

# COLLABORATION TO EXTEND TARGET COSTING TO NON-MULTI-PARTY CONTRACTED PROJECTS: EVIDENCE FROM LITERATURE

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## ABSTRACT

Target Costing (TC) has been used in the manufacturing industry as a means of managing product profitability during the product development process. Efforts to adapt the TC manufacturing approach to the construction industry resulted in a management approach called Target Value Design (TVD). So far TVD research and practice are linked and limited to collaborative forms of project delivery based on multi-party contracting such as Integrated Project Delivery (IPD).

Prior studies and anecdotal evidence suggest that early collaboration among key project stakeholders plays a significant role throughout the TVD process. As a result, TVD application in less collaborative project delivery arrangements (e.g., design-bid-build or design-build) remains a challenge. As yet, TVD literature lacks a wide overview of theoretical and empirical evidence relating early collaboration through other means than multi-party contracts.

This paper attempts to address this gap in the TVD literature by conducting a systematic mapping study to shed some light on future TVD research. Following an evidence-based approach, we seek to answer the following research question: Which research topics have been covered for promoting collaboration among key project stakeholders (owner, architect, engineers, contractor and subcontractors) when their incentives are not aligned through multi-party contracts?

The selected papers are classified with respect to the common research subjects. Out of our sample of 47 papers, the most common categories of research subjects are: project partnering, incentive systems and public-private partnership. These three categories can be considered as evidence clusters and the remaining categories (cooperative procurement, social network analysis, trust and project alliancing) can be considered as scarce evidence. We discuss these categories and suggest future research directions to overcome the potential barriers of TVD application in construction.

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## **KEYWORDS**

Collaboration; Target Costing; Target Value Design; Construction industry.

## **INTRODUCTION**

Target costing (TC) is a fundamentally different approach to relating prices and costs, and to managing costs. TC was developed in Japan and has been used by leading Japanese manufacturing companies such as Toyota, Nissan and Honda since the 1980s (Yook et al., 2005). While the traditional cost-plus-profit approach uses production costs estimation to obtain a market price, the TC approach starts with a market price and a planned profit margin for a product and establishes an allowable cost for the product (Ansari et al., 1997).

TC application in the manufacturing industry has attracted an increasing interest from both construction industry practitioners and academics in the last decade. Early TC implementations in construction (Nicolini et al., 2000; Ballard and Reiser, 2004; Robert and Granja, 2006) have followed different strategies and none of them corresponded to a literal implementation of the manufacturing TC method (Jacomit et al., 2008).

TVD research has been undertaken within the framework of lean project delivery (Ballard, 2008). To this date 12 TVD projects have been completed in the USA and the Sutter Health's Cathedral Hill Hospital (CHH) project represents the most advanced application of TVD (Zimina et al., 2012). Most of these TVD projects occurred under collaborative contractual arrangements such as Integrated Project Delivery (IPD) or Integrated Form of Agreement (IFOA).

The IPD and the IFOA are forms of contract, and have very distinct characteristics which promote collaboration in the Architecture, Engineering, and Construction (AEC) industry (Lostuvali et al., 2012). The IFOA binds the project team (usually client/owner, designers, general contractor and trade partners) into a single contract which requires them to share risks and rewards (Lichtig, 2005). IPD is "a project delivery approach that integrates people, systems, business structures, and practices into a process that collaboratively harnesses the talents and insights of all project participants to optimize project results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication, and construction" (AIA California Council, 2007).

Although the TVD process has been used in projects under contractual arrangement such as IPD or IFOA, the TVD process might require changes when applied under less collaborative project delivery arrangements. Moreover, there are still cultural, procedural, and organizational barriers to widespread use of IPD within the construction industry (Kent and Becerik-Gerber, 2010). Yet, there has not been any significant research investigating the possibility of TVD working under different management strategies (Zimina et al., 2012).

Following an evidence-based approach, this paper attempts to answer the following research question: Which research topics have been covered for promoting collaboration among key project stakeholders (owner, designers, general contractor and trade partners) when their incentives are not aligned through contractual arrangements? The outline of the paper is as follows. First, a brief overview of the evidence-based paradigm is presented. Second, the research method is explained.

Analysis of the selected studies and discussion of the results follow. Finally, the implications and limitations of this paper are discussed in the conclusions.

## EVIDENCE-BASED PARADIGM

Kuhn (1962) uses the term ‘paradigm’ in several ways. For the purpose of this paper the term ‘research paradigm’ will refer to the combination of research questions asked, the research methodologies allowed to answer them and the nature of the pursued research products (Van Aken, 2004). The Evidence-Based Paradigm (EBP) has its roots in the 1980's and has attracted both followers and critics.

EBP has had a major impact in many domains and disciplines; e.g., medical science, software engineering. Practitioners and policy-makers have been greatly influenced by its results (Chartes et al., 2009). However, despite its influence, the construction management research community has been slow to adopt EBP (Viana et al., 2012). Our purpose is not to argue about the constitution of evidence in the AEC research domain. We rather intend to extend the current TVD research through an evidence-based approach.

Systematic literature reviews (SLR) are widely used in EBP as an aid to evidence based decision making. SLR differs from traditional narrative reviews by adopting a method of locating, appraising, and synthesising evidence (Petticrew, 2001). Individual studies contributing to a SLR are called primary studies; a SLR is a form of secondary study (Kitchenham, 2007).

However, a systematic mapping study (SMS) may be more suitable than a SLR when there is very little evidence available or the topic area is too broad during the initial examination of the domain. SMS allows the identification of evidence clusters and evidence gaps to direct the focus of future SLRs and to identify areas for more primary studies to be conducted (Kitchenham, 2007).

## RESEARCH METHOD

As mentioned in the previous section, a SMS is a precursor to a systematic literature review. SMSs (also known as Scoping Studies) are designed to provide a wide overview of a research area. A set of guidelines for undertaking a SMS is defined in Kitchenham, 2007 and in Konda and Mandava, 2010). These guidelines are the basis for the study presented in this paper. Figure 1 shows the unbiased search strategy followed for this SMS. Each search strategy phase will be discussed in the following sections.

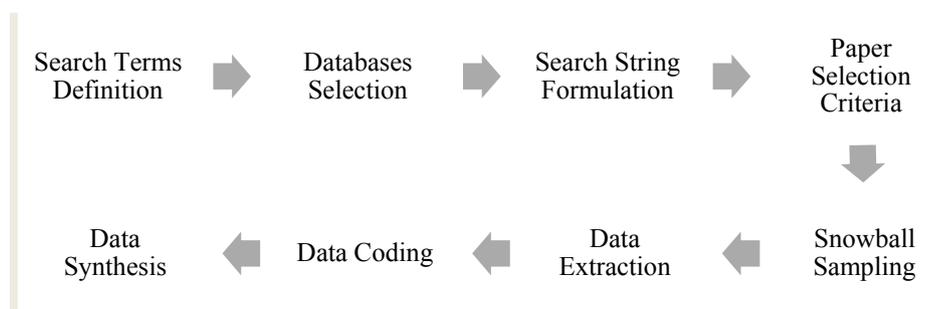


Figure 1: Unbiased search strategy

### **SEARCH TERMS DEFINITION**

The search terms for SMSs are less highly focused than for SLRs and are likely to return a very large number of studies (Kitchenham, 2007). From our research question (Which research topics have been covered for promoting collaboration among key project stakeholders when their incentives/interests are not aligned through contractual arrangements?), we derived the following major search terms: collaboration, incentives and construction. The word ‘construction’ was included to limit the search results to the AEC domain.

### **ARTICLE DATABASES SELECTION**

We selected three article databases to undertake the SMS: Compendex, Web of Science and SciVerse Scopus. Our rationale for this selection is that these article databases facilitate the use of complex search strings. Moreover, Scopus database indexes the conference papers from the Annual Conference of the International Group for Lean Construction. The search was done by applying a search string to the title and abstract only, and covers a ten-year time span (2002 - 2012).

### **SEARCH STRING FORMULATION**

During the search string formulation, we conducted trial searches using various combinations of keywords (major search terms, alternative terms and synonyms), truncation symbol (\*) and Boolean operators (AND, OR) to achieve appropriateness to answer the research question. The motivation for conducting trial searches is the large amount of keywords and terminologies related to the concept of collaboration. There is a wide range of definitions for collaboration, and the term has been used interchangeably with terms such as ‘partner(ship)’, ‘cooperation’, ‘coordination’. After several trials, we developed the following search string:

collaborati\* OR partner\* AND incentive AND construction.

### **PAPER SELECTION CRITERIA**

The initial search resulted in 133 papers after removing duplicates. Paper selection criteria are intended to identify those primary studies that provide direct evidence about the research question (Kitchenham, 2007). After a title/abstract screening, a reference list of 40 potentially relevant papers remained. The selection criteria used were:

#### **Inclusion criteria**

- Paper Type: Either theoretical or empirical papers should be included.
- Paper Scope: Papers should be included if they deal with collaboration, or related concepts such as partnering, incentive systems, cooperation and trust.

#### **Exclusion criteria**

- Papers written in non-English languages should be excluded.
- Papers should not be included if they deal with collaboration through Building Information Modeling (BIM) or multi-party contracts (e.g., IPD, IFOA, etc).

## **SNOWBALL SAMPLING**

Snowball sampling is a non-probability sampling technique to investigate the hidden population. Hidden population refers to the papers which are not found when search process is executed. In this approach, if we find a reference in a paper, we will make use of that reference to find two more and so on (Konda and Mandava, 2010). This resulted in 7 extra papers, yielding a final sample of 47 papers.

## **DATA EXTRACTION**

The purpose of this phase is to classify papers and identify papers for later reviews without being so time consuming (Kitchenham, 2007). The following information was extracted from each paper: authors, title, source title, publication year and stated purpose.

## **DATA CODING**

Using a bottom-up (or inductive) approach, we developed a classification scheme for the 47 sample papers. The purpose of bottom-up coding is to classify a large number of textual data into a smaller number of homogeneous categories (Bemelmans et al., 2012).

Given the multidisciplinary nature of our sample papers and the inherent subjectivity of the categorization process, we have tried to find similarities based on the stated purpose of each paper. From this emerging code perspective, seven main categories could be derived. The first three categories were considered as evidence clusters, and the remaining categories were considered as scarce evidence. Table 1 shows the description of each category.

Table 1: Category Description

Categories	Most papers in this category deal with...
Project partnering	...aspects of partnering such as the concept of partnering, main barriers to partnering or a combination of these aspects.
Incentive systems	...a range of incentive mechanisms in construction projects.
Public-private partnership	...general features of public-private partnership.
Cooperative procurement	...cooperative procurement procedures based on incentive-based compensation, joint specification, selected tendering, soft parameters in bid evaluation, joint subcontractor selection...
Social network analysis	... a quantitative approach in the comparative analysis of procurement and project management of construction projects.
Trust	...factors that influence development of trust in client–contractor relationships in construction projects.
Project alliancing	... a method of delivering major capital assets where the owner and non-owner participants work together as an integrated and collaborative team in good faith...managing all risks of project delivery jointly...

## **DATA SYNTHESIS**

The analysis phase of a SMS focuses on summarising the data to answer the research question and graphical representations of study distributions by classification type may be an effective reporting mechanism (Kitchenham, 2007). Figure 2 and 3 show a

bubble chart in which area of the bubble represents the percentage of papers identified in each category.

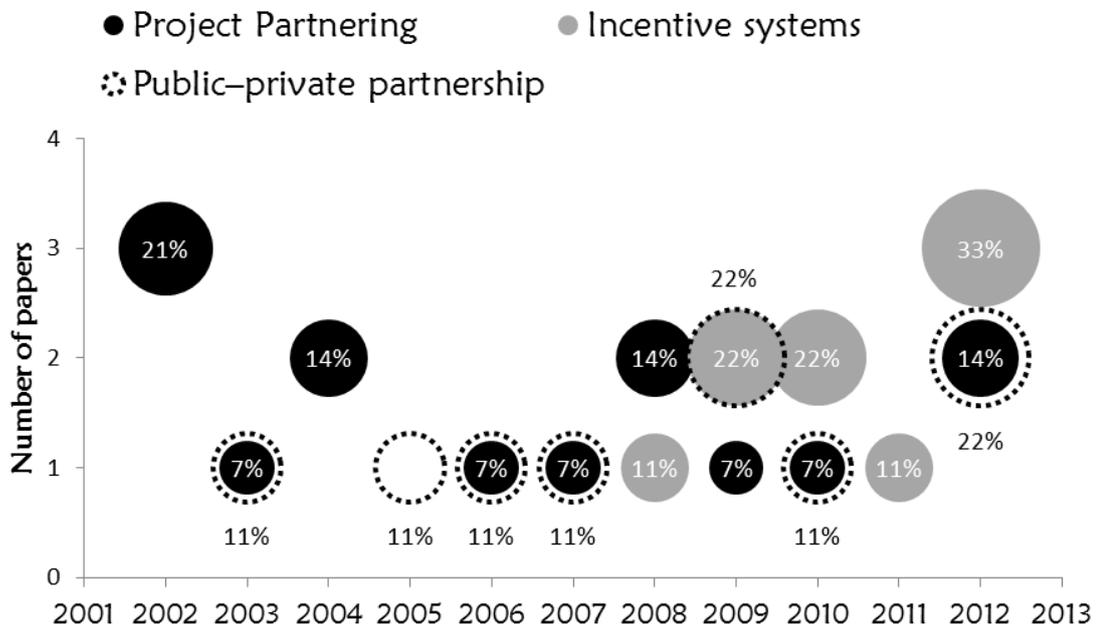


Figure 2: Most Covered Research Subjects - Evidence Clusters

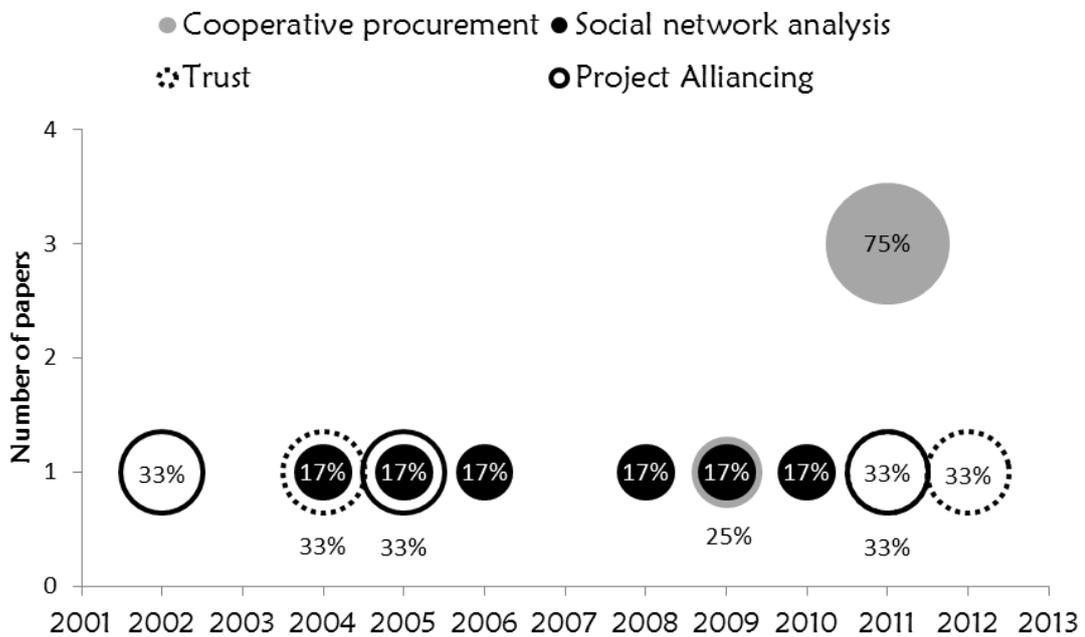


Figure 3: Less Covered Research Subjects - Scarce Evidence

## DISCUSSION AND SUGGESTIONS FOR FURTHER RESEARCH

The evidence clusters (project partnering, incentive systems and public-private partnership) identified in our study could bring insights to extend the current TVD research and practice. Our study corroborates earlier studies (Sobotka and Czarnigowska, 2007; Zimina et al., 2012) which highlighted public-private partnership as a viable setting for TC/TVD application.

We summarized in Table 2 the existing TC/TVD application barriers reported in the literature in order to reflect on how the remaining categories (cooperative procurement, social network analysis, trust and project alliancing) could shed some light on TVD application in non-IPD projects.

Table 2: Potential barriers

Potential TC/TVD application barriers reported in the literature	
Design-phase barriers	Pre-designed projects Zimina et al. (2012)
	Outsourced design Jacomit and Granja (2011)
Attitudinal/Cultural barriers	Service providers that are capable and trusted to execute the TVD technique Zimina et al. (2012)
	Commercial practices Nicolini et al. (2000)
Legal barriers	Projects prohibited by statute from integrating organizationally Zimina et al. (2012)
	Bidding process Jacomit and Granja (2011)
	Design-bid-build arrangements Sobotka and Czarnigowska (2007)

How these potential barriers can be overcome remains a challenge, especially in public sector projects. Public sector owners may be limited in their ability to achieve a complete TVD application due to federal or local laws that prevent early collaboration among key project stakeholders.

However, Ghassemi and Becerik-Geber's work (2011) revealed that pre-existing trust between the owner and the design-build entity has helped to achieve full integration without having a multi-party agreement or shared risk and reward. Since research in the remaining categories is still relatively scarce, we can infer that further research and exploration in these categories is needed to overcome the attitudinal/cultural barriers of TVD application in construction.

Furthermore, we noticed that most papers in our sample suffer from unclear definitions of 'collaboration'. It is important to note that there is no consensus in the construction research community regarding precisely what collaboration really means. As a result, we believe that researchers can contribute to the TVD Literature by defining clear distinctions between 'collaboration', 'cooperation' and 'coordination'.

## CONCLUSIONS

This paper represents initial efforts to follow an evidence-based approach through a SMS. In response to our research question, the research topics that have been covered for promoting collaboration among key project stakeholders are (i) project partnering (ii) public-private partnership (iii) cooperative procurement (iv) social network analysis (v) trust (vi) incentive systems and (vii) project alliancing.

As with any study, there are limitations to this paper. First, we may not have achieved a representative sample of primary studies. We acknowledge that our sample may not include seminal papers dealing with collaboration among key project stakeholders. A larger sample may have given other results. Second, we limited our

search to papers with three keywords in their title or abstract. Certainly, there are papers that discuss the subject but which do not have these keywords. We have tried to mitigate this potential limitation by applying snowball sampling technique.

Our research provides some avenues for further TVD research. TVD literature would benefit from empirical studies. In future research, the authors plan to investigate alternatives ways to overcome the existing barriers through in-depth cases studies in design-build and/or public projects.

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## REFERENCES

- AIA California Council (2007). "Integrated project delivery: a guide" <http://www.aia.org/groups/aia/documents/pdf/aiab083423.pdf> (March 5, 2013).
- Ansari, S. and Bell, J. and The CAM-I Target Cost Group (1997) "Target Costing – the Next Frontier in Strategic Cost Management", Irwin, Chicago, IL.
- Ballard, G. and Reiser, P. (2004). "The St. Olaf College Fieldhouse Project: A Case Study in Designing to Target Cost." Proceedings of the 12th Annual Conference of the International Group for Lean Construction, Elsinore, Denmark, August.
- Ballard, G. (2008) "The Lean Project Delivery System: An Update" *Lean Construction Journal*, 1-19.
- Bemelmans, J., Voordijk, H. and Vos, B. (2012) "Supplier-contractor collaboration in the construction industry: A taxonomic approach to the literature of the 2000-2009 decade" *Engineering, Construction and Architectural Management*, 19 (4) 342 - 368.
- Charters, S., Budgen, D., Turner, M., Kitchenham, B., Brereton, O.P. and Linkman, S. (2009) "Objectivity in Research: Challenges from the Evidence-Based Paradigm." 20th Australian Software Engineering Conference, p. 73-80.
- Ghassemi, R. and Becerik-Gerber, B. (2011) "Transitioning to Integrated Project Delivery: Potential barriers and lessons learned." *Lean Construction Journal*, p. 32-52.
- Jacomit, A.M., Granja, A.D. and Picchi, F.A. (2008) Target costing research analysis: reflections for construction industry implementation. Proceedings of the 16th Annual Conference of the International Group for Lean Construction, Manchester, UK, 16–18 July.
- Jacomit, A.M. and Granja, A.D. (2011) "An investigation into the adoption of target costing on Brazilian public social housing projects." *Architectural Engineering and Design Management*, 7 (2) 113-127.
- Kent, D. and Becerik-Gerber, B. (2010) "Understanding Construction Industry Experience and Attitudes toward Integrated Project Delivery." *J. Constr. Eng. Manage.*, 136 (8) 815 - 825.

- Kitchenham, B. A. (2007) "Guidelines for performing Systematic Literature Reviews in Software Engineering." Version 2.3, EBSE Technical Report, Keele University and University of Durham, UK.
- Konda, B.M. and Mandava K. K. (2010) "A systematic mapping study on software reuse." MS thesis: Blekinge Institute of Technology, Sweden, 85p.
- Kuhn, T. S. (1962). *The Structure of Scientific Revolution*. Chicago: The University of Chicago Press.
- Lichtig, W.A. (2005) "Sutter Health: Developing a Contracting Model to Support Lean Project Delivery." *Lean Construction Journal*, 2 (1) 105-112.
- Lostuvali, B., Alves, T.C.L. and Modrich, R. (2012) "Lean product development at Cathedral hill hospital" *Proceedings of the 20th Annual Conference of the International Group for Lean Construction, IGLC 20, San Diego, USA*.
- Nicolini, D., Tomkins, C., Holti, R., Oldman, A. and Smalley, M. (2000) "Can Target Costing be Applied in the Construction Industry?: Evidence from Two Case Studies." *British Journal of Management*, 11 (4) 303-324.
- Petticrew, M. (2001) "Systematic reviews from astronomy to zoology: myths and misconceptions" *British Medical Journal*, 322 (13) 98-101.
- Robert, G. and Granja, A. D. (2006) "Target and kaizen costing implementation in construction". *Proceedings of the 14th Annual Conference of the International Group for Lean Construction, IGLC 14, Santiago, Chile, 91-105*.
- Sobotka, A. and Czarnigowska, A. (2007). "Target costing in public construction projects" *Proceedings of the 9th International Conference on Modern Building Materials, Structures and Techniques, Vilnius, LA*.
- Van Aken, J. E. (2004) "Management Research Based on the Paradigm of the Design Sciences: The Quest for Field-Tested and Grounded Technological Rules" *Journal of Management Studies*, 41 (2) 219-246.
- Viana, D., Formoso, C. and Kalsaas, B. (2012) "Waste in construction: A systematic literature review on empirical studies." *Proceedings of the 20th Annual Conference of the International Group for Lean Construction, IGLC 20, San Diego, USA*.
- Yook, K., Kim, I. and Yoshikawa, T. (2005) "Target costing in the construction industry: Evidence from Japan." *Construction Accounting & Taxation*, 15(3)5 - 18.
- Zimina, D., Ballard, G. and Pasquire, C. (2012) "Target value design: using collaboration and a lean approach to reduce construction cost." *Construction Management and Economics*, 30 (5) 383-398.

## APENDIX

PROJECT PARTNERING	
Authors	Title
Koraltan and Dikbas (2002)	An assessment of the applicability of partnering in the Turkish construction sector
Moldovanu (2002)	How to dissolve a partnership
Naoum (2003)	An overview into the concept of partnering
Olsson and Espling (2004)	Part I. A framework of partnering for infrastructure maintenance
Ghaffari and Jane (2012)	Concept of partnering in construction projects
Espling and Olsson (2004)	Part II. Partnering in a railway infrastructure maintenance contract: A case study
Tang et al. (2006)	Partnering mechanism in construction: An empirical study on the chinese construction industry
Eriksson (2007)	Cooperation and partnering in facilities construction - Empirical application of prisoner's dilemma

Eriksson et al. (2008)	Client perceptions of barriers to partnering
Chan et al. (2008)	Achieving partnering success through an incentive agreement: Lessons learned from an underground railway extension project in Hong Kong
Tang et al. (2009)	Enhancing total quality management by partnering in construction
Eriksson (2010)	Partnering: What is it, when should it be used, and how should it be implemented?
Liu et al. (2012)	Empirical simulation to compare opportunistic bidding behavior in China and the U.S.A.
INCENTIVE SYSTEMS	
Huang and Sun (2009)	The provision of incentives in the construction projects
Schottle and Gehbauer (2012)	Incentive systems to support collaboration in construction projects
Meng and Gallagher (2012)	The impact of incentive mechanisms on project performance
Tang et al. (2008)	Incentives in the Chinese construction industry
Ball and Chambers (2009)	An incentivisation scheme for a major transportation infrastructure project in the UK
Badenfelt (2010)	I trust you, I trust you not: A longitudinal study of control mechanisms in incentive contracts
Yi and Lu (2010)	Study on the incentive of engineering contractor under information asymmetry
Yin et al. (2011)	Research on profit incentive mechanism of general contractor and subcontractors dynamic alliance in construction project
Hughes et al. (2012)	Is incentivisation significant in ensuring successful partnered projects?
PUBLIC-PRIVATE PARTNERSHIP	
Leiringer (2006)	Technological innovation in PPPs: Incentives, opportunities and actions
Raisbeck (2009)	Considering design and PPP innovation: A review of design factors in PPP research
Fang et al. (2009)	The research on bundling in public-private partnership
Ivarsson et al. (2003)	Private-Public Partnership for Low-Volume Roads: Swedish Private Road Associations
Bernard (2005)	The U.S. National Tsunami Hazard Mitigation Program: A successful State-Federal partnership
Alonso-Conde et al. (2007)	Public private partnerships: Incentives, risk transfer and real options
English et al. (2010)	The changing nature of contracting and trust in public-private partnerships: The case of Victorian PPP prisons
Lenferink et al. (2012)	Public-private plan development: Can early private involvement strengthen infrastructure planning?
Lee and Yu (2012)	Characteristics of public-private partnerships for municipal wastewater treatment in Taiwan
COOPERATIVE PROCUREMENT	
Pesamaa et al. (2009)	Validating a model of cooperative procurement in the construction industry
Eriksson and Westerberg (2011)	Effects of cooperative procurement procedures on construction project performance: A conceptual framework
Osipova and Eriksson (2011)	How procurement options influence risk management in construction projects
Witt and Liias (2011)	Comparing Risk Transfers under Different Procurement Arrangements
SOCIAL NETWORK ANALYSIS	
Pryke (2004)	Analysing construction project coalitions: Exploring the application of social network analysis
Pryke (2005)	Towards a social network theory of project governance
Pryke (2006)	Project governance: Case studies on financial incentives
Chinowsky et al. (2008)	Social Network Model of Construction
Chinowsky et al. (2009)	Project Network Interdependency Alignment: A New Approach to Assessing Project Effectiveness
Chinowsky et al. (2010)	Project Organizations as Social Networks
TRUST	
Kadefors (2004)	Trust in project relationships-inside the black box
Laan et al. (2011)	Building trust in construction partnering projects: An exploratory case-study
Smith and Rybkowski (2012)	Literature review on trust and current construction industry trends
PROJECT ALLIANCING	
Walker et al. (2002)	Project alliancing vs project partnering: A case study of the Australian National Museum Project
Sakal (2005)	Project Alliancing: A relational contracting mechanism for dynamic projects
Laan, A., Voordijk, H. and Dewulf, G. (2011)	Reducing opportunistic behaviour through a project alliance