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Milsons Point NSW 2061
Australia

11 Sep 2015

The Hon. J Prentice MP
PO Box 6021
Parliament House,
Canberra ACT 2600

STANDING COMMITTEE ON INFRASTRUCTURE & COMMUNICATIONS
Inquiry into the role of Smart ICT in the design and planning of Infrastructure

Dear Madam

Following our presentation at the Sydney Hearings on Friday 21 Aug 2015, we have much pleasure to respond to your request for further documents and to outline some matters related to the discussions.

1. Integrated Project Delivery (IPD) Contracts

A key benefit of the adoption of BIM methodologies is the promotion of collaborative ways of working in the design and delivery of projects through the sharing of information held within the digital models. This allows the expertise, knowledge and experience of all project participants down through the supply chain to be brought to bear on the end product, while also encouraging a culture of risk-sharing among all the stakeholders, and leading to more cost-efficient processes.

In Australia, investigations into new forms of contract for projects using BIM have been undertaken by several groups, but largely these developments have not achieved a substantive outcome at this stage.

The Australian legal fraternity believe the process can be readily achieved:

> "The integration of BIM into contracts in Australia does not have to be a complicated one. There are many mechanisms, including adopting the approach taken in the UK whereby BIM protocols are appended to Australian Standard contracts. As more and more of the private sector continue to drive the implementation of BIM and develop their own internal Digital Engineering Management Plans it has become apparent that the adaption of legal requirements to accommodate BIM can no longer be considered an impediment to the wide implementation of BIM in the design and planning of infrastructure in Australia. Especially in circumstances where so many industry bodies, such as buildingSMART are seeking to develop tools to ensure consistency and uniformity wherever possible. On many projects throughout Australia existing forms of procurement such as PPP, Alliancing contracts and NEC3 contracts are being adapted to accommodate the idiosyncrasies of BIM which are not currently catered for in those standard forms."[1]

There are International examples, mainly in the US, on IPD Contracts as follows:

USA:

[1] Lindsay Prehn, Colin Biggers & Paisley, Construction Lawyer, Sydney, tel: +61 (2) 8281 4525

The US has been proactive in developing IPD contracts and it should be considered in any Australian development.

In 2005 a Sutter Health project adopted an IPD contract model and created an individual contract named an *integrated form of agreement* (IFOA). This was agreed between the architect, general contractor, and owner. "As opposed to a design-construct contract that has a single point of responsibility, the IFOA relies on a Core Group of representatives of the owner, architect, and contractor to administer the project ". (Forbes & Ahmed 2010).

Howard Ashcraft, Partner Hanson Bridgett LLP is an expert in this new form of contract and has reported widely on Private sector IPD contract experiences[2].

> "The IPD contract templates use a "value/cost" model that is designed to permit and incentivise early experimentation and creativity, and then in the construction phase, focus on efficient execution. You can think of it as an economic model of the decision efficiency curve popularly known in the US as the MacLeamy curve. Typically the risk/reward system is modified to reflect the owner/team values for the project.
>
> It is particularly appropriate for an institutional owner, such as a University, that is more interested in getting the maximum value for its funds than it is in saving cost to be applied to another project. All of our economic models are project specific, and we have about a dozen different approaches we have used. One form assumes an agreement between an owner/designer/builder with specialised subcontracts used to incorporate trades and consultants into the IPD business and contract model. The choice of form depends on the project, the owner and other variables. The key elements of the business model are similar. These are proprietary agreements, but as we have structured 70+ IPD agreements, they have seen considerable use."

Attached is a Hanson Bridgett contract template used for a Polyparty IPD Agreement, which assumes all parties within the risk/reward group sign a single agreement.

ConsensusDOCS

ConsensusDOCS is made up of 21 member organisations, including; the Associated General Contractors of America (AGC), the Construction Owners Association of America (COAA), the Construction Users Roundtable (CURT), Lean Construction Institute (LCI), and a large number of subcontractor organisations. In 2007 it released its Standard Form of Tri-Party Agreement for Collaborative Project Delivery, entitled *ConsensusDOCS 300*[3].

American Institute of Architects (AIA)

The AIA have developed several industry guides for IPD, with many useful links to industry and standards organisations.[4] The AIA has published two separate IPD families: AIA 295 one, built on a construction management at risk model, and the Single Purpose Entity (SPE) family AIA C195. They have a recently updated IPD form (attached)

United Kingdom

IPD style contracts are less developed for IPD projects, but examples include the U.K.'s Be Collaborative Contract[5].

Australia and New Zealand

[2] A short article for the International Bar Association outlining the key elements of an IPD approach by Howard Ashcraft.

[3] see http://www.consensusdocs.org/

[4] see http://info.aia.org/siteobjects/files/ipd_guide_2007.pdf

[5] see Attachment 1 below

Work has also been undertaken by Standards Australia, in Committee MB10

We would recommend a good reference activity by the Department of Defence, led by Mr Bob Baird[6]. With the assistance of their lawyers, Defence has been examining the changes need for Commonwealth Public Works projects. It is noted that Department of Finance actually administer these contract provisions.

2. Reports on the Value & Implementation of BIM In Australasia

We have provided a link to the following reports

- BEIIC Report (2010) , see BIM Economic Study
- National BIM Initiative (2012), see National BIM Initiative
- APCC & ACIF Framework (2014) see The Framework for the Adoption of Project Team Integration and Building Information Modelling (Framework)
- Joint buildingSMART-SIBA Position Paper (2015), see Integration of Geospatial and Built Environment

The *BEIIC* report was based on one of the first surveys of the adoption of BIM in Australia and the first economic analysis done to identify the productivity benefit.

The *National BIM Initiative* was established by us following a series of national workshops - nearly 300 industry representatives from a wide cross-section of disciplines - who were asked to specify the priorities for widening the use of BIM and identify roadblocks to its adoption. The six issues: Procurement; Guidelines; Education - especially vocational training; National Object Library; Process and data exchange; and Regulatory framework for Planning & Local Government formed the basis of a national plan. Procurement, Guidelines and Object Libraries were addressed by Working Groups but have not gained substantive work due to a lack of resources in a context of uncertainty by business on the opinion of commonwealth & state governments.

That said there are pockets of continuing work, for example NATSPEC & CIL NZ are now developing a framework for naming and data structure for BIM object libraries.

The *APCC* report took the NBI a step further by marrying it with the concepts of Lean Construction[7] and articulating a BIM policy for Government procurement agencies across Australasia. This documents was launched by The Hon. Bob Baldwin MP. A link to the press release is here.

The *buildingSMART-SIBA Position Paper* is a review of the large developments that have been happening globally where BIM has being extended into the infrastructure domain, and overlaps the spatial data community. The UK have recently taken the lead in this with the announcement of their Digital Built Britain initiative. The EU has been quick to pick up the theme and Australia is at risk of having to play catch-up as those economies begin to reap the benefits of early adoption.

We referred to the work of the Air Conditioning and Mechanical Contractors' Association (AMCA) see BIM MEP^{aus}. In addition we have attached a summary of the BIM MEP^{aus} work at the end of this letter.

We believe these reports cumulatively give government a firm foundation for the application of a National policy.

3. Why does Government need to set standards?

[6] Bob Baird, Executive Director CFPC, Department of Defence, Infrastructure Asset Development Branch, +61 (2) 6266 8082, Bob.Baird@defence.gov.au, +61 404 815 676

[7] see Lean Construction Institute of Australia, http://www.leanconstruction.org.au

The Productivity Commission report says, "Governments, in consultation with industry and other private sector procurers, should coordinate the establishment of common technical standards to ensure that the greatest benefits from the adoption of BIM are realised"[8].

The construction industry in Australia is calling for leadership from the Government to provide the essential framework necessary to implement BIM. There are currently no policies to drive the effective use of BIM across the whole of the infrastructure asset lifecycle in Australia.

The private sector in Australia has well-developed techniques for coming up with ideas and generating their own efficiencies and productivity gains. However, agreement on a common framework across the private sector can be very difficult. Government involvement is a key aspect of business confidence and success.

It is important these standards are set by Government, and not by vendors. At the moment, the roll out is working in the vendors favour at the expense of Government. It's like asking corporate accountants to draft the tax rules.

Businesses at all levels in the construction supply chain working on a Government project would collaborate and openly share plans. This would help to strip out waste, mistakes and lost time.

Currently Project delivery is typically based on a disjointed model as a result of the many and varied authorities, consultants, contractors and subcontractors organisations involved. Each individual organisation typically has their own formats they may output information in, and there is no incentive for organisations to share data in formats that are legible to others, in fact the opposite may be considered advantageous.

The primary goal is to to reduce costs, add value and improve efficiency and legibility in data /information transfer. Standards as in other areas permit national and international coordination and compatibility. Standardised data structure or formats permit automatic processing; to avoid costly and time consuming manual data processing, speed up information sharing, avoiding errors, and reducing costs.

An exemplar of this role is **AustRoads**[9], which through policies and standards promotes operational consistency by local road agencies *across all states and territories*. It also provides for service providers in this industry a common way of working and enhanced competition.

Other examples are the World Wide Web (IP address formats); email protocols; telecommunications system protocols; and standardised protocols in healthcare.

As the adoption of digital ways of working in the built environment is new, and indeed very disruptive to processes and skills, it is crucial that we have appropriate standards to gain the greatest productivity benefit across the nation and avoid a 21st Century version of "rail gauges".

4. Data access/security issues

This linked article http://www.siba.com.au/News/News-Articles/Opinion-The-role-of-the-Spatial-Surveyor.aspx, by Michael Haines of VANZI covers all the essential points including why a new legal framework and certification is required (for certainty, privacy, security and ease of access use and trade); how it would work and the roles of the key stakeholders.

On the broader context , see vanzi.com.au

[8] Productivity Commission of Australia, Public Infrastructure, 2014, p. 27.

[9] see http://www.austroads.com.au

5. BIM, Digital Engineering, Digital Built Environment or Digital Australasia - it is all the same thing!

Worldwide there is considerable effort in developing a digital solution that integrates all aspects of the activities in the Built Environment, historically termed independently BIM and GIS. There are different terms being used at present, thus when you see *BIM*, *Digital Engineering*, *Digital Built Environment, Digital Australasia* or *VANZI* they are all referring to a holistic view of the use of digital data in the infrastructure development context for the better asset management of our cities and national infrastructure assets.

6. Can Australia ramp up to World/Asian leadership in BIM?

In the context of US, UK and European competition in the urban infrastructure space we have to quickly accelerate our knowledge, protocols and marketing of digital BE services.

We have excellent technical resources which are already participating in partnership with Standards Australia and Natspec.

Australia can choose to wait for others to address the challenges and become late adopters of the DBE and subsequent opportunities. Alternatively, we can recognise and address the challenges—industry, Government and academia in partnership—and place Australia and our spatial and construction industry sectors in the driver's seat to reap all the benefits of being early adopters.

We are looking for two specific actions by Government:

- As the largest procurer, owner and operator of infrastructure and buildings, Federal, State and Territory governments should play a strategic role in driving innovation in the adoption of BIM technologies and their integration with spatial information. There are enormous productivity and performance benefits to be derived in the efficient use of tax dollars to meet the challenges of global urbanisation. Governments throughout the world are recognising that opportunity and taking appropriate steps, and Australia is at risk of falling behind and losing the export market opportunity.
- Through relatively modest levels of expenditure, government can sponsor cross-industry programmes and deliverables that facilitate the wider adoption of BIM and its integration with spatial information in ways that are impeded if left solely to industry. This includes the development of open standards, a national BIM object library based on agreed terminology and data specifications, guidelines for adoption, establishment of education standards and certification procedures, new forms of contract that recognise the role of ICT, etc. Such modest investment will be returned with huge interest, judging from the UK programme.

Yours sincerely,

John Mitchell
Chairman
buildingSMART Australasia

Attachment 1

The Be Collaborative Contract[10]

March 29 2004

The Reading Construction Forum (RCF) recently assembled a working group of experienced individuals from across the construction sector with the aim of taking forward a variety of the ideas set out in Sir John Egan's Report on the UK Construction Industry. Key among the report's suggestions was that effective partnering should allow formal contracts to be dispensed with. The working group's ultimate objective was to design a construction contract for the 21st century that encourages collaborative working and the proper management of risk.

RCF merged with the Design Build Foundation last year to form Be (Collaborating for the Built Environment), and the Be Collaborative contract was published in September 2003.

The contract contains a number of unique features, which are discussed in detail below.

Structure

Partly in deference to Egan, who compared construction with the motor industry where work is done virtually without contracts and on the basis of a purchase order, the team decided to separate the practical (and variable) issues from the terms and conditions. The contract comprises the purchase order and the collaborate construction terms.

The purchase order is signed by the parties and sets out details of the project and services to be provided. There are boxes for the many variables in a construction contract, such as completion dates, defects liability period, liquidated damages or bonus, insurance, price and payment terms.

The collaborative construction terms are set out in eight sections over 15 pages, which cover the following issues:

- working together;
- primary obligations of the purchaser;
- primary obligations of the supplier;
- allocation of risks;
- measurement of performance;
- payment;
- general terms; and
- definitions.

The contract is in plain English, avoiding legal jargon. The terminology differs in some respects from the usual: for example, the terms ‘purchaser’ and ‘supplier’ replace ‘employer’ and ‘contractor’ (or ‘client’ and ‘consultant’). There is also a set of guidance notes.

Underpinning Collaborative Working

A contract cannot compel people to collaborate, but it can encourage this approach. The Be Collaborative Contract promotes collaboration in a variety of ways.

Overriding principle

The overriding principle in Section 1 of the contract terms states that it is the intention of the parties “to work together with each other and all other project participants in a cooperative and collaborative manner in good faith and in the spirit of mutual trust and respect.”

Consensus instead of instructions

The contract terms provide for decisions to be reached by agreement between the parties, not by an instruction from the client or project manager. There is a fall-back position if agreement cannot be

[10] Taken from http://www.internationallawoffice.com/ 11 Sep 2015

reached on issues such as the pricing of a claim or a relief event, but the emphasis throughout is on consensus.

Project team

Although this is a two-party contract, it provides for the establishment of a project team, which will include the client and other key participants in the project. Membership may change as the project progresses. The role of the project team is to guide delivery of the project. The precise structure of project team activities is left to the project team members to decide. Project team decisions do not generally have a contractual effect – the project team members will implement them under their own contracts.

Project protocol

A task of the project team is to draw up a project protocol which sets out the aims and objectives for delivery of the project. While this will be prominently displayed where those engaged on the project are working, it has no contractual effect.

Management and Allocation of Risk

Risk management is a hot topic in the construction industry; but there is little evidence of it actually taking place. A 2001 investigation by the Building Research Establishment into how a number of contractors priced the risks when submitting tenders concluded that none of them did so.

The Be Collaborative Contract emphasizes proper risk management in two ways.

Risk register

One party in the project is to be responsible for preparing and updating a risk register. This is not a contractual document, but it can potentially have a major impact on the effective assessment management of risks.

Risk allocation schedule

The principle that risks should be allocated to the party best able to manage them is ignored in every contract except the Be Collaborative Contract. The risk allocation schedule is included in the purchase order and must be completed by the parties before the contract is signed. It replaces the list of 'relevant events' in standard contracts, but with a difference. The risks which are relevant to the project must be identified and the risk allocation schedule will show the amount, if any, in the contract price which is allocated to deal with each risk and, if agreed, any allocation of time the supplier will allow in its programme. If that amount is exceeded, the schedule specifies how responsibility for the time and cost consequences is to be shared by the parties.

The Be Collaborative package of documents includes a guide to risk management.

Relief Events

Relief events cover variations, breach of contract and risks not allocated to the supplier in the risk allocation schedule. Whenever a relief event occurs, the parties must try to reach agreement on the time and the cost implications. If they fail to do so, the dispute resolution procedure can be applied. There is an early warning requirement to ensure that relief events must be notified as soon as they are identified.

Wide Scope of Application

The Be Collaborative Contract is written so that it can be used by everyone on a construction project, whether as a main contract, as a consultant appointment or as a subcontract.

Certain clauses are identified as not applying when the contract involves the appointment of a consultant. Similarly, there are certain clauses which only apply when the contract is used as a subcontract.

There is also a product supply contract which follows the same format.

Payment

There are two payment options, as follows.

Target cost

With the target cost option, the supplier is paid actual costs plus a margin to cover overheads and profits. Actual cost is recorded on an open-book basis.

The target cost option can be with or without a guaranteed maximum cost. If the actual cost is below the target cost, the saving will be shared in the proportions specified in the purchase order. If the target cost is exceeded, the cost overrun will be shared in agreed proportions, with the supplier liable for all costs above the guaranteed maximum.

Fixed price

This is payable against a payment schedule (with or without milestones).

If the fixed price is chosen, all sums included in the contract price allocated to particular risks will be payable to the contractor, even if the risks do not arise. With target cost, by contrast, if the risk does not arise, the money will not be spent and there may be a saving on the overall target cost.

Pilot Testing

The Be Collaborative Contract is being tested on three projects.

The largest is for the University of Manchester Institute of Science and Technology's £30 million Interdisciplinary Biocentre. All consultants were appointed on the Be Collaborative form and the selected contractor was brought in initially as a consultant to assist the professional team in developing the design. Once the design was finalized, the contractor was then appointed to realize the project under the Be Collaborative form. So far, the project team is happy with the form of contract. David Bailey of architects Anshen Dyer is the project coordinator. He says:

"*The Be form of contract is entirely consistent with and has underpinned the way that the design, construction and client teams set out to work together from the outset of the project. Team members have been able to invest 100% of their energy and resources into moving the project forward without periodically being diverted into a contractual game of attack and defence. The completion date remains unaltered since the outset of the project and we continue to enjoy working together as a team.*"

Two health projects are also using the contract: Royal Devon and Exeter Healthcare National Health Service (NHS) Trust on a £15 million maternity suite, and the Gwent Healthcare NHS Trust in Wales for a cardiology unit. They are both proceeding on a two-stage tender.

Before publication there was extensive consultation.

The UK Office for Government Commerce has shown interest, and the Joint Contracts Tribunal (responsible for most of the standard form construction contracts used in the United Kingdom) and Local Government Association have had preliminary discussions on using it as a basis for a local government 'partnering' contract.

Comment

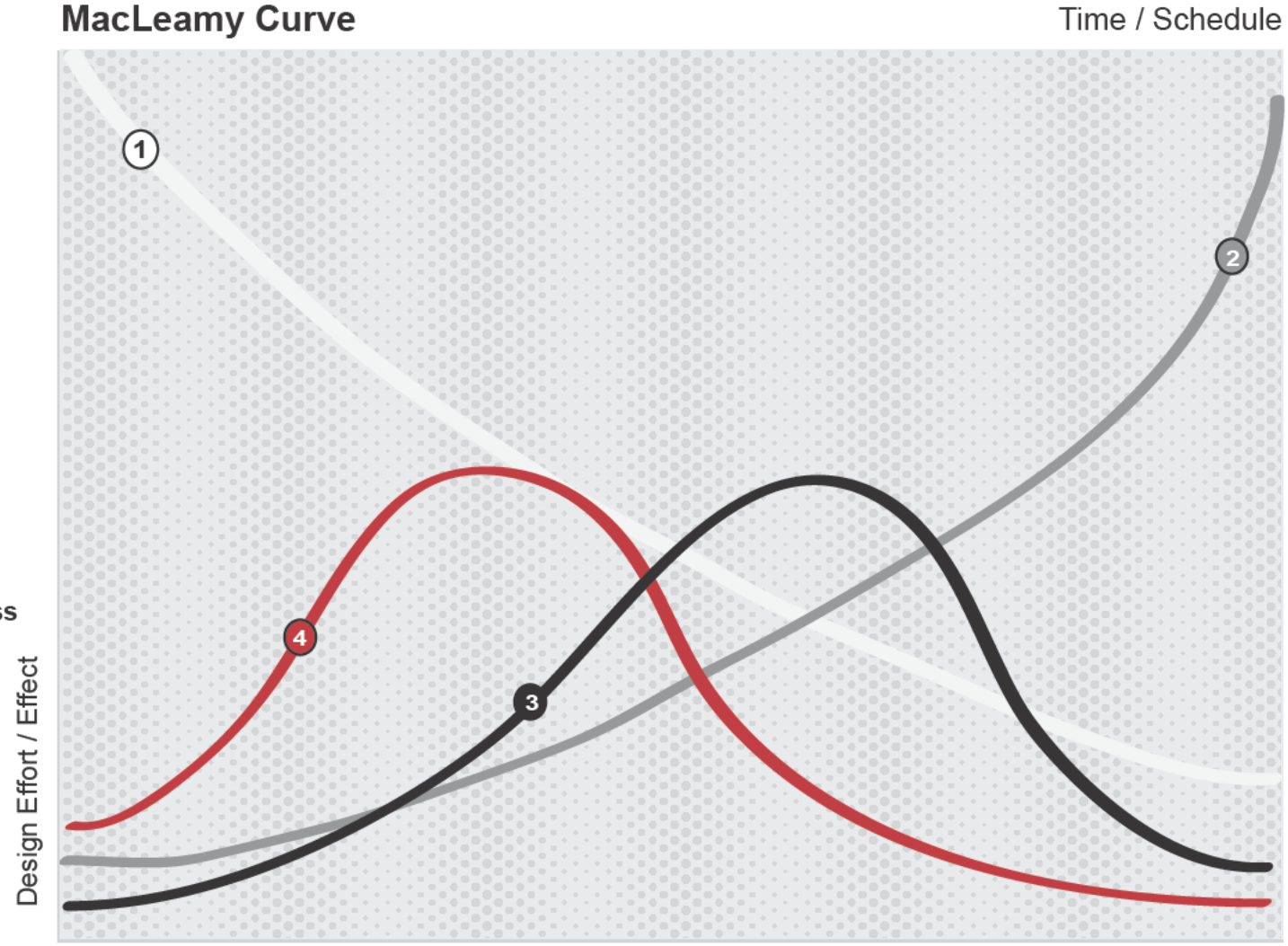
The Be Collaborative contract is easy to read and operate, but as a result of the risk allocation schedule and the collaborative structure, using it requires collective thinking and real teamwork – one reason why it was written.

The Be Collaborative contract is only available in electronic form. It can be viewed on the Be website at www.beonline.co.uk.

For further information on this topic please contact Roger Button at Shadbolt & Co by telephone (+44 20 7332 5750) or by fax (+44 20 7332 5799) or by email (roger_button@shadboltlaw.co.uk). The Shadbolt & Co website may be accessed at www.shadboltlaw.co.uk.

MSA
INTEGRATED PROJECT DELIVERY LLC
DESIGN DEVELOPMENT CONSTRUCTION MANAGEMENT

MacLeamy Curve



1. ability to impact cost and functional capabilities
2. cost of design changes
3. traditional design process
4. Integrated Project Delivery Process

Introduced in the Construction Users Roundtable's "Collaboration, Integrated Information, and the Project Lifecycle in Building Design and Construction and Operation" (WP-1202, August, 2004)", the "MacLeamy Curve" illustrates the advantages of Integrated Project Delivery.

Howard W Ashcraft
Hanson Bridgett, San Francisco

Integrated project delivery: a prescription for an ailing industry

Integrated project delivery (IPD) seeks to overcome many of the obstacles to efficiency on large construction projects through alignment of goals and incentives among the project participants. Drawing on the insights of 'Lean' theory, studies of organisational behaviour and experience with building information modelling, this article provides an accessible primer on IPD for construction industry professionals.

Increased collaboration[1] is transforming the nature of project delivery. Driven by the need to eliminate waste, improve creativity, effectively engage technology and deliver sustainable projects, project sponsors are rethinking how projects are structured and managed. A leading solution, integrated project delivery (IPD), provides an economic and structural basis for high performance projects. IPD experience in the United States and Canada has been very positive and this approach has begun to take a foothold internationally. IPD complements other collaborative approaches, such as contractual partnering and project alliances and is particularly useful in complex projects that require many project participants to be integrated into a virtual organisation.

High performance defined – but not achieved

A project delivery system should reliably deliver projects that are efficient, effective and sustainable. An efficient project uses the minimal amount of labour and material necessary to achieve the project goals. Value is maximised and waste is eliminated or minimised. An effective project responds to the sponsor's needs, whether those are improving employee productivity, improving a learning environment, more productive manufacturing, or other sponsor goals. A sustainable project minimises adverse effects on the natural environment and the project users. Unfortunately, very few projects meet all of these criteria.

Many of the current dysfunctions are chronicled in *The Commercial Real Estate Revolution* where the authors estimate that half of all construction activity is non-productive and discuss the ineffectiveness of many projects.[2] Other researchers have similar findings. For example, studies of tool time (the amount of time actually spent working) have shown efficiencies as low as 19 per cent.[3] The analysis of construction productivity of Professor Paul Teicholz of Stanford University demonstrates a continued decline over the last 20 years – despite all of the improvements in tools and construction technology and at the same time that industrial productivity has risen sharply.[4]

The poor performance of the design and construction industry is not a uniquely American phenomenon. Studies in the United Kingdom have reached similar conclusions regarding construction productivity.[5] Summarising data from the UK, the US and Scandinavia, Sir John Egan's taskforce found that 30 per cent of construction is rework, labour is only 40–60 per cent efficient, accidents absorb three to six per cent of construction costs and at least ten per cent of all materials are wasted.[6] A more recent study of international mega-projects concluded that half result in failure (using a very lenient measure of success) and that failure in some industries is as high as 78 per cent,[7] and Miller and Lessard have previously reported that over 40 per cent of their studied projects 'performed poorly'.[8] Although infrastructure is critical to the world's welfare, we are not doing very well.

Much of this abysmal performance can be explained by the very structure of traditional project delivery. Organisational behaviour

Half of all construction activity is non-productive. Fragmentation of the industry is the prime problem. Most projects are designed and constructed by a multitude of designers and trade contractors

research has shown that structure can strongly influence and even determine behaviour.[9] And in examining traditional project delivery, structural characteristics of fragmentation, misalignment and individual incentivisation all conspire against project success.

Fragmentation of the industry is the primal problem. Instead of having a single organisation delivering a project, most projects are designed and constructed by a multitude of designers and trade contractors. Even if there is a design/builder or an engineering, procurement and construction (EPC) contractor, much of the actual work is done by subcontracted designers and trades. This fragmentation compartmentalises the information necessary for optimised design and construction and builds barriers to communication and collaboration. Traditional contract structures reinforce the fragmentation because each participant is locked into its own contractual silo that has its own boundaries and goals. Designers avoid responsibility for cost, schedule or means-and-methods. Contractors avoid responsibility for design. Accountability is limited to a participant's contractual scope and no one is responsible for the project as a whole. Finally, this misalignment is cemented by compensation systems based on individual performance rather than overall project outcome. For example, if a trade has a fixed price or guaranteed maximum price contract, it is incentivised to execute its scope as inexpensively as possible, without any consideration of the effect on the project or others.[10] It is hardly surprising that this fragmented, misaligned structure drives disappointing outcomes.

Attempts to improve projects have focused on effective use of technology, prefabrication, integration of Lean[11] principles, and enhanced attention to sustainability. But each of these responses is dependent on deep collaboration and integration.

The trend to integration

A solution to fragmentation is to create a virtual organisation drawing from the many project participants. As will be discussed in this article, this requires the early involvement of key participants and deep collaboration among them. Building information modelling (BIM) requires deep, early collaboration if the BIM is to be used for simulation, optimisation, cost management and constructability. Sustainability similarly requires deep, early collaboration.[12] And the use of Lean principles and processes is likewise dependent on deep, early collaboration. The Lean Construction Institute recognised the need of integration and sponsored development of an integrated construction contract, the Integrated Form of Agreement, as a platform to integrate the project team. Thus, the IPD model not only addresses the inherent dysfunctions of current project delivery, it strengthens other critical goals of effective BIM use, implementation of Lean principles and processes, and achievement of sustainable projects. It is also consistent with emerging international standards for collaboration.[13]

The IPD structure

The essential IPD structure has been defined and updated since its initial definition in 2007.[14] The author's approach, referenced as the optimal approach in the most recent IPD definition document,[15] consists of three elements: (i) a business model; (ii) a contract model; and (iii) enabling behaviours. This reflects current IPD theory and practical experience from over 60 full IPD projects. It blends Lean and IPD principles and although phrased differently, it is consistent with the approach suggested by other researchers.[16]

IPD business model

The business model should align the participants' interests to the overall project goals, reduce excessive contingencies and it should limit opportunity to circumvent the system through change orders. The participants should be accountable for the entire project, and if problems occur, they must jointly solve the problems. In our experience, the business model has four primary elements.

Fixed profit – ideally 100 per cent profit at risk

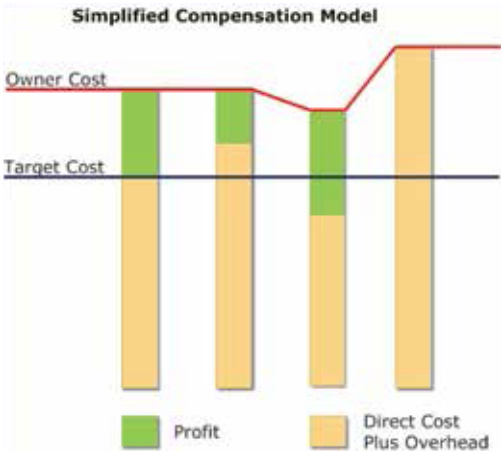
Profit should not be calculated based on units of labour or materials as this acts as an incentive to increase the number of units to increase profitability. Instead, the incentive should be to increase margin by reducing the underlying costs while maintaining a fixed profit amount. Ideally, 100 per cent of a parties' profit should be at risk to ensure the division of profit from underlying costs. Moreover, the at-risk profit provides the owner with a buffer against cost overruns, and less than full profit at risk can result in an inadequate buffer.

Variable costs without cap

There are several reasons for the owner guaranteeing costs without a cap. Cost caps lead to excessive contingencies because the capped party wisely includes buffers in its cost estimates to protect against the potential cost overrun. These bubbles of contingency are repeated throughout the project at each level and sub-level and in sum exceed the amount required to buffer against project risks. The cap also creates defensive behaviour because if there are any project disruptions, the parties will necessarily begin the claims/change order process to avoid losing claim rights that may be important if the project continues to suffer additional costs. This creates an antagonistic project atmosphere that turns the participants away from joint problem solving towards risk shifting and blame. In addition, caps are often ineffective when they are arguably needed most. They are effective when the cost overrun is minor but if there are major overruns, litigation almost always ensues. Thus, the owner pays once in excessive contingencies, again in reduced efficiency and then pays again when it incurs claims costs and possibly claims payments. Finally, the variable cost guarantee is a fair trade for the fixed profit being at risk and the limits on change oders.

A solution is to create a virtual organisation drawing from the many project participants. The IPD model addresses the inherent dysfunctions of current project delivery

Figure 1



Profit based on agreed project outcomes

Tying profit to achieving agreed project outcomes assures goal alignment and increases the likelihood of aligned action. The agreed outcomes are whatever the owner and the team value most. Often this will be cost and schedule, but it can also be quality, sustainability, functionality, lifecycle costs, owner satisfaction or whatever else the team may agree upon. By tying profit to project instead of individual outcomes, the team is incentivised to collaborate in pursuit of common objectives and selfish behaviour is discouraged.

The compensation and incentive plan is custom built to meet the needs of the project and the participants. These plans range from simple systems measured against a target cost to complex indexed systems, with different incentives in different project phases. Designing a proper system requires close coordination with all stakeholders. Figure 1 depicts a simple system under four different outcomes. Figure 2 is an example of a more complex model that incentivises creativity during the design phase and smooth execution during construction.

Limited change orders

Change orders are limited to a few specific situations, such as an owner elected change. Team responsibilities, such as errors and omissions in the drawings or construction productivity issues, are issues for the team to resolve, not opportunities for additional revenue. This attribute, in conjunction with limited liability and profit based on project outcome, creates a closed system where escape through change orders and claims is largely eliminated. If problems arise, the team must solve them regardless of cause because not doing so reduces everyone's profit. Once understood, this attribute leads to more effective constructability evaluations, coordination and a rapid response to problems that occur.

Figure 2

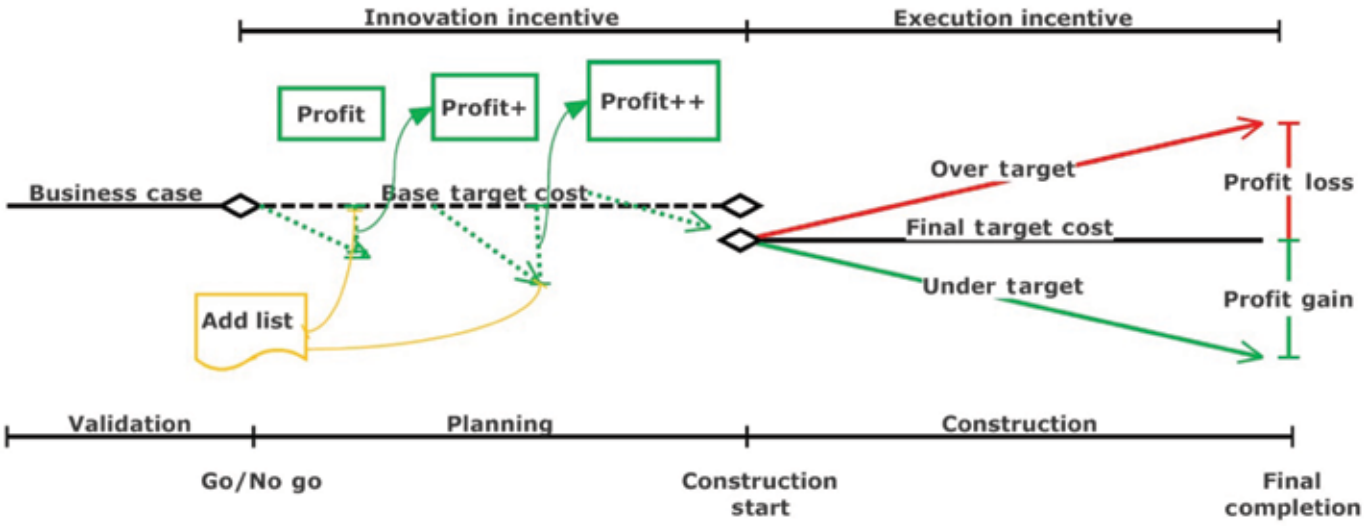
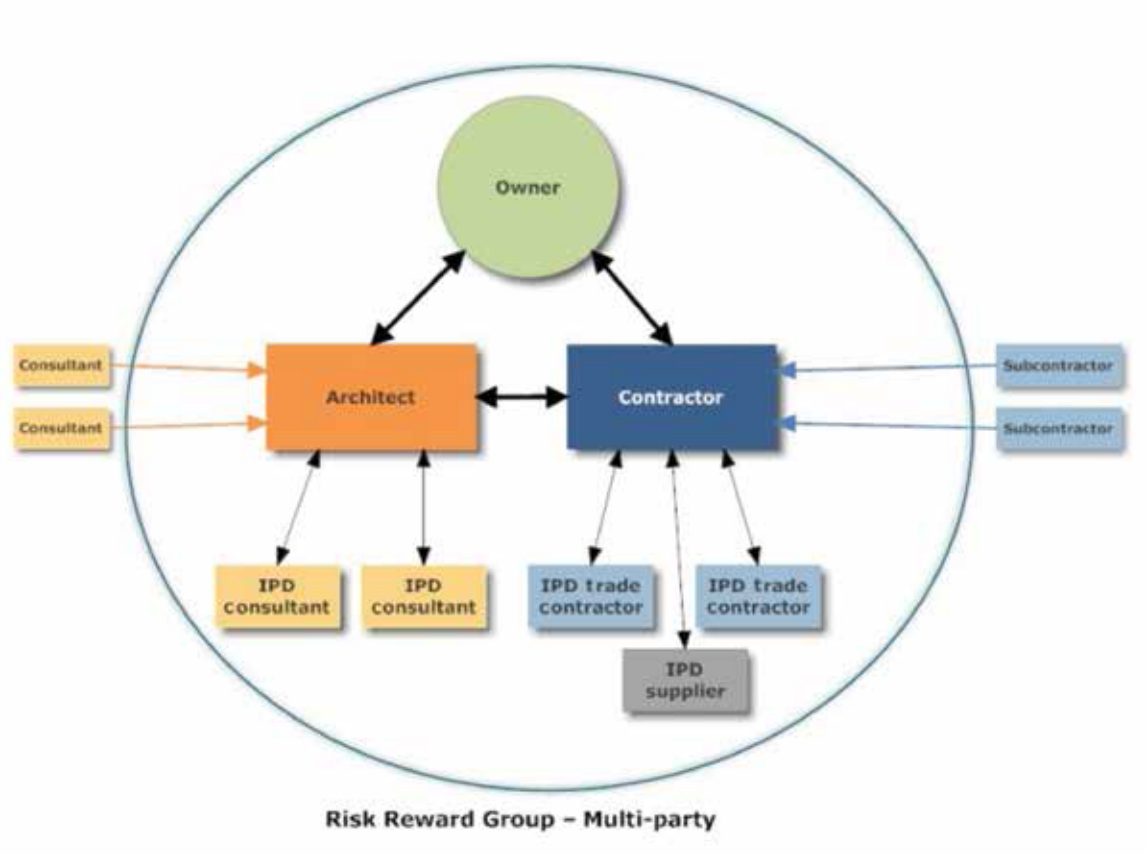
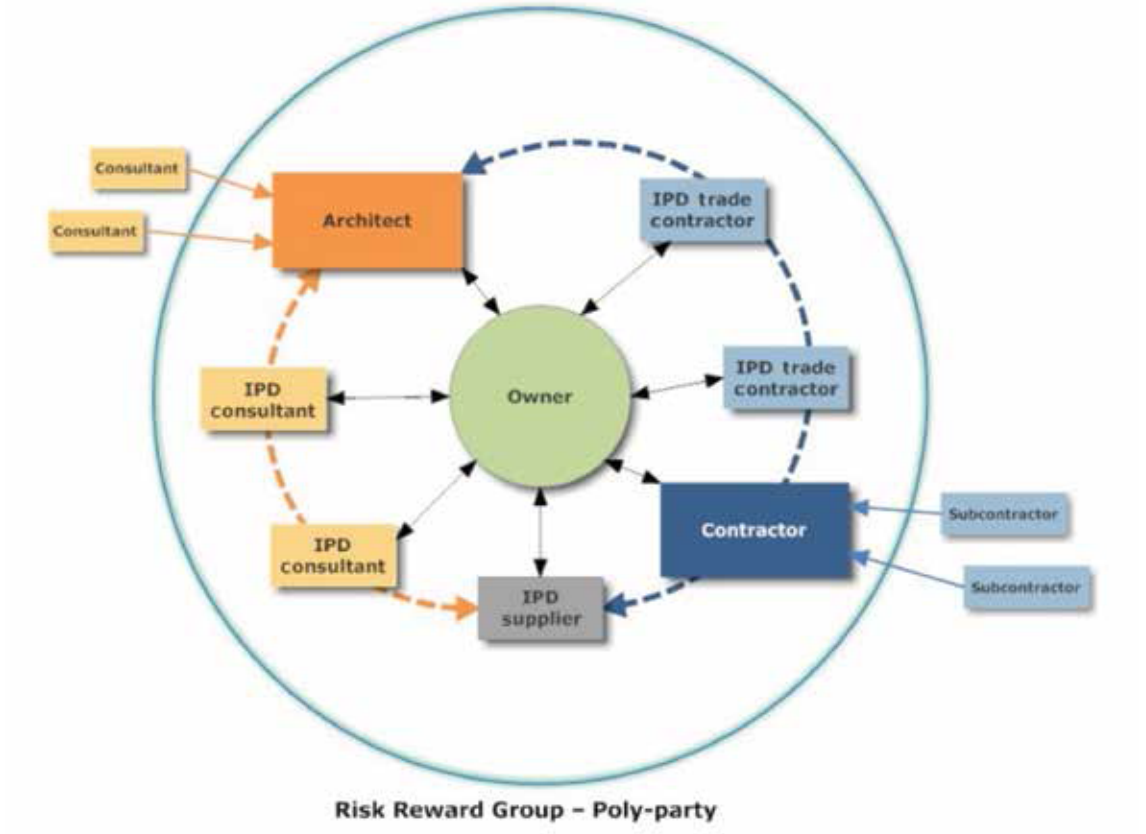


Figure 3


Owner
Consultant
Consultant
Architect
Contractor
Subcontractor
Subcontractor
IPD consultant
IPD consultant
IPD trade contractor
IPD trade contractor
IPD supplier
Risk Reward Group – Multi-party


Consultant
Consultant
Architect
IPD trade contractor
IPD consultant
Owner
IPD trade contractor
Contractor
Subcontractor
Subcontractor
IPD consultant
IPD supplier
Risk Reward Group – Poly-party

IPD contract model

The IPD contract model binds the parties to their joint goals and requires them to jointly manage the project. The contract model can be accomplished through a series of interlocking agreements, but more commonly – because it is much simpler – it is achieved by using a single agreement signed by all participants (polyparty agreement) or a single agreement signed by the principal parties (multiparty agreement) with appropriate sub-agreements to incorporate trades and consultants within the risk/reward group.

Whichever approach is taken, we believe the following elements are necessary for an IPD agreement.

Early involvement of key participants

The key parties are contractually engaged at the earliest responsible moment. This is consistent with research indicating that higher performing projects have their teams assembled before 20 per cent of design has occurred.[17]

Key parties are those that have a substantial stake in the project outcome or who have a material effect on project outcome. Involving these parties early has many beneficial effects. It increases the overall knowledge base before design is developed and improves the designer's understanding of systems, equipment, alternatives and costs implications. It also increases the diversity of opinions and perspectives – a key determinant of creativity.[18] It avoids much of the rework inherent in the transfer of design information to builders and can allow for an efficient distribution of design effort between the licensed design professionals and the design/assist or design/build trades. Moreover, it allows for coordination and constructability to be built into the process rather than applied after the fact enabling target value design and eliminating value engineering.

Joint project control and decision making

Joint project decision-making is an essential step in creating a virtual organisation. By empowering the team to jointly manage the project, decision making is accelerated and moved closer to the sources of knowledge and information. Joint decisions have an inherent check-and-balance that improves decision accuracy. Joint project decision making also increases overall ownership of the project, leading to higher levels of commitment and provides a fair balance for the profit risk undertaken.

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Shared/risk reward based on project outcomes

This is the contractual tie between profit based on agreed outcome and limitations on change orders. By putting both of these attributes in an enforceable agreement, the business model becomes an obligation, not an aspiration. This is one of the distinctions between true IPD and other collaborative approaches, such as partnering, that seek to achieve behavioural changes – but which can be abandoned mid-project because they are not contractually required.

Jointly developed validated targets/goals

The jointly developed and validated targets/goals are an enforceable 'mission statement' for the project. Because they are used to determine project success – and compensation – they align the team's actions to the agreed goals. Agreement to goals also leads to commitment to achieving them. In addition, they provide a check, through the validation process, on the feasibility of the project. Aggressive goals also create the stress that leads to behavioural change, but because the stress is felt by all project members it becomes a shared incentive to jointly develop new and more effective approaches.

Project goals should be visible and repeatedly examined. In most IPD projects, the goals and reporting of progress are openly posted (usually on walls of the 'big room') to reinforce the team's direction and commitment.

Reduced liability among risk/reward members

Reduced liability is an element in closing the system, forcing the participants to take responsibility for the project rather than attempting to blame other participants in an attempt to escape the impact of a problem. But perhaps more importantly, it removes disincentives to direct and continuous communication between the parties. As parties that suffer because of incorrect information can often claim against the information

provider, project participants (particularly the design professionals) have become wary of providing early and incomplete information to contractors. But without an understanding of where the designers are headed, the builders cannot effectively plan. Similarly, builders are mindful of providing advice about design that might draw them into a design issue. But effective teams rely on rapid, direct and continuous communication. Reducing liability among risk/reward team members removes much of the anxiety around communication and promotes healthy teamwork.

The enabling behaviours

The business model and the contractual model set the stage for a successful project. They align the parties, remove barriers to effective teamwork, and close the system to force the team to jointly confront their problems and be accountable for the whole. But they are only enablers. The team members must seize the opportunity to change behaviour. In our experience, the most successful projects concentrate on using the IPD framework to support the significant behavioural changes described below.

Optimise the whole, not the parts

An essential change in IPD is that the project is viewed as an indivisible whole. Every action and every decision should be judged by whether it will lead to improving the overall project outcome. This is distinctly different from current project delivery that hopes – often in vain – that the sum of individual behaviours will benefit the project. But if individual self-interest is not aligned with project outcomes, the parties are like a team of horses pulling in opposite directions: there may be lots of motion, but there is little progress.

Trust

Trust is a critical element of IPD. However, it should not be blind trust. It is trust built on transparency, respect, integrity and keeping of commitments. In many IPD projects, the percentage of kept commitments is a measured key performance indicator. Thus, trust in IPD is actually a measure of accountability – not a warm, fuzzy feeling. But when trust is created, the entire project is accelerated. The parties can trust their colleagues to perform as they promised allowing everyone to plan based on those promises. Moreover, the parties can trust that their colleagues will respect their interests and ideas, creating a safe environment to extend their capabilities. Earned trust is a performance catalyst.

The most successful projects concentrate on using the IPD framework to support significant behavioural changes

Integration (information, people and systems)

High performance projects and project delivery requires integration throughout the process. Integrated information provides a means for information exchange and developing a common understanding. Integrated organisation melds the disparate companies and individuals into a virtual organisation. Integrated processes lead to coordinated and efficient action. Integrated systems enable optimisation of the entire project. Integration creates the possibility of utilising the capabilities of the entire team and creating results that are greater than the sum of the parts.

Continuous improvement/learning

IPD is not a static concept. It is a process of continual examination and improvement. In IPD, learning is not just the subject of retrospectives, it is a daily process where learning is turned into action, tested, modified and tested again. Information is made visible and open to analysis and critique. Processes are studied and challenged, experiments undertaken, and the results immediately fed back into the project. The goal of IPD is not to just to learn how to deliver the next project better; it is to deliver the current project better than originally envisioned.

Appropriate technology

IPD does not demand any specific technology and technology should not be seen as a crutch for failed procedures. But most IPD projects will rely on appropriate technologies, particularly BIM which is an important vehicle for collaboration. It is a platform for rapid prototyping and simulation, creates a common understanding between the parties and is a tool for identifying and resolving conflicts. Astute IPD teams take advantage of project websites, simulation and optimisation software, 3, 4 and 5D models,

and any appropriate tool that will increase understanding, promote communication, collaborate virtually, and better achieve the project objectives. Thus, while no specific technology is required, not using technology appropriately violates the principles of continuous improvement and optimising the whole.

Collaboration

IPD requires collaboration, not just cooperation. Collaboration is working together to achieve the agreed goals. It is synergistic and creates results that exceed what can be achieved by coordination alone. Collaboration in IPD is most visibly shown through collocated activity, where the parties are not just meeting together, they are performing their daily work together in cross-functional groups composed of the best suited employees drawn from all of the IPD participating firms. They engage in a vigorous exchange of ideas and perspectives to develop solutions to project problems and to achieve the common goals. It should be viewed as not simply an exchange seeking to win a debate, but a joint exploration leading to solutions.

IPD requires collaboration, not just cooperation. Collaboration is working together to achieve the agreed goals

Conclusion

Integrated project delivery overcomes the dysfunctions created by a fragmented design and construction industry. It aligns the parties to common goals, removes impediments to collaboration, and encourages the behaviours necessary for high performing, sustainable projects. Experience in the United States, Canada and elsewhere has been quite positive and as teams develop experience executing integrated projects additional improvements are likely. However, as IPD is fundamentally different, construction counsel must assess IPD without the colouration of prior experience and must draw upon a wide range of new tools, including understanding of Lean theory, Building Information Modelling and organisational behaviour principles. And while construction counsel must always

protect the client's interests, he or she must now understand that structuring a successful project for all may be the most effective way to promote the client's interests. IPD is a new approach to construction that requires new approaches from the legal community.

Notes

1 As used in this article, 'collaboration' is a process of individuals working together across organisational lines to jointly accomplish common goals. Collaboration should be distinguished from 'coordination' which implies organising work between entities. A fully integrated project relies on collaboration, with all individuals acting as if within a single, albeit virtual, organisation.

2 Rex Miller, Dean Strombom, Mark Iammarino and Bill Black, *The Commercial Real Estate Revolution* (Wiley 2009).

3 CII, *Lean Principles in Construction* (Research Report 191-1, Construction Industry Institute 2005).

4 Paul Teicholz, 'Discussion on U.S. Construction Labor Productivity Trends 1970-1998' [2001] Journal of Construction Engineering and Management 427; Paul Teicholz, 'Labor-Productivity Declines in the Construction Industry: Causes and Remedies (Another Look)' (AECbytes, 14 March 2013), see: www.aecbytes.com/viewpoint/2013/issue_67.html.

5 Sir Michael Latham, *Constructing the Team: Final Report of the Government Industry Review of Procurement and Contractional Arrangements in the UK Construction Industry* (HMSO 1994); Sir John Egan, *Rethinking Construction: Report of the Construction Task Force to the Deputy Prime Minister* (Department of Trade and Ministry 1998).

6 Sir John Egan, *Rethinking Construction: Report of the Construction Task Force to the Deputy Prime Minister* (Department of Trade and Ministry 1998).

7 Edward Merrow, *Industrial Megaprojects: Concepts, Strategies, and Practices for Success* (Wiley 2011).

8 Roger Miller and Donald Lessard, *The Strategic Management of Large Engineering Projects* (Massachusetts Institute of Technology 2000).

9 Peter Senge, *The Fifth Discipline* (2nd edn, Doubleday 2006).

10 One of the author's projects, a public waste water treatment, provides a good example of compensation misalignment. The concrete trade was paid for concrete in place of a percentage of completion basis and proceeded rapidly to maximise its cash flow and profit by pouring concrete. The electrical contractor could have reduced its costs by placing conduit beneath concrete slabs and within the concrete walls, but the concrete trade was intent on maximising its own outcome and poured concrete before the electrical trade could install conduit resulting in greatly increased delay and expense to the electrical trade, and ultimately to the project itself. If the profits of both parties had been tied to the project outcome, this would not have occurred.

11 'Lean' refers to principles, procedures and tools designed to improve value and eliminate non-productive activity throughout the design and construction process. Lean is commonly associated with the Toyota Production System, and Lean design and construction incorporates and expands on the principles espoused by Toyota, as appropriate to design and construction projects.

12 ANSI, *Integrative Process: ANSI Consensus Standard Guide 2.0 for Design and Construction of Sustainable Buildings and Communities* (American National Standards Institute 2012); Kristen Parrish, *A Path to Successful Energy Retrofits: Early Collaboration through Integrated Project Delivery Teams* (United States Department of Energy, Lawrence Berkeley National Laboratory 2012).

13 BSI, *Collaborative Business Relationships – Part 1: A Framework Specification* (British Standards Institution 2010).

14 AIACC, *Integrated Project Delivery: A Working Definition* (American Institute of Architects, California Council 2007); AIA AIACC, *Integrated Project Delivery: A Guide* (American Institute of Architects California Council 2007).

15 AIACC, *Integrated Project Delivery: An Updated Working Definition* (American Institute of Architects, California Council 2014).

16 Glenn Ballard, Yong-Woo Kim, Catherine Myers, John Strickland, Glynn Rogers and Fred Voll, *Starting from Scratch: A New Project Delivery Paradigm* (Research Report 271-1, Construction Industry Institute 2011).

17 Mark Konchar and Victor Sanvido, 'Comparision of U.S. Project Delivery Systems' [1998] Journal of Construction Engineering and Management 435.

18 Stephen Robbins and Timothy Judge, *Essentials of Organizational Behavior* (11th edn, Prentice Hall 2012).

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