ASSESSING BUSINESS STRATEGY OPTIONS FOR ACTIVE WATER TREAMENT FACILITY PROJECTS

by

Douglas John McKay

B.A.Sc., (Chemical Engineering) University of British Columbia, 1981
Ph.D., (Metallurgical Engineering) University of British Columbia, 1990

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Name: **Douglas John McKay**

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Supervisory Committee:

Leyland Pitt
Senior Supervisor
Professor, Marketing and Dennis F. Culver EMBA Alumni Chair of Business Faculty of Business Administration

Michael Parent
Second Reader
Professor of Management Information Systems and Marketing
Faculty of Business Administration

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Abstract

This document reviews a spectrum of potential of alternative service delivery project models that might be advantageous for Teck's Active Water Treatment Facilities by achieving capital and operating cost reductions, and allowing Teck to focus on core mining activities. Screening criteria are provided to assess if these models should be considered as part of a framework to guide decision-making. In principle, the attributes of these water treatment facilities support alternative service delivery, but would require verification of potential economic benefits. It would also need a shift from Teck's traditional project delivery culture that likely cannot be achieved in a timely manner for the facility at Fording River Operations, which is now in the engineering study phase. However, a comparative analysis of different models for this facility would define whether further consideration of alternative service delivery is warranted for subsequent facilities.

Dedication

This manuscript is dedicated to Andrea, who, throughout the EMBA program, forfeited too many evenings and weekends that could have been more pleasurably spent on other activities with family and friends, but who instead accommodated and supported a husband preoccupied with assignments and, finally, completing this work.

Acknowledgements

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I want to thank my colleagues: Christian Baxter for providing seed ideas that led me to tackle this project; Fran Noone for helping to navigate the literature, producing several of the key citations that framed my analysis, Karla Mills for explaining Teck's operations outsourcing strategy and status at West Line Creek; and Rob Stephens for discussions that encouraged my analyses and final assessment, editorial review, and, just as importantly, for the support to complete this project so I could refocus on my "real" work.

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Glossary

Term	Definition
ABMP	Area-Based Management Plan
ASD	Alternative Service Delivery, generally meaning DBOM and DBFOM
AWTF	Active Water Treatment Facility
CMAR	Construction Manager at Risk
CRD	Capital Regional District of the City of Victoria, British Columbia
DB	Design-Build
DBB	Design-Bid-Build
DBF	Design-Build Finance
DBFO	Design-Build Finance-Operate
DBFOM	Design-Build Finance-Operate-Maintain
DBO	Design-Build-Operate
DBOM	Design-Build-Operate-Maintain
DBOO	Design-Build-Own-Operate
DBOOM	Design-Build-Own-Operate-Maintain
EPCM	Engineering Procurement Construction and Construction Management
ETP	Effluent Treatment Plant
EVO	Elkview Operation
EVWQP	Elk Valley Water Quality Plan
FBR	Fluidized Bed Reactor

FRO	Fording River Operation
GE	General Electric
IPA	the company Independent Projects Analysis
NPA	Non-Disclosure Agreement
NPC	Net present cost by discounting future cash flow to today
O+M	Operate and Maintain
P3	Public-Private Partnerships in the context of assessment guidelines published by PPP Canada
PFI	Private Finance Initiative, related to the public-private partnership initiative in the UK
PPP	Public-Private Partnerships in the context of the Crown Corporation PPP Canada
PRT	Peer Review Team for the assessment of the project delivery models for the Capital Regional District of the City of Victoria, British Columbia
QA/QC	Quality Assurance and Quality Control
UK	United Kingdom
VFM	Value for Money calculation to assess difference in life cycle cost between various project delivery models
WLC	West Line Creek water treatment facility at Teck
WPO	Water Projects and Operations within Teck's Coal division

1 Introduction

Open pit mining activities to produce coal generate large volumes of waste rock, from which release of selenium, nitrate, and other constituents into watersheds is a growing industry problem. At Teck Coal, selenium and nitrate concentrations in surface waters are above conservative provincial guidelines at monitoring locations in the Elk River watershed, and are increasing in many areas, although currently at levels not yet significantly affecting aquatic health. Teck's Area-Based Management Plan, approved by the Minister [ABMP, 2014], commits to installing active water treatment facilities (AWTFs) at strategic capacities and locations over a number of years as a key component of a broader inventory of activities to stop the increase in selenium and nitrate loading in the watershed, and then to reduce the levels towards historical background values. Since operating wastewater treatment facilities is a cost centre, the high-level strategy for Teck is simple: deliver reliable performance at minimum net present cost.

Teck's traditional approach to project delivery involves contracting an engineering service provider to design and manage construction of a facility with close oversight by Teck, and then to operate the facility with in-house resources. Currently, Teck Coal's Water Projects and Operations (WPO) business unit does not have the in-house resources or expertise necessary to operate these AWTFs and will thus contract out basic services for the first AWTF at West Line Creek (WLC) for a short-term period (6-12 months) through plant commissioning. During this period, Teck will evaluate the service provider's performance for a three-year-term operations and maintenance contract, including full staffing of the water treatment plant up to the site manager. The alternative model would be for Teck to transition WLC AWTF operations and maintenance to Teck-only operating personnel, but this would require staff recruiting and training not currently planned beyond that to provide management oversight.

A pre-feasibility study for the second AWTF at Fording River Operations (FRO) started in May 2015. The project is on a very tight schedule to be operating before the end of 2018. A decision to outsource, or not, operations and maintenance of this AWTF has not been made. Project execution is currently following a traditional engineering-procurement-construction-management (EPCM) model with technology selection led by Teck, an engineering services contractor designing and managing construction of the AWTF facility, and with expected handover to Teck for operations and maintenance after completion of construction and water commissioning.

There are precedents for outsourcing wastewater-treatment facility design, construction, operations, maintenance, and even ownership or financing. Motivations are so that the owner can focus on core businesses and, because the service provider can bring focus, discipline, and expertise, lower life cycle costs by attributing some risks to the provider. A spectrum of potential of outsourcing or alternative service delivery (ASD) business models exist that might achieve capital and operating cost reductions. ASD is a term used by EPCOR [Sonnenberg, 2015] and is appropriate to cover a range of project or service delivery models for both public-private partnerships (P3) and private-private partnerships. At one end is full outsourcing whereby the service provider designs, constructs, owns, operations, and maintains the facility. At the other end is the current trajectory for FRO following Teck's traditional approach to project outlined above.

This project reviews potential ASD business model options that might be advantageous for Teck's AWTFs and offers screening criteria to assess whether these models should be considered as part of a framework to guide a decision analysis. The criteria and framework draw largely from PPP Canada, a Crown Corporation established to guide municipalities in assessing public-private partnerships for infrastructure projects, but also from literature learnings and interviews with selected potential ASD providers. This document consists of the following sections:

2 Wastewater Treatment Industry Analysis – This section overviews the wastewater treatment industry and establishes that competition to operate wastewater treatment plants is a favourable opportunity for Teck.

3 Learnings from the Literature – This section outlines the pros and cons of potential project delivery models, presents an ASD screening assessment criteria, outlines a framework to guide a decision analysis, and provides interview results with selected potential ASD providers.

4 Case Studies – This section highlights the methodology and outcomes of an evaluation by Deloitte to assess P3 potential for the City or Regina and the financial summary by a peer review team to assess P3 potential for the Capital Regional District, in the City of Victoria.

5 Teck Perspectives and ASD Assessment for AWTF – This section makes a preliminary screening assessment for ASD of Teck' AWTFs and identifies challenges for Teck to consider this procurement method.

6 Conclusions and Recommendations – This section wraps up the report with key conclusions and offers recommendations to evaluate ASD further.

2 Wastewater Treatment Industry Analysis

This document defines industrial wastewater treatment of mining-impacted water as an "industry" and focusses on Teck Coal specifically. The *products* are, effectively, reputational image and license to operate the mines and coal preparation plants, but of course treated water is also physically produced, along with some byproducts. The *customers* are governments and a range of stakeholders. *Competitors* may be defined broadly as competing coal companies that must also comply with water quality standards in their respective jurisdictions, but more specifically in this document, *competitors* are the technology vendors, contractors, and operators that provide both the wastewater treatment technologies and services to operate them. The industry *geographical* basis is global, from the perspective of both the coal and the wastewater treatment industries: Teck, the vendors, and contractors compete globally. Teck operates in both industries, one serving as the license to operate in the other.

2.1 Wastewater Treatment Strategy

The strip ratio to produce coal at Teck, the ratio of waste rock moved out of the way to access the desirable coal-rich material, is about 12:1. As a result, there are now very large and growing piles of waste rock at each of the mines. This material contains small amounts of pyrite and other selenium-containing minerals, as well as residual nitrates from the blasting emulsions. These waste piles are not sealed to prevent water and air ingress. Over time, water and air flow through the waste piles mobilizes the selenium and nitrate into adjacent creeks, leading to elevated concentrations in the Fording and Elk Rivers.

Teck's Elk Valley Water Quality Plan (EVWQP), developed with input from the public, First Nations, governments, technical experts, and other stakeholders, commits to installing and operating active[1] water treatment facilities (AWTFs) at selected mine sites to treat creek waters before they enter the Fording and Elk Rivers until covers are possibly proven to prevent water and air infiltration into the waste piles and thus stop neutral rock drainage from occurring. Start-up of the first plant was initiated in late 2014, but was shut down shortly after start-up to make modifications, still underway, after an environmental incident. A second plant at a different location is planned to be operating before the end of 2018, with pre-feasibility engineering now underway.

[1] The term active means operated like a production process as distinct from a passive water treatment system.

Figure 2.1 shows an understanding of Teck's target position at the green dot on a conceptual performance (productivity) frontier. Somewhat better than minimum acceptable performance (dictated by permits) is desired to ensure compliance is maintained though inevitable and natural variations in operation. Minimizing costs is paramount for an operation that, apart from the opportunity to build reputation, is simply a cost centre. The high-level strategy for Teck's active wastewater treatment is simple: deliver reliable performance at minimum net present cost (NPC), but importantly, also to adapt to changing needs of the watershed as they become evident.

Expanding the performance frontier, with say new technology or ASD, opens two opportunities: reduce NPC or increase reputational image by achieving better performance by reaching concentrations for selenium and nitrate concentrations below permit requirements. The shape of the curves is intentional to suggest that for a given effort and shift in the frontier, there *might* be more to be gained in cost reduction at a given suite of target conditions than gained in reputational image by reaching ever-lower effluent targets.

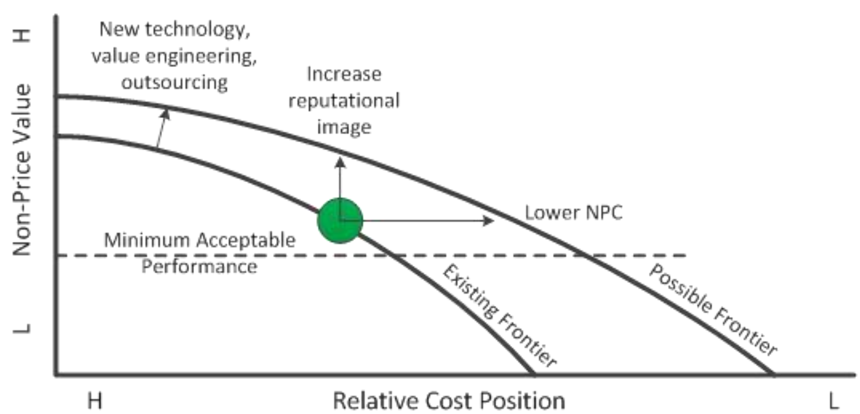

Figure 2.1 Performance frontier modelled after Porter's productivity frontier [Porter, 1996].

The volume of mining-impacted wastewater to treat at Teck is relatively small compared to other wastewater treatment applications across a range of industries and municipalities. This is illustrated in **Figure 2.2** for selected Effluent Treatment Plants (ETPs) and the first three AWTFs at Teck versus total sewage treatment for Greater Vancouver in five wastewater plants and the upgraded and expanded wastewater treatment plant now under construction for the City of Regina using an ASD model. All plants except the ETP utilize biological processes. Worth noting is that technologies cannot necessarily be transferred directly across applications, or even from Teck's ETP applications to the AWTFs.

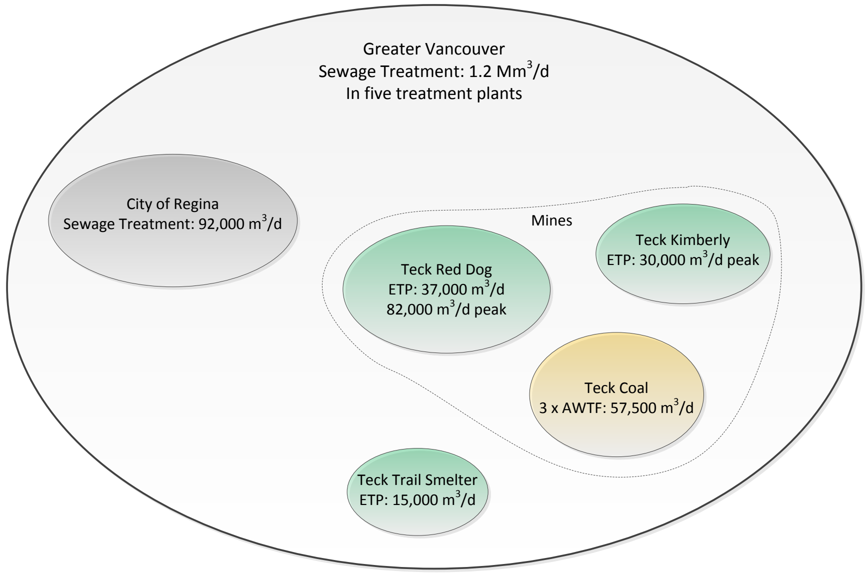

Figure 2.2 Relative size of selected water treatment facilities at Teck versus Greater Vancouver [GVRSDD, 2009] and City of Regina [Deloitte, 2013] sewage treatment plants.

Figure 2.3 takes a Porter's five forces [Porter, 2008] approach augmented by the Government factor [McGinn, 2010] to defining the wastewater treatment industry. Bubble size represents estimated influence. Green represents a potentially favourable force and red is undesirable with respect to Teck Coal. Clearly, there are more and larger red influencers than green, meaning wastewater treatment is not a desirable industry to be in from a coal producing perspective, but exiting is virtually impossible. Producing coal now means cleaning up impacted water.

***Customers* -** The main product from an AWTF is, of course, treated water, but it is of negligible monetary value. The effective products are reputational image and license to operate as judged by governments, NGOs, and other stakeholders, who, in effect, are the "customers". They have considerable influence on the AWTF operator in a way that generally increases costs, although working openly with the stakeholder groups has allowed Teck to develop AWTF end-of-pipe targets in the EVWQP that are protective of aquatic life in the watershed.

***Substitutes* -** Covers and diversions are substitutes to avoid having to treat the water, or as much of it, in the first place. These would be favourable outcomes.

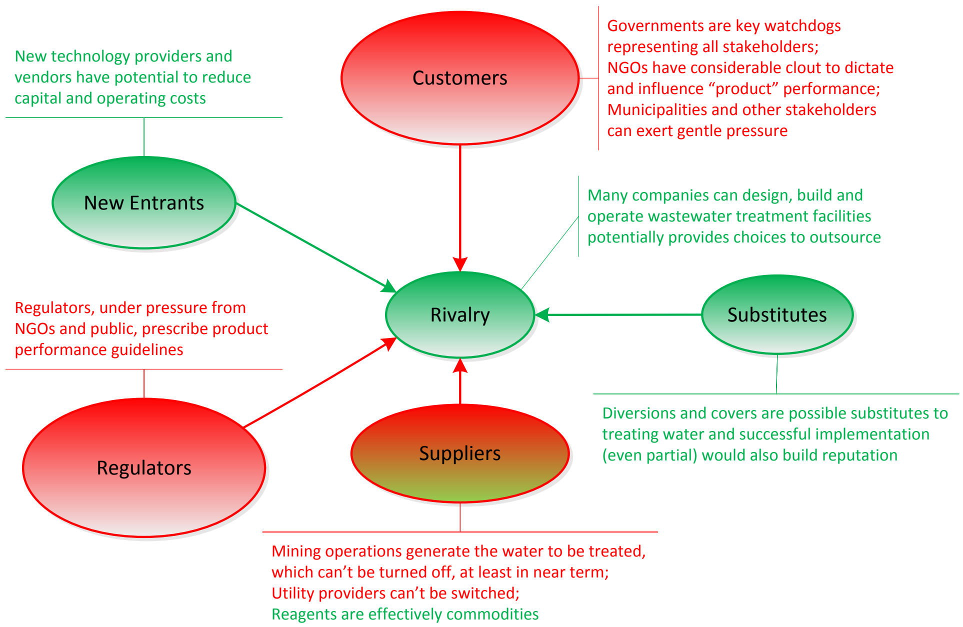

Figure 2.3 Porter's Five Forces [Porter, 2008] with the Government Factor [McGinn, 2010]

Suppliers - Upstream mining operations create the wastewater in the first place. The mines have high influence because in the near-term, until methods can be developed to mitigate mobilization of selenium and nitrate (which, by the way, are being vigorously investigated by Teck) and once it has been prescribed and promised that the wastewater will be treated, the supply cannot be turned off. Labour accounts for only about 15% of operating costs, but these facilities will operate 24/7 to maintain treated water flow. As well, shutting down and restarting biological processes is not an ideal situation. Therefore, there is some sensitivity with respect to possible labour flexibility. Also, in terms of process engineering for new AWTFs, there seem to limited companies with good process engineering experience. For these reasons, the bubble is (mostly) red.

The leading technologies for selenium and nitrate removal are currently biological. Based on scoping-level estimates, reagents and chemicals, including specialty and proprietary reagents for the biological systems in the AWTFs, make up about 50% of the overall operating costs, so there is certainly sensitivity to escalation in reagent prices. However, price hold-up is unlikely because most are commodities and even the proprietary and specialty reagents can be substituted; therefore, reagent supplier power is low. Again, in terms of constructing new AWTFs, other than processing engineering capability, there are many companies that can provide Engineering, Procurement, and Construction Management (EPCM) services. For these reasons, the bubble has a hint of green.

Regulators – Government regulators set the compliance targets (product quality) that must be met (although Teck has leeway on end-of-pipe targets as mentioned above) and have the power to impose fines and other penalties for inadequate performance.

New entrants – This group represents mainly new technologies, vendors, and potential outsourcing contractors (described next), all of which represent favourable opportunities to reduce capital and operating costs.

Rivalry – This project focusses on this issue. A representative listing of the many precedents for outsourcing wastewater treatment is presented in **Table 2.1**. In fact, the *more* rivalry amongst potential technology and ASD providers, the better. Other contractors not included in **Table 2.1** include Severn Trent Costain, United Water (operations group of French company Suez), Evoqua (formally Siemens), Woodard and Curran, and California Water [Chwirka, 2015].

There are important nuances worth noting amongst the potential outsourcing providers. First, experience may not be fully transferable. For example, EPCOR started as Edmonton's power and utility company and evolved its water business through infrastructure project execution capability [EPCOR, 2015] and now consider themselves class-leading operators [Cudrac, 2015]. They have experience with biological systems, which is also a technology deployed in the first two AWTFs, but that experience is all for municipal systems that do not treat for selenium.

Next, some are also technology providers; for example, BioteQ Environmental Technologies Inc., Envirogen Technologies, Inc., GE Power and Water, and Veolia Water Solutions and Technology Canada all offer proprietary technologies. Yet, development of their technologies was not necessarily initiated in-house, but rather by purchase of others to grow their technology platforms, or by licensing other technologies. As examples, Applied Biosciences, which initiated development of ABMet®, was bought by Zenon Environmental, which was then bought by GE. Further, the two co-developers from Applied Biosciences are no longer with GE, but are now leading competing companies, Inotec, Inc. and Frontier Water Systems, to develop new technologies that each believes will improve on their origional collaboration. Veolia is a licensee of the Anox Kaldness systems. An early version of Envirogen's Fluidized Bed Reactor (FBR) technology was initiated at Dorr Oliver before being commercialized by Envirogen with input from a key individual on contract who had previously worked for Dorr Oliver [Enegess, 2015].

Table 2.1 Representative wastewater and groundwater treatment outsourcing examples.

Company	Clients/Application	Contracting Models
EPCOR [2015]	Municipalities in Alberta and British Columbia (water distribution and wastewater treatment) Oil sands operations (water distribution and wastewater treatment for operating camps)	Operate/Maintain Own Operate/Maintain Build-Own-Operate/Maintain Design-Build-Operate/Maintain Design-Build-Finance-Operate/Maintain (contracts from 10 y to in-perpetuity)
	Britannia Mine (metals removal by lime, and storage of lime/sludge mix)	Operate/Maintain (20-y guaranteed performance contract with Province of British Columbia for mine and water treatment facilities)
	Municipalities in USA (water and wastewater treatment/distribution)	Own-Operate (contracts in-perpetuity)
Veolia [Oliphant, 2014, 2015]	Consol – (six coal mines in West Virginia - mine wastewater treatment by chemical precipitation, reverse osmosis)	Design-Build-Operate/Maintain (10-y contract)
	UK Coal Authority – (closed Wheal Jane Tin mine - wastewater treatment)	Operate/Maintain (10-y contract to 2020)
	Coal mine in US (new NO_3 and Se AWTF)	Operate/Maintain
	Molycorp (wastewater treatment)	Design-Build-Operate
Water [2004, 2005, 2006]	Municipalities in China, Germany, Czech Republic (wastewater treatment)	Design-Build-Operate Operate/Maintain Build-Operate/Maintain (20-30-y contracts)
CH2M	Patriot Coal (NO_3 and Se AWTF) Hanford (NO_3, chromates)	Design-Build-Operate
GE [Behr, 2015]	Bradwell-on-Sea, UK (influent water treatment)	Capital and Service Contract
	Conoco Humber Refinery, UK (influent water treatment)	Own-Operate/Maintain
Envirogen [Enegess, 2015]	Groundwater AWTF using FBRs at Tronox superfund site for Nevada Environmental Response Trust; Industrial wastewater at Aerojet and Nammo Talley; plus others	Operate/Maintain
	Superfund sites AWTF at Ventron–Velsicol, Blosenski Landfill	Design-Build-Operate
BioteQ [2013]	Raglan Mine (water treatment plant – nickel mine), Quebec	Build-Own-Operate
	Dexing Project, China (acid mine drainage)	Design-Operate as joint venture
	Bisbee Project, Arizona (wastewater treatment 2004-2013)	50/50 joint venture with Freeport-McMoRan
	Mount Gordon, Australia (water treatment plant)	Build-Own-Operate

Furthermore, strategic direction can change. For example, CH2M HILL (now CH2M) restructured to merge their municipal and industrial water divisions, and there have been resignations by several key industrial water treatment experts [Sandy, 2014]. In summary, knowing the origin of the technology and if the individuals that developed it are still around or if their protégés have "learned the trade" and following the migration of expertise are important. Technology providers may overstate their current technology development status, which ART learned in a pilot program with one vendor. Some amount of owner due diligence cannot be avoided.

Finally, leadership change may result in different compensation philosophies. For example, BioteQ now seeks a royalty and/or partial to use their technology (once they advance it sufficiently) rather than a one-time licensing fee.

2.2 Teck Strategy Areas and Opportunities

Figure 2.4 remaps the New Entrants and Rivalry forces into several strategy areas to reduce NPC, balanced by several largely internal (The British Columbia Mines Act is an exception) key constraint areas. The distance from the fulcrum estimates the relative potential or actual influence of the strategy and constraint areas to influence NPC. The colours (green is most, red is least, orange is in between) indicate the relative extent to which the given strategy has been or is being explored at Teck as explained below. Teck's investigation of the three strategy areas under *Rivalry* are constrained by a well-defined project development stage-gating process and traditional EPCM delivery model. The balance of this MBA project explores ASD models as opportunities to reduce life-cycle project costs.

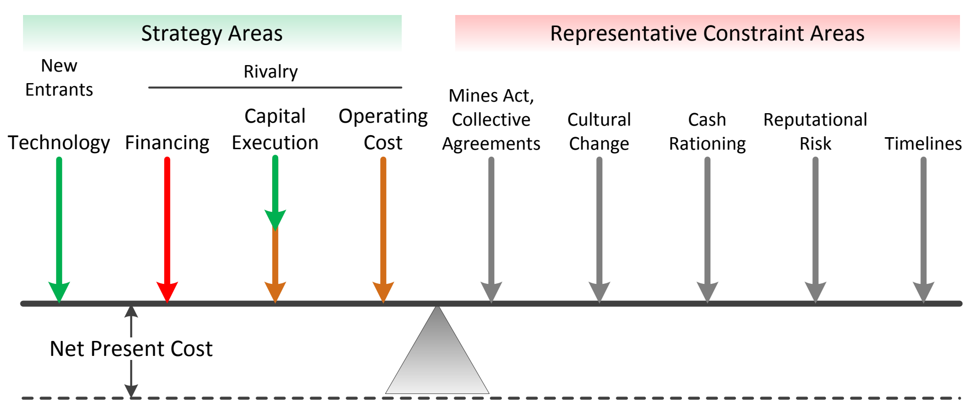

Figure 2.4 Balancing strategy areas versus constraint area.

Technology – Following pilot programs in 2011, 2013, and 2014, work is continuing in 2015 with another pilot program directed by Teck to address concern areas remaining from the previous pilot programs in order to verify a technology this October for the next AWTF at FRO. In parallel, scanning and evaluation of a spectrum of other potential technologies continues from previous years' effort with a view to subsequent AWTFs.

Financing – Teck's current strategy has been to own and operate wastewater treatment facilities, or "in-sourcing". There are outsourcing precedents in wastewater treatment to design-build-own-operate (DBOO) that Teck has not explored.

Capital Execution – Teck's strategy has generally been traditional EPCM contracts based on Teck design guidelines. The civil works and building in the first AWTF were expensive. These items, which are somewhat independent of technology, are being examined by value engineering as part of the current pre-feasibility study for the FRO AWTF. Alternative delivery models have not been explored in depth yet may identify potential paradigm-shifting cost reduction opportunities, especially related to risk attribution to a contracting consortium.

Operating Cost – Technology selection largely defines reagent and utility inputs, and thus associated operating costs. ASD have not been explored in depth that might identify life-cycle cost reduction opportunities.

3 Learnings from the Literature

This section reviews the pros and cons of potential project delivery models, presents an ASD screening assessment criteria, and outlines a framework to guide a decision analysis, and provides interview results with selected potential ASD providers.

3.1 Project Delivery Models

Traditional competitive bidding for construction contracts may yield the lowest price, but it is part of a process whereby there is a trend to pass down risks from design to construction and from construction to operations, which has resulted in an adversarial and litigious environment that has degraded product quality and contributed to loss of value to the owner [Abi-Karam, 2006]. A paradigm shift is underway whereby constructors are seeking long-term alliances with owners by offering design and build, operate and maintain, and financing services. Furthermore, companies with an operating focus and those that provide equipment technology are also seeking to provide life-cycle single-point-of-contact services. Engineers are now working for constructors and operators. For example, in the water solutions area, EPCOR's expertise is in operations, yet they proactively seek new wastewater projects as the prime contractor from design to operation by managing design and construction subcontractors [Cudrac, 2015]. They also use their financing ability as a "utility" to access low cost of capital as a competitive advantage. In another example, GE, an equipment technology vendor for ABMet® mentioned earlier and a suite of membrane technologies, also appears to partner with preferred design and construction companies while they provide the long-term operating services (for membranes) for an overall design-build-operate package. In summary, there is a trend with precedents to single-point-contact outsourcing design, construction, and operation of water and wastewater treatment.

There are many made-in-Canada examples of private-public partnerships (P3) in which municipalities have reached favourable arrangements with private-sector companies to execute combinations of design, build, operate, finance, and own facilities that provide public services, including water and wastewater treatment [PPP Canada 2011, Iacobacci, 2010]. The Crown Corporation PPP Canada was created in 2009 to improve the value, timeliness, and accountability of public infrastructure though P3 projects [PPP Canada, 2015] and all Federal infrastructure projects having an expected lifespan of at least 20 years and a capital cost over $100 M are required to be screened for P3 potential [PPP Canada, 2014b]. The driver for many municipalities has been the need to expand/upgrade old and poorly-performing water waste water treatment infrastructure to meet increasingly rigorous performance standards [Brubaker, 2011]. Generally, municipalities struggle to execute these infrastructure projects for several reasons:

- Lack of expertise (planning, management, operations, and financial),
- Lack of financial capacity and project controls (contributing to a track record of cost overruns), and
- Reliance on infrastructure grants is unsustainable.

Private-public partnerships are viewed as a way to access funding (including pension funds), transfer construction scheduling and cost risks (payment at completion is a powerful incentive to execute to schedule), and improve cost efficiency (private-sector discipline will filter out projects that are not viable). In essence, P3 projects are seen to generate value through optimal allocation of risks, increased innovation and efficiency, and by stipulating lifecycle asset performance [PPP Canada, 2014b].

Public-private partnerships are acknowledged to have originated in the United Kingdom, but are now well advanced in Canada across all levels of government and a range of project types, including water and wastewater facilities [PPP Canada, 2011]. For example, from the early 1990s though 2011 more than 150 P3 projects were completed in Canada, including large and complex projects valued at $100 m to over $1 B. The most significant factor with respect to project size is transaction costs (financial, legal, technical evaluations) relative to the value generated by the P3 contract. There are now many precedents to draw from, which has reduced transaction costs such that projects as small as $10-20 M are viable P3 candidates. Clearly, a private-public partnership is not a possible situation at Teck Coal, but many of the drivers, criteria, and principles should also apply to private-private ASD models. Therefore, studying highlights of P3s should offer guidance on options for AWTF project delivery at Teck Coal.

The spectrum of project delivery models are illustrated in **Figure 3.1**, showing, importantly, the increasing shift in project control and associated risk allocation from owner to contractor moving from left to right. To note is that PPP Canada consider both Design-Bid-Build and Design-Build to be traditional project delivery models. Abbreviated definitions and the principal pros and cons of selected models shown in **Figure 3.1** are provided in the following sections [Shorney-Darby, 2012; Deloitte, 2013; PPP Canada, 2011, 2013, PRT, 2010]. The peer reviewer report for the Capital Regional District of Victoria [PRT, 2010] provides pragmatic insights from the peer reviewers who have extensive financial, legal, and practical experience related to ASD models.

Figure 3.1 Project delivery models [PPP Canada, 2014].

3.1.1 Design-Bid-Build (DBB)

Under this traditional model, the owner is generally responsible for specifying the design of the project, with design development (detailed design) carried out by the owner or contracted to an engineering company. A separate contractor, selected by a separate tendering process based on the design documents, is responsible for constructing the project. After construction, the project turns over to the owner to operate.

The advantages of this model are high level owner control throughout design and construction and inventory of standard contracts based on experiences from prior projects. The main disadvantages are that DBB requires the longest time because the design and construction activities are sequential, with duplication of some activities such as piping runs (once be the designer and verified by fabricator to prepare the construction estimate), and there is lack of emphasis on life-cycle costs and innovation.

3.1.2 Design-Build (DB)

Under this model, a single source provider is responsible for both the design and construction of a project, thereby seeking the best combined solution. A critical aspect of DB is transfer of design liability to the contractor, who is then fully responsible for the project design and bears all the risks associated with design errors and omissions. The owner’s responsibility is to provide performance objectives and standards rather than detailed design and tender documents. After construction, the project turns over to the owner to operate. The DB is considered a “traditional” procurement model by P3 Canada [2011, 2014]. The DB model can essentially be viewed as the fixed-price version of EPCM, for which there is a range of payment options.

An advantage of DB is single-point contact, thereby eliminating potential adversarial relationships between designers and constructors that can occur when sorting out responsibilities for problems as with separate DBB contracts. Another advantage is faster project delivery because some aspects of design and construction can happen in parallel since the design documentation can be less detailed before commencing construction. This advantage is often cited as a key reason for choosing DB project delivery [PRT, 2010].

Disadvantages are that risk allocation is limited to design and construction only and, like DBB, there is no vested interest by the contractor beyond the limited demonstration period for performance/acceptance testing. Performance guarantees under the traditional models DBB, EPCM, and DB are often of little value, not easily enforced, and often don not apply after an early performance demonstration period anyway. This presents a real possibility for the contractor to reduce quality to save costs but potentially create long-term operating issues. Problems also arise when the owner is overly prescriptive, running the risk of negating the intended transfer of design liability. In other words, it may be difficult for an owner who is typically closely involved in developing the final design to relinquish control.

3.1.3 Construction Manager at Risk (CMAR)

This model is for the owner seeking many benefits of DB delivery but wanting to retain direct control of project definition and design [Shorney-Darby, 2012]. Like DBB, there are separate contracts for the design and construction phases. However, under this model the owner's construction manager works with the owner's engineer in design advancement, ideally from about 30%, but up to 60% design completion. At 60% to 90% design completion, the constructor bids a guaranteed maximum price. It is similar to the practice of "split contracting" as defined by Independent Project Analysis (IPA) whereby the design phase is reimbursable and construction is fixed price [Sanborn, 2015]. It differs from and provides advantages over DBB by (a) delegating considerable administrative responsibility to the construction manager, (b) permits more integration of the design and construction activities, thereby compressing the project schedule, and (c) achieves some degree of cost certainty for the owner earlier in the project, but not as much as for the DB method. Disadvantages versus DB are owner exposure to change orders and responsibility for process performance. The separate contracts require the owner to set QA/QC responsibilities for the designer and constructor to ensure complete project coverage.

3.1.4 Design-Build-Operate (DBO) and Design-Build-Operate-Maintain (DBOM)

Under this model a single source provider is responsible for the design, construction, and operating phases of the project. The DBOM model is thus more seamless than DB. The intent is to transfer life cycle cost risk to the contractor; therefore, contracts typically run for 15-20 years.

Advantages to DBOM include working with one contractor rather than several, greater appropriation of risk management, potential for reduced capital and maintenance coats, use of advanced technology and equipment, performance guarantees, and shortened delivery schedules [Adams, 2003]. When the design-build and operating contracts are separate and sequential, there are always challenges and there potential lack of "buy-in" from the operating contractor [Adams, 2003]. Long-term performance incentives, as a result of being at risk to operating profits, motivate the contractor to achieve life-cycle cost efficiencies during procurement, construction, and particularly operation. For example, the operating perspectives and insights at the design phase can streamline maintenance later on [Cudrak, 2015].

The main problem with DBOM is if the contractor simply does not perform and escalating remedies do not result in self-correcting performance. Eventually, the owner may have to sue the contractor (or parent company), especially if the non-performance relates to rehabilitation (major maintenance and sustaining capital investments). In the end, the quality of long-term risk transfer boils down to contractor guarantees, which is difficult to appraise at the outset when the contract is awarded. The key is to partner with highly-qualified companies with solid reputations. However, operating firms often specialize in the water industry and carry out due diligence into the technology, design, and constructability of their DB partners [PRT, 2010], thereby mitigating the likelihood of performance risks. In fact, dozens of DBOM projects have been successfully executed in North America without a change order or performance breach [PRT, 2010]. Another shortcoming to some owners, perhaps even more so than for DB since the operating phase is included in the contract, is relinquishing the control to which they are accustomed. Finally, depending on project size, there may be fewer qualified DBO proponents to ensure a competitive procurement process, although those that do compete are felt to be strong companies (and partnerships) specializing in providing these services [PRT, 2010].

Interestingly, the DBOM model has been in the United States only since IRS Revenue Procedure 97-13 allowed such contracts and long-term relationships [Adams, 2003], but the model has worked so well that, in 2002, 97% of the contracts of the 2400 public-private partnerships were renewed [Adams, 2003], albeit driven largely by lack of funding available to the public owners.

Payments are made as though there were two contracts. First, payments are at specified milestones during design and then monthly during construction [Shorney-Darby, 2012], or just at construction completion [PPP Canada, 2013, 2015]. Second, payments during the operations phase may be fixed fee plus variable costs (chemicals and energy), or flow through to avoid contractor mark-up. Rehabilitation payments may be made on a regular schedule at constant amounts or "lumpy" to match when the contractor actually incurs expenses.

Risks are generally allocated as highlighted in **Table 3.1**. Contract development is relatively complex due to the long operating term, thereby potentially limiting proponents. The RFP process has fewer prescriptive design requirements, so proposals tend to generate a wider array of design solutions in the proposals that must be thoroughly evaluated for technical risk and are easier for mature technologies. A more complete risk listing is provided later in **Figure 3.5**.

Table 3.1 Risk allocation in DBOM contracts [Shorney-Darby, 2012].

Risk	Owner	Contractor
Site acquisition	X	
Major permits	X	
Financing (shifts to contractor for DBFOM)	X	
Technology (AWTF technology section may need to be shared)		X
Design		X
Design-specific permits		X
Construction/acceptance		X
Schedule		X
Quality of influent	X	
Capacity to treat water		X
Quality of treated water		X
Uncontrollable (change in law, force majeure, inflation)	X	

3.1.5 Design-Build-Finance (DBF)

Under this model, the contractor finances the project and the owner makes fixed monthly payments to the contractor starting when the project is complete and passes acceptance parameters, and then throughout the financing period, typically 15-25 years, or during construction upon completion of defined milestones, or at completion of construction. The contractor arranges its own financing. Once the DBF asset is constructed and passes acceptance testing, it is similar to traditional procurement and has a warranty period of one or two years.

Potential advantages to the owner are similar to DB in terms of single point contracting and faster project delivery, but there is also cost and time certainty by paying on fixed milestones rather than by progress.

The main potential problem of DBF relative to DBB, DBOM and DBFOM is the least consideration for life cycle costs due to the short-term interest of the contractor compounded by a procurement process that emphasizes capital costs. This can result in a facility that does not operate well and/or is expensive to operate, with little financial recourse for the owner. Accordingly, PPP Canada gives it limited consideration, there is no precedent for it in municipal wastewater treatment [Shorney-Darby, 2012] and thus it is not recommended for Teck Coal's AWTFs either.

3.1.6 Design-Build-Finance-Operate (DBFO) and Design-Build-Finance-Operate-Maintain (DBFOM)

This model combines DBF and DBOM. Under this model, a single source provider is responsible for designing, building, partially or fully financing, and then operating and maintaining the facility for a period of 20-30 years. There are three basic DBFOM variations: (a) build-own-operate-transfer, whereby ownership transfers to the client at the end of the financing period (b) build-own-operate, whereby ownership stays with the contractor in perpetuity, and (c) build-operate, whereby ownership resides with the owner throughout, but the contractor provides some or all of the financing. Option (b) is the design-build-own-operate (DBOO) model at the right-most position in **Figure 3.1**.

The DBFOM model is not common when the owner has a lower cost of capital unless key risks can be transferred to the contractor. Based on the risk transfer aspect it is reportedly quite common internationally for municipal wastewater projects, except in the United states, [Shorney-Darby, 2012] and is the default procurement option for municipalities under British Columbia provincial policy [PRT, 2010]. The DBFOM contractor is commonly a limited liability company or corporation, or limited partnership formed exclusively for the project whereby facility completion and performance guarantees are provided by the prime contractor with the financial resources to support the guarantees [Shorney-Darby, 2012]. When fully contractor funded, payments generally do not start until the facility is built, placed into service, and performing, and then typically include: (a) a monthly "capacity of availability charge" to offset fixed contractor costs plus (b) a variable charge to offset energy and chemical inputs [Shorney-

Darby, 2012]. In a P3, the provider is selected based mainly on total net present costs [Deloitte, 2013].

The DBFOM model shares the advantages of the DBO and adds cost certainty through transfer of equity risks to the contractor, and provides timing certainty of payments by paying on milestones rather than on progress. As well, the long-term agreement provides incentive to the contractor to perform throughout the full project life cycle. The DBFOM aligns with all of P3 Canada's reasons to support and invest in a project [PPP Canada, 2013]. The quality of various operating phase securities for DBOM and DBFOM P3 models are provided by PPP Canada [2013]. In general, company guarantees are judged to be weak with limited coverage to rectify performance, whereas letters of credit for DBOM and the equity investment associated with DBFOM are felt to be strong and relatively straightforward to address performance issues. Third-party investment in DBFOM is considered to provide very strong security and requires the least owner involvement to rectify performance issues since the lender will mitigate its losses by monitoring the contractor directly.

Disadvantages to DBFOM are similar to those for DBOM but with increased procedural and contractual complexities, requiring increased due diligence of the contracting consortia to understand the project requirements and allocation of risks to the contractor. There are several other often-underappreciated challenges [PRT, 2010]. First, to address performance issues relative to permit requirements the owner has to deal with the project company/partnership rather than the actual operating services company because the owner has no privity of contract with the operator. Second, convenience termination is difficult because the termination fee has to cover operating contract breakage costs, as well as the equity, equity return, and outstanding loan balances. This would be a particularly relevant issue if new AWTF or substitute technologies become economically favourable and obsolete the incumbent technology leaving stranded capital under a DBFOM contract (recall discussion on New Entrants and Substitution in Section 2.1 with respect to a Porter's forces overview shown in **Figure 2.3**). Without the financial burden in DBOM, convenience termination would be easier and stranded assets "just" an owner liability.

Another challenge with DB, DBOM, and DBFOM is that the concurrent nature of design and construction. Permitting agencies are generally accustomed to complete designs to grant approval, whereas these models require a series of submittals for various project phases with requests for related permits. Finally, and related to privity of contract for both DBOM and DBFOM due to their long contract term, the owner cannot attribute statutory risk to the operating services consortia and would ultimately be responsible if the consortia defaulted.

3.2 ASD Problems and Pitfalls

Outsourcing does not always provide a beneficial outcome for several reasons, key ones being lack of management outsourcing decision-making competencies and processes, including how much to outsource, lack of skills to deal with the more strategic and collaborative relationships and associated service agreements, and focussing on achieving short-term benefits [Harland et al., 2005]. The key is to manage relationships instead of internal functions and processes, and to be mindful of social aspects such as employment. A clear understanding of core activities is critical to avoid outscoring them.

Five representative case studies on geographically disperse (global) remunicipalisation from private operators included the City of Hamilton that, in 2004, did not renew the contract with the private operator [Pigeon at al., 2012]. This case highlighted the problems that can arise when there is misalignment of risk and accountabilities. As well, the contract was the outcome of "intense political networking" and signed without a tendering process. Eventually, the City of Hamilton took back operations and maintenance wastewater treatment services from the private contractor, who had been taking advantage of a service agreement that allocated risks poorly. For example, (a) small maintenance repairs were deferred until the cumulative scope exceeded the threshold at which the City was financially accountable and (b) the contractor pumped faster during non-peak hours to save money, but overloaded the piping network, not their responsibility, leading to several main breaks that the City had to repair.

Werkman and Westerling [2000] collated a number of empirical studies that compared DBO contracting with traditional procurement models. Contract operations produced lower costs when (a) the scope of work was precisely specified in advance, (b) the contractor's performance was evaluated easily, and (c) the contractor could have been replaced after the contract term. They found that capturing and maintaining the benefits of market competition on service costs in a long-term DBO model may be an elusive objective for several reasons:

- The process to solicit proposals is more open-ended for DBO than for traditional procurement models, with proponents proposing their own capital execution plans, resulting in potentially different technical approaches and scopes of work. This makes comparing bids difficult.
- Proponent proposals for allocating risks, which is key to evaluating the long-term cost of the DBO contract, may differ, again making bid comparison difficult.

- Changing circumstances over a long contract period, particularly in regulation, make quantifying risks impossible over the long-term. Since the contractor cannot take on risks it cannot quantify, these tend to be borne by the owner as pass-through costs, but this runs counter to the premise of risk allocation that is meant to be the advantage of DBO contracts in the first place. Terms that protect the contractor also negate incentives to control costs.
- The long-term DBO contractor does not face competition every 3-5 years, and thus has less incentive to maintain a high level of performance nor yield on issues that must be negotiated.
- A complex set of rules is necessary to adjust prices to accommodate the magnitude of changes likely to occur over several decades that cannot be forecast reliably, which thus requires considerable owner legal, technical, and financial expertise.
- The long-term DBO allows the contractor to "shore up" barriers to entry by controlling access to information and developing relationships with client personnel.

In the end, the long-term superior efficiency of contractors may be "an article of faith", which presumes they are more efficient managers than owners are. Owners need expertise to (a) develop a procurement process generating price competition, (b) develop contract terms in which the owner has control over key design criteria for capital projects, and (c) assess impact of changing circumstances on future costs. Finally, a DBO contract should not be used to fix a budget shortfall. Brandes et al. [1997] reviewed five case studies that resulted in the same assessment: outsourcing should be a strategic decision including to retain focus on core competencies and achieve cost efficiencies, not motivated by financial problems. There must be a strong believe the contractor can provide a better product and a more competitive price than was done in-house. Finally, the transition to outsourcing should be rapid to avoid discouraging proponents with a long-term close relationship.

Finally, while the United Kingdom may be recognized as the originator of public-private partnerships and private finance initiatives (PFIs), a study on road and hospital PFIs concluded that is it not clear if the risks have in fact been attributed to the private sector as intended at the outset of the agreements. More importantly, the PFIs introduced new risks that were not recognized or valued when the value for money (VFM) comparisons were done to support the PFI procurement [Edwards et al., 2004].

3.3 ASD Delivery

The payment profile and potential cost advantages of the P3 model versus traditional project execution are illustrated in **Figure 3.2**. As mentioned earlier, in the PPP Canada models, the owner does not pay until the facility is actually delivering according to specifications, providing a very strong incentive for the provider to deliver on-time or absorb capital and operating cost overruns, and construction delays. The end result is that cumulative payments (the combined area of all cost items) with the P3 model can be less than for traditional procurement.

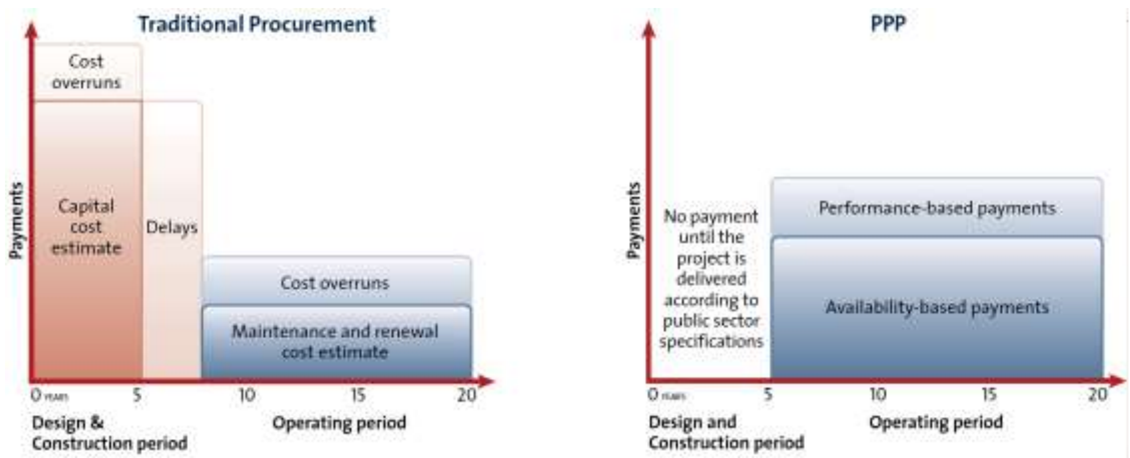

Figure 3.2 Traditional procurement versus P3 model [PPP Canada, 2011].

The data underlying **Figure 3.2** are based statistical analyses (cost overruns, schedule delays) of traditional projects and ASD projects by independent financial/accounting consultants such as Deloitte and Price Waterhouse Coopers [Sonnenberg, 2015] and, potentially, from commissioned studies by project analysts such as Independent Project Analysis . However, the assumptions by these consultants to quantify the risks attributed to the contractor, which is key to completing VFM comparisons between models, appear to be confidential and certainly not in the public domain [Mackenzie, 2013; Sanger, 2013]. As well, few precedents are available for industrial projects by DBOM or DBFOM [Sanborn, 2015], again since project cost data details for corporations tend not to be in the public domain.

An illustrative VFM comparison of DBB and DBFOM procurement drawn from Deloitte's P3 preliminary assessment for the City of Regina's wastewater treatment plant upgrade and expansion [Deloitte, 2013] is shown in **Figure 3.3**. In this case, the project lifecycle cost savings was estimated at about $35 M, or 7% of total project costs, before application of the P3 grant. The savings were associated with allocating risks to the service provider, such as cost overruns and schedule delays as presented in **Figure 3.2**, for a relatively low risk premium charged by the service provider.

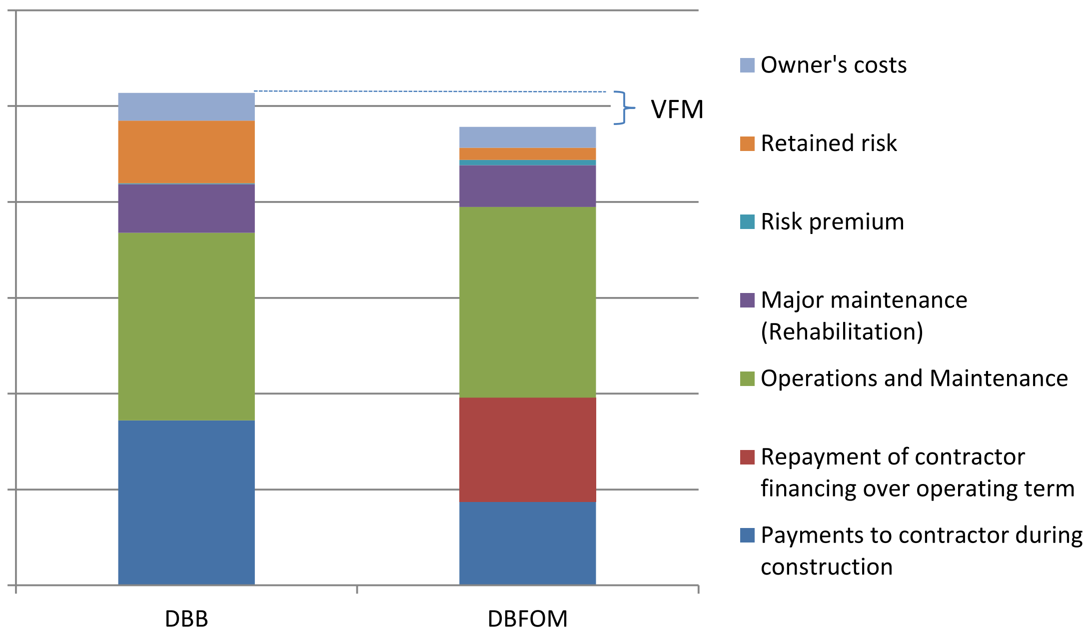

Figure 3.3 Illustrative VFM comparisons [re-plotted from Deloitte 2013].

A key feature of ASD DBOM and DBFOM models is the 20-30-year term for the contracted operation service phase for the following main reasons [Johnson et al., 2002; Adams, 2003; PPP Canada, 2011, 2014b]:

- Improved performance and compliance – Service providers make greater up-front investments knowing costs can be amortized over a longer time frame. With short-term contracts, service providers have limited ability to make capital investments that will reduce long-term operating costs. In fact, a short-term focus was found likely not to result in the intended benefits to outsourcing [Harland et al., 2005]. As well, providing incentive to the service provider to exceed targets is likely to result in premium performance.
- Cost savings – Service providers often bring improved economies of scale to achieve better prices for capital equipment, chemicals, and supplies.
- Accountability – Accountability for performance compliance, cost overruns, and missed schedules shifts to the service provider. The more discrete project components that can be bundled into the contract, the greater the degree of accountability.

- Capital improvements – Service providers can be more capital efficient. The capital savings were then used to make system improvements that reduces overall net present costs. (The reference did not explain how the capital savings were derived, but presumably thorough value engineering, avoiding scope creep, and capital execution efficiencies not identified by the municipalities.)
- Community benefits – From a sustainability perspective, improved water and wastewater performance can attract other economic development. Private-sector companies also often become involved corporate citizens

Clearly, a key philosophical issue for Teck is whether project delivery and operation of the critically-important AWTFs should be contracted out or performed in-house. A change in thinking is needed from traditional DBB and EPCM contracts to ASD models [17 PPP Canada, 2011]. First, and as mentioned earlier for DB, DBOM, and DBFOM, the owner specifies only what is needed, not how the service provider should deliver on these needs. Second, as explained above, the owner must anticipate at least 10 and preferably 20-30 year terms for DBOM and DBFOM, not a short-term focus to minimize initial capital spending. The owner needs to understand what they are looking for; otherwise, comparing bids will be difficult or impossible [Adams, 2003].

3.4 Assessing Delivery Models

PPP Canada offers very helpful guidance [PPP Canada, 2011, 2013, 2014, 2014b]. In fact, following a multi-step PPP-Canada Business Case Development Guide [PPP Canada, 2014] is a prerequisite to qualify for PPP Canada funding and should thus be a good template to assess the opportunity for alternative outsourcing models for Teck's AWTFs. The essential elements of the initial stages of the P3 guidelines are illustrated in **Figure 3.4**. A case study of Deloitte's assessment for the City of Regina, covering Steps 2-3, is presented later in Section 4.

An essential requirement of Step 1 is obtaining sufficient project definition using traditional project delivery to compare ASD methods meaningfully. Such definition requires at least a pre-feasibility study, a Class 4 estimate at -20%/+35% resolution based on up to 5% of the engineering and which is the stage by which Independent Project Analysis recommends the contracting strategy should be known [Sanborn, 2015]. A feasibility study, a Class 3 estimate at -15%/+20% resolution requiring completion of up to 40% of the engineering may be necessary per PPP Canada guidance.

At Step 2, Procurement Model Assessment, screening criteria to assess the suitability of a project for ASD delivery are outlined in **Table 3.2** [PPP Canada 2014b]. Based on the current project trajectory for the FRO AWTF, DBB is the baseline delivery approach. Additional criteria listed in **Table 3.3** from Shorney-Darby [2012] and Deloitte [2013] are assumed for this MBA study to be must-have P3 criteria.

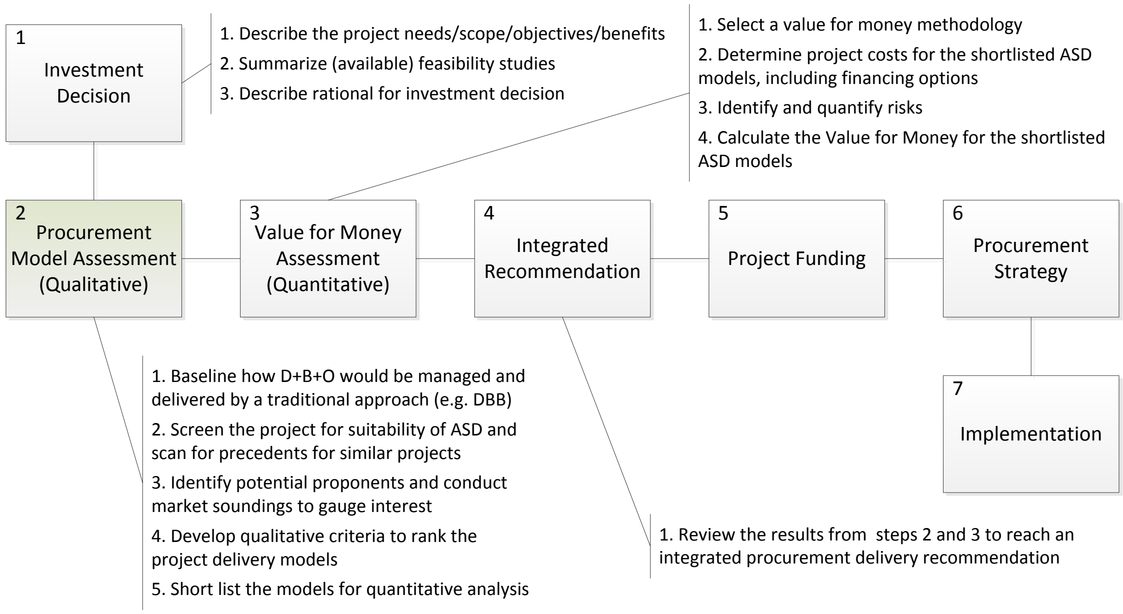

Figure 3.4 Essential steps and elements of P3 Canada Business Development Guide [PPP Canada, 2014].

The next requirement at Step 2 is to identify potential proponents and conduct market soundings to gauge market capacity and interest in the project. This activity is outside the scope of this MBA study, but potential proponents and corresponding reference ASD models were outline earlier in **Table 2.1**. As well, representative companies identified by Teck are overviewed in **Table 5.2** and discussed later in Section 5.2. Another Step 2 requirement is to develop qualitative criteria to rank ASD against traditional project delivery. A representative listing is given in Table **Table 4.2** as part of the City of Regina case study discussed in Section 4.

Step 3 focuses on quantifying risks and calculating the VFM. A generic listing of representative risks are provided in **Figure 3.5**. Technology risk, shown as Technology Selection at top left, might be the principal risk facing Teck with respect to executing AWTF projects, which explains why a fourth pilot program is now underway at FRO to verify several very promising options. The challenge is quantifying these risks to make a quantitative VFM assessment such as shown in **Figure 3.3**. For this, the owner will almost certainly have to hire a financial or project analysis consultant because the owner will not have an in-house database on ASD to make such quantitative comparisons. Steps 4 should be straightforward with information from Steps 2-3 and Steps 5-7 are well understood at Teck.

Table 3.2 Screening criteria to assess suitability of a project for P3 delivery [Shorney-Darby, 2012, PPP Canada, 2011, 2014, 2014b].

No	Criterion	Desirable Conditions
1	Project Size - Operations and Maintenance Scope	The project is large enough to justify the transaction cost/time to develop the contracts. A significant operations component is needed so the contractor can produce design and operating efficiencies through focussing on life-cycle costs.
2	Market Capacity and Contractor Expertise	There are sufficient interest, capacity, and proficiency by potential proponents to ensure competition.
3	Market Precedents	There are P3 precedents of similar size, technical scope, and contract bundling.
4a	Scope	Facilities and interfaces with existing infrastructure can be clearly defined.
4b	New versus Refurbishment	Refurbishment projects not well suited to P3 because latent defects can be difficult and expensive for consultant to assess during the proposal development and thus to valuate.
5	Innovation Potential	There is potential for the contractor to contribute ideas and best practices to improve the project efficiency by integrating design, construction, and operation activities.
6	Legal	No barriers exist to executing a contract. Intellectual property (IP) can be protected for the owner and the technology providers with acceptable non-disclosure agreement (NDA) language and timeframes.
7	Contract Bundling	There is opportunity to bundle several contracts together representing the project phases, including financing
8	Project Term	A long-term period, 20-30-years, is needed for the contractor to recover initial investment (when the contract has an operating component).
9	Project complexity	Different asset classes can be bundled together, for example, roads, facilities, and water and power conveyance.
10	Performance Specification - Construction	Construction performance can be measured.
11	Consistency/Stability	There will be stable operations and maintenance performance requirements and use of the assets over time.
12	Performance Specification –Operations and Maintenance	Inputs and outputs, reliability, quality, and maintainability are available or can easily be defined clearly and objectively based on quantifiable parameters.
13	Refurbishments and Life-Cycle Costs	The refurbishment cycle is expected to be stable over the life of the contract. Life cycle costs are understood and can be estimated accurately.
14	Revenue	There is scope for the contactor to generate additional ancillary review.

Table 3.3 Must-have criteria for P3 project delivery [Shorney-Darby, 2012 p49].

No	Criterion	Desirable Conditions
a	Site right-or-way, land acquisition, and conditions	Land access can be obtained to site the facility. No known issues are evident that could delay or increase the scope of the project, such as unstable soil conditions and subterranean conditions.
b	Environmental conditions	No known issues are evident that could delay project, such as endangered species or archaeological findings.
c	Stakeholder circumstances	No significant stakeholder issues exist that would delay/stop the project, such as objecting to transferring the project assets and operations to the contractor.
d	Degree of risk transfer	Some risks can transfer to the contractor.
e	Timeframe	There is enough time available for ASD procurement.
f	Technology	The technology is defined well enough for ASD procurement.

Figure 3.5 Generic project [reproduced partially from Sonnenberg, 2015] and statutory risks.

3.5 Service Provider Perspectives

Interviews were conducted with executives from four potential service providers to solicit perspectives on a range of outsourcing models. Three providers are also technology vendors. The following questions were covered and the responses were collated to protect the identity of each company. All have operations in at least Canada and the United States, while several are multinational. Twelve key questions were asked across the companies, and the responses are listed and discussed below.

1. *From the provider's perspective are there general themes/consideration that drive clients towards outsourcing, and then to a specific outsourcing model (DB, DBO, DBOO, O&M, other), such as:*

    a. *Client can focus on its core business,*

    b. *Cost,*

    c. *Single point contact versus separate engineering, construction, operation contracts,*

    d. *Past reputation of provider and associated technology relative to needs,*

    e. *Lack of client knowledge, experience, capacity, and*

    f. *Other?*

Responses – Client focus or core business, cost savings, and performance certainties were noted as drivers. In one testimony, the service provider developed a process to regenerate a key reagent at the customer's site a product the provider had sold. This differentiated the provider from others selling the same product. Eventually, the client outsourced operation of the process using the product in addition to the regeneration facility to focus on its core business. Some clients have not been able to appropriate capital for utilities and wastewater treatment facilities, but were able to execute the projects by bundling financing in the outsourcing contract. The service provider advantages in an outsourcing model are singular focus on its scope – no distractions – and support from its corporate resources aligned to its operating responsibilities.

The cost savings accrue by transferring risk, such as construction cost overruns and above forecast chemical quantity and utility usage, to the service provider. Unit price risk is usually borne by the owner.

A provider should offer complimentary consulting activity as part of their service (no need to spend additional money on consultants) and in-house expertise, say to help assess strategies to adjust/modify the facility if inputs change and to support discussions with regulators. A Teck interpretation of this complimentary service is to develop relationships so the conversations start early on to mitigate problem escalation.

2. *What are typical strengths and shortcomings with clients as seen by the provider working towards the outsourcing models?*

Responses – This really depends on contract language. Client flexibility and openness are extremely important, but much time and effort to share information (hurdle rates, turnaround scheduling, and operating and maintenance costs) are required at the level needed for the provider to be able to develop a possible service scope and complete a value-for-money evaluation. A communicative and collaborative culture is needed. In essence, the provider needs to be an extension of the client's operating staff and evaluate upgrades the same way as the client would.

Clients have to understand that to get value from outsourcing, especially for ASD, they need to let go of the details, focus on inputs/outputs and leave the provider to determine how to execute the project. "Don't be too prescriptive!" Weak attempts to outsource are procurement (purchasing) driven or when there is mistrust between the parties or lack of knowledge of the other party. The more efficient and valuable process is when outsourcing is driven by environmental, operations, and technical aspects, and develop a trusting relationship. Finally, both parties need participation at a management level with authority to sign the deal from the beginning.

3. *Which party tests/evaluates/recommends/decides which technology will be used and to what extent is the client typically involved in technology selection?*

Responses – This depends on the relative expertise, and it may take some time for each party to understand meaningfully the other's capabilities, meaning working collaboratively with clients. For some clients, one provider selects the process and materials of construction. Teck is "definitely leading the way" on pushing technologies for selenium removal. A culture shift at Teck would be needed to progress beyond a DBB and DBO – Teck's involvement in technology selection/evaluation would be valued, but after that would need to let go of design and construction management. Another response indicated that since the technology is not totally verified, it would likely be a shared risk. When the technology is well understood, the service provider would take on all the technology risk with a long-term view.

4. *To what extent does owning technologies sway evaluating technologies for client applications?*

Responses – One provider that also owns technologies maintained they sell a result, not a technology, so they work with what is best, not from where or whom it comes. Client involvement in the process is important and again must develop trust. From a Teck perspective, due diligence would be needed to monitor bias that could affect technology selection.

5. *Is Teck's lead role in technology selection unique or common compared to others?*

Responses – To some providers, Teck knowledge ranks very high and Teck is more dedicated to understanding the technologies for facilities than most clients, and is on the leading edge of technical capability. The skill set at Teck's Applied Research and Technology Group (ART) allows Teck to be good partners, although sometimes ART does not solicit provider input on technology decisions. To another provider, who serves across other industries, Teck's capabilities are comparable to their other industrial clients (about 10% of their business).

6. *What are the provider's prominent 5-6 criteria to assess an outsourcing opportunity to with clients? In other words, what client attributes suggest there is a good opportunity to develop a working relationship with to DBOO?*

Responses – A key consideration is to provide service where the provider believes they have special expertise, which should translate into reduced operating and maintenance costs. However, the cost of capital can be more or less than the client's. Project execution savings then come from good work plans and efficient use of manpower. More importantly, the provider is generally willing to invest capital up front to achieve operating cost savings, whereas clients tend to minimize initial capital expenditure and not make upgrades later on that can reduce operating costs because the upgrades are usually difficult to appropriate, thereby living with inefficiencies. The result is often a facility that does not perform as intended or last as long. Quite simply, when the provider owns the facility, long-term contracts are the most cost effective since the costs are amortized over a longer-term. The client must be open to the idea of a long-term business relationship, a minimum of 7-10 years, and negotiating a final solution. One provider seeks a financing or ownership position on wastewater treatment, which is aligned with *their* core business.

Interestingly, the vendor-provider's equipment design philosophy can be different between just selling the equipment to a client versus owning and/or operating it. When selling, there is a tendency to provide equipment to pass a performance test, but when operating and/or owning, the vendor-provider will provide a more robust design to achieve longer wear and performance over the contract life. In short, the provider strives to minimize life-cycle costs, whereas owners are generally driven mainly by minimum capital costs.

Other considerations from the provider's viewpoint are (a) the financial viability of the potential client, for example, how would a bank view the business opportunity, (b) trust and free flow of technical and cost information, (c) clearly defined success criteria, and (d) open access to decision makers.

7. *On the operations side, can there be different contracts for operations staff (for example, union versus non-union) than for the client's facilities and if so what are the associated challenges?*

Responses – Understand constraints up front. For example, a union site may prohibit the provider, if non-union, to complete major maintenance. The key is to avoid "stranded costs", that is a requirement for just a fraction of a person. The provider needs to integrate fully into the client's operating staff. Owning the equipment (DBOO) allows the provider to operate the facility the way they deem best, including consideration of union versus not, but following the client's safety programs if they are more robust. The client would control emergency response. Generally, the providers can work with a range of staff contracting models.

8. *On performance risk, what is the general approach around accountability/responsibility if treatment targets are not met? To what extent can risks be passed to the provider, and for what risks is the client ultimately responsible?*

Responses – The provider is incentivized to save net present costs, which might mean spending more capital to save operating and maintenance costs. To this end, longer contracts provide more opportunity for the provider to recover capital costs. The provider can assume the risk of unbudgeted expenses. The client is ultimately accountable to the Ministry, but contracts can be written whereby the provider will indemnify the client for fines associated with missing mandated permit targets. The client buys a result, and when not met the provider must correct at its own cost. Accordingly, the provider will consider carefully all risks, but this requires good discussion with client. As well, the provider has to have control of the facility (initial capital and upgrades) and one provider has its name on several permits. Teck would own the reputational risk, but the regulatory risk can be allocated. A contract can be written to share operating costs savings.

9. *What timeframe is typical to execute an outsourcing agreement and does size matter?*

Responses – Size does not really matter. Timeframes are hard to pin down. Every situation is different, though 12-36 months is a good starting allowance. Discussions on scope (system specification, operating responsibilities, and risk allocation) and unit process design take time; therefore, early collaborative and concurrent discussions on these issues can streamline contract execution. Another key is involving counsel from both sides with a penchant for "getting a deal done" to work through personal preferences on wording. If both sides are motivated, one provider can execute an agreement within 60 days of commitment by client. One provider has executed a DBO contract in just six weeks, but a DBFO could be six months. Assessing risks takes time. These timeframes do not include the client time to determine first which procurement delivery models make sense.

Two contract principles are important to one service provider. First, the provider never takes ownership of the influent, in-process inventory, or product water. Nevertheless, indemnity provisions can at least cover fines after making "reasonable commercial efforts". Second, a "change of law" provision is needed to adjust the set points if permit mandates change. On this point, over-performance by a wide margin could lead to more stringent regulatory targets that could be difficult to reach. The likely idea is to perform just a bit better than well enough.

The contracting process steps are as follows:

a. Agree on the client's needs (technical, operational, financial),
b. Select the technology (footprint and performance),
c. Assess the client's constraints (union contracts, analytical resources, maintenance preferences, …),
d. Understand financing preferences (ultimmate ownership, accounting principles, etc), and
e. Execute contract with "boilerplate" indemnities, warranties

One provider indicated clients have a penchant for providing their version of the contract, whereas it makes much more sense to outline risks first and then work on contract terms.

10. *At what point in a client's stage gating process would the provider recommend* initiating *outsourcing options evaluation? For example, a key consideration for clients is the value-for-money. Yet, to complete this analysis the client, and service provider, need a good baseline capital and operating costs estimate for the traditional DBB or DB and owner operate model.*

Responses – One provider has experience getting involved a conception, and also taking over projects being operated by others. In other words, the earlier the better, but clients need to complete some level of estimate to quantify the potential VFM of ASD. One provider indicated clients would typically have completed a ± 30% estimate before engaging them for different delivery models and another provider will complete 30% of the engineering so as to quantify the risks accurately.

11. *The Teck Coal opportunity would represent a large industrial account. What fraction of the provider's existing DBO, DBFO, operate contracts are with companies like Teck?*

Responses – One provider has clients in size ranging from $5 M to $1 B, with operating contracts ranging from a few hundreds of thousands of dollars to tens of millions of dollars per year. The sweet spot depends on the client's needs and approach. Teck's AWTFs is in this provider's sweet spot for size. One provider acknowledged an Elk Valley Teck Coal account would grow their water treatment business by quite a bit, and they have their eyes on this big prize.

12. *What are the differences in approach between municipal and industrial, especially on risk allocation?*

Responses – Municipal clients can have a very political component and there are some different risks than for industrial clients, such as bill collection. In the final analysis, it comes down to what is important to the client.

One provider's main goal is to invest and believe they have operations expertise, so are aligned with the DBFO, DBOO, and DB-own-operate-transfer models. The latter involves transfer of ownership to the client at the end of the contracting term. This is the (a) variation of the DBFOM model described earlier in Section 3.1.4.

In summary, these interviews highlighted the following themes:

- The owner and ASD provider have to be willing to exchange financial information and potential project constraints upfront openly in a trusting relationship to be able to negotiate a win-win solution, and then integrate with the owner's team during the operating phase,
- The owner has to be flexible and be prepared to let go of the details and set clear, explicit mandates and then monitor outcomes rather than how the mandates are achieved,
- An ASD model works best when the provide has special expertise, then savings arise from good work plans and execution,
- The actual contract can come together quickly (two months) if the lawyers on both sides are motivated to make it happen, but generally takes longer,

- Alternative service delivery is about life-cycle costing, rather than minimizing upfront capital as with traditional delivery models, which may mean greater initial capital investment and more robust equipment designs,
- Long terms are needed to provide the provider time to recover the cost of installed capital, and
- Sufficient engineering study is needed first to quantify the VFM of ASD. This is understandable. The contractor needs to complete enough design work to be able to justify making a long-term contractual cost commitment, including the operations and maintenance phase.

4 Case Studies

This section highlights the methodology and outcomes of an evaluation by Deloitte to assess P3 potential for the City or Regina and the financial summary by a peer review team to assess P3 potential for the Capital Regional District, in the City of Victoria.

4.1 City of Regina

The City of Regina's process to determine a procurement strategy for upgrading and expanding by 20,000 m^3/d to 92,000 m^3/d the capacity of its wastewater treatment plant provides a good case study for Teck AWTFs for several reasons:

- The project capital costs were comparable to the scoping–level estimates for the FRO AWTF at about $180 M,
- The plant technologies to be upgrade and deployed included several unit operations similar to those at WLC and planed for FRO (biological reactor, sludge thickening, effluent filtration, anaerobic digesters, and biogas systems),
- This project was a step out from the City's traditional DBB procurement approach, but they accepted shortcomings of DBB for this large project,
- Publically-available documents outline the logic and provide the assessment criteria lists consistent with the P3 guidelines, albeit these documents do not provide the economic assumptions and risk analyses details, which were redacted, and
- There was a significant change management effort devoted to deal with the considerable opposition to the P3 option leading up to a final referendum.

Deloitte was retained by the City to carry out a delivery model assessment in conjunction with AECOM who provided the cost estimates [Deloitte, 2013, 2014]. A key challenge facing the city was the project size, which was expected to have overwhelmed the City's engineering and procurement resources using the DBB approach. As well, the City recognized that DBB would not have provided connection between the designer, builder, and operator. The preferred proponent, EPCOR Saskatchewan Water Partners. (EPCOR as prime contractor), was eventually selected based on estimated net present value and the project agreement was signed in July 2014. As at the beginning of June 2015, the project was about 40% constructed [Cudrak, 2015].

Selection of the delivery model progressed through three stages of assessment: (1) screening for P3 potential, (2) strategic (market sounding, qualitative risk review, and multi-criteria analysis), and (3) VFM calculations on short-listed P3 options based on capital, operating, and risk estimates. Starting in 2012, 22 P3-suitability criteria across 14 categories were carried out in a screening workshop to assess P3 potential (Stage 1). These are listed and explained in **Table 4.1**. These criteria were evaluated as "Yes" or "No" relative to P3 potential.

Having confirmed P3 potential, the City evaluated five procurement models (DBB, CMAR, DBOM, DBOM, and DBFOM) and moved to a strategic assessment (Stage 2), starting with two rounds of market sounding with potential proponent teams to test the market interest to support competitive bidding. Next, a risk workshop was conducted to identify risk areas (such as construction delay, construction cost overrun, scope changes, and design errors) and to assess qualitatively the probability and impacts on the various execution models. The workshop determined that DBFOM presented the lowest overall project risk potential. The City then carried out a multi-criteria assessment, with 21 criteria across four categories, to rank the various execution strategies. Selected criteria are listed in **Table 4.2** that might be instructive for Teck. The City recognized that DBOFM and DBOM would only be feasible if the City was willing to transfer operational responsibility to the contractor for a 27-y period following construction completion (30-year agreement). They also had concerns about the long-term quality of DB-built projects. Qualitatively, DBFOM was judged superior to DBOM because the contractor-provided financing was felt to provide a strong and liquid security for the long-term performance of the contract. The CMAR + DB hybrid (upgrading and new-build scope, respectively) were judged better than CMAR because the former was felt most likely to result in capital cost savings and be less demanding on City resources. Strategically, the City determined that DBFOM and CMAR+DB were favoured, depending on whether the City was willing, or not, to transfer responsibility. The case study shows the scores for the project delivery options, but now how these were calculated.

Table 4.1 City of Regina P3 Screening criteria [Deloitte, 2013].

Category	Criteria
Demand	Are the long term operation or service needs and performance requirements relatively stable and/or predictable?
Duration and Technological Change	Is the capital asset of an enduring, long-lived nature and is the service life of the asset at least 20 years? Is there a significant long term maintenance, operation, or service need associated with the capital project Are the capital asset and service needs sustainable and the risk of technological change minimal over the entire service life of the P3
Innovation	Is there scope for innovation in the design of the solution and/or the provision of operation, maintenance, and services, which may lead to cost efficiencies?
Legal Barriers	Is the proposed P3 approach or the provision of the service free of any potential legal conflict with legislative or regulatory prohibitions or substantial restrictions (that cannot be changed in the short term)?
Market	Are there likely to be at least 3 bidders for the project if it is procured as a P3? Are there precedent projects (examples of similar projects) in other jurisdictions? Has the City received unsolicited proposals for P3-style delivery of the project, or similar projects? Does the private sector have the expertise and capacity to deliver on the performance specification?
Procurement	Is there enough time available for a P3 procurement process?
Availability Payments, Revenue Potential, Affordability	Can payment be tied to measured performance? Is there a potential revenue opportunity for the private sector partner, which can be also tied to performance? Does the City have the financial capacity to undertake the project?
Project Risk	Are there risks associated with traditional procurement that might be better managed by a private partner?
Project Size	Is the estimated capital cost significant enough to attract the market? Can the project be bundled with one or more other similar projects to achieve economies of scale and a larger project size more suitable for P3?
Specifications	Can the capital asset and related services be defined in a performance or output specification?
Land	Is the land for the project being provided by the City?
Project Stage	Is the project new build or greenfield?
Integration	Is the project relatively independent of other City projects, infrastructure, or control systems?
Human Resources	Does the project, if delivered by a private partner, obviate any current City staff positions?

Finally, VFM assessments were calculated (Stage 3) on both DBFOM and CMAR+DB, which involved quantifying identified risks. Calculation details are not publically available, but summary results are listed in **Table 4.3**. The total risk-adjusted project cost for DBFOM was estimate at about $479 M over the life of the 30-y contract versus about $514 M for DBB, for a savings of $35 M [Deloitte, 2013]. Interestingly, risk-adjusted costs for DBFOM and CMAR+DB were similar; however, DBFOM qualified for a PPP Canada Grant estimated at about $44 M, thus making this option favourable overall. This option was also Council's preferred strategy. Noteworthy is that savings for the DBFOM model resulted entirely from transfer of risks. In fact, the DBFOM project base cost was higher than for the other two options.

Table 4.2 Multi-assessment criteria for City of Regina P3 assessment [Deloitte, 2013].

Category/ Weighting	Criterion	Importance
Resource capacity 25%	Minimize demand on existing City procurement resources	High
	Minimize design-related demands on City resources	High
	Minimize construction-related demands on City resources	High
	Solve operation and maintenance resourcing challenges	High
Economic 40%	Minimize exposure to construction cost estimation	High
	Maximize capital cost certainty (i.e. degree of cost certainty)	High
	Maximize operation and maintenance cost certainty over 20+ years	Low
	Optimize whole-of-life costs	Low
	Maximize flexibility for future expansions/upgrades/other changes	Low
	Maximize scope for innovation (i.e. design, construction, operation)	Med
	Maximize competitive pressure on capital costs	High
	Maximize competitive pressure on O&M costs	High
Alignment with Management Strategy and Goals 25%	Ensure a robust and easy to operate facility	High
	Avoid deferring major maintenance	Med
	Transfer design risk (rather than embrace it)	Med
	Transfer construction risk (rather than embrace it)	Med
	Transfer operation and maintenance risk (rather than embrace it)	Med
	Maintain labour support	High
Social 10%	Maintain public support	High

Table 4.3 Preliminary VFM (in millions) from City of Regina's perspective [Deloitte, 2013].			
Cost Activity	DBB	CMAR+DB	DBFOM
Total project base cost (NPC)	452.9	434.1	460.2
Retained risk	60.9	43.1	12.7
Risk premium	0.8	1.1	6.4
Total risk-adjusted project cost	514.5	478.3	479.2
P3 grant	0	0	44.0
Total risk-adjusted project cost after grant	514.5	478.3	434.9

A final VFM calculation (**Table 4.4**) was done after concluding the procurement process to include updated and estimates and actual costs and replacing the estimated DBFOM with costs of the financial offer from EPCOR Saskatchewan Water Partners, the successful proponent. The cost advantage to DBFOM over DBB increased to $95 M ($472 M to $377 M) [Deloitte, 2014]. Savings were roughly equal between reduced base project costs and reduced costs of retained risks (risks not allocated to EPCOR).

Table 4.4 Final VFM (in millions) from City of Regina's perspective [Deloitte, 2014].			
Cost Activity	DBB	CMAR+DB	DBFOM
Total project base cost (NPC)	409.7	Not	[1.] 358.2
Retained risk	61.3	Provided	12.5
Risk premium	0.8		[1.] 6.5
Total risk-adjusted project cost	471.8		377.2
P3 grant	0		43.5
Total risk-adjusted project cost after grant	471.8		333.7
Note 1: Estimated for DBFOM from **Table 4.3**			

Key milestones are plotted in **Figure 4.1**. About one year was required to determine the delivery model and about 14 months to progress through the procurement process. The contract was executed in about five weeks.

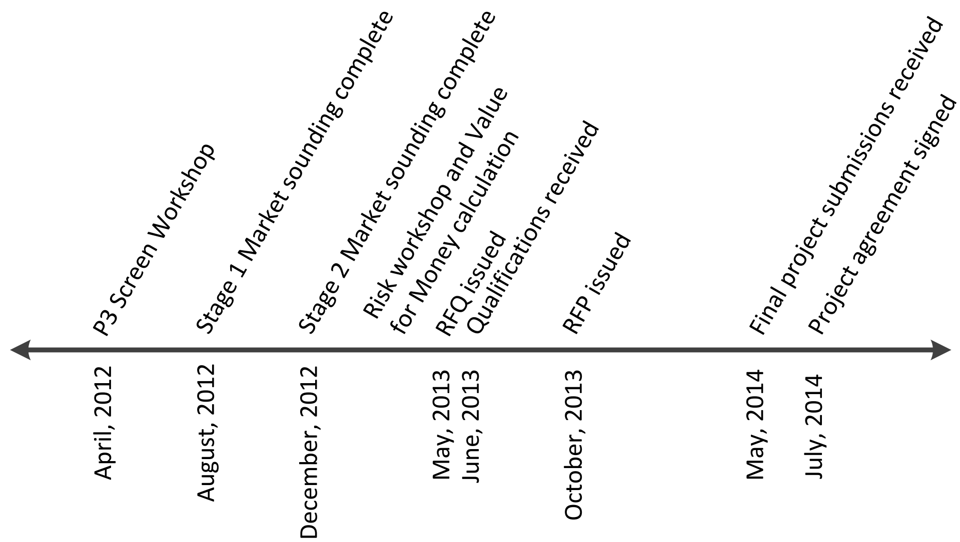

Figure 4.1 Timeline for City of Regina to evaluate procurement options and award contract.

City council faced considerable opposition to their P3 proposal, and with respect to the lack of transparency in Deloitte's FVM calculation in particular [Mackenzie, 2013, Sanger, 2013]. Some believed the promotion of P3 delivery by the Harper Federal Government stems from a privatization ideology, leading accounting companies to become "ever more inventive in their calculations of risk … to justify the DBFOM P3" [Sanger, 2013]. The referendum passed with 57% support.

The following consortiums were selected from the request for qualification phase [Regina Water Watch, 2015]. The EPCOR-led consortia were chosen and as at the beginning of June 2015 the project was about 40% through construction [Cudrak, 2015].

EPCOR Saskatchewan Water Partners

Lockerbie Stanley Inc. – Design and Construction Lead
Stantec – Design, Construction Team
EPCOR Water Services Inc. – Project Lead, Operation and Maintenance Lead, Financing Team
Gracorp Capital Advisors – Project Lead, Financing Lead
Graham Infrastructure LP – Design and Construction Lead

Prairie Water Partners
CH2M Hill Canada Ltd. – Project Lead, Design and Construction Lead, Operation and Maintenance Lead
Maple Reinders Constructors Ltd. – Design and Construction Team
Alliance Energy Ltd. – Design and Construction Team
Westridge Construction Ltd. – Design and Construction Team
GEC Architecture – Design and Construction Team
Macquarie Capital Group Limited – Project Lead, Financing Lead

Wascana Environmental Partners
Alberici Constructors, Inc. – Design and Construction Lead
Burns and Mc Donnell Engineering Co. Inc. – Design and Construction Team
Black and McDonald Limited – Design and Construction Team
Allnorth Consultants Limited – Design and Construction Team
Brookfield Financial Corp. – Project Lead, Financing Lead
Fiera Axium Infrastructure Canada II LP – Project Lead, Financing Lead
United Water Environmental Services Canada LP – Operation and Maintenance Lead

4.2 City of Victoria

A peer review team was solicited by the City of Victoria to review a range or project delivery options (Traditional: DBB, CMAR; Alternative: DB, DBOM, and DBFOM) for the Capital Regional District (CRD) Core Area Wastewater Management Program [PRT, 2010]. The economic comparison is provided in **Table 4.5**. The Hybrid option is a mixture of traditional and alternative for the various geographically separate project components within the regional district. Alternative delivery by DBFOM was forecast to save about $76 M on design and construction, but life-cycle net present costs were similar for all three strategies. This was attributed to conservative assumptions on efficiencies and cost savings on risk transfer for the DBFOM model, as well as differences in financing. The peer review team recommend to consider DBOM, which had not been estimated, and to carry out sensitivity analyses on a range of less conservative assumptions. This collection of projects does not appear to have progressed.

Table 4.5 Value for Money (in millions) from CRD's perspective [PRT, 2010].

Cost Activity	Traditional	Hybrid	DBFOM
Project cost	880.1	826.4	815.6
Retained risk	61.7	29.8	24.9
Risk premium	0	20.3	25.3
Risk-adjusted project cost	941.8	876.6	865.8
Annual operating and maintenance costs	18.6	18.4	17.6
Net present cost	923.8	924.6	929.1

In summary, these cases highlight the following points:

- Estimating the benefits of risk transfer is not straightforward, but is key to determining the economic potential ASD,
- A consultant is likely necessary with a database of comparable projects to quantify realistically the transferred risks,
- Engineering must be sufficiently advanced to refine costs enough to be able to resolve between options, which may not be readily apparent at a preliminary evaluation, and
- A sufficient timeframe must be provided to calculate the VFM and, if chosen, to solicit independent peer review.

5 Teck Perspectives and ASD Assessment for AWTFs

The following discussion assesses whether the ASD model may be appropriate for Teck's AWTFs using the PPP Canada screening criteria (**Table 3.2**), and criteria weightings and scoring guidelines [PPP Canada, 2014b]. Again, while the PPP Canada P3 screening guideline was developed to guide Federal organization assess P3 potential across a range of infrastructure projects, the concepts are generally the same for industrial companies. As well, the criteria weightings, and scoring guidelines have been developed from considerable effort over several years and should thus provide a progressed starting point for assessing ASD for Teck's AWTFs. Development of scores for each criterion is provided in subsequent subsections.

The criteria scores were collated to total an overall rating for ASD potential per the P3 Canada guidelines in **Table 5.1**. Scores at or below 50 points are not considered candidates for ASD execution, while scores above or equal to 75 have strong ASD potential and should be considered for further evaluation. This analysis determined the AWTF projects have mix of favourable and unfavourable attributes for ASD. The high score is just reaches the minimum threshold value where ASD should be considered. The low score results from criteria (5 and 7) where Teck may have trouble "letting go" of input specifications. The issues are:

- Technology selection, for which the low discharge levels of nitrate and selenium from such high influent values is unprecedented,
- Current uncertainty in influent definition (Criterion 12) and potentially required effluent end-of-pipe targets,
- Timing and the timeframe to negotiate an ASD contract given the accelerated pace to deploy AWTFs,
- Teck's project execution culture might not be able to adjust timely to the different mind-set necessary for ASD procurement, and
- Quantifying risks that could be attributed to a service provider needed to support calculating the VFM.

On technology, a must-have criterion from **Table 4.2**, risks of non-performance will likely need to be shared with an ASD provider [Sonnenberg, 2015]. Teck has already solicited participation of the prefeasibility study contractor in the current pilot plant program. An operating service provider will also need to participate if Teck intends to contract out the operating phase or use full ASD. The technology selection for FRO is planned in October 2015.

Table 5.1 Criteria scoring summary and overall rating for ASD potential.

No	Criteria Description	Weighted Scores		
		High	Low	Max
1	Project Size - Operations and Maintenance Scope	50	50	50
2	Market Capacity and Contractor Expertise	30	30	50
3	Market Precedents	15	15	25
4	Scope and New versus Refurbishment	25	25	25
5	Innovation Potential	30	**15**	50
6	Legal	15	15	25
7	Contract Bundling	50	**15**	50
8	Project Term	25	25	25
9	Project complexity	50	50	50
10	Performance Specification for Asset Construction	12	12	25
11	Consistency/Stability	17	17	25
12	Performance Specification for Operations	10	10	25
13	Refurbishments and Life-Cycle Costs	40	40	50
14	Revenue	5	5	25
	Total Score	374	324	500
	Total Score Normalized to a Maximum of 100	75	65	100

On influent water quality definition, a consultant will have a report ready in time to commence the feasibility study for FRO in November 2015 to support detailed process engineering design. However, there is some regulatory risk for end-of-pipe targets as discussed in Section 5.11 with respect to Criterion 11.

On timing, and as mentioned in Section 3.4, sufficient project definition for traditional project delivery is needed to compare meaningfully ASD methods, but not advancing past the point at which decisions are cast in stone. This balance point is judged to be at least at pre-feasibility but not past feasibility. Therefore, the timing will be good in October 2015 to calculate the ASD VFM with reference to the FRO AWTF, if even to serve as a benchmark for the next AWTFs.

The issue of the timeframe to execute an agreement was discussed with several service providers in Section 3.5 and is another must-have criterion from **Table 3.3**. Actual timeframes range from a few to many months. The “soft” gate (no time delay) planned between the pre-feasibility and feasibility studies for the FRO AWTF likely does not provide time to assess ASD for this project, particularly given the timeframe required in the City of Regina case study, the anticipated timeframe for management of change to an ASD model within Teck, and the timeframe to analyse/quantify risks. Change management alone would be a big effort given Teck's existing project execution culture. Nevertheless, an analysis would provide definitive clarity for the next AWTF planned for EVO.

On culture, and recognizing that treating such high combined loading of nitrate and selenium is charting new technical ground, specifying outcomes do not align with Teck management's "desire to understand the problem at the most detailed level by having [in-house experts], people [management] trust, dig into the detail and be confident in a proposed solution or path forward." However, while Teck's strong in-house technical expertise is acknowledged in feedback from potential ASD proponents in Section 3.5 "Service Provider Perspectives" and by others, Teck does not have a monopoly on technical talent. Collaboration with others generally provides fresh perspectives and knowledge, and stimulates in-house thinking. Therefore, Teck's in-house experts can continue to dig into the details and provide valuable input to an ASD proponent for a joint path forward, already seen as a likely path forward by a potential proponent [Sonnenberg, 2015]. In short, collaboration improves outcomes.

Again, on culture, Teck's management sees that "having a long-term contractual boundary between the owner who has accountability for performance (environment) and the people doing the work, the situation exists where it is less efficient to effect needed change and improvements resulting in additional time and cost to yield results. This could also mean additional regulatory risk due to the time it would take to effect changes to improve facility performance." On the contrary, the ASD model incents the service provider to perform according to contracted specifications; otherwise the owner may withhold payment. The key would be executing the contract with provisions for changes in regulation.

On quantifying risks, Teck would need to solicit a financial/accounting consultant or project analyst, which could take up to several months if data is not available.

The following subsections describe, for each criterion, what is being measured, tables the desired conditions and scoring guidelines, and concludes with the criterion score. This analysis is a representative. Further criteria development and analyses beyond this MBA report and with a broader stakeholder group may be appropriate.

5.1 Criterion 1 – Project Size

Criterion 1 measures if the project is large enough to offset the higher transaction costs for ASD than traditional project delivery. The extra effort to prepare the value-for-money estimate against the baseline project delivery cost was not specifically mentioned by P3 Canada for this criterion, but this calculation also requires effort. The capital costs for the next several AWTFs are forecast to be over $150 M and undiscounted 25-year operating costs are forecast to be equal to or up to 40% greater than capital costs. (The 25-year period represents the mid-point target duration for P3 contracts and the assumption for this project is that the scoring guidelines refer to undiscounted cash flow.) On these bases, Criterion 1 scores at five (5) and receives 50 weighted points (5 x 10).

Wt	Desirable Conditions
10	The project is large enough to justify the transaction cost/time to develop the contracts. A significant operations component is needed so the contractor can produce design and operating efficiencies through focussing on life-cycle costs.

Scoring Guidelines

5	4	3	2	1
$100M or more	Capital costs are less than $100M, but operating & maintenance costs will be 2-3 times larger than capital costs	$50M or more, but less than $100M	Capital costs are less than $50M, but operating & maintenance costs will be 3-4 times larger than capital costs	Less than $50M

5.2 Criterion 2 – Market Capacity

Criterion 2 ensures there are enough potential proponents to ensure (a) a competitive bidding environment and (b) that the proponents have enough capacity to perform all of their project obligations and manage the allocated risks as committed in the contract. A Teck Coal AWTF account would be a substantial undertaking for any proponent. Hiring and training new staff would be required for all, but also for Teck.

Wt	Desirable Conditions
10	There are sufficient potential proponents with interest, capacity, and proficiency to ensure competition.

Scoring Guidelines

5	4	3	2	1
There are more than 5 private sector firms capable of forming teams with the expertise to design, construct and maintain/operate this type of asset	There are more than 5 private sector firms capable of design, construct and maintain phases. Operations capability is not yet determined.	There are 3 to 5 private sector firms capable of forming teams with the expertise to design, construct and maintain/operate this type of asset	There are 3-5 private sector firms capable of design, construct and maintain phases. Operations capability is not yet determined.	There are fewer than 3 private sector firms capable of forming teams with the expertise to design, construct and maintain/operate this type of asset

Seven potential proponents are listed and assessed in **Table 5.2**. There may be others, for example BioteQ. Teck has no first-hand experience with the commercial operating capability of any of these vendors, although has some pilot plant operating experience with GE. As well, some of these companies may not have experience executing projects the size of Teck's AWTFs. Market capacity was noted to limit potential proponent by peer reviewers assessing delivery methods for the $940 M wastewater management plan for the CRD in Victoria British Columbia [PRT, 2010]. The identified potential consortia were led by CH2M Hill, EPCOR, Veolia, United (now Suez), and American Water, but, apart from EPCOR, little to no experience with such large DBFO projects in North America. Individually, the Teck AWTFs are much smaller, theoretically qualifying more options. On these bases, Criterion 2 scores at three (3) and receives 30 weighted points (3 x 10).

Table 5.2 Potential proponents for Teck Coal ASD and quick assessments.

Proponent	Quick Assessment
Corix	Privately held corporation, principally by the British Columbia Investment Management Corporation. Representative experience indicates 70 years of design, fabrication, and operations capability, including wastewater treatment, for small- to medium-size municipal clients throughout North America. Has implemented composting for residuals management. Strength appears to be developing, designing, and fabricating custom packaged and modular wastewater treatment plants using a range of unit operations consistent with several in Teck's AWTFs [Corix, 2015].
Envirogen	Developed, designed, built, and operating the Henderson water treatment plant for NERT using most of the technologies planned for Teck Coal's AWTFs.

	Strength is FBR bioreactor and selected other technologies; partners with others to design-build.
EPCOR	Privately held corporation with City of Edmonton as sole shareholder. Started as Edmonton's power and water company 120 years ago [EPCOR, 2015]. Has several municipal wastewater treatment contracts in western Canada and in Arizona and New Mexico with a range of delivery models using some of the technologies in Teck's AWTFs; operating Anglo's demonstration wastewater treatment plant at Peace River Coal for nitrate and selenium removal; in discussion with Teck for WLC operating contract. Awarded to lead City of Regina wastewater treatment DBFOM contract for about $600 M life of 30-y agreement [City of Regina, 2014b]; now about 40% construction completion. Strength and strategic focus is operating wastewater treatment plants, preferably through investment potential (DBOO, DBFO); partners with others to design-build.
Suez-Degrémont Suez-United Water	Offer a range of delivery models (DB, O+M, BO + transfer) globally for municipal and industrial clients. Strength is a business focus on water treatment, including aerobic membrane bioreactors, but applications using biological technologies anaerobically appears lacking. [Degrémont, 2015]
GE	Has over 150 BOO contracts (six wastewater) internationally using a range of their own technologies including membranes, evaporation-crystallization, multi-media filtration, (one membrane bioreactor application). Working towards an operating service agreement using ABMet® bioreactor for confidential client. Very engaged with Teck's ART group and carrying out in-kind technology development work to progress ABMet®. Strength is ABMet® biofilter, membrane technologies, ultrafiltration, and evaporation-crystallisation; partners with others to design-build.
Newterra	Representative experience indicates 150 years of design, fabrication, and operation capability for wastewater treatment globally. Strength appears to be testing, designing, and fabricating custom packaged and modular wastewater treatment plants, including for remote applications [Newterra, 2015].
Veolia	Operate 38 wastewater and 6 groundwater treatment plants for a range of industrial clients [Oliphant, 2015]. Examples include: • 10-y DBOM contract with Consol for mine wastewater treatment in West Virginia. • Operations and maintenance contract for three small Alpha Natural Resources wastewater plants for nitrate + selenium treating using Veolia's own bioreactor and solid-liquid separation technologies. Has 20-30-y BOM contracts for municipal wastewater treatment in China, Germany, others. Strength is MBBR biofilter, dissolved air flotation, ballasted sand clarification; partners with others to design-build.

American Water	Headquartered in Voorhees, NJ, are the largest publically-traded water and wastewater utility company in the United States [American Water, 2015]. Have operations in which they own, as well as operations in which they provide operations and maintenance services.

5.3 Criterion 3 – Market Precedents

Criterion 3 measures the precedents for P3s for similar assets to indicate viability for the project being evaluated. While there have been numerous P3 projects delivered in Canada of similar or greater capital cost [Conference Board of Canada, 2010], none are similar in technical scope to what is required for the AWTFs at Teck. (Scope for this project is taken with reference to a technical basis.) The Conference Board of Canada omitted some municipal examples by EPCOR [2015] that include unit operations similar to those in the AWTFs, although the project size is likely less than an AWTF for Teck based on project data provide by Deloitte for several municipal facilities [2013]. As well, in 2014 the City of Regina awarded a DBFO contract to upgrade its wastewater treatment plant to a consortia led by EPCOR [City of Regina, 2014]. The cost of construction to treat the design 156,000 m^3/d was agreed at $181 M, which was $43.5 M less than budgeted [City of Regina, 2014b]. The long-term cost for the 30-y agreement was reported at $611 M, $248 M under budget. This is certainly of similar or greater size to what is required for the AWTFs at Teck but is a municipal application, so of somewhat different technical scope. There are ASD models of similar or somewhat smaller size of very similar technical scope (CH2M DBO for Patriot Coal at Apogee and for The US Department of Energy at Hanford; Veolia DBO for Consol; Worley Parsons/EPCOR DBO demonstration plant at the Trend Mine for Anglo American; USFilter DBO at Henderson[2]). On these bases, Criterion 3 scores at three (3) and receives 15 weighted points (3 x 5). This scope assume size is less important that technical scope.

[2] USFilter was reconfigured shortly after construction completion, with Veolia picking up the operating capability and who operated the facility until several years ago when the contract was renewed with Envirogen.

Weight	Desirable Conditions
5	There are P3 precedents of similar size, technical scope, and contract bundling.

Scoring Guidelines

5	4	3	2	1
Projects of similar size and scope have been procured as P3s in Canada	Smaller projects of similar scope or, projects of similar size but smaller scope have been procured as P3s in Canada.	Projects of similar size and scope have been procured as P3s internationally	Smaller projects of similar scope or, projects of similar size but smaller scope have been procured as P3s internationally.	Projects of similar size and scope have not been previously procured as P3s.

5.4 Criterion 4 – New or Refurbishment

Criterion 4 considers if the project has opportunities to transfer risk relative to existing infrastructure where distinguishing between the defects in pre-existing and new construction would be difficult. Since all AWTFs subsequent to WLC will be new with no existing infrastructure and no existing site development, the scope of facilities will be straightforward to define and Criterion 4 scores at five (5) and receives 25 weighted points (5 x 5).

Weight	Desirable Conditions
5	Facilities and interfaces with existing infrastructure can be clearly defined.
	Refurbishment projects not well suited to P3 because latent defects can be difficult and expensive for consultant to assess during the proposal development and thus to valuate.

Scoring Guidelines

5	4	3	2	1
Asset is new construction on an undeveloped site.	Asset is new construction on an already developed site	Project involves at least 50% new construction and also significant renovations to the existing asset	Project involves expansion and/or refurbishment of an existing asset.	Asset procurement is mainly for refurbishment, modernization, minor renovation, or involves integration of new facilities with existing facilities

5.5 Criterion 5 – Innovation Potential

Criterion 5 tests the extent to which the owner (the response indicators are written from the perspective of a public entity – municipal, provincial, or federal government) is prepared to let the proponent innovate to achieve specified outcomes and not to prescribe inputs, or how the outcomes will be delivered. The ASD model is not well aligned with Teck's project development and execution culture and is inconsistent with Teck's project execution stage gating process.

Due to the small owner's team at Teck Coal to assess and select the technology, coordinate the design and construction activities, build the process management systems, and hire timely the operating/maintenance staff, the AWTF at WLC was executed essentially as DB+O project contracted to CH2M. The originally anticipated short-term operating contract of several years was intended to provide Teck time to build its own operating and maintenance team, with a plan to operate the next AWTF at FRO from day one.

The literature on P3 project delivery does not appear to address the issue of technology readiness, other than to comment that, for public owners, private service providers will likely incorporate new technologies as appropriate to achieve life-cycle cost efficiencies. For municipal ASD models, the contractor normally assumes all the technology risk [Sonnenberg, 2015]. The situation at Teck Coal may be more complicated in that potential technologies to achieve the target selenium and nitrate performance without inadvertently producing toxic water [Hume, 2014; Black, 2015] remain to be verified, but is expected to become better understood over the next few years. Teck has commissioned and/or led pilot programs in 2013 and 2014, and is leading a pilot program again in 2015. Since this program will conclude the technology selection by Teck and the prefeasibility engineering contractor before a potential ASD service provider has been solicited to provide a proposal, the technology risks in an ASD model would likely be shared with the service provider and not fully allocated as for a municipal client for a process using more proven technology [Sonnenberg, 2015]. As well, the AWTF projects must be operating within timelines proposed by Teck's EVWQP, and accepted and prescribed by the Ministry of Environment.

Once the technology is selected, there should be opportunities to use output specifications for the design, construction, and operation. Indeed, in early 2014 Teck considered what amounted to a DBO proposal from a consortium through one vendor [GE] for the FRO AWTF, and currently is requesting process design recommendations from the engineering contractor during the pre-feasibility study for FRO. In other words, there is some openness towards output-specification project execution, although it remains to be seen to extent to which this will evolve given the aggressive schedule for FRO. Overall, the highest plausible score for Criterion 5 is three (3) and receives 30 weighted points (3 x 10), otherwise a score between one (1) and two (2) seems appropriate, or 1.5 for 15 weighted points (1.5 x 10).

Weight	Desirable Conditions
10	There is potential for the contractor to contribute ideas and best practices to improve the project efficiency by integrating design, construction, and operation activities.

Scoring Guidelines

5	4	3	2	1
The owner is prepared to use output specifications for all phases of the project.	There are very few areas where the owner feels it must be prescriptive/use input-based specifications.	The project requirements will be a mix of input-based and output-based requirements	The project's design and construction will be based on input specifications.	The owner believes it must make specific input requirements for the majority of the asset.

5.6 Criterion 6 – Legal Considerations

Criterion 6 is intended by PPP Canada to assess security level requirements for Federal projects. Since security as defined in the P3 screening guideline does not apply to Teck's AWTFs, this project recasts security as an issue of intellectual property across multiple vendors, and particularly if one technology vendor is awarded a DBO contract in which the process includes one or more competing technologies. A new set of response indicators is proposed. This criterion has not been tested, but a score of three (3) seems probable based on conversation with some technology vendors also offering ASD and receives 15 weighted points (3 x 5).

Weight	Desirable Conditions
5	No barriers exist to executing a contract. Intellectual property (IP) can be protected for the owner and the technology providers with acceptable non-disclosure agreement (NDA) language and timeframes.

Scoring Guidelines

5	4	3	2	1
No IP issues are expected across the suite of vendor technologies based on appropriate NDA terms.		Firewalls are not required, but each technology vendor performs major maintenance within their equipment to protect IP.		Firewalls between technology vendors are required and a technology-agnostic prime DBO contractor is required

5.7 Criterion 7 – Contract Bundling

Criterion 7 measures the potential to bundle the different project phases (design, build, finance, own, operate) into a single contract. In some respects, the criterion overlaps with

Criterion 5 in that the more comfortable the owner is toward output specification, the more likely that owner would be to bundle project phases together. A single contract is meant to motivate the proponent to minimize combined capital and operations/maintenance costs for the life of the asset. Interestingly, the PPP Canada guideline substitutes financing for ownership.

Scoring this criterion is difficult. Teck's current trajectory for the FRO AWTF does not include an operating component, equivalent to a score of one (1). However, there is probably no technical reason (e.g. legal, permitting) why several project phases could not be bundled together, equivalent to a score of five (5). Teck is seeking an operations and maintenance contract for WLC and a DBO is probably a reasonable extension for FRO since Teck had executed a DB+O initially for WLC, albeit not based on ASD analysis. The financing option may also be attractive so that Teck can allocate capital to core mining activities, not just at Teck Coal, but across the company, although a shift in culture would be required that might take longer than timeframe constraint for the FRO AWTF. Since the response indicators are framed around what is possible rather than what is the owner's tendency or comfort level, the first-pass score for this report is five (5) to produce 50 weighted points (5 x 10), otherwise the score is probably 1.5, for 15 weighted points. A sensitivity analysis may be advised but is outside the scope of this MBA project.

Weight	Desirable Conditions
10	There is opportunity to bundle several contracts together representing the project phases, including financing

Scoring Guidelines

5	4	3	2	1
All P3 project phases design-build-finance-maintain-operate could be integrated into one contract	Design-build-finance-maintenance and some operations could be integrated into one contract	Design-build-finance and some maintenance could be integrated into one contract	At least design, build, finance will be integrated into one contract	Only two phases of the project can be integrated into one contract

5.8 Criterion 8 – Asset Life and Project Term

Criterion 8 simply records the lifespan of the asset. The P3 contracts tend to correspond to the useful asset life, and so asset life and contract term are synonymous. Long life provides cost certainty for the owner, and a revenue stream sufficient to recover initial capital costs. With suitable sustaining capital provisions the AWTFs are forecast to operate for at least 25 years, resulting in score of five (5) to produce 25 weighted points (5 x 5).

Weight	Desirable Conditions
5	A long-term period, 20-30-years, is needed for the contractor to recover initial investment (when the contract has an operating component).

Scoring Guidelines

5	4	3	2	1
Asset life is greater than 25 years	Asset life is 20-24 years	Asset life is 15-19 years	Asset life is 10-14 years	Asset life is less than 10 years

5.9 Criterion 9 – Project Complexity

Criterion 9 accounts for the number of asset classes, the idea being the greater the diversity in asset classes the greater the potential for ASD. As an example, the FRO AWTF has an access road, building, process equipment, power and natural gas transmission, piping conveyances, and a residuals storage area (landfill). The score for Criterion 9 is clearly five (5) and receives 50 weighted points (5 x 10).

Weight	Desirable Conditions
10	Different asset classes can be bundled together, for example, roads, facilities, and water and power conveyance.

Scoring Guidelines

5	4	3	2	1
Combines three or more classes of asset i.e. building + road + outbuildings	Project by its nature is very complex i.e. bridge and involving two or more assets, or significant technology	Combines two classes of asset of medium complexity i.e. rail line and station	Combines two assets of low complexity i.e. road and toll booths, or one asset of higher complexity, water treatment plant	Single asset class

5.10 Criterion 10 – Performance Specifications for Construction

Criterion 10 looks at the status of or the effort required to prepare "output specifications" for the construction phase, in other words to define what the facility has to do rather than to specify how the facility needs to be construction to achieve target requirements. As an example for the FRO AWTF, input specifications would prescribe the number of parallel treatment trains, which equipment must be inside a building and specifications on the building (e.g. equipment spacing and access). An output specification would provide the seasonal variation in flowrate and nitrate/selenium loading, and seasonal snow-load and temperature along with the required effluent quality. The trade-off studies performed by the engineering contractor during the current pre-feasibility study for FRO are effectively responding to output specifications; except that Teck has outlined which trade-off studies were to be carried out and has a voice in assessing and selecting each option. The score for Criterion 10 is felt to be between two (2) and three (3), or 12.5 (round down to 12) weighted points (2.5 x 5).

Weight	Desirable Conditions
5	Construction output performance can be measured.

Scoring Guidelines

5	4	3	2	1
Output specifications for same type of asset(s) exist and are available.	Output specifications for similar asset are available.	Existing conventional specifications can be converted into output or performance specifications easily.	Existing conventional specifications can be converted into output or performance specifications with some difficulty.	New technical outputs and specifications will have to be developed.

5.11 Criterion 11 – Operations and Maintenance Stability

Criterion 11 assesses if the long-term operational and equipment maintenance needs are relatively stable and predictable to be forecast at the outset of the agreement. The criterion balances asset life, contract duration, and potential influences of external drivers, such as regulatory changes. A guidance example in the P3 screening guideline recommends scoring five (5) if the operating permit for the facility is renewed every 10 years and the operating contract is renewed every 10 years or less.

The permit guiding performance requirements for the AWTFs is long-term, albeit the terms may be amended by the Ministry in accordance with Section 16 of the *Environmental Management Act*. There is also a lingering threat that Federal Metal Mining Effluent Regulations (MMER) under the *Fisheries Act* might be imposed over Provincial authority. The MMER would mandate known end-of-pipe criteria as opposed to in-stream criteria that provide for dilution zones, which are written into the current permit for Teck Coal by the Provincial Ministry of Environment. Mining coal does not currently fall within the MMER definition of "mine" [Fisheries Act, 2002]; therefore, Teck's coal mines are currently exempt. As well, performance enhancements might be required pending findings from the adaptive management plan that must be carried out as prescribed in this permit.

Technology uncertainty may be implicit in this criterion, in which case forecasting operating costs and maintenance requirements will be very difficult when there are no or few technical performance precedents on similar influent water. Equipment maintenance requirements are more certain and for the most part should be able to be inferred from other operations and piloting experience at Teck Coal on actual influent water. Overall, the score is judged to be between three (3) and four (4), or 3.5 and receives 17.5 (round down to 17) weighted points (3.5 x 5).

Weight	Desirable Conditions
5	There will be stable operations and maintenance performance requirements and use of the assets over time.

Scoring Guidelines

5	4	3	2	1
Operations and maintenance requirements are predictable and stable	Operation and maintenance requirements are predictable, but have some instability based on known factors	Operations requirements are unstable, but maintenance requirements are predictable	Operations requirements are not stable and maintenance requirements are somewhat predictable.	Operations and maintenance requirements cannot be predicted and are unstable throughout the project life.

5.12 Criterion 12 – Performance Specifications Operations and Maintenance

Criterion 12 assesses the availability of operating and maintenance performance specifications of the asset, whereas Criterion 11 accounted for the stability of these specifications over time. For the AWTFs at Teck Coal, there are elements of specifications spanning the full scoring range. For example, specifications for the treated water are well defined by the permit, scoring five (5), but maintenance indicators are probably less well developed but can likely be inferred from non-Teck facilities using similar equipment (unit operations), thus scoring a three (3). Seasonal concentrations variations of key species in influent water at FRO are currently being modelled as a cross-check on existing available data. These data are needed to verify definition of the output specifications for seasonal ramp up/down, which represents a principal long-term facility design consideration. Currently, the score on this specification would be one (1) to two (2), though results are expected to be available at the next study phase (feasibility). Overall, the score is judged felt to be two (3) and receives 10 weighted points (2 x 5).

Weight	Desirable Conditions
5	Inputs and outputs, reliability, quality, and maintainability are available or can easily be defined clearly and objectively based on quantifiable parameters. In other words, performance can be easily described and measured.

Scoring Guidelines

5	4	3	2	1
Performance outputs and indicators for operations and maintenance activities are available	Performance outputs and indicators exist, but are not readily available	Performance outputs and indicators for comparable assets exist and are available	Performance outputs and indicators for comparable assets exist and are not readily available	Performance outputs and indicators will have to be developed

5.13 Criterion 13 – Refurbishments (Sustaining Capital)

Criterion 13 assesses the availability and reliability of information to profile operating and maintenance costs, including sustaining capital (refurbishment) investments over the contract period. A guidance example in the P3 screening guideline recommends scoring five (5) if major design, construction, energy, and replacement costs can be documented "fairly easily", whereas scoring three (3) is recommended if major design, construction, and energy costs can be documented, but replacement costs cannot. Overall, the score is judged to be four (4) and receives 40 weighted points (4 x 10).

Weight	Desirable Conditions
10	The refurbishment cycle is expected to be stable over the life of the contract. Life cycle costs are understood and can be estimated accurately.

Scoring Guidelines

5	4	3	2	1
Project life-cycle costs are well understood and accurate estimates can be developed by the owner	Project life-cycle costs are understood but estimates, while accurate are incomplete to some extent	Project life-cycle costs are well understood, and can somewhat be accurately estimated by the owner	There is limited understanding of life-cycle costs but costs cannot be accurately estimated by the owner	Project life-cycle costs are not well understood and cannot be estimated by the owner

5.14 Criterion 14 – Ancillary Revenue Potential

Criterion 14 measures the opportunity for the service provider to generate additional ancillary review. Notwithstanding the small possibility to capture some biomass for composting, generating additional revenues is unlikely at this stage of project development, thus scoring one (1), for a weighted score of five (5) (1 x 5).

Weight	Desirable Conditions
5	There is scope for the contactor to generate additional ancillary review.

Scoring Guidelines

5	4	3	2	1
Project will generate revenues and the private sector may be willing to assume associated revenue risk	Project could generate revenues and private sector may be willing to share revenue risk	Project could generate revenue and the private sector's willingness to accept revenue risk is unknown	Project could generate minimal revenue and the private sector is unlikely to accept any revenue risk	It is unlikely that the project will generate any revenues

5.15 Summary

Given that Teck solicited in 2014 a scoping-study-level DBO proposal for the FRO AWTF and is currently negotiating a contract for outsourcing operation and maintenance of the WLC facility, there appears to be some interest in ASD procurement, which should be explored further using FRO pre-feasibility study data to provide clarity for subsequent AWTFs. The following self-assessment might help determine Teck's aptitude (capacity, capability, potential) for ASD [Shorney-Darby, 2012 p56]:

- Are there legal capabilities/restrictions/limitations to executing an ASD contract,
- What are the objectives and motivation,
- Is there a learning culture to try new options, and if not, what are the obstacles,
- Is there capacity for change (change management as noted earlier), such as from managing details with a linear reactive approach by departments and groups with strictly defined roles, responsibilities, and administrative processes to a flexible structure and culture for macro-managing collaboration, and from thinking in terms of low-bid to best value
- Whether having designer of record not working for Teck is acceptable,
- Can the innovation and performance promises from a contractor can be trusted,

- What is the appetite for risk sharing, and accepting that some risk can’t be off-loaded (for example, environmental permits, unforeseen hazards and conditions, changes in law/regulation), and
- Is a third party is needed to facilitate the ASD assessment process?

6 Conclusions and Recommendations

A spectrum of potential of alternative project delivery models and associated benefits and shortcomings were described that might be advantageous for Teck's Active Water Treatment Facilities by achieving capital and operating cost reductions, and allowing Teck to focus on core mining activities. There are several industrial precedents with similar technical scope or size for alternative service delivery as well as a host of P3 wastewater treatment projects in Canada valued at $100 M to over $1 B. The Crown Corporation PPP Canada has developed a framework for evaluating whether project attributes are suitable for P3 delivery for public agencies and municipalities that should also provide guidance for ASD potential in the industrial sector.

The P3 screening criteria assessed that Teck's AWTFs are suitable candidates for ASD, such as DBOM or DBFOM, and should be considered further. However, issues associated with ownership of technology selection, quantifying risks assigned to the ASD provider, timing and timeframes to quantify cost benefits to ASD, and a shift from Teck's traditional project delivery culture likely cannot be achieved timely for the facility at Fording River Operations, which is now in the engineering study phase.

A comparative quantitative analysis of DBOM and DBFOM against the current project execution trajectory for the FRO AWTF is recommended to provide definitive clarity on economic potential for the next facility planned at Elkview Operations. Two methods are recommended for the quantitative analysis. First, following the pre-feasibility study now underway for FRO a financial or independent project analyst consultant would be consulted to quantify risk that could be assigned to an ASD provider. Risks would be identified in a workshop, ideally with a potential proponent. The consultant should have databases comparing different delivery models, for which Teck likely does not, providing a statistical basis to evaluate the risks. This option would produce the quickest VFM, but the resolution would likely be poor. The other method would start with a market sounding to ensure a level of competition. This would be carried out in parallel with the engineering studies now underway. Following feasibility, a potential ASD proponent would be solicited to prepare a formal ASD proposal (DBOM and/or DBFOM) that could be compared to the feasibility study. This option would produce the best resolution, but would take longer and cost more because it essentially involves a shadow feasibility study by the potential ASD proponent.

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