Interdependence between Structural Engineering and Construction Management
Edited by Ozevin, D., Ataei, H., Modares, M., Gurgun, A., Yazdani, S., and Singh, A.

ISBN: 978-0-9960437-6-2

IMPLEMENTING CONTRACTOR KNOW-HOW IN EARLY PHASES OF COMPLEX INFRASTRUCTURE PROJECTS

LENA PAAR, CORNELIA NINAUS, and DETLEF HECK

Institute of Construction Management and Economics, Graz University of Technology, Graz, Austria

The importance of bringing contractor know-how into early construction project phases has long been recognized by the construction industry. Although experts and practitioners have considered new forms of procurement and management for construction projects, no significant solutions have been identified until now. It should be mentioned in this context that the Austrian government initiated the implementation of a new procurement approach in 2015 by reducing the opportunity for public clients to award the contract to the bid with the lowest price in conformity with the European guidelines. Austria´s infrastructure industry is thus seeking new approaches that are able to implement the know-how of all parties involved in a project. The aim of this paper is to identify possibilities for early contractor involvement and its potential for optimizing the project management in the Austrian infrastructure industry.

Keywords: Project delivery model, Early contractor involvement, Project alliancing, Competitive dialog.

1 INTRODUCTION

The construction industry is a project-based industry, which utilizes a variety of separate firms in a temporary multidisciplinary organization, to produce investment goods such as buildings, roads and bridges (Kamara *et al.* 2002). Every construction project must fulfil its own unique requirements in dependence on budget, time and technical conditions and has to meet client's specifications. In order to meet these requirements, the design and planning phase of infrastructure projects need to insure an orderly course of construction. In Austria the project phases of design and construction are traditionally separated: based on a more or less finished design the client awards the construction contract to the contractor based on lowest price principle. Specific knowledge gained during a construction project is frequently lost after completion of the construction phase. Figure 1 shows the typical planning and design phases of traditional infrastructure projects. The client hires designers who are responsible for the whole planning process (from basic evaluation to operational design). Contractors are only involved in the last phase of operational design, which makes it very difficult to implement practical knowledge and innovative ideas from them. It is an acknowledged fact that teamwork and a collaborative relationship among project parties are essential for a successful construction project (Black *et al.* 2000, Mosey 2009, Bellini *et al.* 2016). When thinking of alternative delivery models for infrastructure projects in Austria, aspects of cooperation among project participants should also be taken into consideration.

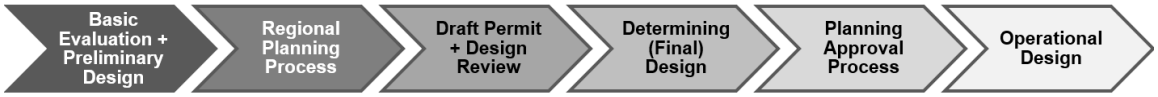

Figure 1. Planning and design phases of traditional infrastructure projects.

The aim of this paper is to identify possibilities for implementing contractors' know-how in the initial project phases of infrastructure projects and its potential for optimizing the project management in order to imply approaches of collaborative delivery models. This paper therefore describes the existing limitations and hindrances in the current situation for public clients of complex infrastructure projects and proceeds to the question of how this process can be optimized.

2 METHOD

In order to assess the possibilities for implementing contractor know-how in order to optimize the project management of construction projects and to enable innovation within construction projects a qualitative survey was carried out. The aim of this survey was to establish the existing hindrances and limitations for the implementation of contractor know-how in public infrastructure projects in Austria. For that purpose, six qualitative interviews were conducted, in a first phase with seven experts in the field of infrastructure construction. The selection criteria for these experts were: (1) number of years experience in the field of construction, (2) working experience in the field of infrastructure construction in Austria, (3) working experience in the field of infrastructure construction outside Austria (e.g. UK; Finland, Sweden, US, AUS) and (4) an open-minded attitude to alternative delivery models (e.g. participation in committees on this topic, publication of papers regarding some form of alternative delivery models). Three experts had a client background, which means that they work for a public client and are involved in infrastructure projects on the client's side as project managers. Three of the experts were employees of contractors and one expert had a neutral background. The interviews were conducted by the first author between June 2016 and April 2017. The length of the interviews was between 1.5 and 2.0 hours. The interviews were semi-structured and can be described as mostly narrative. A transcript of all the interviews from a tape recording (conforming to defined transcription rules and with no consideration given to latent content) provided the foundation for the qualitative content analysis. In a first step the text of the transcript was subdivided into logical units (from 1 up to 3 sentences) and summarized into paraphrases. In a second phase these paraphrases were converted and clustered into 7 main categories with different subcategories on the basis of which mutual statements were summarized. The next step was to find out possibilities for improving the current situation of infrastructure projects. The aim was to analyze alternative forms of project delivery models (e.g. Early Contractor Involvement, Project Alliance, Integrated Project Delivery, Competitive Dialogue, Project Partnering), which are already in use in other countries of the European Union and define their field of application. The necessary data came from a literature review that also considered case studies (e.g. Ross 2003, Mosey 2009, Schlabach 2013, HS2 2014, Gee *et al.* 2018). Based on specific literature for the infrastructure market in Austria and Germany (Schlabach 2013), in a third step an investigation was made into the applicability of these alternative delivery models in the context of the Austrian legal system. Based on the findings, recommended courses of action for adapting a new delivery model for infrastructure projects in Austria were developed.

3 RESULTS

The analysis of the conducted qualitative survey shows the essential role of a cooperative relationship between the parties in order to capture know-how from the contractor's perspective and implement this in the construction project phases. The main findings can be sum up as followed: (1) Project parties are dissatisfied with the current atmosphere of infrastructure construction projects in Austria and are confirming a lack of cooperative behavior on site. The construction market is therefore seeking new (alternative) delivery models for e procurement and contractual phases of infrastructure projects. (2) Infrastructure projects in Austria face a wide range of different legal restrictions, concerning procurement law and the law of environmental impact assessment. There is also general reservation against the binding application of best value criteria for the awarding of contracts. Against this background it is essential to establish "intelligent" and suitable best value criteria in the procurement regulations in order to find the best tender. (3) The key success factor is in the domain of the persons involved in the project (key staff members) who should have full decision-making powers in order to react immediately to disruptions, delays and claims. In order to avoid opportunistic behavior in the relations between the parties it is necessary to implement more collaborative contracting tools, such as project alliancing, integrated project delivery, project partnering and early contractor involvement. Regarding the analysis of the literature review, the joint characteristics of the investigated alternative delivery models (Project Alliancing, Early Contractor Involvement, Integrated Project Delivery, Project Partnering) can be systematized in the following findings: (1) Contractors are involved in the early project phases of construction and their specific knowledge can thus be implemented in the design phase. The client defines the exact scope of work in collaboration with the main contractors. (2) The contractual relationships between client and contractor are on an "open book" basis and "no blame, no dispute"-principles. It is essential to formulate project principles that also include the common goals of all the project participants. (3) During procurement and execution, the emphasis lies on co-operational behavior between client and contractor, which is achieved by means of mutual workshops and interviews. (4) Moving on to the organizational characteristics, it is significant that a leadership team and a separate management team are responsible for controlling and implementation. Both teams consist of at least one member from every project party (client, designer and contractor) who should work together as a team with the same shared interests. This also leads on logically to the principle that each project party will either win or lose ("gainshare/painshare"), if the project costs are higher than estimated.

4 RECOMMENDED COURSES OF ACTION

To establish an alternative delivery model for complex infrastructure projects in Austria, two fundamental aspects must be described beforehand: the current situation of delivery models in Austria (see chapter 4.1) and a definition of "complex" infrastructure projects (see chapter 4.2).

4.1 Traditional Delivery Model of Infrastructure Projects in Austria

As mentioned above nearly all the design work for infrastructure projects in Austria comes from the client side, which means that based on a more or less finished design, the public contractor awards the contract by an open procurement procedure. In the past, the tender was awarded in most cases to the lowest priced bid. The regulation was introduced in 2015 that public clients must now also consider best value aspects in procurement procedures.[1] These circumstances

[1]This is attributable to European procurement regulations: Directive 2014/24/EU and 2014/25/EU.

made it necessary to adapt procurement principles in order to enhance the selection of the "best" instead of the "cheapest" tender. However, the current procurement model is still based on approach of design-bid-build. Figure 2 shows the traditional delivery model for infrastructure projects in Austria.

Figure 2. Traditional delivery model of infrastructure projects.

Starting with project planning and basic evaluation, developing the preliminary and afterwards final design, the procurement process begins on the basics of operational design. Contractors are involved only in the last two project phases (procurement and contractual phase), which make it very difficult to implement practical knowledge and innovative ideas from them.

4.2 Project Classification for Infrastructure Projects

Although construction can be defined as a complex and dynamic task (Bertelsen 2004), it is not necessary to consider every construction project as a complex infrastructure project in this paper. A classification was necessary for making a distinction between non-complex and complex infrastructure projects. Table 1 shows the project classification matrix, which refers to 9 different criteria (K1 to K9) for defining complexity: type (K1) and scale of project (K2), schedule (K3), duration (K4) and specifications of work (K5), structure of tender market (K6), risk of approval (K7), budget preferences (K8) as well as the strategic role of the project (K9). The different criteria have been deduced from the literature (e.g. Bertelsen 2004, Schlabach 2013).

Table 1. Project classification matrix.

	Assessment [points]							
K1: Type of Project	small redevelopment	0	new construction (open terrain)	1	rebuilding (with restraints)	3	rebuilding (during full operation)	6
K2: Scale of Project	< 5,548M EUR	0	> 5,548M EUR < 50M EUR	1	> 50M EUR < 150M EUR	3	> 150M EUR	6
K3: Schedule preferences	no priority	0	moderate schedule	1	tight schedule + penalty	3	fast track-project	6
K4: Duration of Construction	< 1 year	0	> 1 to 5 years	1	> 5 years	3	> 10 years	6
K5: Specifications of works	standardised specification of works	0	new type of contruction method (partly)	1	new type of contruction method (mostly)	3	contractors know-how necessary	6
K6: structure of tender market	many (>10) potential tenderers	0	some (>3) potntial tenderers	1	< 3 potential tenderers	3	unknown	6
K7: environment (approval)	low risk	0	moderate risk	1	high risk	3	very high risk	6
K8: budget preferences	no budget defined	0	increase of budget possible	1	increase of budget difficult	3	increase of budget impossible	6
K9: strategic role of project	low	0	moderate	1	high	3	very high	6

Clients of infrastructure projects should use this project classification matrix to assess the complexity in an initial phase. The sum of all points divided by 6 results in a score of between 0.0 and 9.0. Roughly speaking all projects with a score below 6.0 can be characterized as "non-complex" and above as "complex" (see Figure 2).

Figure 2. Score of project classification matrix.

This paper as also the recommended alternative delivery model refers to projects that reach a score of at least 6.0 or higher and can therefore be qualified as a complex infrastructure project.

4.3 Recommended Delivery Model for Complex Infrastructure Projects

Figure 3 shows the developed alternative delivery model for infrastructure projects. Contractors in this recommended delivery model are involved much earlier in the project: after the client specifies the preliminary design, a competitive dialogue (CD) must be accomplished. The client finally awards the contract to the "best" tender and concludes the construction contract using project alliancing approaches.

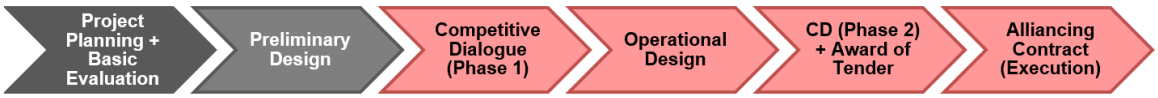

Figure 3. Recommended alternative delivery model for infrastructure projects.

For a successful implementation of this alternative delivery model it is necessary to consider the following recommendations: (1) The competitive dialogue should take into consideration the legal restrictions under public procurement law. In Austria this means the client must select at least 2 (better 3) bidders for a tender using an objective prequalification system. In phase 2 of the competitive dialog the bidders develop the exact scope of work in order to find the best solution for the project and to define the target costs. It is not possible to select the bidder using a non-price procedure under the procurement regulations. The definition of the target price must thus be taken into consideration when awarding the contract. (2) During the project execution phase the client and the contractor should work together based on an alliancing contract, installing a leadership and management team that works on the basis of "no blame, no dispute" and "best for project" principles.

5 CONCLUSION

The results of the qualitative interviews and the literature review show that there is a need for more cooperative delivery models in the field of infrastructure projects. To address this collaborative behaviour it is necessary to implement contractors earlier in project phases than in the current procurement and contract model. The recommended alternative delivery model presented in this paper has the advantage of implementing contractor know-how early in project phases. Selecting the bidder for a tender based on a competitive dialogue, as part of the recommendations, is also in compliance with public procurement law. In Austria, however, it has

not been possible to also include the designer in the project team until now, due to legal restrictions. It is highly recommended that the designer should also be included in the project team in order to achieve a more cooperative working atmosphere. Whether and how this recommended delivery model will find a field of application in practice will need to be investigated in the course of further research.

References

Bellini, A., Aarseth, W., and Hosseini, A., Effective Knowledge Transfer in Successful Partnering Projects, *Energy Procedia*, Elsevier, 96, 218-228, 2016.

Bertelsen, S., *Construction as a Complex System*, Proc., Int. Group for Lean Construction 11th Annual Conf. (IGLC-11), IGLC, Blacksburg, May 15, 2004. Retrieved from http://leanconstruction.dk/ August, 1, 2018.

Black, C., Akintola, A. and Fitzgerald, E., An Analysis of Success Factors and Benefits of Partnering in Construction, *International Journal of Project Management*, Elsevier, 18, 423-434, 2000.

Gee, R.A., Parker, C. J., and Cuttler R. J., Nortside Storage Tunnel, Sydney: Investigation, Design and Construction. Retrieved from http://www.ats.org.au on August 01, 2018.

HS2, Early Contractor Involvement (ECI) Guidance, High Speed Two Limited, October 17, 2014. Retrieved from https://www.gov.uk/government/publications/early-contractor-involvement on August 01, 2018.

Kamara, J. M., Augenbroe, G., Anumba, C. J., and Carrillo, P. M., Knowledge Management in The Architecture, Engineering and Construction Industry, *Construction Innovation*, Emerald, 2, 53-67, 2002.

Mosey, D., *Early Contractor Involvement in Building Procurement*, Wiley-Blackwell, Chichester, West Sussex, United Kingdom, 2009.

Ross, J., Introduction to Project Alliancing (on Engineering and Construction Projects), April 2003. Retrieved from https://iccpm.com on August 01, 2018.

Schlabach, C., *Untersuchungen zum Transfer der Australischen Projektabwicklungsform Project Alliancing auf den Deutschen Hochbaumarkt*, Kassel University Press, Kassel, Germany, 2013.