

ASOCSA2017- Paper 038

Delivering construction projects using innovative building technologies

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ABSTRACT

Purpose

This paper presents a project delivery model developed for use by public sector clients tasked with using innovative building technologies (IBTs) in lieu of conventional building technologies (CBTs) in the delivery of social infrastructure projects.

Methodology

The data were obtained from international and national construction procurement literature; Agrément South Africa publications; and CSIR Built Environment research on IBTs. A comparative analysis of the fit between the standardised contracting and procurement arrangements for CBTs; and Agrément South Africa Conditions of Certification for IBTs identified which activities to maintain; which activities to alter; and gaps to fill to align public sector project delivery with The Conditions of Certification. The insights gained from the analysis served as an input to develop an IBT-specific project delivery model.

Findings

Substituting CBTs with IBTs has major implications for contracting and procurement arrangements, in particular, choice of contracting strategy, scope of professional services and form of contract.

Limitations

The research is only applicable to Agrément South Africa certified building systems, herewith referenced as IBTs.

Value

This paper contributes to South African research on non-standardised construction subjects. The findings are of value to policy-makers, researchers and construction stakeholders

Keywords:

Building technologies, public sector, project delivery, construction procurement, social infrastructure

Sub Theme:

Public sector procurement and contracting

1. INTRODUCTION**1.1 Background**

An important national objective for South Africa in the post-1994 period is to eradicate the backlog of social infrastructure, particularly with regard to clinics, schools and student residences. The South African building sector has a critical role to play in achieving this objective. Unfortunately, the sector relies predominantly on conventional building technologies (CBTs), that is, brick and mortar constructions that are slow to build due in large part to the time-consuming curing periods associated with wet work.

In April 2013 the Council for Scientific and Industrial Research: Built Environment (CSIR BE) made a presentation to the Presidential Infrastructure Coordinating Commission (PICC) highlighting the potential role that Agrément South Africa (ASA) certified innovative building technologies, hereafter, "IBTs" could play in speeding up the delivery of infrastructure projects. Following this presentation, PICC commissioned a preliminary CSIR BE study which was completed in July 2013. The study found that as compared to CBTs, the advantages accruing from project delivery with IBTs include but are not limited to a lower construction costs; a shorter construction period; and enhanced building quality (Van Wyk, 2013).

In August 2013, Cabinet resolved that IBTs be used for the delivery of some of government's social infrastructure projects, that is, schools, clinics and student residences. The resolution stipulated that the proportion of social infrastructure programmes completed using IBTs would gradually be phased in to 60% over a period of three to five years, starting with the implementation of a limited number of IBT-based schools and clinics in the 2013/2014 financial year (Van Wyk, 2016).

Given its long standing acceptance as the standard in South African, the public sector project delivery model has been developed and standardised over time with brick and mortar construction in mind. Hence, public sector clients tasked with implementing the Cabinet resolution require information and guidance on infrastructure project delivery with IBTs.

1.2 Innovative building technologies defined

The use of building materials and technologies in South Africa is controlled by the National Building Regulations and Building Standards Act 103 of 1977, hereafter, “The Act”. There are three routes to compliance with The Act, namely, meet the deemed-to-satisfy provisions of the regulations; undertake rational design; or undergo Agrément South Africa (ASA) certification (ASA, 2010).

The deemed-to-satisfy provisions, which are supported by building standards published by the South African Bureau of Standards (SABS), are concerned with standard subjects (ASA, 2001) referenced in this paper as CBTs. The rational design provisions of The Act are concerned mostly with safety. The mandate of ASA is to evaluate and certify the fitness-for-purpose of non-standard subjects – building materials; building components; and building systems – to which the deemed-to-satisfy provisions of The Act cannot be applied directly, and for which no SABS standards exist. The Board of ASA grants two types of certificates to non-standard subjects – an Agrément Certificate or a Minimum Agrément Norms and Technical Advisory Guide (MANTAG) Certificate. The term innovative building technologies (IBTs) as used in this paper is limited to building systems that have been granted an Agrément Certificate and are listed at <https://www.agrement.co.za>

1.3 Objective

This paper presents a project delivery model developed for use by public sector clients tasked with using innovative building technologies (IBTs) in lieu of conventional building technologies (CBTs) in social infrastructure project delivery. The IBT-specific project delivery model forms part of the research output from a study that developed guidelines for key construction stakeholders on how to use IBTs in project delivery.

1.4 Methodology

1.4.1 Data sources

The data were obtained from international and South African construction procurement literature; Agrément South Africa sources; and CSIR Built Environment research relating to the use of IBTs.

1.4.2 Data interpretation

The existing project delivery model for CBTs comprises three core processes – project initiation; project implementation; and project completion (SAICE/CIDB, 2004a; CIDB, 2007a). The contracting and procurement activities which could potentially influence the success or failure of project delivery are carried out during project initiation and project implementation. Project completion is limited to contract completion and reporting – hence, a switch in building technology from CBTs to IBTs should not influence project completion. The contracting and procurement activities, termed “contracting arrangements” and “procurement arrangements” in this paper, have been used as a basis to conduct a comparative analysis of CBTs and IBTs with a view to identify:

- Activities to be maintained when CBTs are substituted with IBTs;
- Activities to be altered when CBTs are substituted with IBTs; and
- Gaps in the existing activities that need to be filled to align public sector project delivery with the Conditions of Certification for IBTs.

The insights gained from the comparative analysis of CBTs and IBTs were used as an input to develop the IBT-specific guidance and project delivery model presented in this paper.

2. COMPARATIVE ANALYSIS OF CONVENTIONAL AND INNOVATIVE BUILDING TECHNOLOGIES

This section uses the contracting and procurement arrangements which underpin South African project delivery to conduct the comparative analysis of CBTs and IBTs. The contracting arrangements are concerned with selecting contract strategies; pricing strategies; and forms of contract. The procurement arrangements identify the processes to be followed to solicit tender offers from and to conclude contracts for the provision of professional services; and construction and/or maintenance services.

2.1 Contracting arrangements for The Works

2.1.1 Works contract strategy

A contract strategy is the strategy which is adopted by an organisation to procure engineering and construction works, hereafter “The Works” in the most advantageous and cost effective manner (SAICE/CIDB, 2004a). Contract strategies differ from each other in the way that the risks for design and construction are shared (Wearne, 1989; CIDB, 2007a); and what degree of completeness of design is required before construction starts (CIDB, 2007a). The Contract strategy has a major impact on the time to construct, the cost to construct and the quality of a given project (Bower, 2003).

Box 1¹: Exerpt from Agrément Conditions of Certification for building systems²

“The building system described in this certificate must (i) be designed by the Certificate Holder; (ii) be erected by the Certificate Holder or a Licensee³, provided that the Licensee is appointed by the Certificate Holder and registered as such with Agrément South Africa; (iii) be constructed in accordance with the technical description set out in Part 3 of the Agrément Certificate, the Certificate Holder’s detailed specifications and the quality management documentation; (iv) comply with the Conditions of Certification. Any person required to check on details of construction must refer to the documentation listed above, which is available from the Certificate Holder”.

The Design-by-Employer contract strategy, in terms of which the building contractor undertakes only construction on the basis of full designs issued by the employer (SAICE/CIDB, 2004b), has been the historic approach to delivering CBT projects in the public sector. However, the Agrément South Africa Conditions of Certification, hereafter, “The Conditions of Certification” call for the IBT certificate holder to bear both the design and constructions risks; or assign the construction risks to a licensee. Hence, the traditional Design-by-Employer contract strategy is not suitable for delivering IBT projects.

¹ This statement appears in Part 1 of the Agrément Certificate of every IBT.

² In this paper, IBT is used interchangeably with building system.

³ The Lincensee is a building contractor who is (i) registered in an appropriate category of the CIDB Register of Contractors; (ii) has been certified by the Certificate Holder as a Licensee; and (iii) has been registered as such with Agrément South Africa prior to site handing over.

This study investigated the fit between the Conditions of Certification; and other standard contract strategies endorsed by the *CIBD Standard for uniformity in construction procurement* (CIDB, 2010), hereafter, *CIBD Standard for uniformity*. The findings are that Design-build and Develop-and-construct contract strategies assign both design and construction risks to the building contractor (CIDB, 2007a); and hence, align most closely with The Conditions of Certification. Nevertheless, Design-build and Develop-and-construct are not suitable contract strategies for IBT projects. The single point of accountability for design and construction on which these alternative contract strategies are founded implies that the construction risks cannot be assigned to a licensee. Thus, the provision of construction services on IBT projects would be set aside for only IBT certificate holders, potentially violating the fairness requirement of South African procurement regulations.

This study concluded that a non-standard contract strategy which requires the IBT certificate holder and a licensee to bear the design risks and the construction risks respectively would provide the best means to comply with national procurement prescripts and The Conditions of Certification of IBTs.

2.1.2 Works pricing strategy

A pricing strategy is the approach adopted by the Employer to secure financial offers and to remunerate the building contractor in terms of the building contract (SAICE/CIDB, 2004a). The standard pricing strategies recommended for use with the Design-by-Employer contract strategy are bills of quantities, activity schedule and target cost (CIDB, 2011; CIDB, 2005).

As compared to the abundant guidance on pricing strategies for CBTs, The Conditions of Certification are silent on pricing strategies for delivering IBT projects. However, this study found that the three standard pricing strategies are compatible with The Conditions of Certification. Furthermore, target cost, which is predicated on single point responsibility for construction and maintenance, is the best pricing option for delivering IBT projects; and creating an enabling environment for the predicted building service life to be achieved.

2.1.3 Works form of contract

The standard forms of contract recommended for use by public sector clients delivering CBT projects are (CIDB, 2005):

- General conditions of contract, 2004 edition (GCC 2004);

- Joint Building Contracts Committee Series 2000 contract (JBCC 2000);
- International Federation of Consulting Engineers contracts, 1999 edition (FIDIC 1999); and
- New Engineering Contracts, third edition (NEC3).

The GCC 2004 and JBCC 2000 standard forms of contract are most suitable for use with the Design-by-Employer contract strategy (CIDB, 2005). The FIDIC 1999 and NEC3 standard contracts make provision for the full range of contract strategy options including Works designed by the employer; Works designed by the contractor; and Works designed by a management contractor.

Based on analysis of the literature, this study found that each of the standard Works contracts endorsed by the *CIDB Standard for uniformity* assumes two contracting parties – the employer; and one building contractor. However, a public sector employer delivering projects with IBTs is obliged to conclude contracts with two contractors, namely, The IBT certificate holder, to provide a design service termed “technical design service” in this paper; and a licensee, to provide construction services.

The study concluded that the standard forms of contract are appropriate for procuring construction services from the licensee; and that a Service Level Agreement represents the best available means to procure a technical design service from the IBT certificate holder.

2.2 Contracting arrangements for professional services

It is common practice for public sector clients to appoint professional service providers (PSPs) – typically, architects, civil/structural engineers and quantity surveyors - to act as Employers’ agents in the delivery of The Works. The contracting arrangements for PSPs require the employer to decide on the professional services contract strategy; and to use this information to select a project-specific professional services contract (PSC).

2.2.1 Professional services contract strategy

The risks accepted by the public sector employer in respect of The Works will determine the type of professional services required; the scope of professional services; and hence, the professional services contract strategy. The traditional position when delivering CBT project is that the employer bears design risks; and the contractor bears construction risks (Wearne, 1989).

However, The Conditions of Certification shift both design and construction risks to the IBT certificate holder. This study found that the implications for the professional services contract strategy on IBT projects are that:

- The design professionals – architects and structural engineers – should provide a reduced scope of professional services, tailored to avoid conflict with the design mandate of the IBT certificate holder
- The non-design professionals – quantity surveyors and project managers – are not affected by the new design mandate of the IBT certificate holder

2.2.2 Professional services form of contract and pricing strategy

Public sector clients delivering CBT projects have a choice of two standard professional services contracts (PSCs), namely, the NEC3 Professional Services Contract and the CIDB Professional Services Contract (CIDB, 2010).

Based on the findings from the previous section, design professionals, that is, architects and engineers will be subjected to reduced scope of professional services due to the new design mandate of the IBT certificate holder. Any reduction in scope of professional services should however not preclude the use of an amended version of a standard PSC when delivering IBT projects.

2.3 Procurement arrangements

2.3.1 Works and services procurement procedure

A procurement procedure is the procedure selected for the solicitation of tender offers in a specific procurement (SAICE/CIDB, 2004a). A public sector client tasked with delivering CBT projects would solicit tender offers for the provision of two types of services, namely: standard professional services; and standard construction and/or maintenance services. However, when delivering IBT projects, the Conditions of certification oblige the public sector client to procure a third type of service – a design service – from the IBT certificate holder.

This study scrutinised standard procurement procedures set out in The *CIDB Standard for uniformity* and found none to be suitable for procuring a technical design service from IBT certificate holders. Previous research by Ampofo-Anti et al (2013) highlighted the need to first select an appropriate IBT – based on climate considerations, building performance; and supply chain management information; and thereafter, obtain technical design inputs from the certificate holder. Based on this consideration, the present study concluded that a Call for Expression of Interest provides the best means to first select the most appropriate IBT for project delivery and

thereafter obtain the desired technical design service from the certificate holder.

2.3.2 Works and services tender evaluation methods

Historically, price was the sole criterion relied on to solicit tender offers from potential service providers. However, the inclusion of other, additional criteria to facilitate the selection of the most advantageous tender is now widespread internationally (CIDB, 2007b). Thus, the Preferential Procurement Policy Framework Act (PPPFA) No. 5 of 2000 and its Regulations of 2001 require all procurement to adhere to a preference point system whereby tenders are evaluated on the basis of quality (functionality), preference and price.

The *CIDB Standard for uniformity* endorses four standard tender evaluation methods, namely, Method 1: Financial offer; Method 2: Financial offer and preferences; Method 3: Financial offer and quality; and Method 4: Financial offer, preferences and quality. The appropriateness of using standard tender evaluation methods to evaluate tender offers for the provision of professional services, construction services and technical design services on IBT projects was investigated. The results confirm that the standard tender evaluation methods are applicable to tender offers for professional services; and construction services but not to a Call for Expression of Interest in respect of technical design services.

2.3.3 Quality strategy

Quality relates directly to the goods, service or supplies being procured (CIDB, 2007b). The introduction of quality into the solicitation and evaluation of tender offers provides a viable means of managing construction risks without violating the requirement that procurement of goods and services be fair, equitable, transparent, competitive and cost effective (CIDB, 2007b). The South African construction procurement literature, including, but not limited to the *CIDB Standard for Uniformity* (CIDB, 2010) and *SANS 294: Construction procurement processes, methods and systems*, 2004 provide abundant guidance on appropriate quality strategies and quality criteria as pertains to the procurement of standard services for CBT projects. Given the non-standard nature of IBTs similar guidance is lacking.

This research study investigated the requirements for incorporating quality into the procurement of IBT projects. The results indicate that the available guidance on quality strategies for standard services does not conflict with the Conditions of Certification. However, the procurement of technical design services from IBT certificate holders would need to comply

with Agrément South Africa (ASA) quality requirements, in particular (ASA, 2010; ASA 2001) an IBT that is shortlisted for tender award must be listed as “Active” on the Agrément South Africa website; and must be certified for erection of buildings in the occupancy class of the proposed project. Furthermore, the IBT certificate holder should have an ASA approved quality assurance system in place which conforms to an ISO 9000 standard.

3. SUMMARY OF REQUIREMENTS FOR PROJECT DELIVERY WITH IBTS

Using IBTs instead of the more familiar CBTs as a basis to implement social infrastructure projects would cause a fundamental shift in the public sector approach to project delivery – from an employer-led to a contractor-led approach. The major impacts on the established contracting and procurement arrangements are that PSPs must be appointed to provide partial services only; and the IBT certificate holder, who bears the risks for design and quality of the finished buildings, becomes an additional party to the building contract. It follows that the public sector employer must appoint two building contractors when delivering IBT projects – the IBT certificate holder, to provide technical design and quality management services; and a licensee, to provide construction services and preferably, future maintenance services. The choice of contracting and procurement arrangements needs to be guided by the Conditions of Certification for IBTs.

4. RECOMMENDED MODEL FOR PROJECT DELIVERY WITH IBTS

To maintain the established tradition of employer-led project delivery in the South Africa public sector, a new, IBT-specific version of the Design-by-Employer contracting strategy depicted in Figure 1 is proposed. To satisfy the Conditions of certification for IBTs, a two-step contractor appointment strategy is proposed.

In the first step, the Employer uses a Call for Expression of Interest, advertised at the initial design stage, to select an appropriate IBT for the delivery of the proposed project. The Employer enters into a Service Level Agreement (SLA) with the IBT certificate holder for the provision of technical design services. PSPs are also appointed at the initial design stage, based on reduced scope of services, standard procurement procedure and standard forms of contract. The PSPs prepare the conceptual design. To meet the Conditions of Certification, design development and design documentation are carried out by the PSPs with significant inputs from and sign off by the IBT certificate holder.

In the second step, the PSPs complete the procurement documentation with sign off by the IBT certificate holder. The Employer uses a standard procurement procedure to solicit tenders for the construction of the proposed project; and enters into a contract with the building contractor for the construction and maintenance of the proposed IBT project. To satisfy the Conditions of Certification:

- The building contractor is trained and certified as a Licensee by the IBT certificate holder prior to site handing over;
- The IBT certificate holder carries out site audits from time to time during the construction process;
- The PSPs supervise the construction process provided that no variation orders are issued or executed without prior consultation with and sign off by the IBT certificate holder.

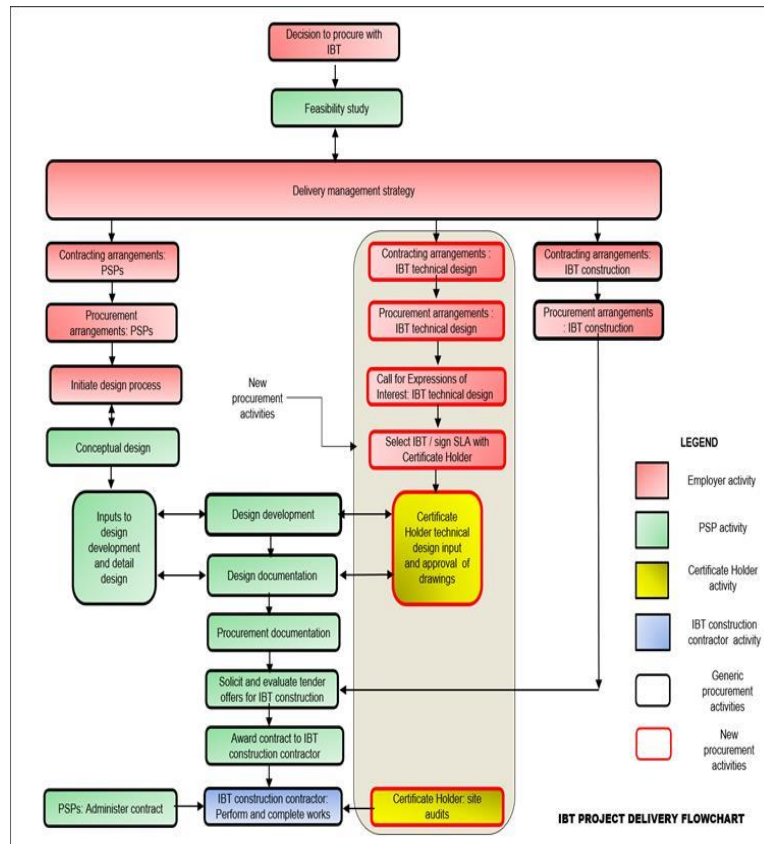


Figure 1: IBT delivery flowchart

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