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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 collaboration¹ 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 Lean¹¹ 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

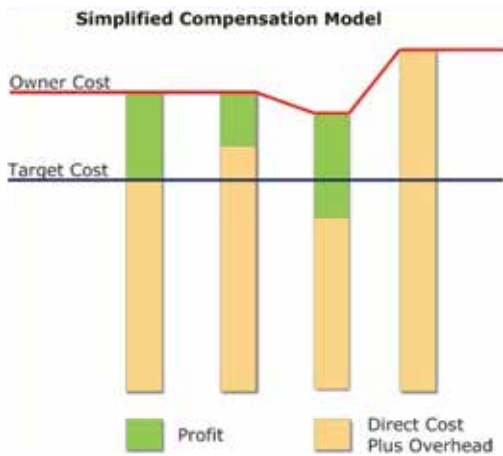
Profit should not be calculated based on units of labour or materials as this acts as an incentive to increase the number of units to increase profitability. Instead, the incentive should be to increase margin by reducing the underlying costs while maintaining a fixed profit amount. Ideally, 100 per 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 orders.

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

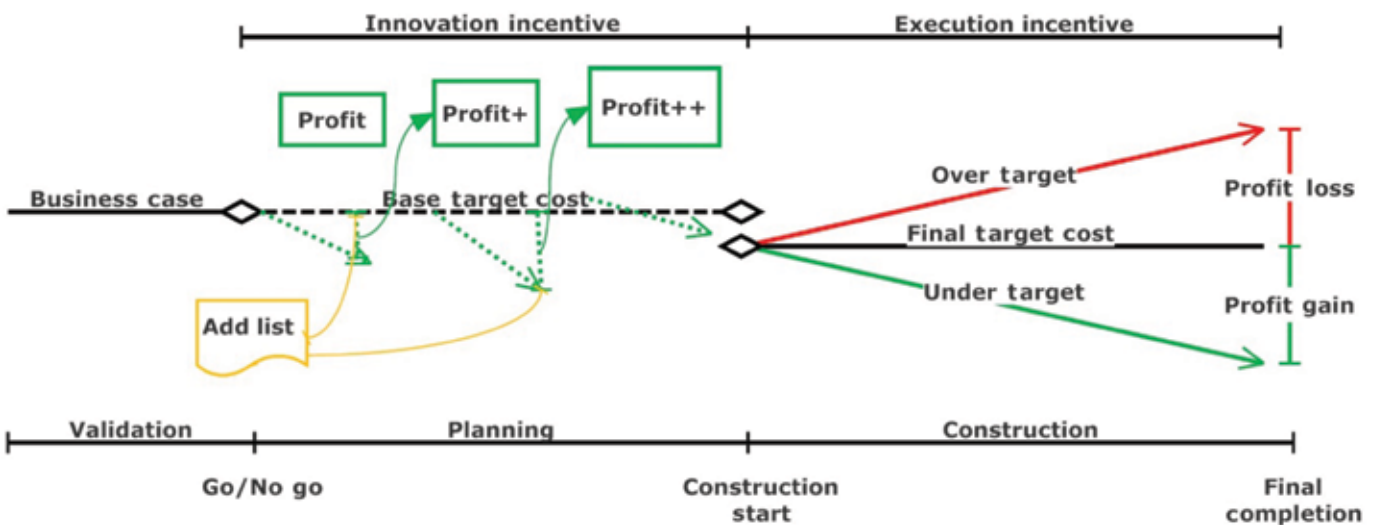
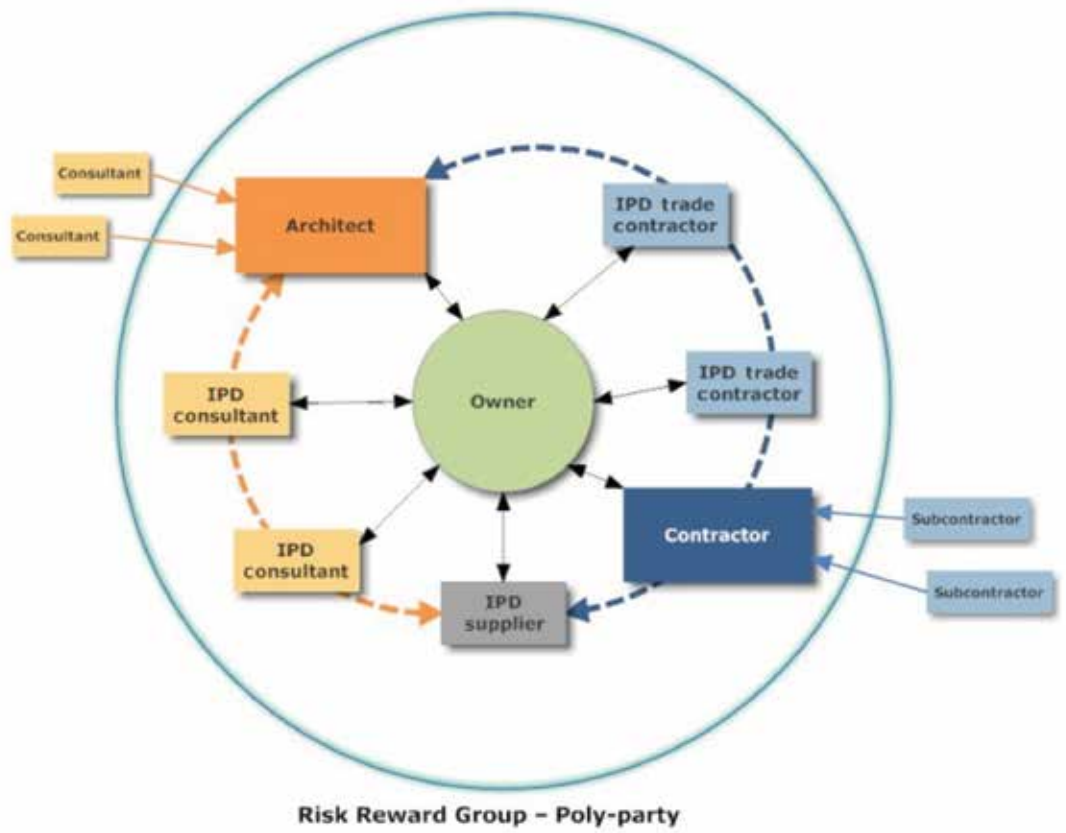
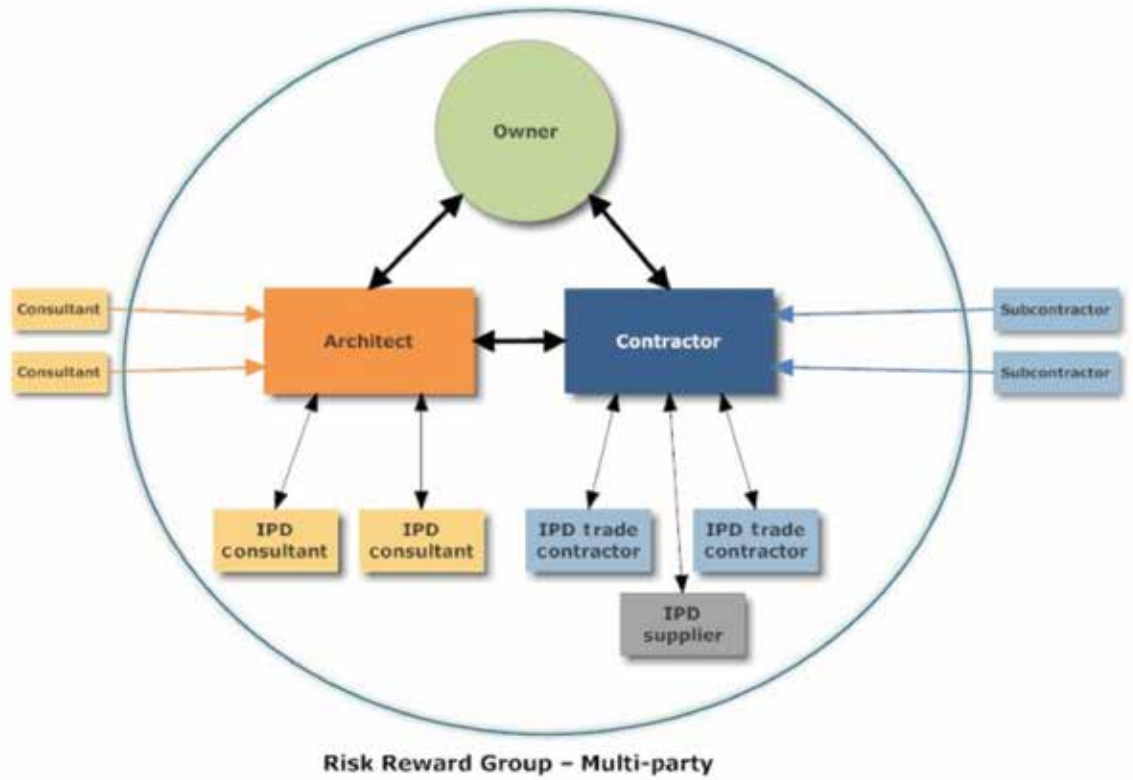


Figure 3



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

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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.

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 Contractual 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, 'Comparison 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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