Deloitte.

The Boxfish Group

Ottawa Light Rail Transit System

Lessons Learned from Confederation Line & Stage 2 Implementation Implications

December 2015

Table of contents

Chapter 1: Study Overview

With the benefit of over two years of construction and implementation of the Confederation Line Project behind us, it is now possible to assess the challenges faced during the planning, preparation and procurement of this innovative and multi-award winning project delivered by the City of Ottawa (the "City"). This report (the "Report") will summarize key lessons learned from the procurement process and implementation to-date of the Confederation Line project and the implications it has with respect to the City's planned Stage 2 extension of the Confederation Line light-rail transit project ("Stage 2" or the "Stage 2 Project").

Scope

Deloitte and The Boxfish Group ("we", "us", or "our") were retained by the City to undertake a Lessons Learned study (the "Study") that: (i) identifies key lessons learned from the procurement and implementation of the Confederation Line project and (ii) identifies key challenges facing the implementation of the Stage 2 Project.

Methodology

For purposes of completing the Study, we undertook a series of 19 interviews throughout the period January to April 2015 with numerous stakeholders that were involved in the Confederation Line project from the early planning phase up to managing the currently ongoing construction. The interviews included various City staff, consultants, Infrastructure Ontario ("IO") staff and others. The interviews were primarily structured around gathering feedback on aspects that worked well on Confederation Line, aspects that didn't work well on the Confederation Line and features of the Stage 2 Project that pose a challenge from a delivery model perspective. In addition, interviews were conducted with a number of key federal and provincial officials with insight into the Confederation Line project and the future extensions of Ottawa's O-Train system that are planned as part of the Stage 2 Project.

Project Background: The Confederation Line Project

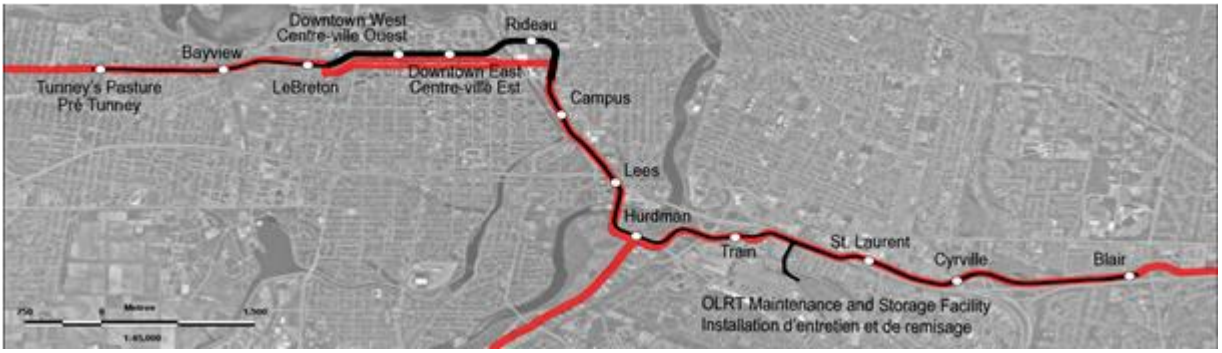
Planning and Procurement

The origins of the Confederation Line project go back to the Transportation Master Plan ("TMP") adopted by Ottawa City Council in November 2008. The 2008 TMP set out the planning for the move to LRT as a way to address the downtown bottleneck of backed-up buses and improve the productivity of the transit system in Ottawa. It has long been recognized by the City that running buses through the downtown core places limits on productivity growth and total capacity for the City's transit system. Currently, at more than 9,000 people per hour per direction, the transit system has begun to reach the physical limit on the number of buses that can move through the downtown transit priority corridor during peak hours.

Stage 1 of the City's LRT system, known as Confederation Line was approved by Council in December 2012 and is currently being constructed by the Rideau Transit Group ("RTG"), a private sector consortium, under a Design-Build-Finance-Maintain ("DBFM") contract structure. The contract with RTG runs from 2013 until 2048. Construction began after financial close in February 2013 and is scheduled for completion by June 2018. The 30-year maintenance term will run from the beginning of revenue service in Q2 2018 until contract end in June 2048.

When finished, the new transit system will be able to accommodate up to 24,000 riders per hour in each direction. It will run primarily along the City's existing Transitway from Tunney's Pasture in the west to Blair Station in the east. A summary of important milestones and timelines for the procurement process of the Confederation Line project is included in Appendix A to this Report.

Figure 1: Map of Confederation Line



The key elements of the Confederation Line are:

- A 12.5km dedicated light rail transit ("LRT") line running from Blair Road to Tunney's Pasture;
- A 2.5km tunnel that traverses the downtown core;
- 13 stations along the LRT line including 3 downtown underground stations; and
- A new Maintenance and Storage Facility ("MSF") where the Confederation Line light rail vehicles ("LRVs") will be assembled, maintained and stored.

Once the Confederation Line is completed, OC Transpo will operate the system as part of Ottawa's integrated transit system along with the network of regular and rapid transit bus routes. Addressing the downtown bottleneck through the implementation of the Project is the City's first step in moving to rail-based transit system east, west and south with a feeder bus system collecting passengers intending to use the LRT spine.

The Confederation Line project was bundled with the Ontario Ministry of Transportation ("MTO") funded widening of Provincial Highway 417 from Nicholas St to Ottawa Road 174 ("Highway 417 Widening"). This component of the Project was implemented using a Build-Finance delivery model. The bundling of project components is regarded as an important and highly successful innovation (discussed in detail later in this Study).

Rationale for choosing an Alternative Financing and Procurement methodology over a traditional procurement model

The Alternative Financing and Procurement ("AFP") approach used in Ontario is most suitable for the delivery of large, complex infrastructure projects. In such procurements, all of the vendors and contractors required to complete the construction work are represented by a Design-Build Joint Venture ("DBJV") under contract to Project Co. Project Co must privately finance at least 15% of the project's capital costs. This private financing is fully "at risk". Repayment of the private financing and payment for maintenance are contingent on the proper upkeep and performance of the infrastructure over the 30-year maintenance term. AFP produces stronger net public benefits, principally derived from on-time completion of construction and compliance with maintenance performance requirements, where there are challenges due to size, complexity and the level and types of risk.

The creation of LRT infrastructure is a good candidate for AFP because it involves so many different suppliers, contractors and design integration. Experiences in other municipalities are instructive in understanding just how difficult it can be for the public sector to manage the integration of all of the elements effectively. LRT projects procured under traditional design build models are often late, over budget and mired in disputes.

In planning the Confederation Line project, the City undertook an analysis in conjunction with Deloitte of the various delivery models. This analysis concluded that a DBFM model would deliver the best value for money for the City, a conclusion that was further reflected though the application of the P3 screen required by the Federal and Provincial governments as a condition for funding. The factors that contributed to this decision included:

- The project's size, complexity and level of risk;
- The clear direction by City Council to transfer the risk for on-time and on-budget construction of the Project to the private sector; and
- The desire to manage the unique risk elements of the project such as the geotechnical risk associated with the downtown tunnel.

IO was included in the project team in an advisory role in order to leverage their well-developed, standard AFP procurement methodology. Building on the IO templates, the City evolved a full LRT contract with all requirements clearly set out. A feature of AFP procurements is that competing teams bid against a clear and well-developed contract known as the Project Agreement ("PA") with technical requirements grouped in a contract Schedule (15) known as the Project Specific Output Specification ("PSOS"). This allows direct and clearly comparable proposals and facilitates fair procurement and rapid financial close upon selection of the successful proposal.

Allocation of responsibilities between the partners

The Confederation Line PA allocates responsibilities between RTG and the City. RTG is responsible for:

- The design and construction works, including the design, construction, installation, testing, commissioning and completion of the system, and obtaining all required permits, licenses and approvals;
- Provision of the required fleet of LRVs;
- Options to purchase up to 15 additional LRVs that can be exercised during the "Option Period" which is seven (7) years from financial close (Feb. 2013);
- 30 years of maintenance and rehabilitation services;
- The construction, installation, testing, highway commissioning and completion of the Highway 417 Widening; and
- The cash allowance works (principally by specified utilities).

RTG is also responsible for the performance of the financial obligations, including the development and implementation of the optimal financial solution, the funding of all required capital and the payment of charges and costs related to any financial security obligations.

The City's responsibilities were limited to those best dealt with prior to contract award and financial close, such as obtaining permits and approvals prior to the contract award (subject to certain limitations) and acquiring the real property interests in the after-acquired lands. A limited number of risks were retained by the City during the construction where these risks could best be managed by the City, or where the risks were very unlikely to occur and where, consequently, it would have been financially inefficient to ask the private partner to reserve against those risks (e.g. archeological, known contaminations, etc.).

Project Financing

The City's total capital cost for the Confederation Line is $2.1B, comprised of $1.8B in contractor costs and $300M in City direct costs for land acquisition, engineering and contract administration. The City funds the project with $600M contributions from each of the federal and provincial governments, with the balance being funded directly by the City through gas tax revenues, development charges and capital contributions from the transit levy.

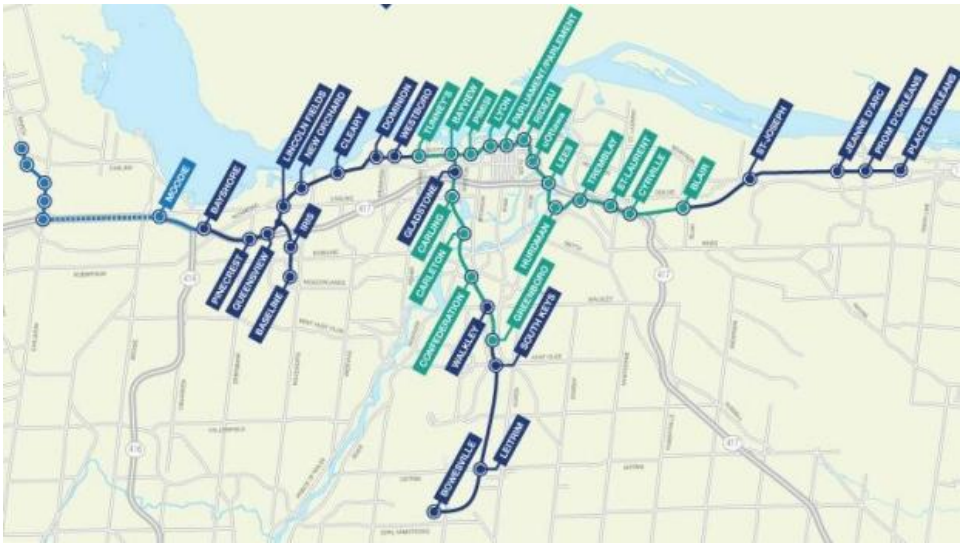
Current Status of Confederation Line

The Confederation Line is approaching the end of its second year of construction and RTG is on schedule regarding the most significant portion of construction, the tunnel. The Highway 417 Widening Project has been completed and the newly widened lanes are being used as the alternative to the Bus Transitway in the east during construction of the LRT.

Stage 2: The East, West and South Extensions

Looking forward to 2018, the City has begun the preliminary engineering and investigative activities toward the implementation of the $3B (dollars escalated to time of spend) Stage 2 Project involving an extension of the LRT system. The Stage 2 Project will run from Bayshore and Baseline Stations in the west to Place d'Orleans in the east with an expansion of the existing Trillium Line to Bowesville in the south (as described in the Transportation Master Plan approved by Council in November 2013.

Figure 2: Map of Stage 2 LRT Extension



The Stage 2 Project will build on the Trillium and Confederation Lines and will add 30 km of new rail and 19 new stations to Ottawa's O-Train system. The goal of this expansion is to bring ~70% of the City's population within five kilometers of rail transit by 2023. This nearly doubles the number of residents who will be within five kilometers of rail from the completion of Confederation Line.

The primary objectives of the Stage 2 Project are to:

- Increase ridership;
- Reduce travel times;
- Reduce the number of transfers to rapid bus transit ("BRT") at Tunney's Pasture and Blair;
- Enable the delivery of more efficient transit on a city-wide basis;
- Further improve productivity;
- Enhance reliability and on-time performance for the transit system;
- Attract and retain more riders through an enhanced ride experience; and
- Help to contain transportation costs (both operations and maintenance).

The goal is to make LRT the first transportation choice for more residents, particularly during peak hours.

Chapter 2: Confederation Line - Major Challenges and Solutions

The Confederation Line project is the largest infrastructure project in the City's history. Consequently, Ottawa City Council and the project team was focused on ensuring that the project was delivered on time and on budget while avoiding some of the pitfalls endemic to these types of large and very complex infrastructure projects. Mayor and Council gave clear direction to the City's project team to:

1. Deliver the project within the budget presented to City Council in 2009: $2.1B, absorb inflation and AFP costs, and ensure no risk to the City of cost overruns during construction;
2. Meet an accelerated project schedule with revenue service in Spring 2018;
3. Ensure that the City's downtown would be in good shape with major project infrastructure complete and ready to be showcased in Summer 2017 for Canada's sesquicentennial;
4. Minimize the impacts on the City's existing transit and transportation networks;
5. Minimize the impact of construction on business and community life; and
6. Maintain a single public operator of a seamless bus and rail transit system.

Major Challenges

This section highlights the key challenges faced in the procurement of the Confederation line as identified through the Study.

1. Meeting the Project Budget

Overview of Issue and Lessons Learned:

Both the Province of Ontario (the "Province") and the federal government approved their contributions ($600M each) to the Confederation Line based on an initial cost estimate of $1.8B. Reference to a $2.1B budget was subsequently made in January 2010; however, this estimate was never intended to be a budget or final cost and did not include construction inflation (at that point the schedule showed a completion date of fall 2019). The estimate also did not include financing and transaction costs. The fixed nature of senior government contributions resulted in significant pressure to deliver Confederation Line at $2.1B as the City would have to cover any incremental increases without senior government funding support.

While it is impossible to know if the federal and provincial governments would have contributed more funding to the project if a higher cost estimate had been provided, the necessity to provide early cost estimates for cost sharing to the federal and provincial governments presents challenges for municipalities. This is a peculiarity of undertaking large infrastructure projects in Ontario, where the Environmental Assessment ("EA") process focuses on assessing a range of options, rather than a single clear project.

The cost estimates done at the EA phase are intended to compare the different project options, at a high level, the costs relative to one another, as required by the Province's EA process. These estimates are typically developed at a very high level and do not involve a meaningful constructability review.

In a typical large scale infrastructure project that requires senior level funding, requests for funding need to be made during the EA phase, where the estimates are simply order of magnitude estimates based on very little detailed design (typically 10% or less). This puts significant pressure on the municipality to develop a cost estimate that will dictate the two thirds fixed contribution from the federal and provincial governments without the benefit of advanced designs or the procurement/contracting model selected. On the Confederation Line project, the initial estimate of $1.8 billion was developed and submitted without allowance for inflation, and appropriate amount of contingency (as it related to the level of design), or other financing costs typically associated with AFPs. This estimate was then used as the basis for the federal and provincial funding announcements, which capped their contributions at 1/3 of these estimated costs.

This early funding request is a result of the requirement to ensure eligibility for cost-sharing on the preliminary engineering work. Both the federal and provincial governments require that a Green Light letter be developed signaling preliminary respective Treasury Board approvals on the funding before costs incurred in the development and planning of the project are eligible for cost-sharing. As preliminary engineering is early design work that is often done concurrently with the Value for Money ("VfM") analysis, it is necessary to make an early funding request in order to receive the Green Light letters as soon as possible post-Council approval on implementation. The only alternative for municipalities is to advance preliminary engineering without federal or provincial funding commitments and risk paying 100% of the costs of the associated cost without certainty of cost-sharing on the total cost.

On the Confederation Line project, once the preliminary engineering team was engaged and as design of the reference concept progressed, it became clear that it would simply be impossible to achieve the alignment that was proposed in the EA and functional design documents for the stated budget of $2.1B. In fact, the "deep dive" alignment posed significant constructability challenges and associated cost pressures.

With the benefit of this experience, it is recommended that at the functional design level, the order of magnitude cost estimate for the Stage 2 Project should at least be presented with costs as expected at the time of the construction spend and that a reasonable allowance should be included for financing and transaction costs. Based on the financing and transaction costs for the Confederation Line project of $177M, it is recommended that an estimate related to these cost be in the order of $200M and be carried within the Stage 2 Project procurement budget.

It is also recommended that at the time of announcing project funding, the federal and provincial government be encouraged to identify a contingency with an upset limit in their cost commitment in case of cost amendment during design advancement to help ensure affordability.

Given these tensions relating to budget, one of the most important goals of the AFP model was to achieve significant cost compression by encouraging and enabling competition between the bidders. This, in turn, necessitated the use of some novel strategies and methodologies with respect to the delivery of linear transit infrastructure, which subsequently have been adopted and refined in other AFP projects in Ontario; in particular the Eglinton Crosstown LRT project in Toronto.

Where AFP is being considered, the need to develop a robust cost estimate needs to be countered by the potential to over-specify technical requirements. It is recommended that on major infrastructure projects where AFP is likely to be considered, the design should only be advanced to a level optimized for AFP procurement leaving room for innovation in design and construction during the bid stage. Project costs should be a governing principle in the design and procurement decisions on the Stage 2 Project. While rough order of magnitude budgets need to be developed for comparison purposes, they should include all the elements described above and be escalated to the time of spend. The City has taken this bottom line approach by establishing an Affordability Model in conjunction with its Official Plan and Transportation Master Plan. The City's Affordability Model sets out to determine how much money the City has to improve public transit and transportation infrastructure and informs the prioritization of the infrastructure projects in the TMP.

In general, in large LRT projects, like the Confederation Line or the Stage 2 Project, the preliminary engineering process should center on the development of a reference concept design ("RCD"), the primary purpose of which is to prove constructability as well as to ensure that reasonable budgets have been allocated for project implementation. Typically, the RCD will design some critical elements to 30% and those more straightforward or conventional elements that carry less project risk be designed to 10% or less. The RCD should focus on the major questions and issues that arise in the drafting of the PSOS, as its primary purpose is to give clarity and direction to proponents in interpreting the PSOS.

The development of the RCD should be guided by a sponsor developed Project Definition Report ("PDR"). The PDR clarifies the design elements that have been determined through the EA project phase and clearly articulates the sponsors intentions on certain project elements (i.e. fare control, bundled projects, etc.). This will result in significant savings to the project as this clarity ensures that there is no costly ambiguity for the preliminary engineering team when they are at their highest expenditure phase.

In order to minimize design cost and maximize innovation, it is also recommended that the City' s Stage 2 Project team utilize, as much as possible, the existing Confederation Line design elements rather than developing new designs. It is further recommended that in order to maximize the transfer of knowledge gained during the implementation of the Confederation Line, the Stage 2 Project team engage, to the extent possible, both City and key consultant resources from the Confederation Line preliminary engineering team. This would allow the City to leverage, the significant knowledge generated during the implementation of Confederation Line as a means of limiting engineering efforts as procurement documents for the Stage 2 Project are developed.

Affordability Cap

As all cost overruns for the Confederation Line project fell exclusively on the City without addition funding from the federal or provincial governments, it was very important that the budget be strictly enforced. The IO AFP process is designed to drive to the lowest possible Net Present Value ("NPV") of any proposal. Although heavily dependent on the discount rate assumed, this NPV focus is, in theory, the best value achievable for taxpayers. However, it is possible for a bid that is far more expensive on the capital cost to have the lowest cost overall.

As a result of the shift of alignment and other design solutions implemented to achieve cost compression, the Confederation Line project team believed that it would be possible that the proponents' bids would come within the $2.1B envelope. In order to further incent the proponents to focus on reducing costs through design innovation, an affordability cap was introduced.

The affordability cap informed the bidding proponents that as long as one technically compliant bid came below the affordability cap then any bids above the affordability cap would not be considered in the evaluation process. This forced proponents to ensure that they believed no competing teams would be able to bid below the affordability cap before submitting a bid that exceeded it. This process of establishing a mandatory test where any bid successfully meeting that test would automatically be chosen before any bids failing to meet that test is called "Gating" and was also used elsewhere in the project.

As a result of the success of the affordability cap in driving additional competitive tension and risk transfer on the Confederation Line project it is recommended that it also be implemented on the Stage 2 Project. Now that the City has instituted a global affordability framework on all City expenditure, it is recommended that an affordability cap on operating and maintenance cost be explored in the Stage 2 Project implementation as well. It is recognized that the success of the affordability cap used on the Confederation Line was also a result of, in part, the competitive environment brought by the number of large, high profile AFP projects delivered in Ontario. The Stage 2 Project should be able to rely on this competitive environment to implement a similar affordability approach.

Optimizing Risk Transfer to Obtain a Fixed-price

A related challenge associated with the budget was the desire to eliminate as many drivers of cost uncertainty as possible. Council was clear that the tunnel risk was a major concern with high profile tunnel

projects coming in significantly over budget with claims of unforeseen geotechnical conditions and that, to the greatest extent possible, the goal was to secure a fixed-price for the Confederation Line project. The City recognized that the desired goal of achieving tunnel risk transfer was unprecedented in North America

In order to encourage bidders to accept tunnel risk transfer without breaching the affordability cap, the Confederation Line project implemented a gated risk table in evaluating the proposals. As outlined above, this “Gating” process established key tests that were imposed on each of the gated elements. This gating system provided a strong incentive for proponents to assume schedule and construction risks.

In the early stages of procurement, each competing bid team claimed that it would be impossible to finance their bids should they assume full risk transfer with respect to the downtown tunnel. Bidders claimed that the full transfer of tunnel risk would prevent the ability to achieve an investment grade debt rating, which in turn would limit a large number of institutional investors who would not have the appetite to accept the associated risk.

The response of the procurement team was to test these claims by offering a gated risk ladder. If a team took all the risk on the tunnel, was technically compliant and was below the affordability cap – and if no other team was similarly able to meet those tests – they would be declared the winner.

The top rung of the ladder had a gated acceptance of all geotechnical risk associated with the tunnel without being able to rely on a Geotechnical Baseline Report or Geotechnical Data Report. The next rung down allowed for some capped reliance on the Geotechnical Data Report generated by the City’s advanced investigations and borehole drilling program along the corridor.

In order to make a technically complex project with significant tunnelling risk successful, efforts had to be made by each bidding team to give comfort to lenders (including technical presentations by the DBJV, strong technical advisor and legal counsel support, and a robust performance support package). The gated risk table used competitive tension to ensure each bid team effectively had to undertake this difficult process rather than simply take the position that either their lenders or the DBJV would not take these risks.

Although the bid teams had initially indicated that they (Project Co, the DBJV and the lenders) would not assume all the tunnel risk, this process caused each bid team to accept the risk. The driver for this acceptance was the competitive tension brought by the “Gating” process – even though all the bid teams did not want to assume the full risk, they could not convince themselves that their competitors would not find a way to accept the risk. In the end, this “Gating” triggered an ability to prove it possible for the teams to obtain the guaranteed financing packages required while taking on full tunnel risk.

The ability to fully transfer risk on the Confederation Line project was a novel and extremely successful element of the project. Stakeholders interviewed suggested that the gated risk table was a critical element leading to the single fixed-price for the entire project.

The effect of this gating process was to produce bids that met the City’s fundamental goals of transferring all tunnel risk to the private proponents. The value of this approach was demonstrated again in 2014 when, as a result of unanticipated ground conditions, a portion of the tunnel and surface level collapsed creating a sinkhole. If the City had held the geotechnical risk, it would have been responsible for all remediation costs as well as schedule delay costs. As it was, the contractor had to reassess its plans and cope with the unexpected situation associated with this incident without making a compensatory claim.

Given this successful transfer of risk during the procurement process, it is recommended that this gated risk table approach be implemented in the Stage 2 Project procurement relating to all geotechnical risks, if required.

Other elements of gating that might also be considered in the Stage 2 Project include utility relocation risk. Several utilities will not allow outside proponents to work or modify their infrastructure. Instead, a proponent pays the utility to self-perform the work. Utilities will typically not guarantee take any risk with

respect to performance and may have other priorities and be unwilling to negotiate drop down agreements to allow the DBJV to be confident about cost or timing, which can lead to significant delays. The same risk is inherent with other utilities where delays in inspection and approval can lead to significant additional and unexpected costs.

Eligible Funding

Alternative Financing and Procurement ("AFP") Federal and provincial government policy is to encourage the use of AFP or PPP methodologies for large infrastructure projects. However, the cost-sharing policy for municipal infrastructure has not been aligned to incorporate all costs associated with an AFP. The Ministry of Finance in Ontario continues to take the view that the private finance component of AFP is not eligible for cost-sharing.[1] In the City's case, none of the $300M of private long-term financing associated with the AFP funded by RTG for construction will count toward eligible costs until the City itself has paid the private sector for these costs. In effect, the municipality will incur liabilities to pay for tangible capital works that the Province will not recognize until they are paid for over 30 years.

The policy alignment to properly support AFP would be that senior levels of government would contribute funds as the liabilities are incurred, not as funds are expended. The Province should be willing to recognize capital works created under the AFP model on an equal footing with capital works funded by City debenture. To be consistent and create policy alignment, Ontario should recognize the privately financed liability in exactly the same way that it would recognize capital works funded by City bonds. They are both liabilities on City books and are both equally verifiable in terms of the constructed capital asset. In the context of the Confederation Line, this problem was worked around primarily because the city was funding $900M of the project and so there were ample eligible expenses to share. Where the program is one third municipally funded this problem could impose a serious financial penalty on the choice to use an AFP methodology.

The federal and provincial government should also recognize the challenge of early funding submissions and limiting their funding allocation to a fixed 1/3 of that request. Both level of governments should be encouraged to agree to 1/3 funding and identify a contingency for any cost amendments to a limit of the value as identified through their business case review. Not only would this represent a more balanced partnership with respect to funding, it would also clearly demonstrate their confidence in the AFP model to deliver best value.

Work should continue to encourage Ontario to rectify this policy anomaly for good public policy alignment on infrastructure throughout Ontario. When an AFP approach is used by a municipality, and where there is a cost share between the three levels of government, eligible costs should be viewed on a liabilities incurred basis. Further, as the federal government has done with the P3 Canada fund, the AFP transaction costs and necessary AFP development work including risk identification and a Value for Money exercise should all be deemed eligible expenses.

Recommendation Summary for Stage 2 Procurement:

- Funding requests to senior government should account for cost escalation over time and include the additional financing and transaction costs borne by the City as part of any AFP.
- Federal and provincial government should be encouraged to identify a contingency in their cost commitment in case of cost amendment during design advancement.
- Preliminary designs should be advanced to a level optimized for an AFP model
- The Stage 2 Project team should utilize, as much as possible, the existing Confederation Line design to generate the RCD for the Stage 2 Project infrastructure
- The significant knowledge generated during the implementation of Confederation Line should be leveraged as a means of limiting engineering efforts as procurement documents for the Stage 2 Project get developed.

[1] The federal government took a similar view in its funding for the Confederation Line. However, since the introduction of the PPP Canada Fund, the federal government has begun to fund its share of financing costs.

- City should develop a Project Definition Report ("PDR") early in the procurement process.
- Procurement of the Stage 2 Project should include an affordability cap and use "Gating" processes to drive the effective transfer of geotechnical and other project risks from the City to the DBJV.
- Ontario should be encouraged to update the Financial Administration Act to ensure that AFP private financing, transaction costs, and AFP development costs are properly eligible for cost-sharing by focusing on liabilities incurred instead of dollars paid, including recognizing a privately financed liability in exactly the same way that it would recognize capital works funded by City bonds.

2. Land Ownership and Management

Overview of Issue and Lessons Learned:

A particular challenge with the procurement of the Confederation Line was the combination of government agencies and landowners in Ottawa. For example, the project proponent and/or City needed to negotiate right of ways and land usage/transfer with a number of governmental stakeholders including the National Capital Commission ("NCC") and other elements of the federal government not subject to expropriation.

The NCC's powers stem both the significant lands owned by the Crown throughout the capital and from the necessity to obtain Federal Land Use and Design Approval. Other Federal landowners are also immune to the normal tools a municipality would use to assemble the required lands for a public transit infrastructure project. Resolution of land approvals often required senior engagement by the NCC and other federal officials and the City. Similar issues will arise in the Stage 2 Project as additional federal lands will be required.

Further, the City's unique situation as Canada's capital, and consequently, the significant federal land interest that are required for these project result in unique and disproportionate costs for property acquisition. As Federal lands cannot be expropriated there is an inability to rely tools granted through this legislation to weigh the benefit brought to the adjacent Lands against the potential impacts of the project.

It is recommended that the City approach the federal government and request that lands required for the project be granted to the City in recognition that LRT will enhance the capital and benefits federal public servants. In the case that a particular land parcel has significant development potential or agreed value, the City and the NCC could explore land swaps or integrated development opportunities.

It is also instructive to look at the success/failure of early attempts to engage with the NCC. The City engaged with the NCC very early in the procurement process to try to negotiate approvals for the project before going to market with the procurement.

Detailed designs were developed, at significant expense, for all stations subject to federal land use design approval in collaboration with the NCC and other stakeholders. The objective was to advance station designs such that the NCC would be satisfied with their quality and aesthetic and then impose exactly those designs on the bidders through the PA/PSOS. This would have been a trade-off, reducing the proponent flexibility in exchange for certainty, removing the risk that the NCC would demand costly changes to the bid proposal.

This process was ultimately unsuccessful. The NCC Board did not want to limit its future discretion in relation to the Confederation Line project in any way, irrespective of the level of design imposed on the bidders. Because pre-approval was not acceptable to the NCC, ultimately it was decided there was no value and significant downside to imposing designs. As a result, the bidders were allowed to develop their own designs and approaches with the City taking the risk that these new designs will have to be taken to the Advisory Committee on Planning Design and Realty as well as the full NCC Board for approval.

Land ownership and usage in Ottawa is highly complex owing to the need to engage with multiple levels of government and multiple departments and agencies. As a result, development and property integration is best addressed earlier in the project development phase.

There were also mixed views from interview participants about the utility of the Optional Lands and Innovation Zone provisions in the Confederation Line to address property requirements. Some involved felt that these flexibilities within the RFP and PA were very helpful in driving the proponents to think creatively about Rideau Station in particular. Others in the property group felt that these rules over-complicated property planning and acquisition for the sponsor. It is likely that optional lands regime will continue to be important in the future; however, the innovation zone appears to have caused significant challenges for the property group and should only be used when circumstances demand (e.g. technical tweaking of a tunnel alignment).

Recommendations for Stage 2:

- Engage the property experts at an early stage of the planning process to identify potential challenges with specific alignments relating to property acquisition.
- Early engagement of property experts would also enable the drafting of more sophisticated property budgets.
- The City should approach the federal government and request that the value of the lands required for the project be assessed in recognition that the LRT will be a shared enhancement to the capital.
- Identify significant land costs that could possibly be mitigated through design and/or construction innovation (i.e. MSF, temporary easement rather than permanent ownership, minimizing construction staging footprint, etc.) and ensure that appropriate incentives/disincentives are built into the RFP.

3. Thinking like an Owner: Minimizing Costs and Maintaining Mobility

Overview of Issue and Lessons Learned:

As the Confederation Line project was the first of multiple future LRT extensions, the City, after detailed analysis, decided not to include operations in the AFP contract structure. As a result, a significant challenge that emerged during the process of developing the PA and its corresponding PSOS was the need to provide sufficient incentives to get the proponent to think and “act like” the project ‘owner’. For example:

- Given that the City would be responsible for the ongoing energy costs associated with operating the LRT, how could the proponent be incentivized to minimize energy costs?
- What is the best strategy to protect and optimize mobility during the extended project construction process?
- Similarly, given that OC Transpo would be operating the LRT, what elements of the project would need to be optimized to enable smooth and efficient operations?

To address these questions, three NPV tools (described below) were developed and implemented to force the bidders to consider the financial implications of decisions relating to the long-term operations of the Project. These were included as part of the financial evaluation of bids and used the natural competitive tension between bidders to drive down long-term project costs.

Energy Matters

This tool required the use of an NPV costing for energy usage over the life of the project. In other words, the bidders committed that their solution would require a specific volume of electricity and this commitment was a cost-driver for their proposal.

Although the Energy Matters process was a success, it was identified after the fact that it should have taken into consideration both the total volume of power used and the peak power the system would require. This is because the peak demand drives the cost of electricity for large consumers in Ontario. The PA assumed a single rate charged for electricity in Ontario which is incorrect (large and small consumers of power are charged for the Global Adjustment and on Transmission and Capacity based on a different formula).

For the Stage 2 Project, the City should consider adopting the approach which was taken in the procurement of the Eglinton LRT Crosstown Line which built upon the Confederation Line energy matters schedule by outlining a specific NPV charge for each MW of peak demand for the LRT system.

It was also anticipated that Energy Matters would result in the proponents applying innovative sustainable energy technologies to the stations and LRVs to drive down the total NPV. However, as the introduction of regenerative braking and general energy efficient buildings and LRVs generated significant energy savings none of the competing proponents expended design effort on sustainable technologies like green rooftops, solar panels, etc.

It is recommended that if the City would like to see the application of more sustainable technologies that they be specified in the PSOS as mandatory for compliance, with appropriate technical points allocated, and that an emphasis be placed on these energy saving approaches during design presentation meeting's with proponents during the bid process.

Mobility Matters

One of the ultimate determinants of success for a project of this scope, undertaken in the context of an existing successful BRT system is the ability to build ridership in support of the TMP vision throughout construction. This will be particularly important during the times when the existing BRT needs to be shut down for conversion. In order to ensure the proponents minimized the closure periods the City introduced a lane rental concept called Mobility Matters in the Confederation Line procurement process.

To maintain mobility an alternate busway was required to be put in place before the Transitway could be taken out of service. To minimize other mobility impacts strategy was implemented that required proponents to state the planned road impacts and actually rent traffic lanes from the City with a real NPV impact on their bid price to reflect the compromising traffic patterns (including local transit) during construction. To ensure tight integration with the community, detailed mandatory requirements were set out to ensure support of the City Transit Oriented Development goals.

Stakeholders from OC Transpo indicated a strong degree of support but suggested that in the future it should go further than simply renting lane closures. They suggested that it would be more effective to provide incentives to minimize impact on the existing transit system regardless of the number of lanes that are impacted. Other stakeholders questioned the utility or the lane rental system relative to the administrative burden of enforcement.

Our recommendation would be to take on board the OC Transpo recommendation for the Stage 2 Project and explore strategies to incent the project proponent to minimize the impact of their work on the existing Transit system. In our view, the administrative burden of enforcing lane rental provisions is worth it to both to safeguard the public from unwarranted disruption and drive construction means and method decisions appropriately, balancing cost with disruption.

Operations Matters

This tool forced bidders to take into account the NPV of the cost of operators over the life of the project, since the City will be required to pay the salary for operators. This tool was successful; and despite having adopted a LRV platform, we believe there is still a role in the Stage 2 Project procurement process to build upon the principles behind Operations Matters. It is also recommended that the operator participate in a review of these provisions to ensure they fully capture areas where extra staff might be required by virtue of a particular design.

Although innovative and, therefore, unproven at the time, these tools enabled the City to set a predictable and stable price for a set of previously 'intangible' but costly elements in the project. In addition to the three NPV tools outlined above, Confederation Line process also took a novel approach to addressing the challenges associated with electricity distribution system relocations, a component of utility risk. During the Confederation Line procurement, Hydro Ottawa was engaged to work with the team and provide value

engineering to ensure that power was being delivered to the project as efficiently and in as timely a fashion as possible.

Finally, looking forward it is recommended that the City explore ensuring that all Municipal Access Agreements (agreements to allow utilities to use a right of way for their infrastructure) include a clause that any future reallocations to accommodate LRT projects will be at the sole expense of the utility company and not the City. This was not in place with many existing agreements.

Recommendations for Stage 2:

- Implement a similar suite of NPV tools to drive proponent behavior on the Stage 2 Project:
  - Energy Matters: Consider enhancements introduced on the Eglinton LRT Crosstown project in Toronto which outlined a specific NPV charge for each MW of peak demand for the LRT system; Develop a means where more sustainable technologies can be specified in the PSOS as mandatory for compliance.
  - Mobility Matters: Incorporate suggestions provided on Confederation Line by OC Transpo (provide incentives to minimize impact on the transit system regardless of the number of lanes impacted); and
  - Operations Matters: Replicate and build upon the Confederation Line approach in Stage 2.

- Consider additional NPV tools that may enhance delivery of the Stage 2 Project, such as a Utility Matters tool may have potential.

4. Project Bundling

Overview of Issue and Lessons Learned:

One of the most innovative and successful solutions implemented in this project was the bundling of the Highway 417 Widening and Confederation Line projects. Because the LRT is built on the existing Transitway infrastructure an alternative to the Transitway was needed to maintain mobility through the construction period. The plan to use the widened Highway 417 as the alternate Transitway meant that completion of that work became a potentially costly delay. The Minister of Transportation recognized the need to ensure the highway widening project was delivered in tight coordination with the LRT and agreed to bundle the project into the LRT procurement.

This was a unique approach in that a traditional Design Build was combined with a DBFM. Proponents received the full design and traffic staging and baseline schedules. As such, they had control of the whole plan and could implement strategies to minimize disruptions and to ensure that the various construction and implementation schedules were fully in alignment. Most importantly, the risk of the MTO being slow to complete the highway work, and thus delaying elements of RTG's construction schedule, was eliminated.

At the outset of the project the financial damages that MTO provides for in its project contracts were not replicated in the PA/PSOS associated with delays in opening and closing lanes of traffic. Stakeholders suggested that the PA is not a strong tool for resolving minor issues of this nature in a Design Build context. Although concerns were taken up with the contractor, resolution was driven more by good will and reputation management on the part of the contractor than on the resolution mechanisms that were outlined in the PA.

The City also included a range of associated or complementary municipal infrastructure projects in the RTG contract through a cash allowance method. The cash allowance method means that RTG oversees the project implementation but with 100% City design and corresponding risk. As these projects were already fully designed and funded City projects they did not benefit from the powerful competitive tensions, benefits of scale, nor the some of the enforcement provisions of the PA. A less successful, but still necessary element of Confederation Line is the inclusion of cash allowance projects such as the hydro relocations on Scott Street and the upgrades to Queen Street. In general cash allowance work should be converted into bundled scope whenever feasible.

Recommendations for Stage 2:

- The City should strongly consider bundling any infrastructure utility projects that will have a material impact on the Stage 2 Project into a single procurement.
- The City should work to minimize the use of cash allowance scope items as they do not generally deliver the same level of financial efficiency as the AFP fixed-price scope.

5. Focused Preliminary Engineering

Overview of Issue and Lessons Learned:

Preliminary engineering for the Confederation Line began before the final procurement model had been determined, nor had all necessary City-wide decisions been made (e.g. how fare control would be integrated). As a consequence, the preliminary engineering team was at times consumed with trying to find solutions to City problems that would have been better left to proponents to solve. The oversight of the preliminary engineering team and project management of the Confederation Line project was undertaken by a mix of consultants and City Staff. This model resulted in some inefficiencies and lost opportunity to transfer risk and accountability for outcomes to the preliminary engineering consortia.

Industry wide projects are increasingly starting to use an "Owner's Engineer" model to run major projects. This puts a single line of accountability on project design and budget, as well as creating efficiencies, as the public sector does not need to staff and train redundant levels of technical oversight. It is recommended that this model be explored for the Stage 2 Project.

Recommendations for Stage 2:

- As mentioned previously, it is recommended that the City develop concurrent with the EA advancement, a Project Definition Report (PDR) that will identify and clarify all relevant design decisions to give direction to the preliminary engineering (PE) team. The PDR report should also identify aspects that the PE team should focus on.
- Implement an Owner's Engineer model for the project management and preliminary engineering of the Stage 2 Project.

6. The Need for Flexibility with Respect to Alignment

Overview of Issue and Lessons Learned:

One of the most significant value engineering solutions on the Confederation Line project was to shift the alignment of the proposed line after the completion of the EA. The alignment proposed in the 'deep-dive' tunnel alignment contemplated in the EA was largely an attempt to maximize the catchment area for the line with insufficient knowledge of the geotechnical conditions and resulting cost implications.

The decision to change from the reference concept design to the new alignment was largely driven by the cost considerations as the project was required to absorb all the AFP costs and inflation over the construction period as well as the natural escalation of costs as design advanced. However, there was considerable risk in making such a significant change to the EA at that comparatively late point in the process.

Overall, this solution was highly successful as it played a key role in containing the cost of the project to within to the $2.1B budget. More broadly, this solution points the importance of allowing and enabling flexibility in terms of the approach taken by the bidders to deliver on core functional requirements. By setting clear functional and performance targets along with a gated affordability cap but encouraging innovation in terms of the approach to delivery, the Confederation Line procurement ensured that the budget was maintained while delivering superior value for money.

As quickly as possible the PE team should focus on the constructability and affordability of the EA proposed alignment. If any elements of the high level design need to be questioned, challenged and revisited those aspects should be surfaced as early as possible.

Recommendations for Stage 2:

- Encourage and enable as much innovation as possible in the delivery of the Stage 2 Project. Strategies should be implemented to enable the bidders to propose innovative methods to achieve desired performance and functional criteria while also encouraging innovation in the preliminary engineering team.

7. Early Operator Involvement

Overview of Issue and Lessons Learned:

A consistent message received during the interviews was that the operators (OC Transpo) role in shaping the systems service levels, customer interface and experience, vehicles, operational specification and safety were critical to the project's success. OCTranspo has generated and acquired more LRT experience as they prepare for Confederation Line revenue service. Early and continued engagement with OC Transpo remains a critical success factor.

Recommendations for Stage 2:

- An important asset for the Stage 2 Project will be the more experienced operational presence of OC Transpo with higher internal capacity to participate in the procurement process in additional areas from the outset. It will be important to capitalize on this and involve OC Transpo as early, and as directly, as possible in the planning, development and implementation of the Stage 2 Project.

8. Communications

Overview of Issue and Lessons Learned:

Our interviews revealed that the Communications Plan and communication required of PA (Schedule 18) are a challenge. Interviewees suggested there are no effective incentives in the contract to ensure communications expectation were consistently met. Specifically, there were no requirements written into the PA that set out defined notification requirements related to specific anticipated impacts.

The City did, however, create a dedicated stakeholder relations team, which is the first of its kind for the City. All stakeholders have confirmed that this model has proved to have significant value and should be replicated in the Stage 2 Project.

Recommendations for Stage 2:

- There should be communications champions on both sides (City and private contractor) and performance metrics / incentives in relation to communications. The PA should have enforcement mechanisms that increase in severity (current PA offers an all or nothing dispute resolution mechanism).
- There should be a single integrated communications team with an onsite communications lead.
- The City should define notification and communications requirements related to specific construction impacts and penalties identified for non-compliance. This will force the technical leads on Project Co side to ensure better coordination and consultation with the communications team(s).
- The Stakeholder Group is working very well on the Confederation Line and should be an integral part of the Stage 2 Project communications process from the outset.

9. Milestone Payments versus Earned Value Approach

Overview of Issue and Lessons Learned:

One area of the Confederation Line that is not working as well as hoped is the use of milestone payments as measured against completion of certain “fixed” components. The use of these payments was driven by the desire for financial certainty and efficiency. The verification and even the definition of progress towards milestones has been problematic and each change to a milestone requires approval of co-funders under the contribution agreements.

Since that time IO has moved to an earned value or progress payment system as the basis for payment. Although not without its administrative challenges, the earned value approach is suggested is a more flexible approach and that the fixed completion milestone approach, although sound, is difficult to operationalize in practice.

Recommendations for Stage 2:

- The City should identify best practices associated with the earned value or progress payment approach from projects under construction in Canada and consider it for the Stage 2 Project in lieu of the fixed completion milestone approach.

Appendix A: Key Milestones and Timelines for the Procurement of the Confederation Line

Date	Event
November 2008	Council Approves Transportation Master Plan
May 2009	Council Approves Project Alignment Report
December 2009	Provincial Government Commits Funding
January 2010	Functional Design Begins
June 2010	Federal Government Commits Funding
August 2010	Province Approves Environmental Assessment
November 2010	Preliminary Engineering Commences
May 2011	Council Approves Schedule Acceleration and Procurement Option Report
July 2011	Council Approves Implementation Report & DBFM Procurement Model
June 2011	RFQ Released
September 2011	RFQ Closed
October 2011	RFP Released
March 2012	Council Approves Design Update and authorizes 'bundling 'of Highway 417 widening Project
September 2012	RFP Technical Submissions Closed
October 2012	RFP Financial Submissions Closed
September to October 2012	RFP Evaluations
October 2012	First Negotiations Proponent Notified
December 2012	Preferred Proponent Announcement

Date	Event
December 2012	Council approves Award of Contract to Successful Proponent (RTG)
February 2013	Commercial Close
February 2013	Financial Close
May 2013	Construction Start
September 2015	Substantial Completion of Highway 417 widening
December 2017	Confederation Line Construction Completed
May 2018	Scheduled Substantial Completion of Confederation Line
June 2018	Full Revenue Service
June 2048	End of 30 Year Maintenance Term