PROCURING INNOVATION IN CONSTRUCTION: A REVIEW OF MODELS, PROCESSES AND PRACTICES

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ABSTRACT

Using mass timber as a case study, the question this report aims to answer is: how can the construction procurement process be best deployed to 1) accommodate project specific R&D, 2) allow for new technologies and processes and 3) encourage project team creativity?

Published by the British Columbia Construction Association, the research comprised a review of local efforts and international best practices, in-depth interviews with 10 industry leaders and a deep dive into recently completed innovative wood projects in BC in order to understand how the projects came about, the procurement processes involved, who the innovation champions were, cost implications (if any) and any specific issues and challenges encountered.

Preliminary findings were then used to develop the agenda of an industry workshop held September 30th, 2016 at the Vancouver Regional Construction Association. Using four fictitious but "close to reality" case study projects that were developed in consultation with seven public owner organizations in advance of the workshop, 32 invited industry leaders (owners, architects, engineers, contractors and specialty sub-contractors) were set the task of identifying potential innovations, evaluating the procurement challenges and recommending best practice solutions.

The resulting graphically-appealing, "plain language" 60 page guide is intended to help public and private owners become "innovation friendly" in their construction procurement – to enable them to access the potential environmental, economic and social benefits that innovative construction solutions can bring. It is also intended to guide architecture, engineering and construction firms as they set up their competitive response processes so they can bring their best to projects that push technical and logistical boundaries. Using examples of innovation in mass timber design and construction as a means to illustrate broader themes that can be applied to a wide range of building products and materials, this project explores how innovative solutions can best be encouraged within the many different stages and elements of construction procurement.

This paper offers an abridged documentary of the full guide, which is available for free from the BC Construction Association.

CONSTRUCTION PROCUREMENT STATE OF PLAY

"It is unwise to pay too much, but it is worse to pay too little. When you pay too much you lose a little money. When you pay too little, you sometimes lose everything, because the thing you bought was incapable of doing the thing it was bought to do. The common law of business balance prohibits paying a little and getting a lot - it can't be done. If you deal with the lowest bidder, it's well to add something for the risk you run, and if you do that, you will have enough to pay for something better."

John Ruskin (1819 - 1900), English art critic and social thinker

Procurement is an integral part of a construction project. It includes sourcing, purchasing, and all activities related to providing knowledge, manpower, construction equipment, materials, supplies, supervision, and management services necessary to accomplish the project objectives. Increasingly, it includes the ongoing management of the asset, to the extent that building operation and maintenance procedures are affected by the original work.

Effective procurement identifies a project's target market and packages up the opportunity to appeal to that market. It also focuses on securing a deliverable and affordable solution that best meets the owner's needs, and providing a firm contractual basis against which delivery and performance can be assessed. However, construction procurement can be a highly complex procedure, and present some significant challenges for procurers – not least due to the scale of the works being procured, and the variety of professional services typically required for project delivery.

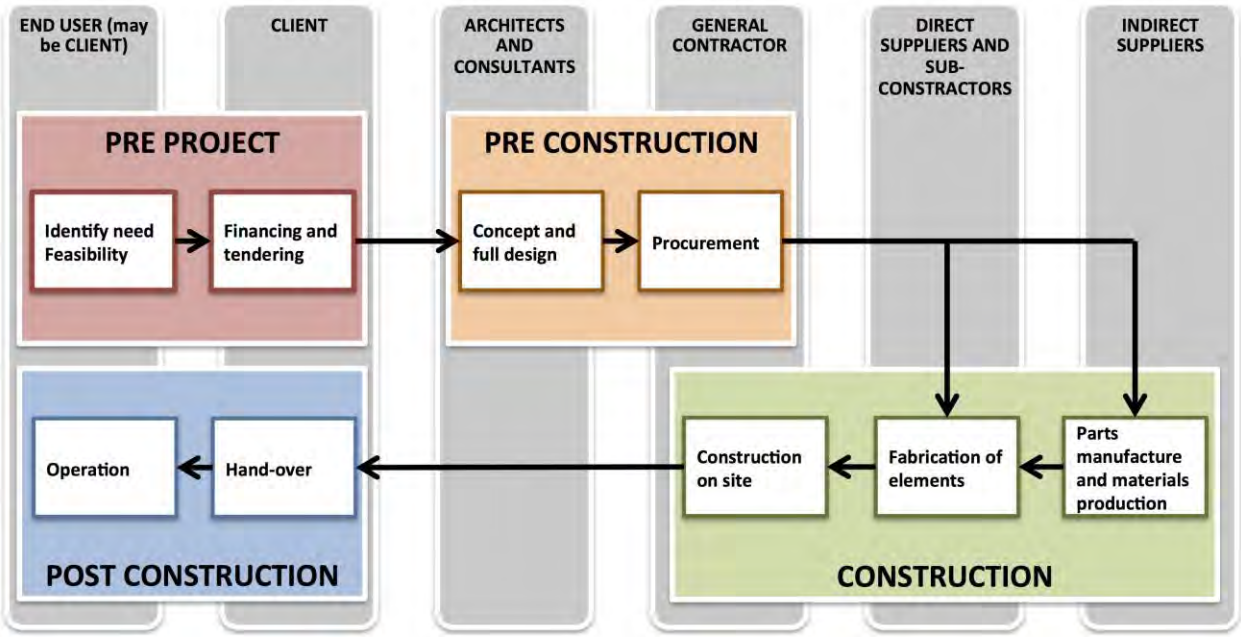

Figure 1: Overview of construction procurement. Source: Adapted from Sci-Network

INNOVATION IN CONSTRUCTION

Broadly, innovation can be applied to a product, a process, an organization or a market. It involves successfully incorporating new ideas, which generate changes that help to solve the needs of a company and so increase its competitiveness. The patterns of innovation in construction are different in many ways from those of other industries, and effective management of innovation is essential to create value for construction companies as well as their customers and owners.

The application of innovation to the construction industry is not straightforward, despite the importance of this sector in the development and growth of the wider economy. Every project is different, which means that construction companies have to be constantly adapting their processes and resources to suit. Every site is a singular prototype whose configuration changes over time. Construction works are located in different places, and involve the constant movement of personnel and machinery. In addition, differing regulations, the weather and other factors can prevent consultants from applying previous experience effectively. This means that although innovative solutions to specific problems add to the overall experience and practices of a company, as innovation is undertaken on a one-off basis, it does not necessarily benefit the company as much as might be expected unless it is possible to incorporate it into the organization's standard management processes. Formatting the procurement process to enable construction companies to manage, measure and control the development and application of new ideas systematically is an important first step towards the standardization of innovation. A construction company that has a standardized management of innovation could see significant improvements in the following areas:

- Organization of activities,
- Competitiveness in the medium and long- term,
- Integration of corporate management processes within the company's overall strategy,
- Efficient exploitation of the organization's knowledge, and
- Systematization of new process and product knowledge.

These improvements will have direct and positive impacts for building owners and clients. However, projects that seek to use unproven products and technologies need to accommodate the time and cost for research, evaluation and testing into the project budget and schedule.

Special Considerations when working with Innovative Wood Technologies

Wood lends itself to modern methods of construction on account of its malleability, affordability sustainability, availability and ability potential to support local economies in British Columbia. Canada's wood industry has been investing heavily in advancing a range of novel building products and structural systems the success of which rely on processes such as off-site construction and digital fabrication. Innovations that are starting to emerge in projects across the country and around the world include:

- Products and materials (oriented strand board (OSB); parallel strand lumber (PSL); laminated veneer lumber (LVL); laminated strand lumber (LSL); glue laminated timber panels (GLT) and wood I-joists),
- Innovative wood structural systems (Cross-Laminated Timber panels (CLT), Nail-Laminated Timber panels, (NLT), post-tensioned systems such as Pres-Lam and other proprietary solutions),

- Connection systems (e.g. proprietary epoxy-based systems developed in Europe).

There are many unique technical and logistical considerations that owners need to be aware of when they contemplate wood projects and how new solutions in wood are brought to market offers important lessons for the other inventions. When working with mass timber, contract documents need to make special provision for weather and moisture protection, constructability (e.g. lifting, storage, etc.) and fire protection during construction. Extra care is required when it comes to the application of technologies that are new (in terms of the location, configuration or application). Testing is required to ascertain the performance of a material, product or assembly for many characteristics, such as structural, moisture resistance, fire, durability and toxicity. Testing takes time and can be expensive so it needs to be identified early and factored into the design and construction process and budget.

PROCUREMENT BARRIERS TO INNOVATION

The procurement of buildings is informed by two distinct and frequently competing priorities: construction businesses need to make money in order to stay in business, while owners need to maximize value for money, in order that limited funds can deliver as much as possible. Times are challenging for building owners. Private developers are faced with the rising cost of land and the public sector is under sustained pressure to maximize value for money, in order that limited funds can deliver as much as possible. There are roadblocks that often preclude innovative designs/construction proposals from being considered, such as the fractured nature of the construction value chain and the pressure to deliver a project for the lowest possible price, which create a procurement climate that is fundamentally hostile to innovation and alternate methods of project delivery. All parties to the procurement process can potentially shoulder some of the responsibility for the poor state of affairs (Table 1).

Table 1: Procurement barriers to innovative construction projects identified by literature review and interviews

Barriers identified by industry	Barriers identified by owners
• Short-term thinking. • Owners are not sufficiently knowledgeable, which can lead to poor advice being taken and results in a project coming in over-budget, outside of timeframes, or to a poor standard. • Low (first) cost of a project is almost always prioritized over Life Cycle Cost (LCC). • Inability to replicate a successful project team, preferring to "mix things up" in the hope of getting a better price but instead simply locking in the inefficiencies that come with unfamiliarity and lack of trust. • Lack of transparency of the procurement process. • Issues over responsibility & allocation of risk. • Lack of integration and standardization. • Lack of continuity of projects dissipates knowledge when teams were dispersed. The lack of continuity severs relationships resulting in a lack of captured learning and no ability to	• Short-term thinking. • Most parties seek to minimize personal/business risk at the expense of another party to the contract. The wrong person is left "holding the bag". • Lack of integration and standardization across the value chain. • Contractors are set up to perpetuate problems with business systems that encourage silo-based thinking. • Lack of recourse (the industry has no code of ethics) against contentious behaviours such as "suicide bidding": a tendering exercise in which a potential supplier, anxious to win business, submits a proposal to carry out the work for less (potentially much less) than it will cost. The term refers to the potential for such a bid, if successful, to be impossible to complete and the bidder goes out of business. • Lack of clear leadership to ensure that construction is properly planned using a design-led approach. • Lack of a culture of training leading to low levels of technical skill on site, omissions of important procedures (e.g. weather protection) and

build on success. • Inadequate incentives to exceed minimum standards. • Some practices in public sector construction procurement, such as pre-qualification, are frequently overly elaborate and increase costs for both the public-sector client and the private sector contractor.	incomplete/shoddy design documentation. • Lack of feedback loops and "captured learning" from previous projects. • Existing insurance and bonding models do not comfortably accommodate collaboration. • Current procurement models inadvertently promote an adversarial relationship between parties i.e. one's profit is often based on the errors and/or omissions of another. • Compressed project timelines and pressure on budgets work against the team's ability to prepare and coordinate adequate contract documents. Inadequately scoped documents lead to price volatility in the bidding stage and price escalation (through contract changes) during the construction phase. • Lack of experience and/or technical expertise within builders and consultants resulting in poor quality of the end product and poor team performance.

Creating a procurement process that is conducive to innovation starts with an owner who can:

- Identify a project with the potential to incorporate innovative solutions,
- Clearly, accurately and completely describe the project requirements,
- Establish a fair, open and transparent project team selection process by which to evaluate responses, and
- Select a delivery model that, for the entire duration of the project, fosters full team collaboration, manages risk appropriately and ensures accountability of all parties (i.e. puts the best interests of the project first).

THE ROLE OF THE OWNER

The success of an innovative project relies on leadership from the owner who not only needs to lead by example, but also establish the structure and tone of key relationships, as well as the values and objectives of the project. This is especially important when assembling a team that has not worked together before. It is the owner's responsibility to seek best "value for money" in their building project – to deliver the functional program within the timeframe required, while meeting stakeholder and society's expectations in terms of financial return, the health and safety of workers and occupants, environmental impacts, aesthetics and so on. Some owners even try to "value" important but intangible benefits such as reputational impacts.

Consultation with industry suggests that owners that have successfully incorporated innovation into their projects (and benefited from the result) seek to provide a supply chain environment in which the 'hands-on' experience of the general and key trade contractors and suppliers is harnessed in such a way that the value created is documented and, if possible, quantified. These owners have found that it is possible to balance risk in the commercial structure without stifling innovation. The key to this lies in their approach to project definition and the team culture. A greater focus on how the ultimate end-user will work in the building once it is complete leads to more 'output-based' definitions. This is not easily achieved, because it requires a major culture shift from the traditional 'silo' mentality, where who does what was precisely defined.

This new approach gives the rest of the supply chain the opportunity to bring its experience to bear, which brings with it innovation, productivity gains and best value. The other benefit is that everyone in the team

can have the opportunity to use their special knowledge, which can be very motivating. But on the other hand, this throws up the challenge of keeping the team together, for the knowledge that they have gained and for the relationships that they have built up.

The lack of continuity of projects has traditionally dissipated knowledge, as teams were dispersed. The lack of continuity also severs relationships. Now, there is a realization that success depends as much on the 'soft' skills as the 'hard' skills. What large experienced owners have learned is that creating supply chain environments, such as Framework Agreements in the UK (Constructing Excellence), that retain knowledge and relationships leads to building success. This is a new vocabulary for many in the construction industry (Leading Edge Management, 2004).

Table 2: Examples of performance targets for building projects

Category	Example of performance target
Schedule	Construction completion date
Cost • Capital cost • Life cycle cost	 Achieve budget cost Achieve budget cost (measured after start-up period)
Quality	Owner satisfaction (measured by survey of end users) Defects & call-backs (e.g. no water damage for wood structures)
Environmental performance	Energy = Steady indoor temperature of (e.g. 20- 22°C) GHG emissions in $kgC0_2/m^2$ Acoustics = STC ratings Waste in tonnes of waste generated (total or per m^2) Indoor Air Quality = presence of mould spores, VOCs (ppm)
Safety	Accident rate

SETTING REQUIREMENTS AND TARGETS

The procurement strategy adopted for a project outlines the key means by which the objectives of the project are to be achieved. The most influential decisions affecting cost, quality and sustainability performance are taken early in the project (during the planning and design phases). Regardless of the procurement procedure and contractual model followed, it is important that performance goals and targets are also set early. Ensuring these targets are clearly communicated throughout the project and in all tendering documents helps to make sure that all involved are working with a common understanding. Evidence shows that $1 extra spent on design, is the equivalent of $20 savings in construction and $60 savings in operation (Dewar, 2016). No matter what type of construction project is being undertaken, the final result achieved will greatly depend on the requirements and targets set by the owner, and how effectively these are defined and communicated to those carrying out the work.

Focusing simply on lowest price can make it very difficult to realize the benefits of novel products, processes or solutions because the advantages may lie in achieving other results such as improved life cycle costs, construction speed, or environmental performance. Construction "value" can be described as the relationship between what you get (or want) and what you pay. Thus, value can be increased by improved function or reduced whole life cost. So, for teams contemplating innovative construction projects it is essential that value is managed, measured and quantified so that the benefits of the new technologies and processes can be evaluated. "Best value for money" is defined as the most advantageous

combination of cost, quality and sustainability (each discussed in more detail below) to meet customer requirements. To encourage innovative solutions, owners therefore need to award contracts based on both financial and non-financial criteria that, together, represent the best value.

Capital Cost versus Life-Cycle Cost

Investing in innovation may have immediate short-term benefits in terms of the speed and cost of the project, it can also have much greater long-term economic and other impacts over the life of the building.

In 1998, the Royal Academy of Engineering in the UK developed the 1:5:200 "rule of thumb" which suggested that if the initial construction cost of a building is 1, then its maintenance and operating costs over the years are 5, and the business operating costs in that building are 200 (Sci-Network, 2012). so, the initial capital cost may only account for around 20% of the total costs that the building owner will incur during the period of ownership – particularly when energy bills and maintenance costs are taken into account. If the costs of staff using buildings are included then this is reduced to just 0.5%.

Life-cycle cost (LCC) analysis is therefore used to assess the total cost of facility ownership. It takes into account all costs of acquiring, owning, and disposing of a building or building system. LCC can be a key enabler of the adoption of new and innovative construction products and techniques. Many innovative solutions may incur higher up-front costs but once operating costs are taken into account the overall investment may provide a better return. LCC can be used as an evaluation tool within competitive tendering procedures so that investments in innovation can be valued correctly and completely. To allow project teams to respond effectively, owners need to establish clear and quantifiable criteria in terms of the expected magnitude and timeframe of the return on investment (ROI) and the value given to non-financial benefits (occupant wellbeing, etc.).

Although LCC is required for federal building procurement in Canada (Government of Canada Policy on Green Public Procurement), published life cycle cost analysis information for most building types is sparse, particularly for wooden structures. Indeed, current indices of the useful lives of various products allocate lower useful lives to wood than other materials without clear basis for any of the chosen values. Despite a pervasive perception that the useful life of wood structures is lower than buildings of other materials – there is no meaningful relationship between the type of structural material and average service life. Owners should therefore be aware that, currently, the combined lack of LCC research on wood use in construction and the common availability of what appear to be non-research based estimates of useful lives of materials can create an unwarranted bias against the use of wood in structures. Development of definitive, research-based information on durability/longevity of wood structural and non-structural elements used in various building applications is needed (Bowyer, et al, 2013). This lack of market data relates to new materials generally, not just wood (e.g. insulated concrete forms), and this needs to be addressed by policy makers to support the timely adoption of a wide range of new solutions.

Defining "Quality"

The notion of "Quality" means different things to different people: functionality, the absence of defects, performance, durability, fitness for purpose; standard relative to things of a similar kind and so on. One

definition that resonated with interviewees for this project is, "A combination of functionality (how useful the project is in achieving its purpose); impact (how well the project creates a sense of place); and build quality (performance of the completed project)".

Quality in a finished building is generally a factor of the owner's proposal or briefing, design process, contract documentation and construction. As quality has no specific definition in standard contract documents, it is very important that proposal or briefing documents set out clearly the level of quality that is required. Specific standards of quality can generally be defined, prioritized and measured quite precisely, and criteria weighting can help in the appraisal of design options, in particular where conflicting views exist amongst stakeholders. When defining objectives for quality, the owner should consider:

- Available funding and time,
- Existing corporate policies (such as environmental policies),
- Key requirements of the business,
- Key requirements of stakeholders, and
- The views of external organizations such as the local governments and community groups.

Sustainability Performance

Sustainable procurement is, "A process whereby organizations meet their needs for goods, services, works and utilities in a way that achieves value for money on a whole life basis and generates benefits, not only for the organization but also to society, the economy and the environment." While the social and economic benefits of purchasing a good or service can be easy to define (see the numerous Social Procurement policies emerging across Canada), environmental benefits are more challenging. Ideally, the goal is to be a force for good as opposed to being "less bad": for example, the consumption of waste products, carbon sequestration, improved water quality, improved biodiversity, etc. Economic, social and environmental sustainability are interlinked. Increasingly, these three strands are afforded appropriate priority in construction procurement decisions. However, achieving these goals can only be validated once the project is operational. Therefore, not only do owners need to set clear and measurable sustainability goals for the purpose of project team evaluation but also to establish incentives for accountability. Sustainability targets can be established for operations and for embodied impacts (discussed below).

1. Operating Targets

The only way an owner can be sure that the project has achieved its energy performance goal is by looking at the utility bills. Building codes and green building rating systems (e.g. LEED) reference design models that make certain assumptions about how the building will be run. Projects that plan to deploy innovative solutions to address energy efficiency and/or GHG emissions reduction can set measurable and absolute standards to be achieved (in kWh, MJ, kg.CO_2e, etc. per unit of gross floor area per year) to demonstrate that a return from the investment in innovation has been achieved. Incentives can then be put in place in the form of bonus for exceeding the goal and/or a penalty for failure. This can work well where the upfront budget for construction work is restricted. The owner can set an intermediate minimum standard and indicate a higher aspirational target, which the project team can be challenged to achieve,

either through setting incentives within their contract, or through running a design contest to win the contract.[1] For renovation projects, an accurate baseline energy performance figure must also be determined. Other operating impacts that can be measured include water consumption and solid waste generated.

2. Embodied Targets

Although still at an early stage of market adoption, the life cycle environmental costs (impacts) that occur outside of direct building operations are increasingly being factored into project decision-making. Life cycle assessment (LCA) is a universally accepted science-based methodology to evaluate the environmental impacts of products and services that go into buildings as well as the buildings themselves over their entire life cycle, i.e. from raw materials extraction to final disposal. LCA is finding its way into green building rating systems (e.g. LEED v4) and in procurement models in Europe. Using LCA, the project team can evaluate a broad range of environmental considerations (such as embodied energy, global warming potential, impacts on water quality, impacts on human health, etc.) against explicitly declared criteria and give a summary of environmental performance. Such assessments can be used for benchmarking performance and monitoring progress towards improvement of performance. LCA is therefore a powerful way to inform owners and the project team of the impacts associated with a material, product or entire building and also provide a basis for demonstrating and communicating the result of efforts to improve environmental performance in construction works as a whole.

LCA largely addresses the non-financial impacts of buildings and is therefore not considered in life-cycle costing (LCC) in current practice. However, as owners begin to integrate the economic, social and environmental goals into a triple-bottom line procurement model, LCA will become increasingly important. Owners can ask for LCA to be conducted on the proposed building (or any portion) to determine the lowest environmental footprint for specific factors such as embodied energy, carbon and more. To meaningfully inform decision-making, LCA should be undertaken early in the design process.

CREATING AN INTEGRATED, COLLABORATIVE TEAM

When contemplating an innovative project, an owner should strive to create an integrated, collaborative team in which the construction expertise is brought on as early as possible. A typical project team involves a diverse group of individuals who need to work together to find creative solutions within physical, cost and time constraints. It is widely accepted that one of the primary success factors of an innovative construction project is the assembly of a multi-disciplinary team with experience and chemistry, preferably before 25% of project design is completed (Natural Resources Canada, “The Integrated Design Process”).

The objective is to utilize every participant’s knowledge through all projects phases. Procurement models that encourage early contractor involvement will enable new concepts to be tested for constructability and compatibility with the project goals. The most important attributes by which to judge the suitability of a consultant or contractor to carry out a particular project, regardless of the selection process stages, generally are professional and/or technical competence, managerial ability, availability of resources (financial, people, equipment, etc.), and professional integrity. The owner should seek detailed information on all these qualities at the short-listing or selection stage by:

- Obtaining comprehensive written pre-qualification information appropriate to the scale and scope of the project,
- Interviewing permanent senior personnel of the candidate at the short listing stage and the key staff identified for the assignment,
- Examining systems and methods of services as well as hardware and software capabilities, and
- Talking to previous owners and clients.

Early Market Engagement

The benefit of construction expertise at the critical early stage(s) of a project cannot be overstated – particularly for projects that intend to employ novel technologies or processes, or which will impose major constructability challenges. Early Market Engagement (EME) can be an invaluable method of capturing intelligence on innovations, new processes, project feasibility and market capacity/capability which can then be factored into options appraisal, specification and procurement of a project. In use in Europe (but not in Canada), EME comprises in-depth dialogue between the owner and potential suppliers prior to tendering for design or construction work. EME can cover a wide range of issues including:

- **Feasibility**: whether what is sought is possible, or has ever been done.
- **Capability**: the ability of the market to achieve what is required.
- **Maturity**: whether there is an established market for the requirement and whether there are enough suppliers in existence for competitive procurement.
- **Capacity**: whether the market can achieve what is required quickly enough, or on a large enough scale.
- **Cost**: whether the desired material or technology can be procured and incorporated into the client's project at reasonable cost.

Different methods for EME exist ranging from a market survey through to "meet the buyer" events or industry days, where interested suppliers are informed in detail of the owner's plans, and can raise questions and pose solutions. Any EME activity needs to be undertaken with due regard to the principles of transparency, non-discrimination and mutual recognition. No advantage or disadvantage should be given to any supplier or group of suppliers. It is important that suppliers understand that the competitive phase of procurement will be carried out separately and all suppliers will be treated on equal terms. This can be stated in any invitation to open discussions.

EME is different to early contractor involvement, which is based on the conditional appointment of a main contractor on an individual project in order to obtain additional input to the design process. EME activities may involve a supplier or group of suppliers providing details of a new, innovative solution or technology to an owner ahead of a formal contract process. This benefits suppliers as it allows them to demonstrate their competitive advantage and ensure that what they can offer will be taken into account in the tender process or included in the project specification. However, it also creates significant risk for the supplier in terms of the potential loss of their intellectual property rights in regards to their innovative solution and the associated development costs. This risk may result in suppliers withholding innovation during early market engagement processes unless they feel their rights will be sufficiently protected.

An example of EME is the UK's Forward Commitment Procurement (FCP) process, which has been developed in the UK specifically for local government procurers and wider public sector procurers (UK

Department for Business, Innovation and Skills, 2011). FCP creates the conditions needed to deliver innovative, cost effective products and services. Designed mainly for use by the public sector, the FCP approach was developed to be consistent with value for money policy and the legal framework that governs public sector procurement. FCP brings together progressive thinking and best practice from the private sector and the innovation and procurement communities, together with understanding of the demand side barriers to the commercialization of innovative goods and services to bring new cost effective goods and services into the market. In brief, FCP provides the supply chain with information of specific unmet needs and, critically, with the incentive of a Forward Commitment: a commitment to purchase a product or service that currently may not exist, at a specified future date, providing it can be delivered to agreed performance levels and costs. FCP provides the incentive, confidence and momentum for suppliers to invest and deliver innovative solutions.

Sanctioned Design Competitions

Competitions to procure design (or design and construction) services, though not common in Canada, are a proven method of delivering innovation in other countries. They tend to attract firms which are newer, younger, hungrier and more predisposed to exploring the boundaries of what is possible in practice. A competition can be 'open' whereby any qualified architect, firm or consortium can enter or it can be based on a preselected shortlist of firms or teams chosen by the competition organizers. Based on the competition terms, the participants are asked to develop an initial (schematic) design concept based on the defined project requirements, which is then evaluated by a jury of experts and the project is awarded to the successful proponent. There is sometimes resistance to competitions from design firms who think owners are getting "something for nothing", so competitions should therefore ensure participants are appropriately compensated for their time. The design competition for procurement can be a useful method of leveraging innovation into the design and construction processes. However, there are administrative and regulatory challenges to holding design competitions in Canada and must be sanctioned by the professional regulatory body (AIBC Bulletin 63, 1994) and there must be financial compensation for all participants. To be successful, design competitions should be launched on the basis of a very clear project brief, including design excellence, minimum and aspirational energy (and other) performance targets and the openness to innovative solutions.

Competitive Dialogue

Included in the 2014 EU Public Procurement Directives, "Competitive Dialogue" is used in European countries to create a separate phase for dialogue with suppliers on the assumption that more and better dialogue results in a better project, product or service. It allows for bidders to develop alternative proposals in response to an owner's outline requirements. Only when their proposals are developed to sufficient detail are tenderers invited to submit competitive bids. The aims are to increase value by encouraging innovation and to maintain competitive pressure in bidding for complex contracts. Although competitive dialogue takes longer and requires more upfront investment of time and money by the owner, experiences in the UK suggest that it can be a powerful method for encouraging and evaluating innovative solutions – particularly for complex projects.

Competitive dialogue is designed to be applied to projects where the owner is able to state its requirement at the outset, but either cannot or does not want to define what the solution should be. For the owner,

competitive dialogue makes it easier to confirm that "all necessary elements" are in place before bids are submitted, resulting in more robust tenders. Fair and formal dialogue should prevent the possibility of misinterpretation by either the tenderer or the owner and hence cost escalation later in the contract. For bidders, the process provides better information flow, together with the opportunity to test the owner's requirements through a progressive development of their proposal. Despite the substantial difference in process between negotiation and competitive dialogue, the outcome should be similar: an affordable and compliant preferred bid on which the parties can proceed to contract. The benefits from competitive dialogue are primarily related to the more detailed testing of the preferred proposal – an important consideration for an innovative project.

Competitive dialogue requires detailed development by multiple bidders. On the owner side, the management and resourcing of the dialogue has to be considered. Competitive dialogue requires owner engagement in design, contracts, service standards and payment mechanisms. The owner must be equipped to respond promptly and fairly to proposals or changes. Although the owner is expected to benefit from faster financial close and a better, more secure solution, bidders are exposed to a greater risk of unrecoverable expenditure. Also, there is no binding offer on the table during the process until final bids are requested. Although the overall objective of the dialogue is to progressively develop multiple proposals that are compliant and affordable, there is no discipline imposed on a tenderer (in other words, they can act how they wish) other than the competitive pressure from other bidders.

Where innovative solutions are being sought, competitive dialogue may be highly desirable. The iterative process of solution development fits well with the development of innovative solutions and so competitive dialogue can generate alternative design proposals, giving greater potential for added value in project delivery. Done well, both the owner and the delivery partner have greater confidence in the quality of the solution and the submission, particularly if it has been progressively tested during the dialogue process. Despite increased interest in Europe, competitive dialogue is not yet done in Canada. So, any owner who considers using the "competitive dialogue" process should be very cautious to avoid the possibility and perception of unfair bidding practices. Thorough preparation must be undertaken so that the owner can fully brief participants and respond appropriately to bidders' proposals during the dialogue using a clear, well-defined and consistent process that has been openly communicated to all parties.

Performance Incentives

Aligning both the owner and project team's individual and collective objectives can be a powerful catalyst for good project performance. For this reason, contract incentives (either financial or non-financial) can be employed to identify and ensure focus on the owner's goals. However, traditionally, owners have relied on contract penalty clauses whereby the owner will claim a specified amount in damages (e.g. for every day the project is late) and/or may include hold back penalty clauses whereby the owner retains a portion of payment until the project is complete. Penalties tend to foster defensive, risk-averse behaviour. They may not create the spirit of trust and respect necessary to ensure the project's best interests are always put first.

When dealing with a new type of construction process or technology, an experienced team can make all the difference to the process and resulting performance of the project. Although there is no guarantee, a team with a proven track record of delivering the required quality of project on time, on budget, and are comfortable working together, will get the project off to a strong start. In fact, some owners prefer to hire

project teams en masse instead of each consultant and contractor individually to ensure smooth and fast "onboarding". To get the right people on the project, it may be necessary to modify the procurement documents. In fact, depending on its wording, an "owner's privilege clause" can permit the acceptance of a bid which was not the lowest and award to the bidder whose reputation and named key staff have the most satisfactory history. Irrespective of the procurement model, the construction contract may also require~~s~~ that those individuals named as being key members of the bidder's team in the bid and/or the contract must exclusively work on the owner's project and they can only be changed by the owner in writing, thus giving the owner a timely opportunity to assess and negotiate the scope, price and completion time.

TENDERS AND REQUESTS FOR PROPOSAL (RFPS)

To allow for innovative responses to a construction project requires a flexible approach that allows for discussion between the owner and the proponent. Construction projects are normally procured using either a "Call for Tenders" or a "Request for Proposals" (RFP) process. Both approaches are predicated upon adherence to the terms and stipulations of the tendering system selected.

- **An RFP** is a submission to an owner by a contractor responding to the owner's needs for procurement of construction services based on the owner's self-defined considerations. The response to an RFP could be fixed price and/or fees for service, as required at the owner's discretion. BCCA recommends that prior to an RFP the owner issue an RFQ to qualify a subset of contractors who would then proceed to the RFP stage. The successful proponent in the RFP stage is awarded the contract. BCCA also notes that a negotiated RFP in the public sector contravenes the public obligation to fair and transparent procurement practices. However in the private sector, negotiation is at the discretion of both parties.

- **A Tender** is a submission to an owner by a contractor responding to the owner's needs for procurement of construction services based on a fixed set of criteria (project documents) usually created by a design team, resulting in a fixed price.

When it comes to evaluating innovation, outcome-based specifications, procedures that invite dialogue, being open to alternative proposals, and the awarding of contracts based on the best fit-for-purpose solution, at the best value, are the most important prerequisites to facilitating the procurement of innovative solutions. A scoring system that allocates points and weighting for specific project outcomes is recommended where performance-based outcomes are required (e.g. total life cycle cost, GHG emissions in $kgCO_2e/m^2$), as opposed to prescribed deliverables (such as gross floor area). Frequently, "innovation" is a deciding factor between proposals that may otherwise be similar. Therefore, the definition of what innovation means to the owner (and the project) and how it will be evaluated, must be included in the RFP. So, an RFP might rank an innovation that shortens the construction period more highly than one that improves the environmental footprint beyond what is required. It may also be valuable to ask firms to describe the innovation and/or R&D that they have undertaken in the past both corporately and on projects.

DELIVERY MODELS

There is no "one size fits all" solution to fostering innovation and none are without shortcomings. Table 3 summarizes the common forms of project delivery in Canada.

Table 3: Summary of common forms of project delivery in Canada (source: RAIC, 2009)

Delivery method	Standard form of contract	Description
Design-Bid-Build	RAIC Document Six: Canadian Standard Form of Contract for Architectural Services *Followed by* CCDC 2 Stipulated Price Contract (CCDC 3 or CCDC 4 may also be used)	Owner engages the architect to provide design services and prepare construction documents, which are issued for competitive bids. General contractors submit bids for the project and the construction contract is typically awarded to the lowest bidder. The architect administers the construction contract.
Construction Management	CCDC 5a - Construction Management Contract for Services CCDC 5b - Construction Management Contract for Services and Work	Owner engages the architect to provide design services and prepare construction documents. The Construction Manager works for the Owner as a consultant providing services that normally include design input on constructability, cost estimating, scheduling, bidding, coordination of contract negotiations and award, timing and purchase of critical materials, cost control and coordination of construction activities. Depending on the type of contract used, the Owner may or may not engage the Trade Contractors directly.
Design-Build	CCDC 14 Design-Build Stipulated Price Contract CCDC 15 Design-Builder / Consultant Contract (subcontract)	A method of project delivery in which the Owner contracts directly with a single entity that is responsible for both design and construction services for a construction project.
Public Private Partnership (P3)	No standard form of contract	A form of partnership between the public and private sectors where a combination of financing, design, construction, operation and maintenance of public projects relies on alternate sources of financing and revenue to cover all or part of the capital costs (including debt servicing, principal payment and return on equity), as well as O&M costs for the project.
Single Purpose Entity for Integrated Project Delivery (IPD)	CCDC 30 IPD Agreement (poly-party form) Draft available. In the UK, JCT Constructing Excellence In the US, AIA Document C195	This new form of project delivery creates a new single purpose entity or limited liability company, which includes members such as the owner, architect, construction manager and other key project participants in the design and construction the project. The entity enters into contracts with non-members for design, trade contractors and suppliers for services, labour and materials. The entity enters into a separate agreement with the Owner to obtain project funding.

In the context of advancing innovation, some models of delivery may be better suited to certain types of project and market conditions than others (see Table 4). In all cases, public sector projects have an expectation of transparency, which must always be considered. Standard documents, best practice guides and other resources are available from the BC Construction Association.

Table 4: Summary of delivery models with project and team characteristics

	Design-Bid-Build	Construction Management	Design-Build	Public Private Partnership	IPD
Time predictability	**Y**			**Y**	**Y**

	Design-Bid-Build	Construction Management	Design-Build	Public Private Partnership	IPD
Cost certainty	Y		Y	Y	Y
Requires an experienced owner		Y		Y	
Requires an experienced construction company		Y		Y	Y
Suitable for a market experiencing rapid price escalation	Y		Y	Y	
Suitable for small projects	Y		Y		
Suitable for complex projects	Y	Y		Y	Y
Suitable for fast track projects		Y	Y	Y	Y
Suitable for an uncertain or developing brief		Y			Y

FURTHER WORK FOR RESEARCHERS AND INDUSTRY STAKEHOLDERS

Owners cannot procure an innovative project the same way as a conventional one. The time and costs required for R&D and testing need to be factored in and the response times for tendering will also need to be extended. However, there are several barriers to advancing innovation in construction generally and increasing the uptake of mass timber as an alternative structural solution in particular. These challenges offer opportunities for further research. For example, research findings suggest that large non-residential contractors may be staying away from mass timber (and other innovative options) because of perceived poor health and safety reputation of wood trades (based on experience with traditional timber framing). Effort and resources may therefore need to be applied to developing standards for occupational health and safety and for fire protection in wood projects (e.g. the use of mobile hydrants adopted in the UK) to build industry confidence. Other opportunities for further research include:

- There is a lack of consistency in how “Best Value” is defined and evaluated during bid selection.
- There is insufficient LCC data on new products and materials.
- There is no harmonized open standard for prefabricated construction in Canada, which allows wood structures, proprietary systems and other systems to compete on a level playing field.
- There are still only a few mass timber suppliers in Canada and the available choice of product may be a constraint. Some Canadian project teams are opting to ship in European products on account of their quality, price and construction support services.
- Construction-specific education is required to address the technical issues of mass timber construction such as protection of the wood elements for transportation requires plastic wrapping but this needs to be removed to prevent mould. Protection during storage and construction may require different approaches. Template language for specifications would be an asset.
- There are issues of efficiency and optimization for all members of the project team. Consultants and contractors need to improve their margins and owners need to get more “bang for their buck”.
- There is little training available on pre-fabrication techniques and management for builders.

- There is fertile ground for researchers in helping businesses become more resilient - so they can deliver more it without costing more. This is as much to do with improving business culture and processes as it is about the adoption of technology.

SUMMARY OF BEST PRACTICES

The following table captures the best practices for procuring innovative construction projects identified throughout this report. The best practices set out below are based on the assumption that the owner will always strive for a fair, open and transparent procurement process regardless of the delivery model they choose to pursue. Opportunities for innovation will vary widely depending on the specific circumstances of the project and that this document is geared towards supporting innovators and those interested in the early adoption of new technologies and processes. There is no question that some of the best practices described below are challenging in practice and effectively impossible in a "lowest cost" driven tendering situation.

1) Owners engage with the market early to ensure the right level of technologies, skills and resources are available for their project.

2) Early involvement of all project team members including the general contractor and key trades

3) When incorporating innovative products and processes, more time and resources are allocated (and budgeted for) early in the project process to adequately understand the owner's requirements.

4) Measurable project goals and KPIs are in place to demonstrate the value of investing in innovation

5) Owners make every effort to create a highly effective and collaborative project team that puts the interests of the project first.

6) Businesses of all sizes should be encouraged to participate because some SMEs are the most innovative.

7) The business case for innovation may best be articulated using life cycle costing (LCC).

8) The technical considerations of building with wood are factored into the procurement process

9) Creativity and "out-of-the-box" solutions may be sought through sanctioned design competitions.

10) Long-range market signals help to boost business confidence and encourage investment in new equipment and training.

11) Project risks are understood, managed and apportioned fairly.

12) Incentives are leveraged to encourage construction innovation.

13) A qualified experienced project team includes the owner, contractor AND the specialist trades. It

may also include operations and maintenance personnel.

14) Ongoing education and training is essential to ensure project team members stay up to date with the latest technologies and processes.

15) Feedback loops are in place to foster a culture of learning at all key points of the project.

16) Intellectual property (IP), proprietary knowledge and expertise of project team members are respected and protected.

17) High quality contract documents that are thorough and complete are critical in order to adequately describe the proposed innovation

18) R&D support in the form of resources, money and/or equipment is available to help companies take ideas from the lab and incorporate them successfully into construction projects.

19) Modern Methods of Construction (such as digital design, pre-fabrication and Lean principles) are leveraged to improve productivity, profitability and performance of projects.

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