City Auditor's Office

New Central Library

January 6, 2017

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Executive Summary

This is the second of three planned audits of the New Central Library (NCL) project, which is a significant build with a planned budget of $245M, and expected completion by Q4 2018. Calgary Municipal Land Corporation (CMLC) is managing the project on behalf of the City of Calgary's Community Services (CS) and the Calgary Public Library (CPL).

In Q2 2015, the City Auditor's Office (CAO) undertook an audit of NCL's project management framework and governance structure, resulting in an assessment that a robust governance oversight was established, utilizing a PMBOK[1]-based framework. Recommendations were raised specific to opportunities to strengthen ongoing risk management, and schedule and cost monitoring.

The objective of this second audit was to provide timely assurance that the NCL project is on track to meet business objectives of time, cost and quality. We assessed the project management team's use of tools and techniques to monitor the project's cost, schedule, risk management, and quality monitoring based on the approved project plan and defined milestones. We also compared project management practices to best practices outlined by PMBOK.

The project management team have designed and implemented project controls to effectively support project objectives of completing the project within the approved budget, meeting approved quality requirements, and identifying and responding to risks. A key challenge to the achievement of the project's objectives is the timely completion of the project, and two recommendations were raised to further mitigate the risk to the project schedule.

The project management team effectively monitor funds spent to date against budget and forecast at completion. The 2015 NCL audit recommended the implementation of project performance monitoring by formalizing performance measurements to monitor cost and schedule. Earned Value Management reports are now produced with monthly information on actual progress billing versus planned cumulative amounts. Changes are recorded and tracked with funding supported by contingency reserves. Contingency reserves are in place to address unknown construction factors. As the project has progressed, the project management team have actively revisited the contingency reserve amount.

The project management team continued to utilize a robust risk management process. The 2015 NCL audit recommended that the project review its risk register to consider different categories of risk, and assign a risk owner and response strategy for all key risks. The project management team identify and re-assess project risks monthly. Project risks contain owners and mitigation strategies. A comprehensive list of project risks is regularly presented to the project's Steering Committee and high risks are discussed with the project's Steering Committee, including their impact and mitigation strategies.

[1] The Project Management Institute's Project Management Body of Knowledge

The NCL project follows a quality assurance process established in the project's quality management plan. Third-party inspections and testing on concrete, steel and the building envelope are being conducted during construction. When quality issues are detected, the project management team escalate the issue, and a resolution addressing the cause of the issue is presented to the project's Steering Committee. The Construction Manager has developed inspection guides that are used as control checklists to review the work of subcontractors.

Schedule management represents the highest uncertainty to the project's objective of delivery in Q4 2018. Quality inspections conducted on the project's truss steel in Q3 2016 identified material and fabrication defects. The subsequent impact and resolution assessment has delayed the project's estimated date for obtaining the occupancy permit by six weeks. Important project milestones that follow the occupancy permit are the project's substantial completion[2] and total completion[3]. The project management team expect to be able to quantify the impact of the truss steel issue on the project's substantial and total completion dates by April 2017. We recommended that the project management team promptly present the impact of the truss steel quality issue on substantial and total project completion dates to the project's Steering Committee with recommended actions to mitigate further risk to the project's schedule.

The project management team deliver project status reports to the project's Steering Committee monthly. However, project status reports do not identify the status of the project's activities and milestones in relation to the project's master schedule and critical path. We recommended future reporting include progress against the master project schedule to provide Steering Committee with additional information to support timely and optimal decision-making.

CS have agreed with our recommendations, and have indicated in their responses a commitment to implement action plans no later than April 19, 2017. The CAO will follow-up on all commitments as part of our ongoing recommendation follow-up process. Given the high dollar investment commitment and the wide public benefit of this project, the CAO has planned a final operational audit, later in 2017, on the readiness of CPL to assume hand-off from CMLC.

[2] Defined by the PMBOK Construction Extension Guide as a contract milestone that is achieved by the owner's acceptance of the product constructed by the contractor. This milestone results in the owner utilizing the product for its intended purpose or a list of items to be reworked.
[3] Total project completion is to be achieved after books, furniture and equipment are moved into the new building.

1.0 Background

The New Central Library (NCL) project has a budget of $245 million, and is expected to be completed by Q4 2018. Preparatory site work has been undertaken in 2014 and building construction started in September 2015. The project is being managed by the Calgary Municipal Land Corporation (CMLC) on behalf of the City of Calgary's Community Services (CS) and the Calgary Public Library (CPL). A Project Agreement (effective February 2013) sets out the funding, duties and obligations of CMLC and The City.

The City Auditor's Office (CAO) undertook an audit of the NCL project in 2015. The 2015 NCL audit focused on the design of the project management framework and the governance structure supporting capital construction of the library. We evaluated whether a strong project governance framework had been established, and secondly, whether a comprehensive project management framework had been created. We observed that a robust project governance framework was established. A PMBOK[4]-based project management framework was adopted but not fully utilized at that stage of the project. The audit raised five recommendations to strengthen project performance monitoring, benefits realization, stakeholder communication, and risk identification and management. CS agreed to our recommendations and, by January 19, 2016 implemented action plans to address the risk exposure.

As stated in the 2015 NCL audit report, given the high dollar investment commitment and the wide public benefit of this project, the CAO committed to provide periodic independent assurance on the effectiveness of construction project management until the successful completion and handover of the NCL.

Since the completion of the 2015 NCL audit, construction has progressed significantly. A C-Train track that bisected the site required the creation of a tunnel-type construction (encapsulation), construction tenders were finalized, and construction was initiated in September 2015. The table below provides highlights of recent and future key completion milestones:

Date	Milestone	Status
2016 Q2	Steel Installation	Complete
2016 Q4	Completion of Steel and Concrete Structure, South Exterior Finish	Ongoing
2017 Q1	Completion of East & West Exterior Finish	Ongoing
2017 Q2	Start of Interior Construction and Finishing	Not Started
2018 Q1	Completion of Exterior Hard Surface Landscaping	Not Started
2018 Q2	Completion of Interior Construction and Finishing	Not Started
2018 Q3	Soft Landscaping, CPL brings in Books, Equipment	Not Started
2018 Q4	Library Opens	Not Started

Source (http://www.calgarymlc.ca/new-central-library)

[4] Best practices outlined by the Project Management Institute in the Project Management Body of Knowledge

Illustration 1 shows the state of the construction, at the time of the audit, in November 2016.

Illustration 1 – Steel and Concrete Structure Ongoing (November 2016)

2.0 Audit Objectives, Scope and Approach

2.1 Audit Objective

The objective of this audit was to provide timely assurance that the NCL project is on track to meet business objectives of time, cost and quality.

2.2 Audit Scope

The scope of the audit included project management's use of tools and techniques to monitor the project's schedule, cost, and quality performance based on the approved project plan and defined milestones. The transition of the built facility to CPL and subsequent operation were outside the scope of this audit.

2.3 Audit Approach

To provide quick and relevant feedback as the project continues to progress, our audit approach included the following:

- Review of the July to September 2016 Earned Value Management reports, and supporting completion reports and cost tracking log to test the reliability of budget forecasts, trend and variance analysis;
- Review of the project cost escalation and change log to determine identification, impact, and approval of changes to cost and schedule;

- Analysis of the July and September 2016 reports to the project's Steering Committee (no Steering Committee meeting in August) evidencing progress reports versus defined project milestones and critical path activities;
- Review of quality inspection reports and checklists;
- Assessment of the May to September 2016 versions of the project's risk register to determine if and how new risks are identified, assessed, and assigned to risk owners for action;
- Interviews with staff and other personnel associated with the NCL project (i.e. members of the NCL Steering Committee, CMLC, project management, etc.); and
- Review of project management practices against PMBOK best practices for project time, cost, quality, and risk management.

During the planning phase of the audit, we conducted an audit risk assessment which included the identification of project management controls which mitigate the risks to project objectives. During fieldwork, we reviewed controls currently in place that mitigate:

- Cost overruns;
- Schedule delays;
- Poor quality facility built; and
- Risks to project delivery not managed.

3.0 Results

The project management team have designed and implemented project controls to effectively support project objectives of completing the project within the approved budget, meeting approved quality requirements, and identifying and responding to risks. A key challenge to the achievement of the project's objectives is the timely completion of the project, and two recommendations were raised to further mitigate the risk to the project schedule.

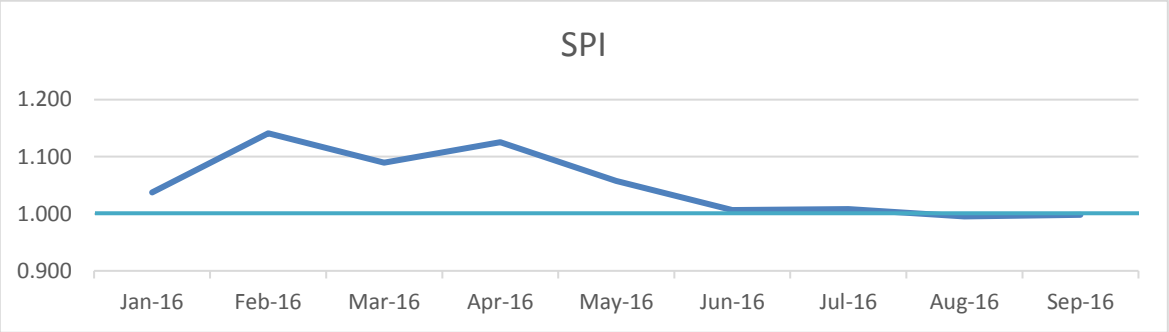
3.1 Schedule Management

Schedule management represents the current highest uncertainty to the achievement of the project's objectives. The project management team have implemented a project master schedule with a sequence of activities, durations, milestones, and monitoring processes.

Monthly, the Construction Manager (CM) produces Earned Value Management (EVM) reports with information on actual progress billing versus planned cumulative amounts. EVM information is based on invoices presented by the CM and verified by the Project Manager. The project management team track progress with the use of a Schedule Performance Index (SPI). SPI[5] is a measure of schedule efficiency used to measure how efficiently the project team is using its time. An SPI value less than 1.0 indicates less work was completed than was planned. As at September 2016, the project's SPI is 0.998, indicating a very slight delay. The following graph shows the evolution of the SPI for the period January to September 2016.

[5] PMBOK Control Schedule Tools and Techniques

Graph – SPI 2016



Source: NCL EVM reports

The project management team assessed a six-week delay in obtaining the project's occupancy permit. This delay is the result of a steel quality issue detected by the project management team through its project quality management process. The project management team determined options and established a resolution to the issue. However, the impact on the project's substantial and total completion dates has not yet been fully quantified. We recommended that the project management team assess the impact of the steel truss quality issue on substantial completion and total project completion dates, and present the impact to project schedule and possible risk-mitigation actions to Steering Committee (Recommendation 1).

The project management team deliver monthly project status reports to Steering Committee, including progress on construction activities. The information on construction activities is supported by progress certificates reviewed and approved by the Project Manager. The information presented to Steering Committee contains project milestone statuses, but only for activities that were completed within the reported month or to be completed in less than two months. The information is presented in a table format and does not show a sequence of activities along the project's critical path, making it difficult to measure progress against the project master schedule. We recommended the inclusion of information in monthly status reports to show progress against the master schedule to track progress along the project's critical path and variations to the schedule baseline (Recommendation 2).

3.2 Cost Management

The project management team effectively monitor spend to date in relation to the project's approved budget. Monthly, the project management team update the forecast at completion information. Based on our sample, invoice payments to the CM were supported by EVM reports and completion certificates prepared by the CM, and validated by the Project Manager. EVM reports were produced with monthly information on actual progress billing versus planned cumulative amounts. The Cost Performance Index (CPI[6]) is a measure of cost efficiency of budgeted resources, expressed as a ratio of earned value to actual cost. The NCL

[6] PMBOK Control Costs Tools and Techniques

project follows a fixed-price contract construction model where earned value equals actual cost (invoices). Therefore, CPI is not used to determine project status. Based on the tracked progress in the EVM reports, the fact that the project has already spent one-third of its construction cost, and with all tenders closed, project management forecasts that the project will be delivered on budget.

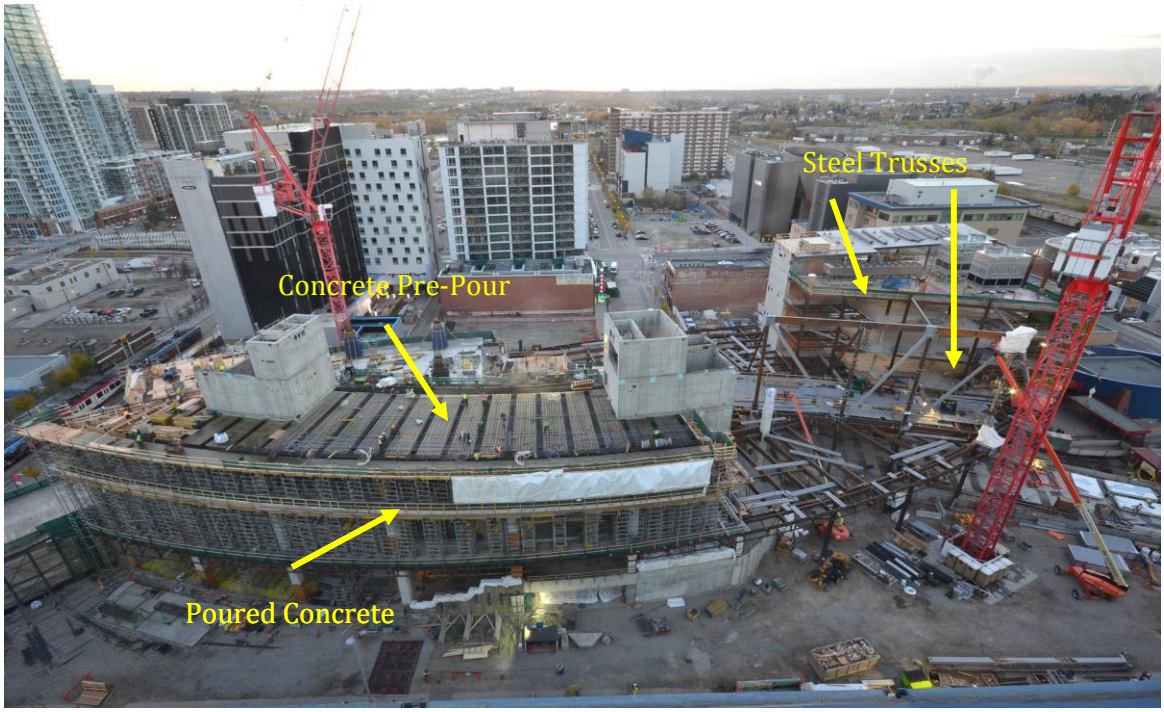
Changes to the project are recorded and tracked. Scope changes, that is, changes that impact the functionality of the building are presented to the Steering Committee for review and approval. By September 2016, there had been two scope changes to the project amounting to $158K. Scope changes were approved by the Steering Committee and paid by the use of contingency reserves. As per PMBOK best practice, contingency reserves are estimated and clearly identified in cost documentation. The project management team actively revisit the contingency reserves as information on actual cost becomes available.

3.3 Quality Management

The project management team have effectively implemented a quality management process. The quality management process described in the project's Quality Management Plan is being followed as evidenced by third-party inspections on concrete, steel, and the building envelope. We examined six quality reports produced in Q2 and Q3 2016 on concrete, steel and the building envelope, and three inspection tests by the CM for the month of September 2016. When quality issues are detected (e.g. quality of the truss steel in Q3 2016), project management conducts a follow up assessment and presents key quality issue to the Steering Committee with a proposed resolution. The CM has developed checklists to be used as inspection guides covering construction items such as concrete, structural steel, insulation, plumbing, and electrical. The CM uses the checklists to inspect and test the construction work. In addition, the CM reviews work by third-party inspectors.

Our analysis of quality reports demonstrated that the quality assurance process is aligned to the project's master schedule. Quality assurance checks take place ahead of the scheduled delivery of items to the construction site (e.g. curtain wall performance mockup) or as material is delivered and installed (e.g. concrete as it is poured and days later it is re-tested for its strength). Illustration 2 shows the state of the construction in September 2016 as the structural steel truss was installed and concrete poured. Testing for the quality of the steel and concrete was conducted in Q3 2016, showing alignment between the quality assurance process and the project's master schedule.

Illustration 2 – Structural Steel Truss Installation & Concrete Pouring (September 2016)



3.4 Risk Management

The project management team effectively utilize risk management on an ongoing basis. We reviewed the project's risk registers for the months of May to September 2016. The project management team continuously assess project risks through a range of means such as inspection reports, meetings between the project management team and the CM, and conversations with suppliers. The project management team maintain the project risk register and re-assess the project risks on a monthly basis by quantifying the likelihood and impact of the risks. Monthly, the project management team deliver to Steering Committee a comprehensive list of risks, including risk responses with risk owners. High risks are discussed with the Steering Committee, including their impact and mitigation strategies.

We would like to thank staff from CS, CMLC and the project manager for their assistance and support throughout this audit.

4.0 Observations and Recommendations

4.1 Project Schedule Delay

The impact to the project schedule of a quality issue has not yet been fully quantified. The impact of the issue on project substantial completion and total completion is required by Steering Committee to make informed decisions regarding the project schedule and any actions required to address the delay.

The September Steering Committee report describes a six-week delay to the construction schedule caused by the steel welding issues as the most serious risk to the project. Micro cracks found on the steel were detected in quality inspections prior to the delivery of the steel to the construction site. The issue arose as a result of material and fabrication problems. One of the pieces could not be fixed and had to be re-fabricated. This impacted one of the building's steel trusses and, in order not to stop the construction, the Construction Manager had to develop a new erection procedure. The time it took to detect the problem, consider the options, develop a solution, and re-fabricate the steel was initially estimated by the project management team to have delayed the expected occupancy permit by six-weeks.

The project management team are in the process of quantifying the impact of the issue on the project's substantial completion and total completion. The project management team expect to be able to quantify the delay at the Steering Committee's April 2017 meeting.

Recommendation 1

The General Manager, Community Services, request that the Project Manager present to Steering Committee the impact of the steel truss quality issue on substantial completion and total project completion dates; and (if required) recommended actions to mitigate further risk to project schedule.

Management Response

Action Plan	Responsibility
Agreed. A detailed verbal report was provided to Steering Committee on November 17, 2016. The General Manager, CS, has written a letter to CMLC dated December 19, 2016 requesting CMLC to present to the April 19, 2017 Steering Committee the impact of the delay on substantial completion and total completion dates, and recommended actions	Lead: Coordinator, NCL Project Support: Senior Project Manager, CMLC Commitment Date: April 19, 2017

Action Plan	Responsibility
to mitigate further risk to project schedule when the building envelope is complete ('sealed'). Project management expects the building envelope to be complete on or about March 31, 2017.	

4.2 Project Schedule Reporting

Monthly Project Status reports do not show the status of the project's activities and immediate milestones in relation to the project's master schedule and critical path. There is an opportunity to include progress against the master project schedule in the reports to provide Steering Committee with additional information to support timely and optimal decision-making.

Monthly project status reports prepared by the project management team are presented to the project's Steering Committee. They contain a Milestone Schedule Status section with a percentage of completion.

The status report contains information on activities that were completed within the reported month or to be completed in less than two months, making it difficult to gauge progress against the project master schedule. The information is presented in a table format and does not follow the project's critical path. For example, the status report describes the building superstructure - vertical truss as one activity with a scheduled date of September 15, 2016, forecast completion date of October 15, 2016, and 50% completion. The building superstructure - vertical truss section in the master schedule is subdivided into 17 activities with dates ranging from June 10, 2016 to March 1, 2017. It is not clear what percentage of the building superstructure - vertical truss section has been completed to date.

Recommendation 2

The General Manager, Community Services, recommend that the NCL Steering Committee request the inclusion of additional information in Monthly Project Status reports to show progress against the master schedule including:

- A Gantt chart showing activities and milestones critical to substantial completion of the project. Activities are to be shown in sufficient detail to identify the planned sequence to track progress along the project's critical path; and
- Schedule performance index (SPI) information to demonstrate the magnitude of variation to the schedule baseline.

Management Response

Action Plan	**Responsibility**
Agreed. The General Manager, CS, has written a letter to CMLC dated December 19, 2016 requesting CMLC to develop a 'high level' Gantt Chart format and Schedule Performance Index (SPI) for future Status Reports commencing on January 1, 2017. The January status report containing the Gantt Chart and SPI information will be presented to the February 15, 2017 Steering Committee.	Lead: Coordinator, NCL Project Support: Senior Project Manager, CMLC Commitment Date: February 15, 2017