EXECUTIVE SUMMARY REPORT

MAJOR CAPITAL PROJECTS REVIEW

UNIVERSITY OF ALBERTA | THE CITY OF Edmonton | CONSTRUCTION INNOVATION CENTRE *Research Driving Change*

CONSTRUCTION INNOVATION CENTRE
UNIVERSITY OF ALBERTA | EDMONTON, AB | JULY 14, 2023

Report Summary

BACKGROUND

Integrated Infrastructure Services (IIS) has strengthened its efforts to proactively counteract the complexities and risks associated with major infrastructure projects. Infrastructure planning and design, infrastructure delivery, and infrastructure life cycle management are the three lines of service supported by IIS's five branches that are responsible for planning, designing, and delivering a project, from the concept to build phase. IIS designs and delivers infrastructure on behalf of the Council and citizens. This department is responsible for delivering more than $7 billion in infrastructure projects over the next few years. In 2013, the Project Management Reference Guide (PMRG) was developed and implemented. It is a standardized project management reference manual developed to assist project managers and City staff in proficiently implementing project management tasks. The PMRG encompasses well-established tools and standardized processes based on the City's and industry's project management best practices to ensure a consistent approach towards managing capital construction projects. In 2017, City Policy Number C591 Capital Project Governance was adopted by City Council to govern the management of capital projects by implementing a project delivery model that provides better information on budget and schedule to make capital investment decisions.

OBJECTIVES

The main goal of this study is to review and assess the IIS department's processes for developing and delivering major capital projects. More specifically, the objectives are to assess whether IIS:

- Has established and implements proper processes for governing and overseeing major capital projects to successfully manage projects within schedule, budget, and desired quality
- Has established and implements a standardized project management framework and practices for properly planning, managing, measuring, monitoring, and controlling project operations
- Adequately and transparently reports on project performance to key stakeholders and public
- Undertakes fair and appropriate approaches to procure Consultants/ Contractors/ Suppliers

SCOPE

The scope of this work covers the review of 13 major capital projects such as transportation infrastructure, neighborhoods, transit, recreation centers, and facilities. These major capital projects include profiles having at least $20 million in expenditures during the 2019-2022 Capital Budget cycle; or profiles that are highly strategic, complicated, involving many stakeholders, significant constraints, and/or a high level of risk. The 13 projects comprise traditional and alternative delivery and procurement methods. 12 Project Managers from IIS have participated in questionnaires and follow-up interviews[1].

KEY FINDINGS

IIS properly performs oversight through a Project Oversight Committee/ Board comprised of key stakeholders such as project sponsors, senior management, subject matter experts, project managers, and other relevant parties. At project level, IIS adheres to industry best practices and standards for establishing an appropriate governance structure, proper delineation of roles, responsibilities, authorities, and accountabilities of different oversight stakeholders. Most projects are properly defined, and their objectives, scope, and value are formally documented and communicated between key stakeholders. Also, project performance and progress are constantly measured against baselines, milestones, and key performance indicators and communicated to key stakeholders throughout a project's lifecycle. Stakeholder issues are properly addressed and feedback from key stakeholders and the public are solicited to guide decision-making.

[1] *The questionnaire and study approach of the research team were approved by the University of Alberta Research Ethics Office – PID: RES0061761*

IIS established and continuously updates a standardized project management system for managing major capital projects to be executed under different delivery methods. This system follows industry best practices and is equally comparable to systems developed by other major high-performing Canadian cities, one of which won PMI's (Project Management Institute) 2014 award, that possess well-established project management framework which entails well-grounded guidelines for all key stakeholders with their interrelationships to conduct standardized processes throughout project lifecycle aimed at the integration of lessons learned for continuous improvement. Standardized processes have been adequately developed and documented to guide project managers and IIS staff in the management of a project from initiation to completion. The reviewed projects have properly developed business cases, charters, and project management plans that clearly describe different processes, requirements, and constraints for various management areas. Appropriate checks, evaluations, verifications, and approvals are performed at each stage before proceeding to the next. Project managers are properly planning, managing, measuring, monitoring, and controlling operations to successfully deliver projects.

IIS undertakes standardized, fair, and transparent approaches for procuring services of consultants, contractors, and/or suppliers on major capital projects. IIS works closely with the City's Corporate Procurement & Supply Services branch to develop and execute the most suitable procurement strategies and purchasing services adequate for each project type in alignment with the City's Procurement Standard and policies. Project managers perform a thorough analysis and hold discussions with key stakeholders to select the best procurement strategy on a project-by-project basis and develop detailed evaluation criteria and plans to select qualified consultants, contractors, and/or suppliers.

When compared to other major Cities, IIS and COE have evidently achieved the most transparent, exhaustive, timely, interactive, and easily accessible reporting approaches of project updates to the public, which sets the standard for other Cities to follow suit.

Another notable observation of IIS's environment is a culture of continuous improvement which entails recording and implementing lessons acquired from finished projects to future projects enhancing project management practices and ongoing improvement.

CONSIDERATION

IIS and COE consistently established proper and standardized governance and management practices; however, the team suggests few considerations for IIS to leverage their standards and practices over other high-performing Cities within specific areas as part of their continuous improvement strategies. These should be considered to improve current practices and are included in order of priority.

Consideration 1

The research team suggests that the PDDM process/templates can be modified to accommodate alternative project delivery methods, e.g., design-build/accelerated projects, such as adding more gates where needed (e.g., at 30% design) and customizing the acceptance thresholds/criteria. Consider the viability of engaging Project Managers and Key Stakeholders earlier in the project should be investigated accordingly (e.g., definition stage) to incorporate their expert feedback early on for smoother hand-offs and higher clarity of project scopes and objectives.

Consideration 2

Earned Value Analysis (EVA) allows project managers to monitor progress against a target in real time and take corrective action in the event of any discrepancies. Though its application on some projects, EVA should be mandated across all major capital projects. Thus, IIS should investigate the viability of making Earned Value Analysis (EVA) a globally applied monitoring, control, and reporting requirement across all critical and complex capital projects.

Consideration 3

The City's Quality Management System (QMS) is outlined in each project's PMP, and each project is handled in compliance with that system. On certain projects, inspections and testing are viewed as insufficient indicators of quality, while on others, Non-Conformance Reports (NCRs) and other quantitative indicators of quality are utilized. As a result, it is abundantly evident that quality measurement across all relevant activities need additional standardization. Furthermore, quality is cited less often than other variables like cost and schedule. Since there appears to be considerable variation in the reporting requirements on quality-related problems between projects, there is an obvious need for improved uniformity in this area. Thus, IIS should consider developing and reporting on consistent and quantifiable quality performance measures, like its well-developed budget and schedule measures.

Consideration 4

Since it is well established that COE adopts value benefit procurement to leverage qualifications over price, IIS may initiate conversations, internally, with key stakeholders, and design consultants around the benefits, risks, and impacts of the qualification-based selection (QBS) approach on IIS projects as a value based procurement practice when procuring consulting services for specifically complex large capital projects that requires more sophisticated levels of expertise . The discussion can revolve around transitionary approaches and necessary cultural changes, support needed, and different adjustments to approaches and systems that need to be performed should IIS consider initiating QBS adoption.

Major Capital Projects Review

BACKGROUND

The construction industry is characterized by complexity, budget and schedule overruns, quality and safety problems, and increased claims and disputes (Diekmann & Girard (1995), Fenn et al. (1997), Kumaraswamy (1997), Semple et al. (1994), Reid & Ellis (2007), and Willmot & Hocker (1998), Blake Waldron & Dawson (2006). To successfully manage the inherent complexity and ensure the success of construction projects, more specifically public infrastructure services, analyzing the underlying governance and oversight systems, procurement methods, as well as the project management practices is integral to a smooth development and delivery of capital projects. The strategic governance direction and the adopted project delivery management approach on a given project sets the framework for the design, procurement, and construction processes and substantially influences the allocation of risks and responsibilities to the different project entities, the timing of engaging specific key players, and the nature of their relationships. Nevertheless, studies have confirmed that inadequate governance and oversight procedures coupled with inadequate project management capabilities exacerbate an already uncertain and complex infrastructure services industry.

Over the years, the Integrated Infrastructure Services (IIS) department has strengthened its efforts to proactively counteract the complexities and risks associated with major infrastructure projects. The IIS department designs and delivers infrastructure on behalf of the Council and citizens. This department is responsible for delivering more than $7 billion in infrastructure projects over the next few years. Infrastructure planning and design, infrastructure delivery, and infrastructure life cycle management are the three lines of service supported by IIS's five branches which are responsible for planning, designing, and delivering a project, from the strategy phase towards the construction and project close phase.

In 2013, the Project Management Reference Guide (PMRG) was developed and implemented. The PMRG is a standardized project management reference manual developed to assist project managers and City staff who are involved in delivering capital construction projects in proficiently implementing project management skills. The PMRG encompasses well-established tools and standardized processes based on the City's and industry's best practices to ensure a consistent approach towards managing capital construction projects. In 2017, City Policy Number C591 titled Capital Project Governance was adopted by City Council to govern the management of capital projects by implementing the Project Development and Delivery Model (PDDM) towards providing Council with better information on budget, and schedule to make capital investment decisions. Investment in planning and design prior to project approval will enable improved project schedule and budget estimates. The PPDM involves formal and well-defined checkpoint reviews (refer to Figure 1) of the project as it progresses through the strategy, concept, design, build, and operate value life cycle of the project. This allows a systematic evaluation of projects against a project business case and scope baseline and will ensure further reliability, accuracy, and transparency in estimates of budget and schedules for projects.

OBJECTIVES

The main goal of this study is to **review, assess, and benchmark** IIS department's existing policies, processes, frameworks, and practices implemented for managing the City's major capital projects against industry best practices. More specifically, the objectives are to assess whether IIS:

- Has established and implements proper processes for governing and overseeing major capital projects to successfully manage projects within schedule, budget, and desired quality
- Has established and implements a standardized project management framework and practices for properly planning, managing, measuring, monitoring, and controlling project operations

- Adequately and transparently reports on project performance to key stakeholders and public
- Undertakes fair and appropriate approaches to procure Consultants/ Contractors/ Suppliers

This work covers these areas:

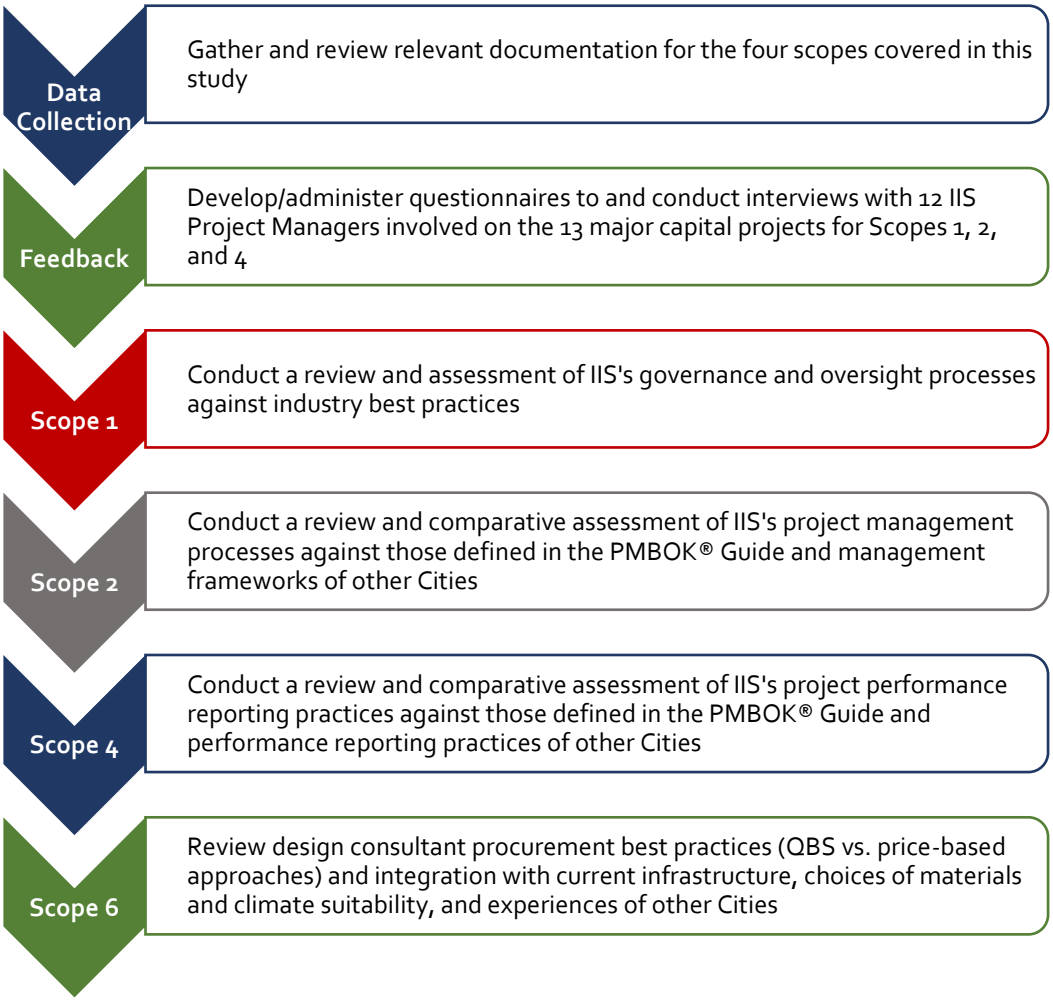
- **Scope 1:** A review of the governance and oversight of IIS's major capital projects
- **Scope 2:** A review and benchmarking assessment of IIS's project management practices
- **Scope 3:** A review of project performance reporting of the COE and other major owners
- **Scope 4:** A review of design consultant procurement best practices

The resulting review and assessment will:

- Indicate the status of current practices
- Highlight potential areas for improvement if any
- Provide considerations, if any, to be incorporated by IIS as part of their continuous improvement strategy

APPROACH

The approach undertaken to conduct this study comprises the main steps aimed at achieving the objectives of the four scopes:



DATA SOURCES

Information reviewed, analyzed, and assessed in this study is an aggregation of the following:

- City-IIS level documents: PMRG, PDDM, Policies, Procedures, Standards, Directives, Audits
- Project-level documents, e.g., Project Management Plans, Charters, Status Reports, Contractual Agreements, PDDM Readiness Criteria, Procurement Evaluation Plans/Criteria
- Feedback from discussions with the Project Management Centre of Excellence (PMCE) team
- Questionnaire and interview responses of 12 Project Managers at the IIS
- Public documentation and reports collected from other major Cities
- Literature work on design consultant procurement practices and climate resiliency standards

QUESTIONNAIRE DESIGN

This table summarizes the content of questions included under the 4 main questionnaire sections:

Project Manager Competencies	Governance & Oversight	Project Management	Performance Reporting
Experience in public projects	Project governance structure	PMRG framework	Reporting guidelines, level, and frequency
Experience at COE	Roles, authority, accountability, and responsibilities	PDDM process & checklists	Data collection, analysis & forecasts
Educational background	Clarity of project scopes & objectives	Processes within project management knowledge areas	KPIs for monitoring & control
Certifications & licenses	Support from top management		Variances & action plans
Workload			Public engagement

ASSESSMENT

A four-level assessment ranking scale is used to benchmark IIS's practices for applicable scopes:

- **Level 1 Inadequate:** ad-hoc, not standard, not documented, major variances between projects
- **Level 2 Satisfactory:** some areas are defined and formally documented, meets minimum requirements, major variances between projects, needs major improvements
- **Level 3 Standardized:** defined, formally documented, standardized with monitoring and control processes implemented on majority of projects, requires minor adjustments
- **Level 4 Distinctive:** defined, formally documented, standardized with monitoring and control processes, integration of lessons learned and continuous improvement

LIMITATIONS

The assessments and recommendations in this study are bound to the following limitations:

- Limited availability and access to documents from other Cities
- Limited sample of reviewed major capital projects
- Potential hidden biases in PM responses to questionnaires
- Project documents do not provide a comprehensive depiction of project management practices
- Day to day observations of operations was not feasible to perform given time &
- Questionnaire limited to essential questions to encourage participation and respect time

Key Findings

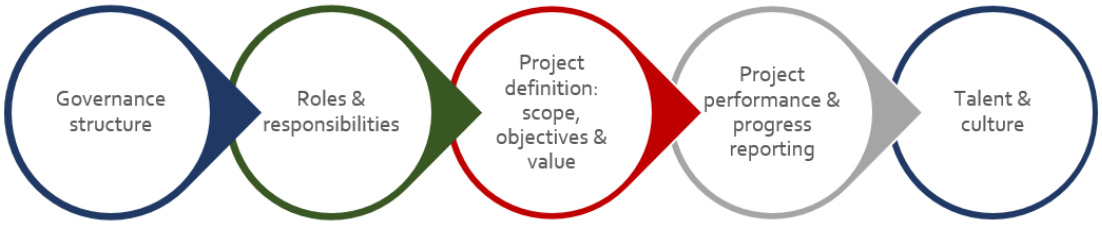
Summaries of the key findings of the review, assessment, and analysis are presented for each scope. Specific recommendations under each scope are also provided for consideration by IIS.

SCOPE 1: REVIEW OF IIS'S GOVERNANCE AND OVERSIGHT OF MAJOR CAPITAL PROJECTS

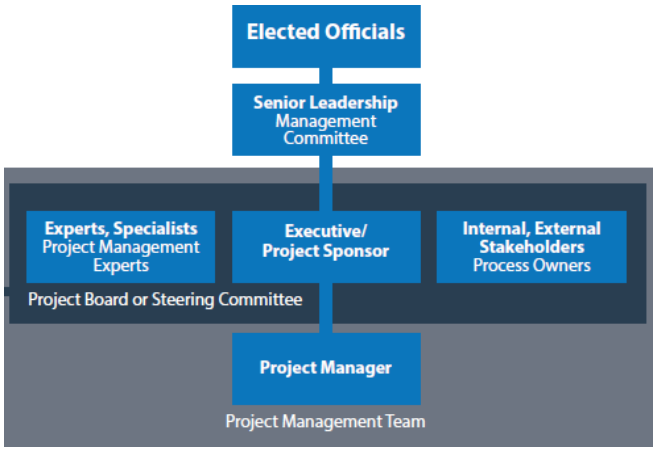
CURRENT STATUS. IIS properly establishes oversight through a Project Oversight Committee/ Board comprised of key stakeholders such as project sponsors, senior management, subject matter experts, and other relevant parties. These committees provide project governance and oversight by monitoring progress, addressing issues, and making critical decisions. Depending on the nature, scale, and complexity of the projects, project oversight practices may differ. The following are some of the main purposes of project oversight and roles of project oversight committees:

- **Project Performance Monitoring**
- **Risk Management**
- **Financial Oversight**
- **Compliance and Quality Assurance**
- **Stakeholder Engagement**
- **Reporting and Communication**
- **Lessons Learned and Continuous Improvement**

An internal review and assessment of IIS's main project governance and oversight procedures, outlined below, against recommendations stipulated in the PMI's PMBOK® Guide was performed to reflect whether the major capital projects have adequate governance systems, practices, and procedures in place.



The revisions of the project-level governance structures of the 13 reviewed major capital projects and feedback from interviewed PMs showed that all projects (1 project had even more sophisticated layers of governance) adopt the standard governance and oversight model structure recommended by the PMBOK® Guide (as shown in the figure below) for establishing the needed governance, oversight, and delegation of authority on projects.



100% of projects adhered to the standard project-level governance structure recommended by the PMBOK

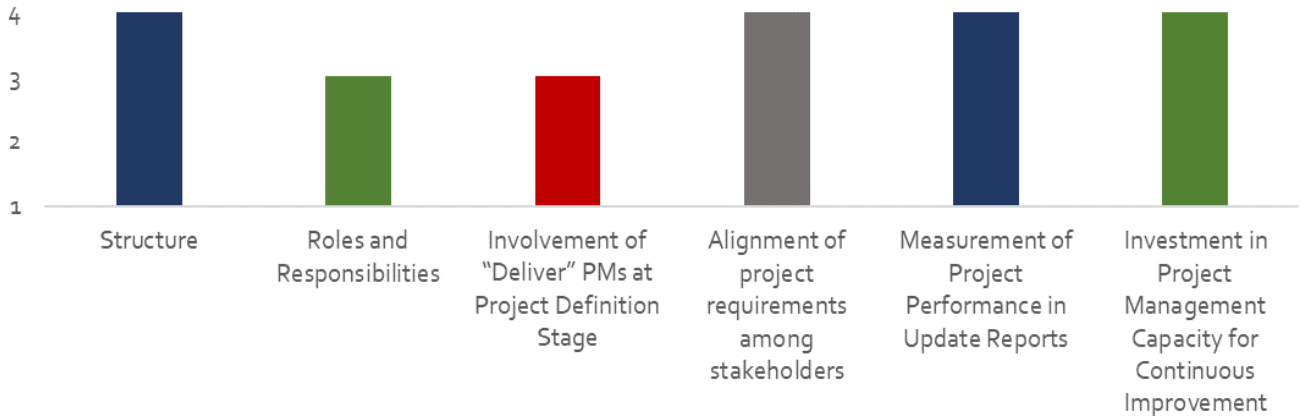
8% of projects (1) had an add-on sophisticated layer of governance structure

special public nature of this project and the relationship of the user group with the owner

user group was involved heavily throughout the design and construction of the project

Additionally, reviewing the project documents of the 13 selected major capital projects such as the project management plans, charters, and status reports as well as feedback from PMs on questionnaires and during interviews indicated that project requirements are aligned among different project stakeholders, project performance is constantly measured in update reports, and that there is a proper level of investment in project management capacity for continuous improvement. The adequacy and standardization of these areas enable Project Managers to properly plan, manage, measure, monitor, and control project operations while reporting on performance and progress to the identified stakeholder channels as needed.

The ranked levels for each of the governance areas are summarized in the following chart.



On the other hand, feedback from some PMs and the associated project documents indicated the need for involvement of PMs of the project delivery stage earlier on, ideally, in the project definition stage and business case development to achieve a better level of understanding of project scope, objectives, and value. Also, some of the responses indicated minor discrepancies regarding the definition of PM and Steering Committee authorities, functions, roles, and responsibilities.

It is crucial to analyze the level of support obtained from the Steering Committee, as this committee's major job is to guide and support the project manager in completing the project. As per feedback from the PMs, the steering committee supplied different support functions to different projects, implying that there is no predefined list of support functions to be provided and that it is determined on a project-by-project basis. Furthermore, the PMPs specify the key tasks and responsibilities of the project steering committee (project director or project sponsor, as applicable), however, the list of functions documented in the PMPs is not exhaustive.

While project managers oversee day-to-day project management and control, certain decisions should be approved by the steering committee to ensure effective governance. As per the interviews, approval requirement of the steering committee across all projects should be definite and project managers' permission to undertake functions without steering committee consent differed among projects. Moreover, according to a review of supplementary project documents conducted in the context of evaluating the duties that the PM is authorized to perform without the consent of the steering committee, the PMPs did identify the key roles and responsibilities of the project managers. However, different initiatives granted project managers varying degrees of autonomy. Thus, a specified list of functions should be consolidated that require permission from the project steering committee, rather this is determined on a project-by-project basis.

POTENTIAL AREAS FOR IMPROVEMENT. Based on the results of the review and assessment of IIS's governance and oversight practices, the research team identified some areas that can benefit from minor improvements to further enhance the overall governance and oversight capability on projects. These are:

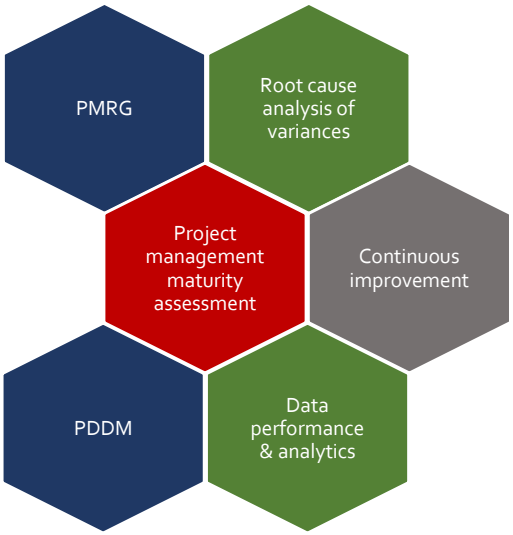
- **Roles and responsibilities:** Detailed predefined list of support functions documented in the PMPs with permission requirement from the project steering committee is applicable
- **Project definition: scope, objectives, and values:** Involvement of "Deliver" PMs at project definition stage

RECOMMENDATIONS. Based on the review and assessment results, the research team suggests minor considerations to IIS to establish more standardized governance and oversight practices.

Roles and Responsibilities	While most projects exhibited that Project Managers' roles and responsibilities are clearly delineated, and to maintain consistency along all projects, IIS can take further assurance steps to standardize the role of project oversight/governance structures across major projects through eliminating the need for unique project-by-project governance structures rather than establishing them per project governance.
Project Definition: Scope, Objectives, and Values	Increase the involvement of "deliver" project managers at the early stages of the project, including the development of the business case.

SCOPE 2: REVIEW & BENCHMARKING ASSESSMENT OF IIS PROJECT MANAGEMENT PRACTICES

CURRENT STATUS. An internal review of IIS's overall project management environment revealed that a well-established Project Management Center of Excellence (PMCE) is in place and consistently adheres to the processes and standards stipulated in the PMRG. Also, the PMCE has developed and manages a set of programs focused on lessons learned and continuous improvement.



100% of interviewed PMs fully implement PMRG
- 1 project was pre-PDDM
- 1 project had additional advanced practices

100% indicated PMRG processes are clear & formally documented
8% need more add-on collaboration with partners to emphasize internal changes

The PMRG provides Project Managers with the essential processes, steps, guides, and templates needed to properly and efficiently manage different project scales (small, medium, large) to ensure projects meet and exceed quality, cost, and schedule requirements. The PMRG's project management knowledge areas and processes adhere to those outlined in the PMI's PMBOK® Guide. Specifically, the PMRG has established standardized and adequate practices for a project's life cycle from project strategy to project closeout.

Overall, the reviewed documents of the 13 major capital projects and feedback from 12 Project Managers (PMs) revealed that projects have well-defined business cases, charters, project management plans, and that PMs properly implement adequate and standardized planning, management, measuring, monitoring, and controlling processes to effectively manage and oversee major capital projects under each of the following 12 areas:

Initiation and Integration Management; Scope Management; Cost Management; Schedule Management; Quality Management; Human Resources Management; Stakeholder and Communication Management; Procurement and Contract Management; Risk Management; Change Management; Project Close; and Stage Gate (PDDM)

Based on the internal assessment of project documents and feedback from PMs, the team provided a **Ranked Level 4 Distinctive** for these 8 areas***: initiation and integration, cost, schedule, risk, procurement, stakeholder and communication, change, and project close.***

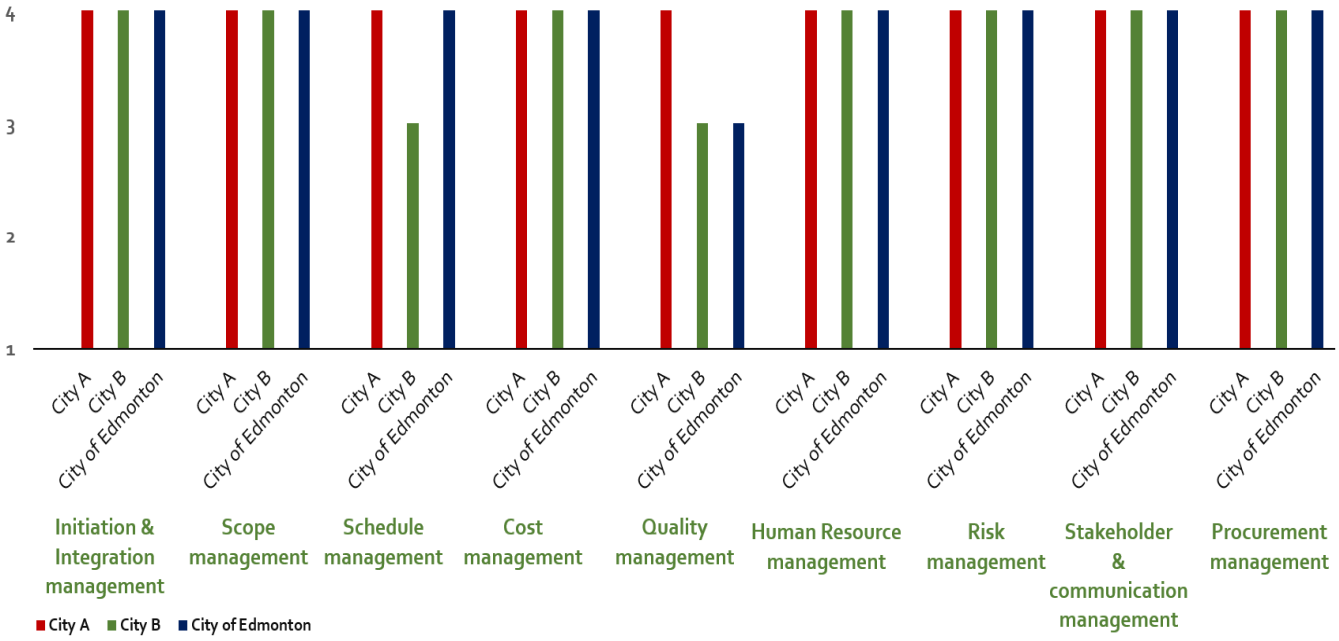
The 4 other areas **Ranked Level 3 Standardized** and require minor adjustments to achieve full standardization and integration for continuous improvement are: ***scope, quality, human resources, and PDDM.***

The general project management framework and practices of the COE are benchmarked against City A's project management framework which won PMI's 2014 Award, and then compared with those of other major Canadian Cities, namely Calgary and Toronto and randomly referred to as City A and City B, irrespectively. Specifically, project management PROCESSES and STANDARDS are assessed and presented in the following chart and table.

Overall, the City of Edmonton performed as well as City A in 8 of the 9 project management areas, the latter being an exemplary City in project management and having a highly recognized project management framework that won PMI's 2014 Award. Although the IIS undergoes an adequate quality management PROCESS, it needs to report consistently on quantitative quality measures internally and externally as it does for both cost and schedule performance reporting.

The findings of the comparison of STANDARDS also indicated that IIS could exceed high-ranking standards of other Cities through improving on their project value management standard, specifically the value management review process, its validity and timing, and the selection of the review team to ensure corporate responsibility and openness in the City's investments in capital projects and informed decision-making before approving investments.

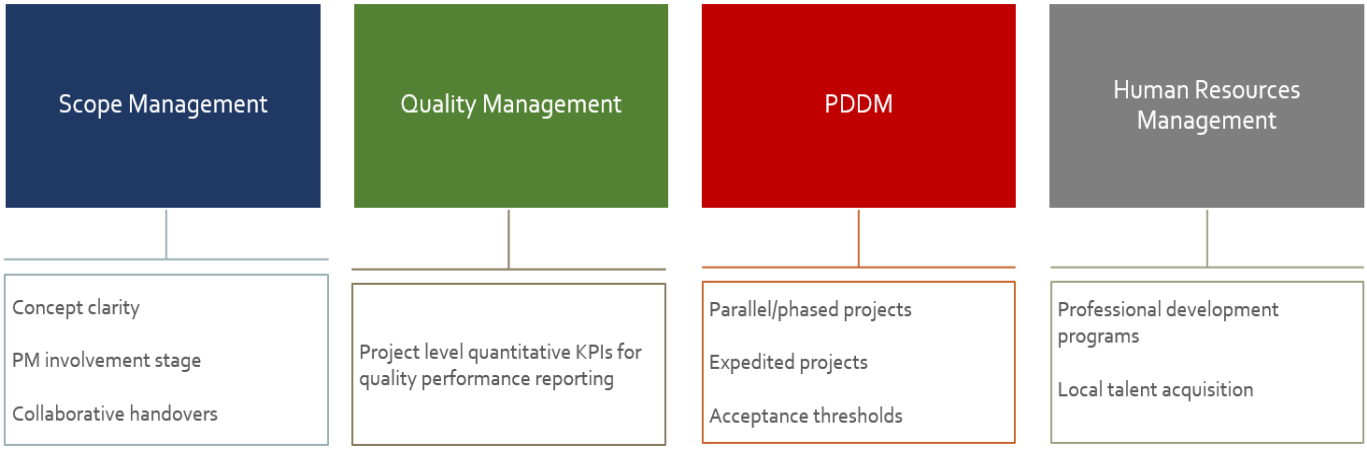
Comparison between COE, City A, and City B for different PROCESSES under 9 project management areas:



Comparison between COE, City A, and City B for 13 project management STANDARDS of City A framework:

Standards	City A	City B	City of Edmonton
Stage Gate Standard	Level 4 Distinctive	Level 3 Standardized	**Level 3 Standardized**
Business Case Standard	Level 4 Distinctive	Level 3 Standardized	Level 4 Distinctive
Value Management Standard	Level 4 Distinctive	Level 3 Standardized	**Level 3 Standardized**
Project Charter Standard	Level 4 Distinctive	Level 4 Distinctive	Level 4 Distinctive
Project Change Control Standard	Level 4 Distinctive	Level 4 Distinctive	Level 4 Distinctive
Project Closure Standard	Level 4 Distinctive	Level 3 Standardized	Level 4 Distinctive
Project Plan Standard	Level 4 Distinctive	Level 3 Standardized	Level 4 Distinctive
Estimation, Contingency, & Schedule Standard	Level 4 Distinctive	Level 4 Distinctive	Level 4 Distinctive
Project Management Quality Assurance Standard	Level 4 Distinctive	Level 3 Standardized	**Level 3 Standardized**
Governance, Team, Roles, & Responsibilities Standard	Level 4 Distinctive	Level 4 Distinctive	Level 4 Distinctive
Risk Management Standard	Level 4 Distinctive	Level 4 Distinctive	Level 4 Distinctive
Records & Information Management Standard	Level 4 Distinctive	Level 4 Distinctive	Level 4 Distinctive
Progress Reporting Standard	Level 4 Distinctive	Level 4 Distinctive	Level 4 Distinctive

POTENTIAL AREAS FOR IMPROVEMENT. Based on the results of the internal review and benchmarking analysis against other Cities, the research team identified 4 management areas with a **Ranked Level 3 Standardized** that require minor adjustments to achieve a full level of standardization. These areas that can benefit from potential improvements are:



Scope Management: The major capital projects undergo a thorough and meticulous scope management phase to ensure the scope of work to be undertaken on these projects is properly defined, planned, managed, monitored, and controlled from project initiation through completion. Project Managers and their teams are responsible for carrying out each step of the Project Scope Management process, but the Senior Leadership Management Committee plays an integral role in each phase of the process to guarantee a seamless transition to the Project Manager and the highest quality results from each step. Different processes may involve the Executive/Project Sponsor and the Project Board/Steering Committee as they may be involved in defining the scope, planning the scope management, and yet others in validating the scope. In contrast, the IIS department and Council/Government Officials sometimes carry out such tasks as determining and validating the scope. The nature, scope, complexity, and consequences of the project determine the extent of involvement and the sectors in which other authorities are involved. Therefore, it is recommended that, especially for major capital projects, potential Project Managers be briefed or involved in the development of the business case and project charter as early as possible. Success will be determined by how well the transition to the chosen Project Manager goes.

Cost Management: Although both Cost and Schedule Management areas **ranked Level 4 Distinctive**, the research team suggests that IIS consistently performs Earned Value Analysis across all large and complex projects which can notably elevate IIS performance over other Cities. Earned Value Analysis (EVA) provides an objective measurement of accomplished work and helps PMs gain real-time visibility of centralized information, perform realistic project planning, measure schedule and budget accuracies, and anticipate risks early so that stakeholders can take proactive measures in case of deviations. EVA can also enhance accountability and motivation as it provides better clarity and control on involved activities and remaining progress.

Quality Management: Each project has a quality management plan and is managed in accordance with the City's Quality Management System (QMS), as detailed in the Project Management Plans (PMPs). Non-Conformance Reports (NCRs) and other quantitative indicators of quality are used on certain projects, whereas inspections and testing are seen as sufficient indications of quality by others. Consequently, there is a clear need for further standardization of quality measurement across all relevant initiatives. Additionally, when generally compared to other indicators such as cost and schedule, quality is reported at a lower frequency which implies a clear need for increased uniformity in this regard, as there have been reports of some discrepancies in reporting requirements on quality-related concerns between projects.

PDDM: There are several aspects that go into determining whether a deliverable has been successfully completed, including the project delivery method, the type of deliverable (small or significant), and the level of cooperation between the planning and delivery teams. As a result, the PM's discretion is required in making the evaluation. The criteria for determining when a deliverable has reached 100% completion vary from one project delivery method to the next. For instance, under the Design-Build process, the design does not need to be 100% complete before building activities may begin. There are required milestone deliverables that should be finished or begun before moving on to the next milestone, whereas other milestone deliverables can be less than perfect and still move the project along. Whether or not a project receives green light to move on depends on the severity of the outstanding items. Therefore, the PDDM process/templates should show this adaptability to suit alternate project delivery methodologies, such as design-build/accelerated projects, by adding extra gates when necessary (for example, at 30% design) and tailoring the acceptance thresholds/criteria.

Human Resources Management: Project Managers are involved in the Project Human Resource Management processes to varied degrees. The project management team does not solely control the roles and responsibilities for Project Human Resource Management processes. These tasks are virtually equally shared with the Senior Leadership Management . More precisely, the Senior Leadership Management and the Executive/Project Sponsor have control over competency development and team performance tracking. Thus, as per interviews, the engagement of the Project Board/Steering Committee and the IIS department in these processes is insufficient.

Even though the project managers' competencies matched the required skills for their project, the current labor market is making it difficult to fill team vacancies. This is particularly true for experienced Professional expertise, which was difficult to attract due to compensation differences compared to the industry and the labor market, and the number of skilled tradespeople. Since the current market has witnessed substantial turnovers and special occurrences related to the COVID-19 pandemic, project managers have reported difficulty in finding people with the necessary capabilities for their projects.

It is evident that factors external to the project, such as market labor shortages and the effects of the pandemic, are limiting the capacity to acquire the necessary skills and competences. Although the IIS department cannot control these factors, it is nevertheless important to identify the talents, competencies, and vital skill sets that are in demand and disseminate this information in a timely manner to the decision-makers who can influence the labor market through policy changes. Depending on the specifics of the project or program, the IIS division may also need special hiring considerations.

RECOMMENDATIONS. Based on the internal assessment and benchmarking analysis, the research team suggests some recommendations to be considered by the IIS department to improve current project management practices.

Scope Management

The research team suggests that IIS investigates the viability of engaging Project Managers and Key Stakeholders earlier in the project (e.g., definition stage) to incorporate their expert feedback early on for smoother hand-offs and higher clarity of project scopes and objectives.

Cost and Schedule Management

(EVA) may be regulated as a standard method of monitoring, controlling, and reporting on all complex and major capital projects.

Quality Management

Like its well-developed budget and schedule measures, the research team suggests that IIS reports on their existing quantifiable project quality performance measures consistently. To add-on higher level of accura KPIs should be tailored accordingly to projects based on scale, type, and complexity. Additional KPIs should be adjusted to projects such as Project Health, Team Healt Public communications, and engagement, Estimate health, Client satisfaction, etc.

PDDM

The research team suggests that the PDDM process/templates can be modified to accommodate alternative project delivery methods, e.g., design-build/accelerated projects, such as adding more gates where needed (e.g., at 30% design) customizing the acceptance thresholds/criteria.

HR Management

The Project Board/Steering Committee and the IIS department should have a larger hand in both improving competencies and tracking team performance, even though these tasks technically fall under the purview of Senior Leadership Management and the Executive/Project Sponsor.

The research team recommends that the IIS department and/or City considers increasing investment in professional development programs for eligible the IIS department staff to further enhance competencies needed for complex projects with specialty types of work.

Industry partners have raised concerns that the labor market and skilled trades numbers pose a risk to future projects, as the industry is struggling on all fronts to find competent talent due to major turnovers as well as specific events that occurred because of the COVID-19 pandemic, impeding the ability to acquire the necessary talent and competencies for the project. This is apparent in all projects in terms of consultant errors and omissions. Although these forces are beyond the IIS department reach, the proper identification of required talents, competencies, and essential skill sets need to be properly and timely channeled and communicated to authorities capable of impacting the labor market through certain policy changes.

SCOPE 4: REVIEW & BENCHMARKING ASSESSMENT OF PROJECT PERFORMANCE REPORTING

Project performance reporting comprises gathering key project performance data at a specific point in time, generating meaningful information from this data, and reporting this information to the project's internal and external stakeholders. Project performance reporting has three main goals, as listed by Martinelli and Milosevic (2016):

(1) establish and transmit how project resources are being used to achieve project objectives
(2) offer information on current performance against the planned performance baseline, and
(3) utilize performance information to facilitate informed project decisions.

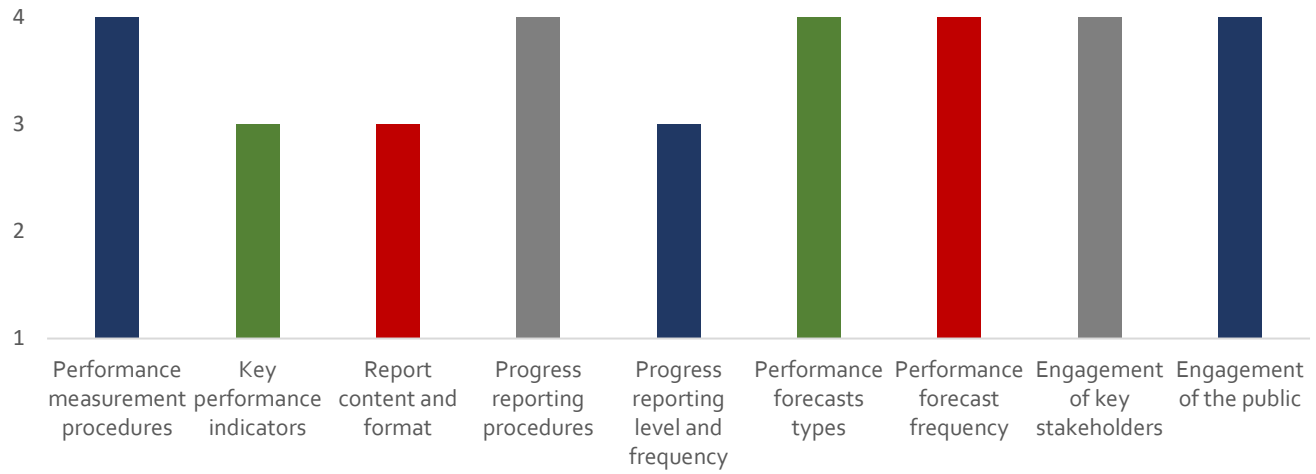
According to the PMI, for project performance reporting to be effective, it must support two chief components of successful project management: (1) transparent communication of information and (2) strong lines of communication.

CURRENT STATUS. The City of Edmonton has established the "Building Edmonton Website" to report project information to the public. The website provides different qualitative and quantitative information on all the City's projects, and links to each project's website, where available. For each project, performance is measured through cost and schedule, i.e., by tracking if the project is On Time and On Budget. To do that, the City compares how the project is forecasted to finish each phase compared to its approved schedule and budget. To define thresholds for each phase (Define or Deliver), comparisons to both private and public organizations were made. The council adopted 30% and 20% thresholds for the develop and deliver phases respectively in the Fall of 2019. If it is anticipated that a project will be finished exactly on time and on budget, it is considered to be on-time or on-budget. This will be indicated by a green light. Additionally, the City posts an Allowable Tolerance with a yellow indicator when it is within 30% for the Develop phase or within 20% for the Deliver phase. This shows that the City is proactively addressing and managing risks and that adjustments to the project may be necessary. Projects moving beyond these levels are highlighted in red.

Status reports, project management plans, and charters of the 13 selected major capital projects, alongside the responses of the 12 PMs to questions pertaining to performance measurement, reporting, forecasting, and engagement of key stakeholders and the public were reviewed and assessed to reflect whether proper and standardized project performance reporting practices are in place. The main processes reviewed against those defined in the PMBOK® Guide are:

Overall, IIS has established well-defined and formalized project performance measurement procedures for Project Managers to implement when managing, measuring, monitoring, and controlling different project activities. Additionally, IIS has established proper and standardized progress reporting procedures at project-level and department-level to ensure that key stakeholders and the public are continuously and routinely engaged and updated. As for the forecasting area, the results of the review indicate that the standard types and frequencies for performance forecasts are established within IIS and adhered to by the Project Managers on the reviewed capital projects. Other areas, as shown in the average rankings in the chart, require minor improvements to advance the standardization and coherence of reporting procedures on capital projects.

The reporting level and frequency of project scope, cost, schedule, and quality are standardized across projects as the answers varied per project at **Level 3 Standardized**, which requires slight adjustments towards full standardization. The projects adhered to daily reports internally with negligible variances (to the project management team) and monthly reports to the steering committee.



POTENTIAL AREAS FOR IMPROVEMENT. Based on the results of the review and analysis against other Cities, the research team identified some project performance reporting areas that can benefit from minor improvements to achieve a full level of standardization. These specific areas are:

- **Performance measurement**
  - Key performance indicators
  - Reporting format and content

- **Performance reporting**
  - Progress reporting level and frequency

RECOMMENDATIONS. The research team suggests the following recommendations:

Performance Measurement	Performance Reporting
The research team indicates that IIS, like its well-developed budget and schedule metrics, regularly reports on their current quantitative project quality performance measures. Additional KPIs should be adjusted to projects based on scale, kind, and complexity, such as project health, team health, public communications, and engagement, estimate health, client satisfaction, and so on, to add a higher level of accuracy.	The research team suggests that the IIS department continues its reporting mechanism to establish consistent reporting procedures across projects, in terms of the required level (internal/external) and frequency (monthly/quarterly) of reporting on different types and scales of projects needed to equip project managers and oversight stakeholders to monitor and control project issues and intervene when necessary.

COMPARATIVE/BENCHMARKING ANALYSIS OF IIS'S PROJECT PERFORMANCE REPORTING WITH OTHER CITIES

The research team also performed a comparison between the performance reporting practices of IIS and other Canadian Cities. The comparison includes the review of the Official websites of and public reports issued by Toronto, Winnipeg, Calgary, Vancouver, and Surrey. Additionally, departments of transportation for US States, Seattle, and Pennsylvania, were referenced to get international insights for their performance reporting which spans the project lifecycle from early design to closeout phases to assist in the local comparison among Canadian Cities. The Cities are referred to as City A, City B, City C, City D, and City E, irrespective of the initial order of mentioning the original names. The comparison was performed to assess the overall transparency in City level reporting based on the 5 following criteria:

Timeliness: refers to the real-time sharing of project information. For this study, sharing content within 3 months is considered adequate real-time sharing. Otherwise, updates in excess of 3 months are considered untimely.

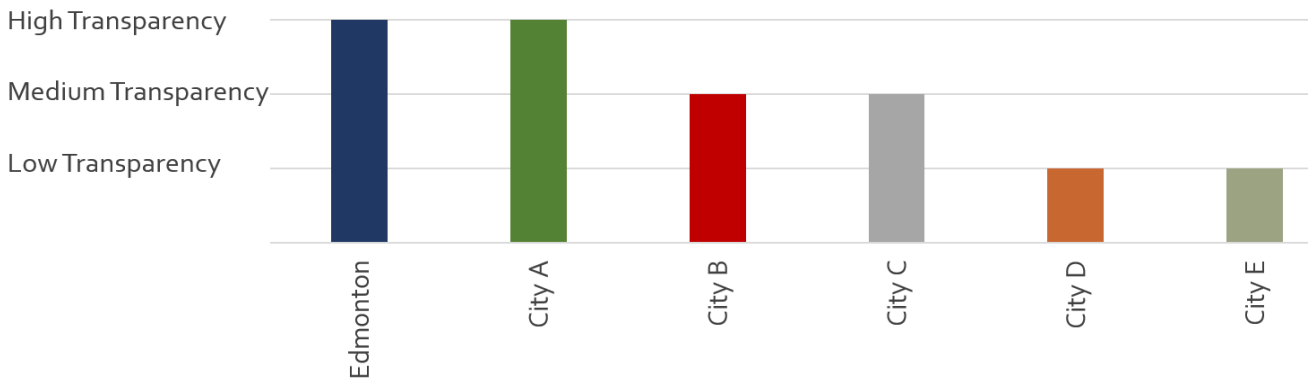
Status reports: refers to the availability of project performance reports to the public.

Reporting content: refers to the content of project performance reporting, either on the websites or through the reports, specifically regarding the cost, schedule, and scope indicators reported.

Ease of access & open file system: refers to the ease of accessing information on websites and reports such as project information being easily accessible to users without having to navigate several websites and tabs.

Visualization & interactiveness: refers to the visualization and interactiveness of the project websites such as Cities providing a "map view", whereby the user can visualize and access project information through pins on the map.

A summary of the overall transparency for each City, after aggregating the individual scores for each criterion is presented.



According to this comparison, the City of Edmonton, and City A both achieved the highest level of overall transparency in the public reporting of project performance on their official websites. Yet, the City of Edmonton is the only City that reports on Key Performance Indicators on the COE's website directly, not solely in the Reports. Additionally, the City of Edmonton's website provides easy access to not only high-level project information, but also detailed project information compared to the other Cities. The content of progress reports published on the City of Edmonton's website is more sufficient and representative than those published by City A, the latter being the only second City that shares project reports after the City of Edmonton. IIS and COE have evidently achieved the most transparent, exhaustive, timely, interactive, and easily accessible reporting approaches of project updates to the public, which sets the standard for other Cities to follow suit.

SCOPE 6: DESIGN CONSULTANT PROCUREMENT BEST PRACTICES

PART A: COMPARISON OF QUALIFICATION-BASED SELECTION AND PRICE-BASED APPROACHES

The use of Quality-Based Selection (QBS) has been gaining popularity as a procurement method that encourages the selection of professional A/E (architectural and engineering consulting) services based on their value for projects. In the United States, the federal government made it mandatory, through the Brooks Act, to procure A/E consulting services using QBS for all federally funded projects. As a result, 47 state governments have started implementing QBS or custom versions of it (Chinowsky & Kingsley, 2009). Canada has also followed this trend, with the government announcing the launch of a pilot program to implement QBS in early 2018. Although some regions have already transitioned to the QBS approach, many jurisdictions still consider price-based evaluations for procurement. A common perception across the AEC (architectural, engineering designs, and construction services) sector is that maintaining bid price as the determining factor ensures fairness and transparency in the selection process on public projects. Such a perception is valid when disregarding the fact that, first, a price-based approach does not consider life cycle cost savings and overall quality performance, and second, that the uniqueness of each project delineates certain technical competencies necessary to achieve project requirements. On the other hand, the ideology of the QBS approach is increasing value creation on public projects that are funded by tax revenues by ensuring life cycle quality and sustainable performance of facilities, cost effectiveness, and satisfying end user needs.

Note 1: The principal investigator has led an extensive study over 2 years (2020 and 2021) on the impacts of QBS approach for procuring A/E services on projects. The study was conducted at the University of Alberta and funded by NSERC Collaborative Research and Development (CRD) Grant and supported by the Consulting Engineers of Alberta (CEA). The content of this section will be referencing the work done in that study. The executive report is accessible through: https://www.cea.ca/files/QBS/UofA%20QBS%20Executive%20Summary.pdf.

Note 2: The research team is objectively providing findings based on research work and other literature. The findings do not reflect the opinions or perceptions of the research team nor does the team advocate for any specific type of procurement.

11 public organizations in Alberta were interviewed in a study conducted by Hole School of Construction Engineering University of Alberta on the Impact of Qualifications-Based Selection of Engineering Services on Project Outcomes. Most of these organizations usually adopt the lowest-price bid procurement approach for small-scale standard projects. The alternatives used for large scale projects differ depending on the nature, scope, and disciplines. The table summarizes the participants' responses to their adopted procurement methods. BVP (Best Value Procurement) considers price and qualifications at varying levels. The BVP one-step statement (One envelope) of qualifications procurement method includes an evaluation of the contractor's technical proposal in addition to proposals for the construction fee, overhead and profit, general conditions.

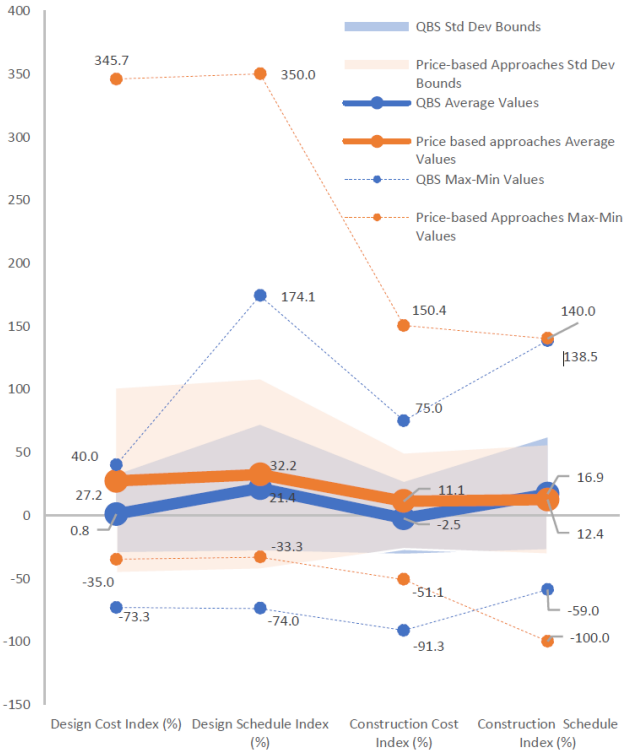
QBS	BVP (One envelope)	BVP (One envelope + interview)	BVP (two envelopes)
9%	55%	18%	18%

(a) Fee competition: 24% of participants stated that excluding the fee from the proposal can lead to overpricing due to lack of competition. QBS can achieve better value where consultants compete based on qualifications to achieve lifecycle performance and savings while negotiating a reasonable fee.

(b) Scope definition: 23% of participants agreed that QBS can provide clearer scope definition due to joint discussions and scope development between clients and consultants. A defined scope can make the estimated fee more accurate and subject to less changes.

(c) Nature of QBS: 23% of participants believe that the qualitative nature of evaluating qualifications under QBS discourages them from adopting it.

QBS can result in better project schedule and cost performance



QBS projects were linked to better schedule and cost performance during design and construction of projects. While price-based approaches were associated with higher cost overruns and schedule delays in design and construction, QBS projects exhibited lower deviations from budgeted costs and schedules which were on average half those values registered under price-based approaches. Additionally, QBS enabled cost savings during construction as opposed to price-based ones. These preliminary findings indicate how selecting A/E firms based on qualifications instead of price can yield better project performance in the key areas of schedule and cost performance.

Design Cost Index: QBS projects had an average value of only 17.2%, almost half of price-based approaches (33.6%).

Design Schedule Index: QBS projects had an avg. value of 15.9%, almost half that of price-based projects (30%).

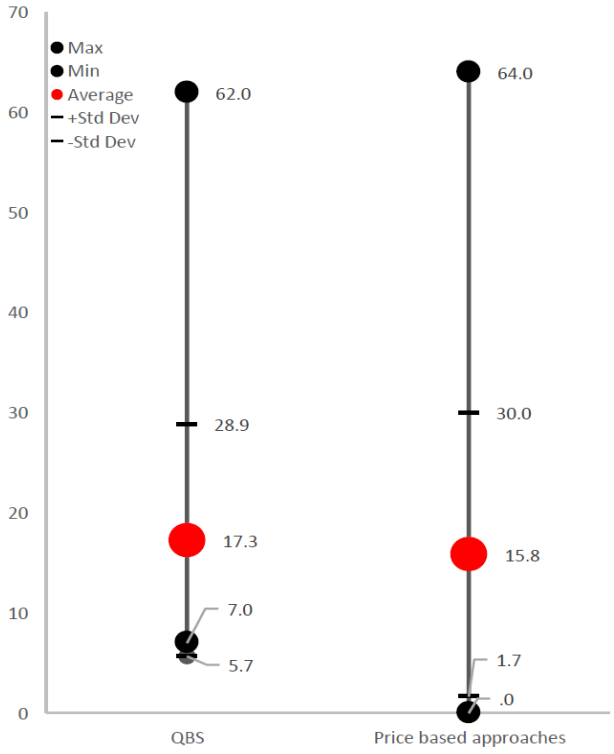
Construction Cost Index: QBS projects had -1.3% cost savings compared to 1.9% increase on price-based projects.

Construction Schedule Index: QBS projects had an avg. value of 24.7%, slightly higher than price-based ones 15.4%.

*Maximum values and standard deviations of these indices under QBS are notably lower than price-based ones.

QBS can be associated with a more cost and time effective procurement process

Preliminary results from the questionnaire data analysis revealed that (1) although the average duration of the QBS procurement process (17.3 weeks) was slightly longer (1.5 weeks) than average durations associated with price-based procurement methods (15.8 weeks) (2) the sampled duration of the QBS procurement process demonstrated slight less variation (smaller standard deviation), while the sampled duration of the price-based procurement methods showed a wider dispersion. Additionally, Shelton (2018) showed that QBS costs were lower than those resulting from price-based proposal development. These observations pertain to an effective joint scope development between the owner and A/E as well as performing meaningful negotiations with only one or two most qualified A/Es instead of individually reviewing detailed proposals from many A/E firms, those of which are or are not qualified. Further questionnaire analysis revealed that a positive procurement process and overall satisfaction of owners with the A/E's performance yielded higher return business with the A/E, where on average, a selected firm under QBS had one and a half times higher number of projects awarded to them than firms procured through price-based methods. Similar results were found for the number of years owner and A/E have worked together where it was higher for QBS.



QBS can decrease the impact of adjustments issued on projects

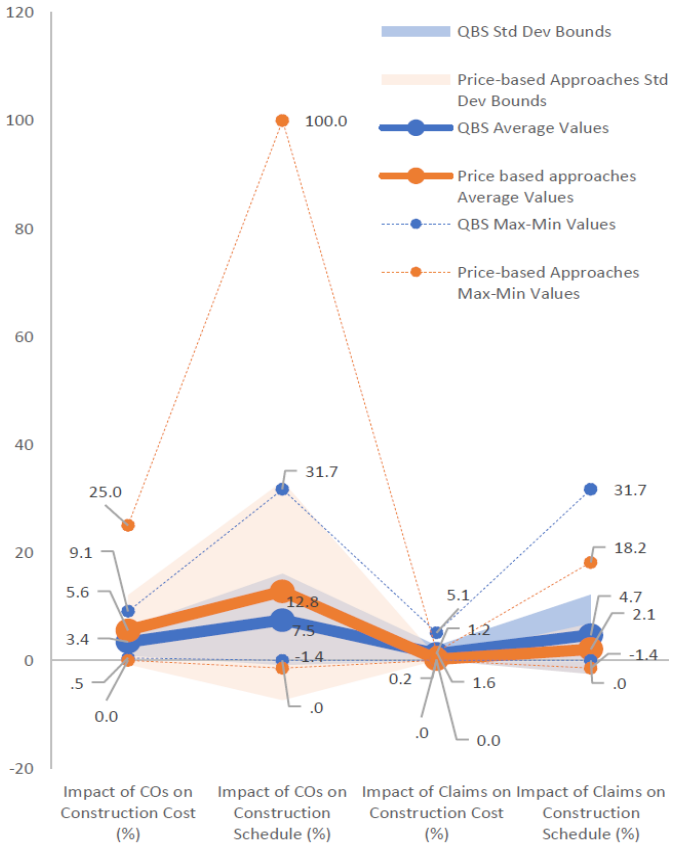
Adjustments to design or construction scopes result in several claims, change orders (COs), RFIs, and NCRs to be issued throughout the project. Primary analysis indicated that QBS projects exhibited slightly higher numbers of claims, RFIs, and NCRs, while significantly lower number of COs. Consequently, the impact of Cos on cost and schedule in QBS projects were considerably lower than that of price-based methods. Further, other factors could have played a role in these observations, but challenges in collecting additional information limits this analysis.

Impact of COs on Construction Cost: QBS demonstrated resilience towards the impact of COs, exhibiting about 40% less impact comparing with the price-based approach.

Impact of COs on Construction Schedule: Similar to the impact on construction cost, QBS had an avg. value of 7.5%, about 40% lower than price-based ones (12.8%). Additionally, sample data of QBS approach demonstrated a smaller variation on impacts of COs.

Impact of Claims on Construction Cost: Both QBS and price-based approach exhibited low impact from claims (1.2% and 0.2% respectively).

Impact of Claims on Construction Schedule: Similar to the impact of claims on construction cost, both QBS and price-based approach demonstrated minimal impact from claims.



CURRENT STATUS AT IIS. IIS undertakes standardized, fair, and transparent approaches for procuring services of consultants, contractors, and/or suppliers on major capital projects. IIS works closely with the City's Corporate Procurement & Supply Services branch to develop and execute the most suitable procurement strategies and purchasing services that are adequate for each project type in alignment with the City's Procurement Standard and relevant policies. The project managers also perform a thorough analysis and hold discussions with key stakeholders to select the best procurement strategy on a project-by-project basis and develop detailed evaluation criteria and plans to select qualified consultants, contractors, and/or suppliers. COE procures professional consulting services using a value-based selection procedure. The successful bidder is the one whose proposal offers the greatest value. The weighting of the cost can range from 0% to 50%, but the majority is typically 10%. The City has begun using Negotiated Requests for Proposals. COE aims to enhance the preparation and estimation of consulting services' scope of work to reduce volume and value of unanticipated change orders. Note: the assessment of the current status at IIS did not involve the review of any specific project.

General Recommendation

Since it is well established that COE uses value benefit procurement to leverage qualifications over price, IIS may continue to initiate internal conversations with key stakeholders and design consultants about the benefits, risks, and impacts of the qualification-based selection (QBS) approach as a tool to foster the implementation of their value benefit procurement on IIS projects when procuring consulting services for specifically complex large capital projects that necessitate more sophisticated levels of expertise. The debate may also include various transitional techniques, as well as the necessary cultural changes, support, and adaptations to processes and systems that should IIS consider commencing QBS adoption.

PART B: CURRENT INFRASTRUCTURE, MATERIAL CHOICES, CLIMATE SUITABILITY, EXPERIENCES OF OTHER CITIES

CURRENT STATUS AT COE. In 2018, the COE published its Climate Adaptation Strategy and Action Plan to address the impacts of climate change and plans to make different facets of Edmonton more resilient. The IIS and Urban Planning and Economy departments are part of an action plan within this strategy to ensure "Edmonton is planned, designed, developed, and built to be climate resilient today and for future Edmontonians". As such, part of the action plan is to develop or integrate climate change adaptation and resilience into infrastructure design and construction standards. Within IIS's Facility Design and Construction Consultant Manual (Volume 1-COE-IM-GUIDE-0001), sub-section "3.1.10.Climate Risk and Vulnerability Assessments" clearly delineates its purpose as to provide an understanding of what a facility project could face due to climate change as well as identify the key climate-based risks, and vulnerability to those risks to help assist the City in making decisions regarding infrastructure planning and design. The manual also encourages the use of Engineers Canada's PIEVC (Public Infrastructure Engineering Vulnerability Committee) protocol. In 2021, the City has also issued the C627 Climate Resilience Policy along with several procedures. The policy states commitments to adapt, prepare for and respond to a changing climate by developing climate prepared and adaptive infrastructure and urban form as well as E.

EXPERIENCES WITH OTHER CITIES. Other Canadian and international cities have been developing different strategies, plans, and policies to make their infrastructure climate resilient as well. In Vancouver, the British Columbia (BC) government published the BC Climate Leadership Plan (2016) which mandates 10-year adaptation plans for public sector operations and supporting more resilient infrastructure. In Toronto, the Climate Change Risk Management Policy commits the city to integrate climate change resilience into decision-making, and coordinates operations and services. New York City Panel on Climate Change (NPCC), a group comprised of scientists who study climate change and its impacts as well as legal, insurance and risk management experts has been releasing climate risk projections and information since 2009 and works with the New York City Climate Change Adaptation Task Force (city, state, federal and private infrastructure operators, and regulators) to assess risk to New York's critical infrastructure. Montreal has developed a comprehensive system to impose a climate test to prioritize large scale projects (implemented over a three-year period) and has incorporated climate change adaptation measures directly in its budget and financial documents. Currently, Montreal has allocated 10 per cent of the 10-year capital expenditures budget to climate adaptation. In Calgary, legal requirements for climate change integration into development planning are through the City Charter and Council Approval of the Climate Resilience Strategy. The City of Calgary Public Infrastructure Climate Risk & Resilience Assessment pilot projects (generally high-profile projects) are underway at The City of Calgary, funded through the Climate Program in partnership with the infrastructure-owning business units. In project-specific climate risk assessments, some climate risk mitigation measures are costed but this is not yet a widespread practice.

The Organization for Economic Co-operation and Development (OECD) emphasizes the role of considering climate resiliency as a determinant factor when comparing competing bids in public procurement processes; unless there is a government requirement to do so, the increasingly severe impacts of climate change expected later in the design life of the project are unlikely to be considered by the project developer at the design stage. Accordingly, the acquisition of specialized expertise in design, engineering, and construction as well as climate resilient materials for Edmonton and Alberta's harsh climate and weather changes are crucial factors in designing, constructing, and maintaining resilient infrastructure. For Public Private Partnership (PPP) contracts, the federal government's recent contributions to capital funding of major transportation systems may further diminish the role of municipalities. In addition to not eliminating risk (financial or otherwise) for governments, it is well established that P3s frequently fail to decrease costs, maintain projects on budget, or ensure on-time completion of development. Therefore, the P3 approach diminishes local public control and authority. For such context, it is important to clarify the allocation of responsibilities regarding climate related risks planning, management, and response and procure expertise that can respond to such hurdles. Based on the team's research and discussions with PMs as well as consultancy experts, three main hurdles are identified as potentially inhibiting the acquisition of special design/engineering expertise and climate resilient materials, namely:

- **Market size of consulting engineering and architectural firms can limit access to specialized engineering services**

Association/Organization	Alberta	British Columbia	Ontario	Quebec
Association of Consulting Engineering Companies	205	243	438	269
Practicing P.Eng.'s (exclusive), Life Members, and License to Practice Holders	45573	25315	72534	52181

The numbers of member consulting engineering companies are the lowest for Alberta when compared to other major provinces. This limits the type and expert services available for solicitation by the City.

- **The impact of infrastructure governance and infrastructure mobility on availability and acquisition of material**

Cities should take an active part in supporting the regional and even international transportation networks that connect to local systems at the same sites rather than focusing solely on local transit. A well-connected transportation network can ease the access to necessary material needed for northern climates like Edmonton that might be in shortage or not locally available. In northern cities, winter's impairment of road and rail operations is a perennial problem that necessitates the time-consuming and money-sucking deployment of equipment and employees over great distances. The Edmonton winter, for instance, is very long and frigid. Edmonton's long, cold winters are exacerbated by its location in the interior of the country and higher latitude compared to other major Canadian cities.

- **The impact of climate on infrastructure and material performance**

The impacts of Edmonton and Alberta's direct changes to weather patterns on infrastructure whereby such changes can lead to accelerating chemical (corrosion), biological (mold), and other (snow loading, heavy wind, etc.) weathering. Changing precipitation leading to urban or river flooding can have a direct impact on facilities such as the water treatment system as well as residential or commercial buildings. Conversely, dry conditions can lead to damage to foundations and linear assets such as water distribution pipes and underground electricity cables.

General Recommendation

To deal with the limited market of specialized design consultant services and to deal with Edmonton's unique climate, the research team recommends that IIS investigates the viability of developing available internal talent to acquire relevant design/engineering expertise, support local start-ups and specialized firms through encouraging collaborations and partnerships, partnering with private entities or creating separate authorities for large scale and complex projects.

Additionally, the team suggests that IIS continue to support policy adoption to fully adapt procurement practices for further integration of climate resilience.

ACKNOWLEDGEMENT

The research team thanks the IIS Department, in particular, the PMCE team members and participating Project Managers of the Infrastructure Delivery Branch and Infrastructure Planning and Design Branch for their time, support, and cooperation during the study.

This study was funded by and undertaken at the request of the Integrated Infrastructure Services (IIS) department at the City of Edmonton. This study was conducted by the research team at the Construction Innovation Centre at the University of Alberta. The findings and recommendations are bound to the limitations mentioned at the beginning of this report.
The study efforts were led and conducted by Dr. Malak El Hattab as the principal investigator with significant research work and input from Zeina Malaeb and Ahmad Abdelazim Attia as the research members. The work was supervised by Dr. Farook Hamzeh. The research team principal investigator, supervisor, and research members are experts in project and construction management and were asked to conduct this study on reviewing the governance, oversight, project management practices, performance reporting, and procurement approaches of the City of Edmonton's major infrastructure capital projects.
The liaison between the research team at the University of Alberta and the Integrated Infrastructure Services department was facilitated and coordinated by the IIS's Project Management Centre of Excellent (PMCE) team, namely Michelle Flesjer, Kristi DeWolfe, and Owen Carroll.