A CASE BASED COMPARISON OF THE EFFICIENCY AND INNOVATION POTENTIAL OF INTEGRATIVE AND COLLABORATIVE PROCUREMENT STRATEGIES

Leentje Volker[1], Per Erik Eriksson[2], Anna Kadefors[3] and Johan Larsson[2]

[1]*Department of Management in the Built Environment, Delft University of Technology, Delft, The Netherlands*

[2]*Department of Business Administration, Technology and Social Sciences, Luleå University of Technology, Luleå, Sweden*

[3]*Department of Real Estate and Construction Management, KTH Royal Institute of Technology, Stockholm, Sweden*

The purpose of this paper is to investigate and compare in what ways different types of integrative and collaborative procurement strategies may enhance efficiency and innovation in public infrastructure projects. Further, implementation challenges are identified and discussed. Interview-based case studies were performed of ten infrastructure projects in Sweden and the Netherlands. The projects involve four types of collaborative procurement strategies - collaborative Design-Build (DB) contracts, Early Contractor Involvement (ECI) agreements, Design-Build-Maintain (DBM) contracts and Design-Build-Finance-Maintain (DBFM) contracts. The findings indicate that the duration of the collaboration is fundamental in setting the limits for innovation and that early involvement as well as long-term commitments open up for more innovation. Naturally, the potential for increased efficiency is higher than for innovation and also occurs in collaborations with limited duration. These integrated project approaches, however, still appear to be in an early stage of learning. For a public repeat client to realise the full potential of a new strategy, it is important to have a long-term perspective and capabilities to analyse and learn from the experiences.

Keywords: public infrastructure, organizational learning, supply chain collaboration

INTRODUCTION

Due to the inter-organizational nature of construction projects and their inherent complexity, innovation in the construction industry often requires knowledge integration and collaboration across numerous actors and their activities (Harty, 2005; Kähkönen, 2015; Rose and Manley, 2012). The typical short-term and arms-length relationships within the industry furthermore result in disruptive learning curves, which are detrimental for efficiency (Eriksson, 2013). Many reports have therefore

[1] L.Volker@tudelft.nl

Volker, L, Eriksson, P E, Kadefors, A and Larsson, J (2018) A Case Based Comparison of the Efficiency and Innovation Potential of Integrative and Collaborative Procurement Strategies *In:* Gorse, C and Neilson, C J (Eds) *Proceeding of the 34th Annual ARCOM Conference,* 3-5 September 2018, Belfast, UK, Association of Researchers in Construction Management, 515-524.

recognized that inter-organizational collaboration is a core mechanism for improving efficiency and innovation (e.g. WEF, 2016).

Traditional procurement procedures involve competitive tendering based on detailed and strict contracts and subsequent control and surveillance. Recent studies, however, advocate that complex infrastructure projects need new types of project management practices, promoting flexible management of change by collaborative teams rather than ex ante planning and control (Gil, 2009; Gransberg *et al.,* 2013; Koppenjan *et al.,* 2011). Early engagement of contractors in the design stage may also improve efficiency through improved constructability and reduction of delivery time due to parallel design and construction processes (Lenferink *et al.,* 2013). Some non-traditional strategies focus on client-contractor collaboration while others emphasize supply chain collaboration and integration by performance-based delivery models that may also comprise maintenance and financing. Although such procurement strategies are not new to some countries and industry segments, infrastructure construction clients in many European countries have been slow to adopt such non-traditional practices.

The purpose of this paper is to investigate and compare how different types of integrative and collaborative procurement strategies may enhance the opportunities and incentives for improved efficiency and innovation in infrastructure projects. Furthermore, challenges and perceived barriers to implement these strategies are identified and discussed. The paper is based on case studies of ten recent and ongoing infrastructure projects in Sweden and the Netherlands with the final aim to provide a learning perspective on integrative and collaborative procurement strategies for public client organisations.

THEORETICAL FRAMEWORK

Following the seminal work of March (1991), the organizational learning literature typically distinguishes between two main learning modes: exploration and exploitation. Eriksson *et al., (*2017a) emphasize that explorative learning involves a distant search for and assimilation of, new knowledge and technologies to enhance creativity and to achieve innovation and radical development of new solutions. Exploitative learning, instead, is based on local search for familiar knowledge and technologies to deepen the current knowledge set and achieve efficiency through incremental development and continuous improvements of existing solutions (Eriksson *et al.,* 2017a). Due to their inherent differences, these two learning modes are difficult to combine and manage together, especially in organizational settings with scarce resources such as project organizations (Gupta *et al.,* 2006).

Construction projects are often complex and uncertain endeavours that require concrete problem solving and explorative learning to manage innovation and adaptation challenges. In addition, the nature of innovations and technology development in construction entails that numerous interdependent components and sub-systems must be coordinated (Harty, 2005). Hence, project actors need to collaborate in joint development processes. Knowledge is often context specific, which makes it difficult to transfer across projects due to varying personal, professional and organizational interests (Bresnen *et al.,* 2003).

However, prior research has indicated that in projects both short-term efficiency based on exploitation and more radical innovation based on exploration can be facilitated by inter-organizational collaboration (Eriksson, 2013; Eriksson *et al.,* 2017a). Based on the work of Eriksson and Hane (2014) and Eriksson *et al., (*2017b) four core procurement strategy components can be distinguished: 1) the delivery system and the nature of the contractor involvement, 2) the collaboration model, 3) the contractor selection procedures and 4) the reward system. The components may be combined in different ways in order to achieve a governance structure that fits project characteristics.

Integrative collaborative delivery models that are used most in the European context are Design-Build (DB), Early Contractor Involvement (ECI), Design-Build-Maintain (DBM) and Design-Build-Finance-Maintain (DBFM). While the traditional Design-Bid-Build (DBB) contracts integrate the client and designer competences, the basic idea of DB contracts is that there is no separation between design and construction that hampers constructability. The contractor then has more freedom to develop technical solutions that improve time and cost efficiency (Eriksson and Hane, 2014). However, neither DB nor DBB contracts promote collaboration between the client and the contractors since they separate, allocate and clarify the actors' different responsibilities in order to make the contracts more transparent from the client perspective (Eriksson *et al.,* 2017a).

An ECI contract engages the contractor earlier than a DB contract normally would and especially suits situations in which the uncertainty is too high to calculate a price in the tendering stage and where the client sees important benefits in involving the contractor in very early design stages to integrate design and production knowledge (Lenferink *et al.,* 2013). DB contracts may also be integrated with maintenance services or private finances. Such integrated DBM or DBFM contracts are associated with other business models of infrastructure projects, but also with improved efficiency and innovation (e.g. Roumboutsos and Saussier, 2014; Verweij, 2015).

Collaboration can be considered as a multi-dimensional concept that can be divided into four dimensions: Scope, Depth, Duration and Intensity (Eriksson, 2015). Collaboration scope involves the nature and number of companies involved in the integrated supply chain (Fabbe-Costes and Jahre, 2007). In construction projects, it refers to which organizations are involved in and jointly perform the integrative activities and technologies, for example clients, suppliers, contractors and consultants (Eriksson, 2015). Collaboration depth refers to the integration of different types of professionals and functions at different hierarchal levels within each partner organization (Eriksson, 2015).

The duration dimension is dependent on the length of the time period during which the partners will collaborate and jointly utilize integrative activities and technologies, which could include integration across sub-sequent projects and/or project stages (Eriksson, 2015). Hence, collaboration duration is strongly linked to the delivery system which decides in what stages of a project the contractor will be involved. The intensity dimension measures the degree or strength of integration, which is dependent on the extent to which integrative activities and technologies are utilized (Eriksson, 2015; Fabbe-Costes and Jahre, 2007).

Prior research on partnering arrangements emphasizes the importance of intense or strong collaboration, which is heavily affected by the implemented collaboration model (*e.g.* Bayliss *et al.,* 2004; Eriksson, 2015). An important element of collaborative procurement strategies is to utilize a collaboration model that includes several integrative activities and technologies. Examples of integrative activities and technologies are: co-location in a joint project office (Bresnen and Marshall, 2002;

Gil, 2009), joint IT-tools (Eriksson, 2015), formulation of joint objectives and continuous follow-up meetings (Bayliss *et al.,* 2004; Eriksson, 2015) and team-building activities (Martinsuo and Ahola, 2010. integrative activities and technologies strengthen the socialization of partners so that they can establish a collaborative climate that serves as a foundation for joint development efforts.

Contractor selection can be based on lowest bid competitive tendering which relies on the idea that a large amount of bidders who compete on the basis of price will ensure that the client can minimize their investment costs for the project. This selection model may work satisfactorily in rather simple and straightforward projects with low uncertainty, where (**i**) the competences and experiences of the contractors are of little importance and (**ii**) the bid price will remain close to the end price due to lack of changes. A strategy that is based on pre-qualification of a lower number of capable contractors and subsequent bid evaluation that also takes into account softer criteria (e.g. organization, experience, reference projects, etc.) may enhance collaboration (Sporrong and Kadefors, 2014; Eriksson *et al.,* 2017b). Partner selection may also promote joint innovation work because the client can select a contractor that is capable and willing to engage in such joint development (Volker, 2012).

With regard to the reward system, fixed price payment have been most common in both DB and DBB contracts when the client wants to ensure that the lowest price is obtained through competitive tendering (Eriksson *et al.,* 2017b). However, this reward system is a poor basis for client-contractor collaboration as the client has no incentive to support the contractor in cost saving development work and the contractor has incentives to lower the quality of the end product if it saves costs (Eriksson and Hane, 2014). Incentive-based payment can enhance project actors' motivation for joint innovation work and is therefore considered suitable when contractors are procured early and involved in the design stage (Rose and Manley, 2012).

Research Approach

The paper draws on empirical data collected through 44 interviews in 10 infrastructure projects on four types of collaborative procurement strategies in Sweden and the Netherlands. Data was collected in the context of the ProcSIBE programme, a Swedish research initiative on procurement for sustainable innovation. This also includes Dutch-Swedish knowledge exchange. Accordingly, we have studied two Swedish DB projects, two Swedish ECI projects, three Swedish DBM projects and three Dutch DBFM projects. The DBM and DBFM project were selected because they currently are in the maintenance phase and have started 8 to 15 years ago. The DB and ECI projects were selected because of their explicit focus on integration and collaboration. They were still in progress at the time of data collection. All projects were pilots or belonged to the early versions of the delivery and contract models. The DB projects, procured by the Swedish Transport Administration (STA), were studied during the construction phase. DB 1 can be considered as a conventional road project worth around 21 MEUR, whereas DB 2 is a sub-project in a mega railway project estimated to 190 MEUR. In both projects procurement focused on price with an open bid invitation and evaluation based upon lowest price. They include a reward system based on fixed price. In both projects the contractor was procured after a pre-design phase in which a large part of all permits for the stretch had been applied and approved.

For the Early Contractor Involvement two railway projects were studied in Phase 1of a two-stage approach. Both were procured by the STA as parts of the same complex urban mega project and estimated to 300 and 430 MEUR respectively. In the ECI model, the design was developed in Phase 1 in collaboration between the parties, along with a jointly agreed target cost. A DB construction contract was then signed, based on the target cost and including a gainshare/painshare component. The contractors were procured based on the proposed contractor's fee, but also soft parameters were evaluated, such as collaboration skills, experiences and technical skills.

The three Swedish DBM projects (two highways of 58 MEUR resp. 130 MEUR and one road of 130 MEUR) were also procured by the STA. They were studied in the maintenance phase so the impact of integrating several phases would be visible. After a restricted tender procedure with pre-qualification and an evaluation based on price, the contracts were awarded to different groups of contractors for a period of 18 to 24 years. In all DBM projects the reward system is based upon fixed price agreement with yearly payments for maintenance.

Two of the DBFM projects (a highway of 135 MEUR procured in a competitive dialogue and a tunnel of 700 MEUR procured in a restricted procedure with pre-qualification) were contracted for a period of 20 to 30 years by Rijkswaterstaat, the governmental agency responsible for the major infrastructure facilities in the Netherlands. The third project, a provincial road of 120 MEUR, was commissioned by Rijkswaterstaat in collaboration with a Dutch province by applying a competitive dialogue. In all three cases, contract management was organised by systematic auditing on quality levels. The reward system was based on fixed prices with incentives for early delivery and yearly performance based maintenance payments.

The empirical data collection was primarily based on 2 to 7 interviews per project with respondents in managerial positions (e.g. director, project manager, contract manager, stakeholder manager) representing the main parties (client, consultant and contractor) in the 10 cases. Also project documents, such as organization schemes, contracts and tendering documents were investigated. In some projects, written reports, observations and case descriptions were available. This information was utilized to triangulate the interview findings. The analytic framework that underpins this study is based on the assumption that the four procurement strategy components - delivery system, collaboration model, contractor selection, reward system - relate to the four dimensions of collaboration of scope, depth, duration, intensity, which in turn influence project performance in terms of efficiency and innovation. We largely present the findings on efficiency and innovation potential per procurement strategy.

FINDINGS

Efficiency potential

With regard to efficiency, we found that in both DB projects the client initiated a basic collaboration model in the early phases. The models entailed some collaborative tools, such as joint project office, formulation of joint objectives and regular collaboration meetings. The co-location of the client and main contractor facilitated informal communication and collaboration among them in both DB projects. This broader scope of collaboration had positive effects on the efficiency of the projects, mostly by enabling faster joint-decision-making and clearer communication. The joint project office also contributed to depth since, especially in DB 1, the construction process has seldom been stopped; minor problems were quickly solved on a low hierarchical level whereas larger ones were brought up to executive level. In both DB projects working tightly and intensively (in the joint project office) created a commitment in which it is everyone's duty to actually contribute to the best interest of the project. However, we also found that the extensive collaborative activities must be put in relation to the contract sum. DB 1 for example, was almost considered to be too small for this type of extensive efforts.

From the ECI projects we learned that in terms of duration, early involvement of contractor enabled constructability in design. The two-stage approach allowed contractor to be involved before all permits were obtained. Further, no technical solutions or cost estimations were required in the tenders, which meant that tendering costs were low, about 10% of those for a comparable DB project. The projects had high ambitions regarding, scope, depth and intensity. There was an aim to include all relevant parties and not only managerial levels. Co-location was mandatory, partnering facilitators were engaged and extensive collaborative activities were planned. In ECI 1, these activities were much appreciated and co-location enabled informal communication and faster joint decision-making.

Still, both ECI projects experienced significant challenges in agreeing on a target cost before entering Phase 2. The gainshare/painshare component was seen more as a risk than an opportunity by contractors and created an incentive for them to inflate the target cost. This caused client distrust especially in ECI 2, where influential individuals with traditional attitudes initially held key positions on both sides. In the end, Phase 1 was delayed by more than 9 months for both projects. When the contract was eventually signed and some managers moved to other projects, relations in ECI 2 quickly improved.

We found that the prolonged duration based on a rather early involvement of the contractors has high time-saving potential since the integration of design and production makes parallel processes possible. For example, in DBFM 1 the tender resulted in an offer of the contractor that gained 11 months from to the initial planning. Findings from the DBM and DBFM projects illustrate that the long-term responsibilities during operations and maintenance also affect the contractors' priorities regarding quality. To some extent, the maintenance responsibility make contractors invest in materials and technical solutions with higher quality, although they may initially be somewhat more expensive, if they result in lower life-cycle costs during maintenance.

Findings from DBFM 1 and DBFM 3 indicate that the inclusion of the private funder may result in an economically more sound tender strategy and solid technical solutions with lower risks. To avoid unnecessary risks, the private funder strongly steers on quality control and assessment of the viability of chosen solutions. Furthermore, the private funder's focus on revenues will put pressure on keeping the time schedule and encouraging early delivery of construction work. The sooner the construction is finished and the traffic can be released, the sooner the private funder can start earning money.

On the other hand, the DBM and DBFM cases also showed that collaboration between the design and construction actors and the maintenance actors was challenging to achieve. Accordingly, the increased depth of collaboration was not reaching its potential, which affected the maintainability negatively. For all DBFM cases, the project organization included at least a dozen different parties, which makes transaction costs in the procurement phase high. During the execution of the contract, approval for significant changes (e.g. the implementation of an innovation) needs to be found among several layers of responsible officers - which takes time. Accordingly, the complex organizational set-up of DBFM projects seems to act as a double-edged sword; it results in slower decision-making, but the decisions taken may be of high quality. Long-term collaborations also create challenges in relation to the ambiguities in contractual agreements since they affect the collective memory of the organization. Decisions and discussions made 15 years ago are hard to remember and most people will not be there during the whole contract. Hence, it is important to get the documentation right when decisions are taken, in order to prevent ambiguities and conflicts in later maintenance stages.

Innovation potential

Whereas the intensity of collaboration in both DB projects contributed to efficiency, none of the projects can however be considered as innovative. The fixed price contract and the design responsibilities seemed to have deterred the contractor from making uncertain innovation efforts. The collaboration may have enhanced some innovation efforts that require the presence of different actors and competences. These innovations mainly related to product quality. Because of the longer duration of the warranty period (10 years), it was for example desirable for all actors to decrease the risk of major maintenance work that resulted in e.g. higher quality of the asphalt in DB 1.

In the ECI-model, there is a higher potential for innovation. In ECI 2, a large design change (the elimination of a bridge) was suggested which saved a substantial amount of money and time, which would not have been possible if the contractor was involved at a later stage. However, the lack of incentives for innovation in Phase 1 was seen as a problem and several changes have been made in subsequent ECI projects to better incentivize both efficiency and innovation in this phase. Also, the sharing ratio was adjusted from 50/50 to 80/20 to make contractors less risk-averse.

In other cases as well, we found that an increased scope of collaboration may enhance some innovation efforts. In DBM 1, the intense collaboration between the client, the consultants and the contractor served as a main driver and enabler for innovation. In DBM 2 the contractor developed both product and process innovations that were beneficial for both the client and the contractor. In DBFM 3 an innovative asphalt development was realized and a similar innovation was seen in DBM 3 where the asphalt on the bridges was substituted for concrete. For the DBFM 2 project, a new way of handling the traffic on the adjacent lane was used by the contractor. Also wider asphalt machines were developed to be able to lay both lanes at the same time and avoid the edge between the lanes, making the road more durable.

Hence, findings also indicate that the early involvement of contractors may not be sufficient to facilitate more radical and large innovations. Too many restrictions are already set during the initial planning and permit processes that are conducted before involvement of contractors. In the DBFM projects, the increased quality control and the risk aversive perspective of the private funder left minimum room for radical innovation. In these projects, the broader scope of collaboration resulted in fewer radical innovations but improved verification of the innovations that were selected and implemented. Contrasting findings from DBM 2 and DBFM 3 indicate the importance of client priorities towards innovation. An ongoing discussion regarding a change to LED lights in DBFM 3 shows that the contractor has no incentive to change existing techniques due to financial reasons, while the client desires this change for environmental reasons. Contrastingly, in DBM 2, the contractor awaited the development of LED and implemented the latest technology in order to fulfil client requirements and reduce the energy costs during the operation and maintenance phase.

DISCUSSION AND CONCLUSIONS

Overall, the findings of our study indicate that the duration of the collaboration is fundamental in setting the limits for innovation and that early involvement as well as long-term commitments open up for more innovation. Naturally, the potential for increased efficiency is higher than for innovation and in addition occurs in collaborations with limited duration.

In all collaborative strategies, early involvement of the contractor improved constructability and reduced delivery time due to parallel processes. In the ECI contracts, early involvement also significantly reduced tendering costs. For maintenance responsibility, our findings align with previous studies suggesting that DBFM contracts encourage stronger focus on quality and LCC. This is because the contractor has strong incentives to reduce maintenance costs arising from poor quality and inferior technical solutions (Rose and Manley, 2012; Lenferink *et al.,* 2013). We further found that the involvement of private funder can result in selection of more robust and verified material and technical solutions and that collaboration with design consultants could enhance development efforts. Private investors increase focus on revenues, put pressure on keeping the time schedule and encourage early delivery of project. The scope, depth and intensity of the collaboration were also important in enhancing efficiency and innovation. In line with prior research (Barnes *et al.,* 2007), we found that collaboration at many different hierarchical levels resulted in improved and quicker decision-making in daily work. Co-location was especially powerful and appreciated. The involvement of design consultants and key sub-contractors in collaboration was valuable in all projects.

It is clear that collaboration among different roles and hierarchical levels, long maintenance responsibilities and early involvement of contractors all carry great potential. Decision-makers also seem to generally have high aims regarding collaboration and integration. This, however, appears to be difficult to fully achieve in practice. Our cases have highlighted several organizational, contractual and cultural limitations and barriers. First, legal restrictions from initial planning processes limits possibilities for innovation. Sometimes, corridors permit only one solution. In this respect, there are often less opportunities for design innovation in horizontal infrastructure projects than in vertical building construction projects. Furthermore, lack of time for joint design and development efforts can be a major barrier, both to collaboration and to innovation. When time pressure is too high, contractors will stick to their existing solutions to avoid time consuming and risky development work. Other hidden costs include that long-term maintenance contracts increase the need for documentation, due to lack of organizational memory and also the complexity of the organisation, which can delay decision processes and raise internal conflicts. Also, it should be acknowledged that improving collaboration intensity by an extensive collaboration model costs more time and money. Thus, there is a delicate balance between positive outcomes and expenses, which has to be considered before deciding on a collaboration model that fits the individual project.

Finally, our findings highlight that the impact of contractual incentives on efficiency and innovation is complex and that there are frequently contradictory effects that may be hard to asses. Some models for early involvement result in increased costs for tendering for the contractor, especially if a design is proposed and competitive dialogue is used. Long maintenance responsibilities encourage efficiency, but could deter radical innovation due to risk for malfunctions and costlier maintenance. The involvement of private funders could also hamper more radical innovation that entails larger risk. Long term maintenance contracts are very difficult to price ex ante, which is the reason why contractors need to add risk premiums to their tenders. The longer the duration, the more difficult to price and the larger the risk premiums. The results of our study further suggest that target cost contracts, intended to share risks and create incentives for contractors to be innovative and reduce costs, in effect may counteract collaboration.

With regard to organizational learning this study identified vital potential improvements of efficiency and innovation as a result of the chosen procurement strategies. The fact that none of the projects studied were part of a long-term contract spanning over a series of projects seems to have hampered efficiency in terms of inter-project exploitative learning. Misalignments occurred, for example, in the level of specification in the DB-contacts, setting target costs in the ECI contracts, integrating maintenance knowledge in the DBM and DBFM contracts and risk aversion of private investors in the DBFM contract. Thus, for a public repeat client to realise the full potential of a new strategy, it is important to have a long-term perspective and capabilities to analyse and learn from these experiences. However, due to the challenges in reaping all the potential benefits of collaboration, actors need to continuously improve their processes, routines and capabilities for managing the projects. These activities seem to leave little room for organizational learning and could hinder further implementation of integrative and collaborative procurement strategies in infrastructure practice.

REFERENCES

Barnes, B, Naudé, P and Michell, P (2007) Perceptual gaps and similarities in buyer-seller relationships. *Industrial Marketing Management*, 36(**5**), 662-675.

Bayliss, R, Cheung, S, Suen, H and Wong, S.-P (2004) Effective partnering tools in construction: A case study on MTRC TKE Contract in Hong Kong. *International Journal of Project Management*, 22(**3**), 253-263.

Bresnen, M, Edelman, L, Newell, S, Scarbrough, H and Swan, J (2003) Social practices and the management of knowledge in project environments. *International Journal of Project Management*, 21(**3**), 157-166.

Bresnen, M, Marshall, N (2002) The engineering or evolution of cooperation? A tale of two partnering projects. *International Journal of Project Management*, 20(**7**), 497-505.

Eriksson, P E (2013) Exploration and exploitation in project-based organizations: Development and diffusion of knowledge at different organizational levels in construction companies. *International Journal of Project Management*, 31(**3**), 333-341.

Eriksson, P E (2015) Partnering in engineering projects: Four dimensions of supply chain integration. *Journal of Purchasing and Supply Management*, 21(**1**), 38-50.

Eriksson, P E and Hane, J (2014) *Entreprenadupphandlingar - Hur Kan Byggherrar Främja Effektivitet Och Innovation Genom Lämpliga Upphandlingsstrategier? Konkurrensverket [Construction Procurement - How May Construction Clients Enhance Efficiency and Innovation Through Appropriate Procurement Strategies?*]. The Swedish Competition Authority.

Eriksson, P E, Leiringer, R and Szentes, H (2017a) The role of co-creation in enhancing explorative and exploitative learning in project-based settings. *Project Management Journal*, 48(**4**), 22-38.

Eriksson, P E, Lingegård, S, Borg, L and Nyström, J (2017b) Procurement of railway infrastructure projects: A European benchmarking study. *Civil Engineering Journal*, 3(**4**), 199-213.

Fabbe-Costes, N and Jahre, M (2007) Supply chain integration improves performance: The Emperor's New Suit? *International Journal of Physical Distribution and Logistics Management*, 37(**10**), 835-855.

Gil, N (2009) Developing cooperative project client-supplier relationships: How much to expect from relational contracts? *California Management Review*, 51(**2**), 144-169.

Gransberg, D, Shane, J, Strong, K and Lopez del Puerto, C (2013) Project complexity mapping in five dimensions for complex transportation projects. *Journal of Management in Engineering*, 29(**4**), 316-326.

Gupta, A, Smith, K and Shalley, C (2006) The interplay between exploration and exploitation. *Academy of Management Journal*, 49 (**4**), 693-706.

Harty, C (2005) Innovation in construction: A sociology of technology approach. *Building Research and Information*, 33(**6**), 512-522.

Kähkönen, K (2015) Role and nature of systemic innovations in construction and real estate sector. *Construction Innovation*, 15(**2**), 130-133.

Koppenjan, J, Veeneman, W, van der Voort, H, ten Heuvelhof, E and Leijten, M (2011) Competing management approaches in large engineering projects: The Dutch Randstad Rail project. *International Journal of Project Management*, 29(**6**), 740-750.

Lenferink, S, Arts, J, Tillema, T, van Valkenburg, M and Nijsten, R (2012) Early contractor involvement in Dutch infrastructure development: Initial experiences with parallel procedures for planning and procurement. *Journal of Public Procurement*, 12(**1**), 1-42.

March, J (1991) Exploration and exploitation in organizational learning. *Organization Science*, 2 (**1**), 71-87.

Martinsuo, M and Ahola, T (2010) Supplier integration in complex delivery projects: Comparison between different buyer-supplier relationships. *International Journal of Project Management*, 28(**2**), 107-116.

Rose, T and Manley, K (2012) Adoption of innovative products on Australian road infrastructure projects. *Construction Management and Economics*, 30(**4**), 277-298.

Roumboutsos, A and Saussier, S (2014) Public-private partnerships and investments in innovation: The influence of the contractual arrangement. *Construction Management and Economics*, 32(**4**), 349-361.

Sporrong, J and Kadefors, A (2014) Municipal consultancy procurement: New roles and practices. *Building Research and Information*, 42(**5**), 616-628.

Verweij, S (2015) Achieving satisfaction when implementing PPP transportation infrastructure projects: A qualitative comparative analysis of the A15 highway DBFM project. *International Journal of Project Management*, 33(**1**), 189-200.

Volker, L (2012) Procuring architectural services: Sense making in a legal context. *Construction Management and Economics*, 30(**9**), 749-759.

WEF (2016) *Shaping the Future of Construction: A Breakthrough in Mind-set and Technology*. Geneva, Switzerland: World Economic Forum.