared to identify the conditions under which PPPs provide the higher perceptual satisfaction of managers. Close public-private interactions and stakeholder connection were found to be a necessary condition. In contrast, this study carries out longitudinal analysis of PPP projects, an important aspect considering their long-term nature (Verweij & Gerrits, 2012). Further, we find contextual moderators to the value of close public-private interactions in PPP. Hence, though not being the first study on PPPs using QCA, it is the first study using longitudinal data in an emerging economy context.

Limitations and Future Directions: In this study, the outcome of interest was successful project commissioning (timely completion). Recognizing, that PPPs involve extensive bundling of activities (construction and operation) (Hart, 2003), our outcome variable only captures the outcome of the construction phase. Hence it does not provide a complete perspective on PPP performance. A study including operational level outcome and the casual predictive configurations leading to themis proposed as an agenda for future study.

As indicated earlier, this study was motivated by Fiss (2011), wherein the Miles and Snow typology of firms was tested using fsQCA in a sample of high-technology firms. However, we do not have the luxury of a recognized topology for PPP projects. Hence, extending the arguments made by Fiss (2011), the next possible step for this study is to develop a theoretically rooted, but empirically validated typology of PPPs. Such a typology would go a long way in integrating the dispersed PPP literature, and deepen our understanding of PPPs, a phenomenon about which we still know so little despite a flood of scholarship (Hodge and Greve, 2007; Caldwell, Roerich, & George, 2017).

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[††]We identified a few other articles studying PPPs using QCA, but these held very different foci. The studies by Eicher (2016) and Krumms (2016) use QCA to examines reasons behind the choice of PPPs and contrast them with other options for infrastructure delivery. Liyanage & Villalba-Romero (2015) use mvQCA to study four European PPP transport projects to emphasize the need for measuring PPP performance from different perspectives. The study by Kort, Verweij, & Klijn (2016) uses a survey for 50 managers to argue that organizational forms and managerial strategies need to coexist to impact outcome, relying on generic views held by PPP managers. The study by Verweij & Gerrits (2015) is a QCA analysis of the manager's responses to unplanned events that occurred in a single large infrastructure project.

This would be a valuable contribution to mid-range theories as indicated by Fiss (2011).

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