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Editor’s Preface

La meilleure façon d’être actuel, disait mon frère Daniel Villey, est de résister et de réagir contre les vices de son époque. Michel Villey, Critique de la pensée juridique moderne (Dalloz (Paris), 1976).

This book has been structured following years of debates and lectures promoted by the International Construction Law Committee of the International Bar Association (ICP), the American College of Construction Lawyers (ACCL), the Society of Construction Law (SCL), the Dispute Resolution Board Foundation (DRBF) and the American Bar Association’s Forum on the Construction Industry (ABA). All of these institutions and associations dedicated themselves to promote an in-depth analysis of the most important issues related to projects and construction law practice and I thank their leaders and members for their important support in the preparation of this book.

Project financing and construction law are relatively young, highly specialised areas of legal practice. They are intrinsically functional and pragmatic and require the combination of a multitask group of professionals – owners, contractors, bankers, insurers, brokers, architects, engineers, geologists, surveyors, public authorities and lawyers – each bringing their own knowledge and perspective to the table. That is why I am very happy to present you two new featured articles – this time from non-lawyers – specifically prepared for the introductory part of this book. Frank Giunta, Maurice Masucci and David Price, senior representatives from Hill International, propose to us ‘A Guide to Alternate Project Delivery Systems’ and Alexander Aronsohn, Ben Elder and Marcia Ferrari, senior representatives from the Royal Institution of Chartered Surveyors (RICS) demonstrate some innovative approaches to spatially enabling land administration and management.

These two new articles combine precisely with the variety already produced for the past editions by Robert S Peckar (Peckar & Abramson), Douglas S Jones (Clayton Utz) and Phillip Fletcher (Milbank, Tweed, Hadley & McCloy LLP), three leading professionals and lecturers of the area of project finance and construction law. Despite living miles away from each other – in the heartlands of the United States (Bob), the United Kingdom (Phillip) and Australia (Doug) – they have equally influenced the main players in project financing in dealing with the complex issues related to the development and implementation of projects, the negotiation of construction and engineering contracts and the challenges of crafting the perfect financing package.
I am also glad to say that we have contributions from six new jurisdictions in this year’s edition: Austria, China, Finland, Germany, Ireland and Russia. Although there is an increased perception that project financing and construction law are global issues, the local flavour offered by leading experts in 33 countries has shown us that in order to understand the world we must first make sense of what happens locally; to further advance our understanding of the law, we must resist the modern view (and vice versa?) that all that matters is global and what is regional is of no importance. Many thanks to all the authors and their law firms that graciously agreed to participate.

Finally, a sad note about the recent passing of Dr Kris R Nielsen, PhD, JD, PMP, MRICS, MJSCE, this past 16 February. I had the honour of working with Dr Nielsen in Brazil and it was a remarkable and unique experience to learn how to deal with projects with a global and strategic perspective on risk management and best practices. Dr Nielsen spent his entire career working towards bettering the construction industry and worked tirelessly to promote the areas of law and engineering with a view to their joint futures. He co-edited and authored an important book entitled Managing Gigaprojects – From Those That Have Been There Done That, published by ASCE Press in October 2012, which is already considered a classic and a great reference for those working in the field. In the words of his beloved wife Dr Patricia Galloway: ‘Dr Nielsen was a global leader in helping contractors and owners to define what makes a successful project. He helped them examine their operations and how to address subjects like risk management, execution, project controls, value engineering, corporate strategy, construction law, dispute resolution, project sustainability, etc. While on assignments, he worked with his clients to help select younger members of their organisation, i.e., to mentor in how to achieve project success. Dr Nielsen derived great satisfaction in knowing there was a growing cadre of people who were learning and then practising their new-found skills while striving for project success.’

I dedicate this third edition of The Projects and Construction Review to Dr Nielsen. He will be greatly missed.

I look forward to your comments and contributions for the forthcoming editions.

Júlio César Bueno
Pinheiro Neto Advogados
São Paulo
July 2013

1 www.pegasus-global.com/personnel/.
Those involved in any way with large capital construction projects will be aware that cost overruns, delays and other problems are seemingly common on such projects. Owners, developers, financiers, agency and governmental officials, engineers and contractors all have discussed, experienced, read about or overheard the stories of significant delays and cost increases. Similarly, those professionals may have become aware of reports of the relative success of other projects being attributed to the use of alternate project delivery systems (‘APDS’).

Over the past 10 years, there has been much discussion within the construction industry about the relative merits of the DB project delivery system and a great deal of anecdotal evidence has been published about its advantages over the DBB or CM approaches. For example, as an alternative to the DBB project delivery system – often characterised as the traditional approach – DB is touted as an alternate approach capable of delivering a project at lower cost and with shorter schedules. Since low cost and fast turnaround may be considered universal goals, the questions that naturally follow are: ‘What are alternative project delivery systems?; ‘What attributes make for their success?; and ‘Can they be used on my project’?

I APDS AND CONTRACT TYPES

There is a recognised distinction between project delivery systems and contract types. A project delivery system is defined as the arrangement of the relationships that establishes the scope and distribution of responsibility and risk among the various parties involved in the design and construction of a project. In other words, it establishes how the final project is produced and provided (i.e., delivered) to the owner. It establishes who is

---

1 Maurice Masucci, Frank Giunta and David Price are senior vice presidents of Hill International, Inc.
responsible for the various phases of the project (the conceptual design, the detailed design and the construction) and the overall coordination and management it entails. The project delivery system also establishes the nature, timing and responsibility for boundaries related to the various ‘hand-offs’ for each of those phases of the project.

So the project delivery system is the contractual structure (exclusive of the financial arrangements) of these arrangements by which the project is delivered to the owner.

For example, in a traditional DBB project delivery system, the design and construction generally are performed by different entities and each phase is distinct in terms of both scope and timing. Many industry experts argue that all types of project delivery systems fall under the umbrella of one of the primary three: DBB, DB and construction manager at risk (‘CM@R’). They point out that any variant of these project delivery systems are distinguishable only by how the contracts are held. For the purposes of this chapter, we will discuss all project delivery systems and variants, which include:

- **DBB**;
- **single prime (‘SP’)**;
- **multiple prime (‘MP’)**;
- **CM**;
- **CM@R**;
- **EPC**;
- **turnkey (‘TK’)**;
- **DB**;
- **DBOM**; and
- **DBOT**.

Necessarily, however, the contract between the parties also must address the financial arrangement among the parties, and the basis for compensation is intimately related and conditioned upon the contractual structure and distribution of risk associated with the project delivery system being used. Nonetheless, it is the project delivery system that defines the working relationships and responsibilities between the owner and those delivering the finished project.

The type of contract relates to the specific financial arrangement among the parties whether the designer or contractor is to be paid for their services at firm fixed price (i.e., a lump sum), on a reimbursable basis of time and materials, on an incentive or award fee basis, or any number of variations of these primary contract types. Common types of contract include:

- **bid or negotiated firm fixed price or lump sum**;
- **bid or negotiated firm fixed price or lump sum with incentive or award fee**;
- **bid or negotiated reimbursable or cost plus**;
- **bid or negotiated reimbursable or cost plus with incentive or award fee**;
- **bid or negotiated guaranteed maximum price**; and
- **bid or negotiated guaranteed maximum price with incentive or award fee**.

The project delivery system and the type of contract can be selected separately to best suit the needs of the owner and the various design and construction service providers. For example, a DB project delivery system can be executed using an lump sum, guaranteed maximum price, cost plus with incentive fee or other type of contract.
II FACTORS TO CONSIDER IN THE SELECTION OF APDS

The selection of project delivery system and contract type is driven by many factors, most of which generally relate to the goals and objectives of the owner with respect to the project. Governmental and agency owners face additional factors that often limit their selection of project delivery system and contract type to those authorised and prescribed by statute or regulation. Nonetheless, the basic goals and objectives of owners are understandably consistent: low cost, high quality and the shortest possible schedule. Additionally, a low risk of cost or schedule growth (or both) is an important owner objective.

These basic objectives are supplemented by specific goals unique to each project and to its owner. For example, the speed of implementation may be more important than cost for certain projects. For others, maintainability and low life-cycle costs may be more important than initial cost. Owner control of the design or construction may be important for some while for others, single point responsibility and limiting the risk of changes causing cost growth is paramount because of the difficulty of obtaining budget increases.

Common owner goals to consider when selecting project delivery systems include:

a) lowest cost consistent with quality and performance objectives;
   initial cost versus life-cycle cost;
b) shortest schedule for overall project delivery;
c) high quality;
d) compliance with technical specifications;
e) meeting overall expectations;
f) promoting innovation and value engineering;
g) limiting the cost of design changes;
h) limiting the risk of cost and schedule growth;
i) control over design decisions;
j) control over construction quality;
k) limiting the impact on current operations, safety and security;
l) limiting construction problems;
m) limiting the demands on owner resources;
n) limiting the number of contractual entities or points of responsibility; and
o) limiting the claims for additional cost.

Among the first steps in selecting a project delivery system for a project is to assess and define the various goals and objectives necessary for the project, and to define any unique issues with the potential to significantly affect the project. These goals, objectives and issues should be ranked in order of priority and importance to best support the selection process. Because some project delivery systems are more effective than others in achieving certain goals, it is important that project goals be effectively matched to the strengths and attributes of the various candidate project delivery systems.

Similarly, some project delivery systems are more applicable and appropriate to certain project situations. For example, by their nature, some projects will be challenged by frequent design changes occurring well into the construction phase or by other potentially disruptive issues: the selection of a project delivery system should also take these issues into account. A good list of questions that owners can consider to assist in defining important project goals and unique issues can be found at the University of
A Guide to Alternate Project Delivery Systems

Colorado’s civil engineering department website. The materials on the web site include a project characteristic questionnaire, which may be used for that purpose. A sample of questions to consider is as follows:

a. How complete will the design be at the time of the bid (e.g., 100 per cent)?
b. Is a need for changes late in the project and during construction foreseen?
c. Is on-time completion be the key to project success, or can the schedule be adjusted to achieve budgetary goals?
d. Will an external funding schedule drive project spending?
e. Is budget adherence the key to project success?
f. How complete will the design be when the budget is established/fixed?
g. How complex or unique is the design or construction of the project?
h. Will the project require emerging or unique technology?
i. Is the owner comfortable with performance-based as opposed to prescriptive specifications (specifying end result for DB projects versus specifying methods and materials)?
j. What is the level of the owner’s construction sophistication?
k. Is the owner’s staff adequately sized and adequately experienced to effectively manage the work or make key design decisions in a timely manner?
l. Will the project be competitively bid or negotiated?
m. What is the owner’s experience with prospective contractors?

III CHARACTERISTICS OF THE VARIOUS APDS

The selection process should strive to match APDS strengths to the project goals and match APDS attributes to the important issues that must be effectively addressed and managed to enhance successful project delivery.

The analysis is not so much a question of advantages versus disadvantages, but rather to select the APDS whose strengths and attributes best match or align with the goals and needs of the project; an APDS may have attributes viewed as a disadvantage for one specific project while those same attributes may prove advantageous for a different project. Finally, no single APDS is a panacea for all situations.

i Design–bid–build

Often considered as the traditional approach, in the DBB project delivery system the project owner or developer hires an architect or engineer to design the project. Upon completion of the design, the architect prepares construction packages with which to solicit competitive bids for construction. Often, the architect’s involvement on behalf of the owner continues during construction in his or her administering the construction contract, managing changes and ensuring general conformance with the contract documents.

In 1999 FIDIC published the conditions of contract for construction for building and engineering works where the design is undertaken by an engineer (or largely undertaken by such an engineer) and construction is performed by the contractor.
Attributes commonly associated with a DBB project delivery system are as follows:

\( \textit{a} \) the owner holds contracts separately with a designer and a construction contractor;
\( \textit{b} \) the design and construction are sequential, so the design is completed prior to construction bidding (a DBB project can be fast-tracked so that construction may begin before design is 100 per cent complete);
\( \textit{c} \) procurement begins with construction;
\( \textit{d} \) specifications are prescriptive;
\( \textit{e} \) significant owner involvement and decisions are required;
\( \textit{f} \) costs are known and fixed once the construction contract is awarded;
\( \textit{g} \) responsibility for project delivery is shared between the designer and the contractor;
\( \textit{h} \) the owner is responsible to the contractor for design errors;
\( \textit{i} \) the owner controls design and construction quality; and
\( \textit{j} \) an extensive number of qualified bidders ensures a high level of competition.

**Single prime and multiple prime**

Variations of the DBB project delivery system include SP and MP. The SP system equates to the DBB project delivery system just described with a single construction contractor (general contractor) responsible for the entire construction of the project. In the MP variant, two or more construction contractors are involved, with responsibility for the construction typically divided along the lines of the major components or systems necessary for the project. For example, separate primes are often contracted to provide civil and site work, construction of the building shell, mechanical, electrical and plumbing work and specialist systems.

In MP projects, the architect must prepare individual construction packages for each prime and the owner will hold a separate contract for each prime construction contractor. As a result, either the owner or some other entity must be assigned to manage and coordinate the work of the multiple contractors. Additional characteristics commonly associated with a MP DBB system include:

\( \textit{a} \) a lower award cost as a result of the elimination of general contractor mark-ups;
\( \textit{b} \) increased effort by the architect and owner for bidding, contract administration and construction coordination;
\( \textit{c} \) the requirement for an experienced owner with the requisite resources for effective construction management; and
\( \textit{d} \) the owner being responsible and at risk to each construction contractor for coordination, delays or impacts on the construction effort.

**Construction manager (management)**

Another variation of the DBB project delivery system is the CM system where a construction manager is engaged by the owner to oversee and manage the construction of the project. In its traditional form, the CM acts as the owner’s agent administering the construction contracts and providing other management and oversight services to assist the owner in the successful completion of the project.

Often, the CM is engaged by the owner during the design phase of the project in order to lend its construction expertise to the design and construction reviews, value engineering, cost estimation, project planning and scheduling, and the construction bid
A Guide to Alternate Project Delivery Systems

solicitation process. Additional characteristics commonly associated with a CM DBB system include:

\[ a \] the transfer of effort from the owner to the CM for contract administration and coordination;

\[ b \] the owner is responsible to each construction contractor for coordination, delay or impact on the overall construction effort, although some responsibility now falls on the CM;

\[ c \] construction experience can be integrated into the design and overall project planning process; and

\[ d \] the construction is managed with construction expertise.

Construction manager at risk
As an alternate to the CM acting as the owner's agent, many projects use a CM@R approach where the construction manager is engaged by the owner to be directly and completely responsible for the construction of the project. Under this arrangement, the CM@R, not the owner, holds the contracts for the construction contractors (or performs the construction itself) and so the CM@R is not only responsible for management of the construction, but also is at risk for the construction costs. The additional attributes commonly associated with a CM@R DBB system as compared with a traditional CM approach include:

\[ a \] the transfer of responsibility and significant risk from the owner to the CM@R for the entire construction effort, including cost;

\[ b \] the CM@R is responsible to each construction subcontractor for coordination, delay or impact on the overall construction effort;

\[ c \] potentially conflicting interests as both CM and contractor; and

\[ d \] minimisation of owner involvement and control over the construction effort.

ii Design–build
As the main alternative to the various DBB approaches, the DB project delivery system differs as the project owner or developer hires a single entity to design and construct the project. An architect is no longer directly engaged by the owner but rather functions typically as a consultant to the DB entity.

In general, the DB concept is not new, having its roots in the ancient ‘master builder’ concept. In some instances, the owner may engage an architect or engineer to assist in the development of a conceptual design and to prepare a clear specification of the functionality and performance requirements that the finished project must provide. This practice of a conceptual architect on a DB projects is sometimes known as ‘bridging’.

Among the issues to consider with DB is that the size of the overall contract and the high bid preparation costs relative to DBB may reduce the number of qualified bidders and limit competition. Also, because the DB entity is responsible for design, the project owner should refrain from imposing design changes and preferences. All such requirements should be included in the performance specifications at the time of the contract award. Finally, because the DB entity is often a contractor, special
insurance may be required to ensure the intended transfer of risk, for example, for errors and omissions.

Characteristics common to the DB project delivery system are as follows:

\[ a \] the owner holds a single contract with the DB entity for the delivery of the entire project;
\[ b \] the design and construction phases often overlap where construction may begin before design is 100 per cent complete, similarly to a fast-tracked project;
\[ c \] procurement may begin prior to construction;
\[ d \] specifications are performance-based rather than prescriptive;
\[ e \] minimal owner involvement and decisions are required;
\[ f \] design and construction quality are primarily controlled by the DB entity;
\[ g \] costs are generally known once the DB contract is awarded, and typically are fixed no later than the mid-point of the design when the scope is established;
\[ h \] the responsibility and most of the risk is transferred from the owner to the DB entity for the entire design and construction effort;
\[ i \] construction experience is integrated into the design process;
\[ j \] the construction is managed with construction expertise; and
\[ k \] the number of qualified bidders is limited.

Variations of the DB project delivery system include EPC and TK although, in reality, these variations are little more than differences in terminology among the various industries. With EPC, one entity is responsible for providing the engineering (design), the materials and equipment, and the construction of the project. As such, the attributes of EPC are the same as DB. The term ‘EPC’ is more commonly used in power and industrial-type projects whereas ‘DB’ seems more prevalent in commercial projects.

FIDIC issued the conditions of contract for plant and design–build for electrical and mechanical plant, and for building and engineering works, designed by the contractor, this design–build contract, commonly known as the Yellow Book. FIDIC also issued in 1999 the conditions of contract for EPC or TK projects, which is commonly known as the Silver Book. The Silver Book is generally regarded by contractors as quite an onerous contract and as a result, the perceived risks are priced by the tenderers. By using this contract, the employer is willing to pay more for construction than would be the case under the Red or Yellow Book, in return for the enhanced certainty over the final contract cost and date of completion. In this scenario, the employer intends the contractor to take total responsibility for the design and construction of the facility and hand it over to the employer ready for operation ‘at the turn of a key’.

TK is a term that denotes little or no owner involvement in a project wherein the contractor essentially turns over the keys for the facility to the owner at the end of construction. In both EPC and TK, there is often included a component of commissioning and start-up of plant and heavy equipment that historically has not been associated with commercial projects. With the advent of sophisticated building and environmental control systems, however, even this distinction between EPC/TK and DB is blurred.

Design–build–operate–maintain and design–build–operate–transfer

True variations of the DB project delivery system include DBOM and DBOT, wherein the scope of services of the DB entity are expanded beyond the completion of construction
of the project to include the operation and maintenance of the facility for a fixed term. With DBOM, ownership of the facility is retained by the project owner or developer. At the end of the term, the operation and maintenance responsibility transfers to the owner.

FIDIC recommends the use of the conditions of contract for design, build and operate projects (which incorporates maintenance by the contractor) when a project is for the design, build and operation of a facility; it was first published in 2008 and is known as the Gold Book. The employer has to provide the essential contract data to the contractor. This contract was published for use internationally by FIDIC in response to the increased requirement of such contracts. Before the issue of the Gold Book, drafters of contracts would often use the Silver Book as a basis from which to draft DBOM contracts.

The critical distinction between DBOM and TK addresses a perceived major weakness in the DB approach in that the DB entity tends to emphasise low initial cost over life-cycle and operation and maintenance costs. By making the DB entity responsible for operation and maintenance for a period of time, a better balance of quality is achieved. The additional attributes commonly associated with a DBOM system as compared with a typical DB approach include:

a greater design emphasis on operability and maintainability issues;
b greater emphasis on life-cycle costs over low initial cost;
c reduction in owner control as to how the completed facility functions in serving the ultimate customer; and

d significant alternatives exist for funding the construction, operation and maintenance of the project.

With a DBOT project delivery system, actual ownership of the facility rests with the DB entity until the end of the term (sometimes via a lease arrangement) when ownership transfers to the owner. The additional attributes commonly associated with a DBOT system as compared with a DBOM approach include:

a a further decrease in owner control as to how the completed facility functions in serving the ultimate customer; and

b additional alternatives exist for funding the construction, operation and maintenance of the project.

iii Other APDS
Finally, there are several other project delivery systems worthy of mention, but the information available with which to judge their performances and applicability to various project situations is more limited than for the APDS already discussed. For example, the National Cooperative Highway Research Program (‘NCHRP’) explored innovative alternatives to traditional contracting methods and produced guidelines for their use.

The NCHRP guidelines3 detailed three innovative contracting methods: warranty, multi-parameter and best-value contracting. Each method focuses on a different aspect of cost-effective contract management, but all are intended to fulfil the same goals. Warranty contracting, for example, includes an extended warranty that places responsibility for

3 NCHRP Report 451: ‘Guidelines for Warranty, Multi-Parameter, and Best Value Contracting’.
product performance on the contractor, intended to produce a longer-lasting product and lower overall maintenance costs. This APDS can be used to counteract the tendency of DB to lower initial cost at the expense of life-cycle cost. In multiparameter contracting, agencies determine contract winners based on the lowest combination of cost, time and other parameters selected by the owner to meet and address project specific goals and issues. Best-value contracting focuses on such factors as technical excellence, management capability, past performance and personnel qualifications.

There also exist two additional variations of the DB project delivery system called ‘bridging’ and ‘novation’. Bridging was mentioned previously when first describing DB, where it was defined as when the owner engages an architect or designer to perform the initial or conceptual design development work. In close concert with the owner, the architect prepares a conceptual design and develops the performance specification, which is then used by the owner in soliciting the contract with the DB entity to complete the design and perform the construction. As a variation of bridging, novation is a practice that is increasingly being used in the United Kingdom, where the owner similarly engages the designer for the initial stages of design but later transfers both the design and the designer to the DB entity, which completes the design and construction. Clearly, the designer needs to be in agreement to this later novation at the outset. Novation of design is beneficial to the employer as the initial designer's knowledge and experience of the project is retained, and it also avoids a potential liability gap between designers.

It is also worth mentioning that alliance contracting, framework agreements and partnering have been successfully used in the international scenario.

The aim of alliance contracting is to achieve cost and time reduction for the employer while providing the contractor with a reasonable expectation of making a profit. The style of contract is suitable where there is the need for the completion of, for example, a series of technically complex, multidisciplinary and multi-project schemes, and the parties wish to avoid conflict. The identified risks in the contracts are typically equitably shared between the parties and this is embodied in the alliance contract wording. The contract may also include financial incentives for the contractor to reduce the final cost and period for completion of the work. An alliance charter will often be signed by senior management of both parties to the alliance to give ‘weight’ to the principles.

A framework agreement is a long-term arrangement that incorporates a schedule of agreed rates, prices and specifications for future work to be ‘called off’ by the employer and constructed by the contractor. It has the advantage for both parties of the employer knowing in advance that it will pay a certain amount for the work and that it will be able to commence work in a timely fashion and the contractor knows that it will be compensated by a trusted long-term client.

Partnering between parties was intended to reduce the number of contractual disputes between parties and has had limited success to date in the UK; there have been a number of problems experienced with partnering contracts such as NEC3. These contracts promote mutual collaboration between the parties but often are very prescriptive in terms of procedures to be followed in respect of, for example, compensation events. Unfortunately, often neither party sufficiently funds the project so as to be able to comply with the tight procedures that are aimed at preventing disputes, which then ultimately leads to the contractual problems the contract originally sought to avoid.
IV PRELIMINARY COMPARISON OF THE PRIMARY APDS

The comparison focuses on how each of the various project delivery systems relate to, or address, owner goals and objectives and other project specific issues. These goals are grouped below to facilitate the comparison:

- **a** final cost;
- **b** life-cycle cost;
- **c** schedule duration;
- **d** owner control;
- **e** need for owner resources/expertise;
- **f** owner risk;
- **g** claim potential;
- **h** cost and schedule growth;
- **i** cost of design changes;
- **j** degree of design completion at construction start;
- **k** prescriptive versus performance specification; and
- **l** number of interfaces and points of responsibility.

These comparisons are general trends of simple comparison from one extreme to the other; specific or detailed comparison between each individual project delivery system is not the intention. For example, final cost generally increases from DB to DBB project delivery systems, although it is recognised that for DBOM systems, final cost may actually be higher than other project delivery systems because of the anticipated emphasis on minimising life-cycle costs at the expense of initial final cost.

In terms of risk, final cost, schedule duration, cost and schedule growth, and number of interfaces all increase as you move from the DB to the DBB project delivery systems. Consistent with this, owner risk also increases. It therefore follows that the DB systems minimise project cost and schedule, few interfaces exist, the degree of owner risk is low, and the potential for claims or cost and schedule growth are low.

In terms of attributes, the degree of design completion at construction start, the need for owner resources and expertise, and owner control of the project and its quality all increase when one moves from the DB and towards the DBB project delivery systems.

i Reported performance of APDS

These initial comparisons are based on subjective intuitive assessments of likely trends given the nature and definition of the structure, relationships, and responsibilities of the parties for each of the various APDS evaluated. For example, as the number of interface points increases, it follows that the potential for problems, disputes, and resulting cost and schedule impacts would also increase. Similarly, owner control was considered to necessarily decrease as the contractual responsibilities for design and construction transferred to other entities.

This necessarily begs the question, ‘What is the actual performance record of these APDS?’ To answer this, a survey was performed to identify industry performance data available in existing studies, reports, assessments and similar evaluations performed by industry groups, universities, and business and industry professionals. A number of examples were identified that present the results of studies comparing the
performance of various APDS. These results are generally consistent with the trends and comparisons presented herein, but also include some interesting perspectives and insights. For example, the University of Colorado published the results of a study in 1997\textsuperscript{4} that found that:

\begin{quote}
... owners most frequently select design–build to shorten schedule duration. Owners expect that the single point of responsibility and the ability to fast-track design and construction inherent in the design-build process will shorten the delivery process.
\end{quote}

Also in 1997, at the Design-Build Institute of America’s annual conference, the Construction Industry Institute presented findings from a national study,\textsuperscript{5} which evaluated three project delivery systems, summarised in the following table; it found DB to have the lowest cost and schedule growth and the shortest schedule duration followed by CM@R and DBB.

<table>
<thead>
<tr>
<th></th>
<th>DBB</th>
<th>DB</th>
<th>CM@R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median cost growth (%)</td>
<td>4.83</td>
<td>2.17</td>
<td>3.37</td>
</tr>
<tr>
<td>Median design and construction schedule growth (%)</td>
<td>4.4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Median design and construction speed (1,000s square feet/month)</td>
<td>3,250</td>
<td>6,842</td>
<td>4,712</td>
</tr>
</tbody>
</table>

In November 2002, the National Institute of Standards and Technology\textsuperscript{6} compared DB and DBB by measuring the impacts of the delivery system on project performance. In performing the study, the researchers solicited opinions from both owners and contractors. While the results are generally consistent between the two, some disparity was identified indicating a difference in perspective between owners and contractors as to which project delivery system outperformed the other.

The findings indicate the use of the DB project delivery system tended to outperform DBB for projects submitted by owners, exhibiting better performance in terms of cost, schedule, changes and rework. The results were not as clear-cut for contractor-submitted projects, where DBB projects outperformed DB projects in schedule, although DB projects had better performance in changes and rework.

\textsuperscript{4} www.colorado.edu/engineering/civil/Design-Build/papers/usuk/.
\textsuperscript{5} Construction Industry Institute, Research Summary 133-1: ‘Project Delivery Systems: CM at Risk, Design-Build, Design-Bid-Build’.
The details of the study also are quite interesting in highlighting deviations from the foregoing summary-level findings based on the specifics of the project type, size and complexity, and whether the project is grass roots or renovation/modernisation.

Among the most comprehensive and informative assessment is a study published in April 2002 by the State of Illinois. The study evaluated SP versus MP and DB versus DBB, compared the project outcomes and opinions of various agencies, owners and contractors, and further surveyed the practices and opinions of half of the 50 US states and several major cities. The particulars of the survey responses are most informative in highlighting the perceived relative advantages and disadvantages of the APDS studied. Again, a difference in perspective was noted between contractors and owners, particularly marked depending on whether the contractor was a general contractor or a specialist contractor.

Regarding SP versus MP, the study found that the MP project approach cost 10 per cent more than SP, and that the MP approach results in higher bid costs, increased administration, more change orders and poorly coordinated work. It was noted that SP general contractors are skilled and experienced in coordinating the various subcontractors and suppliers, and further provide a single point of contact for responsibility to the owner. The use of the SP project delivery system can be expected to decrease design cost, change order cost and litigation cost with no significant increase in construction cost. The study reported the results of a survey in which 26 of the 32 states contacted responded that they primarily used the SP project delivery system, and only five used MP in any way.

The Illinois study reported the findings of other studies that preferences and opinions regarding single versus multiple prime seem to be driven largely by the particular interests of the party: general contractor, specialist contractor or owner. For example, New York City reported that SP is less expensive, while the Illinois Mechanical and Specialty Contractors Association concluded that MP is less expensive.

The study also compared the use of DB with that of DBB, reporting that over 80 per cent of the states that responded to the survey had used DB, although such use was often reserved for uncomplicated projects or projects that needed to be completed quickly. Federal government agencies such as the GSA use DB for approximately 10 per cent of their projects. The DB approach was found to require early and clear definition of project scope and functionality requirements by the owner, as later changes are more expensive than for DBB. This was perceived as a disadvantage by owners who anticipate

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the need for design changes late in the project. It was generally reported by most of the states using DB that project delivery was quicker and required less owner resources to manage. The reporting states also noted their reduced ability to provide owner input and control, so clearly there are trade-offs.

In summary, the findings of all of these various reports, studies and surveys appear to corroborate the trends and comparisons developed in this analysis. The referenced reports and studies do include significant detail and report performance results actually experienced by private and public sector owners across the United States, providing important insights for consideration when selecting an APDS. Nonetheless, the selection process remains a challenging one for owners and developers.

ii Summary of advantages and disadvantages

The primary strengths, considerations, advantages and disadvantages of the primary project delivery systems discussed herein are summarised in the following tables.

<table>
<thead>
<tr>
<th>Contract</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| DBB      | • Owner controls design and construction  
           • Design changes easily accommodated prior to start of construction  
           • Design is complete prior to construction award  
           • Construction cost is fixed at contract award  
           • Low bid cost, maximum competition  
           • Relative ease of implementation  
           • Owner controls design and construction quality | • Significant owner expertise and resources are required  
           • Shared responsibility for project delivery  
           • Owner at risk to contractor for design errors  
           • Design and construction are sequential typically resulting in longer schedules  
           • Construction cost not known until contract award  
           • No contractor input in design, planning or value engineering (VE)  
           • Opportunities for enhanced buildability and efficiency are few due to the separation of design and construction |
| SP (versus MP) | • Lower initial cost  
               • Reduced effort by architect for design and construction package development  
               • Reduced effort for contract administration and coordination  
               • A single prime contractor is responsible to owner for the construction  
               • Prime contractor is responsible for all subcontractor coordination | • Can promote bid shopping by the single prime  
               • Single prime can delay payments to subcontractors  
               • Minimises direct contract opportunity by small, disadvantaged, and specialty contractors |
| CM       | • Owner retains control over design and construction  
           • Transfers significant contract administration and coordination from owner to CM  
           • Owner benefits from experienced construction expertise in design and constructability review, scheduling, cost estimating and coordination and VE  
           • Construction cost fixed at contract award | • Owners still responsible for design errors, construction delay and coordination risk  
           • CM may have limited control over the various contractors  
           • Construction cost not known until contract award  
           • CM effort may be added cost |
<table>
<thead>
<tr>
<th>Contract</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>CM@R</td>
<td>• Transfer of responsibility for construction and some risk from owner to CM</td>
<td>• Reduced owner control of construction</td>
</tr>
<tr>
<td></td>
<td>• Construction cost known and fixed during design</td>
<td>• Design changes after construction are costly</td>
</tr>
<tr>
<td></td>
<td>• CM has total control of construction and all subcontractors</td>
<td>• Potentially conflicting interests as both CM and contractor</td>
</tr>
<tr>
<td></td>
<td>• Construction may start before design completion reducing project schedule</td>
<td></td>
</tr>
<tr>
<td>DB</td>
<td>• Single entity responsible for design and construction leading to clear cut liability</td>
<td>• Minimal owner control of both design and construction quality</td>
</tr>
<tr>
<td></td>
<td>• Construction often starts before design completion reducing project schedule</td>
<td>• Requires a comprehensive and carefully prepared performance specification</td>
</tr>
<tr>
<td></td>
<td>• Construction cost known and fixed during design, price certainty</td>
<td>• Design changes after construction are costly</td>
</tr>
<tr>
<td></td>
<td>• Transfer of design and construction risk from owner to the DB entity</td>
<td>• Potentially conflicting interests as both designer and contractor</td>
</tr>
<tr>
<td></td>
<td>• Emphasis on cost control</td>
<td>• No party responsible to represent owner's interest</td>
</tr>
<tr>
<td></td>
<td>• Requires less owner expertise and resources</td>
<td>• Use may be restricted by regulation</td>
</tr>
<tr>
<td></td>
<td>• Opportunity for the contractor to enhance the buildability of the project producing time and cost efficiencies</td>
<td>• High bid costs/fewer bidders</td>
</tr>
</tbody>
</table>

V GUIDELINES FOR THE SELECTION OF APDS

In selecting the appropriate APDS for a particular situation, the owner must identify and define the goals, objectives and issues of importance, and understand their relative priority in relation to project success. The owner must recognise the various trade-offs relating to cost, time, quality, control and risk, and select an APDS approach with the proper balance. There are a number of potential trade-offs to consider, many of which are intuitive, but also corroborated by the various analyses and reports presented herein.

For example, because the degree of design completion at construction start is high in DBB contracts, the cost of design changes is low because the changes are incorporated before construction. Moving from DBB to DB, the tendency is for an early construction start before design completion in order to shorten the schedule. Once construction begins, however, changes are typically more costly because they affect a design that is completed and both procurement and construction are under way. The trade-off for the shorter schedule often achievable using DB is higher costs for any design changes that occur. Therefore, if DB is used, owners should fix the design as early as possible and avoid changes thereafter.

In terms of the bid process, another trade-off is apparent. Because the cost and complexity of bidding DB projects is high compared with DBB, the number of qualified bidders, the level of competition often decreases. Therefore, if an owner's procurement rules require a minimum number of bidders or a distribution of significant work to small or local contractors, the use of DB may be problematic.

Also, as the number of entities involved in the project increases, so does the need for owner resources, owner risk and the potential for claims.

Other relationships and trade-offs also exist. For example, it has already been shown that the loss of owner control of design and construction quality in going from DBB to DB (as emphasis shifts from low life-cycle cost to low initial cost). It also needs to be recognised that as more cost and schedule risk shifts to the CM@R or DB contractor,
as compared with a DBB approach, those risk pressures also negatively affect design and construction quality.

Similarly, because owner involvement and control decreases in the DB approach as compared with DBB, it is more difficult to ensure the needs of the ultimate customer are met both during construction and for the completed project.

It thus appears that the potential for lower cost and shorter schedules with a DB approach comes at a price. This fact and the various trade-offs are the essence of an owner's challenge in selecting the APDS that achieves the best balance for the project at hand.

To meet that challenge, adhering to the following recommended steps will assist owners in selecting the most suitable APDS to maximise project success:

a. identify and define the goals and objectives are most important to project success for your specific circumstances;
b. identify and define the special or unique issues that must be addressed;
c. recognise the limits of resources and expertise of your owner organisation;
d. select the APDS that most effectively can meet or achieve those requirements; and
e. recognise and acknowledge the trade-offs made in the selection of an APDS.

Once the selection of an APDS is made, the owner’s job is not done as other actions and commitments are necessary to ensure success. It is important that the owner:

a. effectively communicates to the various team members (architects, engineers, CMs, contractors and consultants) the goals, objectives and issues that drove the selection of project delivery system: it is important they understand and commit to the owner's expectations;
b. ensures that the terms and conditions of the various contracts reflect the goals, objectives, issues and expectations for the project and record the agreements in that regard; for example, if changes during construction are anticipated, the contract language should define how those changes will be managed and their cost and schedule impact minimised;
c. considers legal assistance experienced in construction matters for crafting the contract language;
d. commits to the appropriate level of owner involvement (e.g., support-heavy involvement with timely and informed decision making, so as to not delay or affect the project); conversely, avoids imposing owner changes or controls on DB contracts;
e. assesses potential risks and plans how you manage the overall programme: internally or via a programme management consultant; and
f. finally, recognises that disputes over scope, quality and other issues may still arise, so it is important to define how such disputes will be handled in such a manner that minimises disruption and cost/schedule impact to the project; consider the use of such alternate dispute resolution approaches as dispute review boards.
Appendix 2

ABOUT THE AUTHORS

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Maurice Masucci PE is senior vice president in charge of Hill’s construction claims operations in the company’s Marlton, New Jersey office.

Mr. Masucci has over 33 years of progressively responsible experience in civil, geotechnical, and environmental engineering, specialty consulting services, engineering and design services, building design, renovation and modification services, construction, project and engineering management and forensic and claims consulting services. He has performed in various capacities from principal-in-charge, overall programme manager, project engineer, responsible task manager; responsible engineer-of-record, consultant or technical specialist; and construction/field liaison engineer. As a construction claims consultant, Mr. Masucci participates in a broad range of dispute resolution consulting services, claims preparation and analysis, and claims defence, and has testified as an expert witness.

He has managed building renovation and repair projects for government and industrial clients, building alteration and new facilities for the wireless industry, and the engineering, design and construction of commercial/industrial and residential buildings, including the entire architectural, structural electrical and mechanical aspects of the projects.

Mr. Masucci earned his BS in civil engineering from the University of Massachusetts and his MS in civil engineering from the Massachusetts Institute of Technology. He is a licensed professional engineer in New Jersey, Pennsylvania, Delaware, Florida, Maryland, Georgia and Alaska.

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Frank Giunta PE is senior vice president and managing director in charge of Hill’s construction claims and consulting operations throughout the United States and Canada.
He has more than 30 years of extensive experience in engineering and construction consulting. He has been actively involved in the evaluation, presentation, resolution and management of construction claims, as well as project management oversight. Mr Giunta has managed complex consulting assignments on behalf of public and private owners, engineers, contractors, insurance and financial institutions. These assignments have involved a wide range of projects which include highways and bridges, dams, power related facilities, water and wastewater treatment, landfills and building construction. He has been engaged in the design of civil structures, including roads, highways, railroads, hydraulic structures, underground piping systems and has prepared engineer's estimates and technical specifications.

Mr Giunta is a professional engineer with memberships in New Jersey and Pennsylvania. He earned a BS in civil engineering and construction technology and a BS, *cum laude*, in civil engineering from Temple University. He also earned an MBA in financial management from Drexel University.

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David Price is senior vice president of business development and strategy with Hill International.

Mr Price's business development efforts are focused particularly in Europe, the Middle East and Africa. He has over 35 years of experience in the construction and engineering industry and has spent over 25 years providing contractual advice and resolving disputes since joining Knowles Limited (now a Hill International company) in 1986. He is experienced in the strategic management of major international claims and disputes and heads up many of Hill International’s major international construction disputes.

Mr Price is particularly involved in directing the resolution of claims and disputes for international building and civil engineering contractors and also works regularly in the United Kingdom and international oil, gas and power sector for operators, contractors and specialist subcontractors. He is skilled in the drafting of contract documentation, procurement, provision of engineering and construction legal advice and preparation of claims for extensions of time and additional cost.

He is also an experienced speaker on construction law matters, presenting many public and in-house seminars in United Kingdom, Europe, Middle East, Far East, and North and South America on international claims and forms of contract.
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