Royal BC Museum Modernization

Royal British Columbia Museum Modernization
–
Museum Project

Appendix AB

Risk Report

December 2021

Confidential

Infrastructure BC

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1 INTRODUCTION

1.1 MUSEUM PROJECT BACKGROUND

The Royal British Columbia Museum Modernization Project (the Project), consist of two projects, the Collections and Research Building (CRB) Project (the CRB Project) and a new museum on the existing site, (the Museum Project). The CRB Project was approved in July 2020 in a previous business case submission (the 2020 Business Case). This Business Case focuses solely on the Museum Project (the 2021 Business Case) and the new facility on the Victoria downtown site that includes the galleries, the Indigenous collection, the IMAX and offices (the Museum). The CRB Project is referenced only when necessary to describe the integrated nature of decanting portions of existing facilities into temporary space prior to moving them to the CRB along with the associated risks that could impact the Museum Project.

The Museum precinct is currently home to ten facilities and structures, each of which will be impacted by the Museum Project. The table supported by the site plan below identify which facility will be impacted by which scope.

Table 1: Buildings and Scope

Building	Decanting	Hazardous Materials Abatement	Deconstruction	Seismic Upgrades
Exhibition Hall (1)	✓	✓	✓	
Carillon Tower (2)			✓	
Fannin Tower (3)	✓	✓	✓	
Archives Building (4)	✓	✓	✓	
IMAX Theatre & Lobby (5)	✓		✓	
Helmcken House (6a)				✓
St. Ann's Schoolhouse (6b)				✓
Mungo Martin House (6c)				
Glenshiel Building (6d)	Out of Scope			

1

Figure 1: Site Plan

The the Royal British Columbia Museum Corporation (the Royal BC Museum) is embarking on a modernization initiative which is envisioned to consist generally of five scopes of work.

Table 2: Scope Description

Scopes of Work	Scope Description	Timelines	Buildings Impacted
Decanting	Decanting of the exhibition building into a temporary storage facility[2] followed by decanting of the collections	2.5 years	1, 3 & 4

[2] Temporary space was secured and approved by Treasury Board.

Scopes of Work	Scope Description	Timelines	Buildings Impacted
	and archives located in Fannin and Archives buildings to the CRB[3].		
Hazardous materials abatement and deconstruction	Hazardous materials abatement and deconstruction of the existing buildings.	2.5 years	1, 2, 3, 4, 5
Museum construction	Construction of the new Museum including core galleries, public and office spaces, collections storage (Indigenous collection), Indigenous artists studio, and IMAX Theatre.	4 years	1, 2[4], 5
Seismic upgrades	Seismic upgrades of other on-site buildings	With previous scope	
Exhibition and Gallery Fit Out	The fit-out of the exhibition and galleries will be the final step prior to opening to the public	1.5 years	1

1.2 PURPOSE AND CONTEXT

The purpose of this report is to document the risk analysis process for the 2021 Business Case. The Museum Project is being delivered by the Royal BC Museum, the Ministry of Tourism, Arts, Culture and Sport (the Ministry), Transportation Investment Corporation (TI Corp) and Infrastructure BC – collectively the Project Team. Key areas covered by this report include:

- An overview of Infrastructure BC's project risk management approach and guidance from the planning stages through to implementation;
- The methodology by which risks were assessed, quantified, and incorporated into the financial analysis of the business case; and
- The results of the risk analysis conducted.

This report reflects the risk management work that has been completed by the Project Team to date. The process has primarily focused on identifying specific Museum Project risks, allocating those risks between the Royal BC Museum and the private partner (also referred to as the Contractor) for the selected

[4] The bells of the Netherlands Centennial Carillon will be preserved and relocated within the site.

procurement models, developing potential risk management strategies and incorporating quantified risks into the financial analysis of the business case.

As discussed in Part C of the business case, the two procurement options analyzed in this report are the Competitive Alliance model and the Design-Build (DB) model with Construction Management (CM) also referred as DB with CM.

The risk assessment excludes operating and maintenance risks because the two procurement models under consideration do not include long-term maintenance and operation of the Museum.

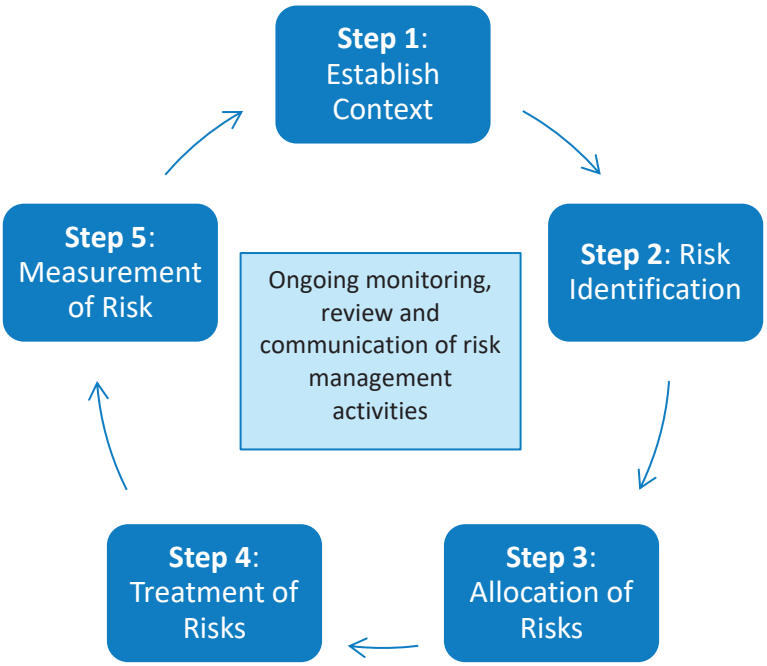
2 RISK MANAGEMENT METHODOLOGY

2.1 PROVINCIAL GUIDANCE

Project risk is defined as the chance of an event or condition happening which could cause the actual project circumstances to differ from those assumed when forecasting project outcomes or objectives. Risk is an inherent part of any project, and to ensure a successful project outcome, risk must be effectively managed. Depending on the amount of information available, risk can be measured both qualitatively and, in some instances, quantitatively.

Risk management includes the actions or planned actions that impact the probability and consequences of a risk event in order to ensure that the level of risk assumed falls within an acceptable limit for the project team. Every project must consider and manage risk in order to be successful. A project's risk exposure is fluid and adjustments will need to be made as the project moves through its various stages. Careful risk management allows project teams to anticipate key vulnerabilities and develop proactive strategies on how to best deal with them. The following figure provides an overview of the risk management process.

Figure 2: Risk Management Overview



Risk management in the context of large capital infrastructure projects does not simply involve transferring all project-related risks to the private sector. The goal of an effective contractual arrangement is to allocate project risks to the party best able to manage them at the lowest cost. This can be further enhanced when assigned risks are supported by appropriate incentives and penalties through the use of performance-based contracts. For example, under any procurement model, the Contractor is better suited than the Royal BC Museum to manage the physical construction activities so construction risk is transferred to the Contractor.

An efficient or optimal allocation of risk between the public and private sector participants will ultimately maximize value for money for taxpayers.

The Government of British Columbia, through Infrastructure BC and in conjunction with the Risk Management Branch (RMB) of the Ministry of Finance, has established a guideline with respect to risk management for large capital infrastructure projects through the stages of planning, procurement and implementation. Notwithstanding differences in terminology, the Province's guideline is generally consistent with the principles, framework and process described in the ISO 31000:2009 Risk Management Principles and Guidelines.

A failure to fully take account of risk is one of the key factors when public projects are not delivered on time, on budget or to specification. Infrastructure BC's guidance on risk management takes a systematic

approach to risk, estimating the range of potential impacts of risk on a risk-by-risk basis through the project's planning, procurement, design and construction and operating phases.

This systematic approach to risk considers:

- An extensive risk matrix to ensure a comprehensive assessment;
- The range of possible outcomes or consequences;
- The risks associated with capital, operating and life cycle costs; and
- Specific characteristics of unique risks.

Infrastructure BC uses a standardized risk matrix (also referred to as a risk register) template to consolidate risk information (refer to Section 2.3.4 for additional information about the risk matrix).

Risk analysis is dynamic and should be revisited throughout the life of a project. A project team should plan regular updates to the risk matrix as part of ongoing risk management efforts. As a project moves through the planning phase and into procurement, and more information emerges, new risks not previously recognized will be identified (especially through development of the legal documents or "Contract"[5] and associated payment mechanism). These risks should be added to the risk matrix, allocated appropriately and quantified where possible. Similarly, some risks previously identified may no longer exist and should be reclassified.

During negotiations and contract execution, the main subject for negotiations becomes the Contract. The risk matrix allows for the identification and allocation of risks at a high level, but the detailed risk allocation will be reflected in the Contract wording.

2.2 RISK MANAGEMENT BRANCH

RMB, in its role as the enterprise risk management agency within government, advises government on risk management issues, reviews and approves indemnities given by government, and assists ministries in establishing their own comprehensive risk management programs.

In its role as a risk management advisor/consultant, RMB provides a wide range of risk management services to its client group, assisting them in areas such as loss control, risk financing, risk identification and transfer, and in the development of coordinated enterprise risk management programs.

[5] The term Contract in this context refers to either an Alliance Project Agreement (APA) in the case of a Competitive Alliance or a Design Build Agreement (DBA) in the case of a DB.

During the development of the business case, project teams should engage early on with RMB to benefit from their experience in addressing key risk and insurance related issues throughout the project's development.

2.3 RISK ASSESSMENT

Risk assessment is the overall process of risk identification, risk analysis and risk evaluation. It allows the project team to better understand how risk can affect achievement of the project objectives and ensure that effective treatment strategies and project controls are developed.

During the business case phase of the project, risk assessment can be broken down into the following steps:

(a) Identifying and clearly describing the major potential risk events for a project;

(b) Analyzing the range of possible consequences of the risks identified;

(c) Evaluating the likelihood and potential impact of those consequences;

(d) Quantifying, where possible, the dollar value of these outcomes to the project;

(e) Developing prevention and mitigation strategies for identified risks; and

(f) Recording the results of this process in a risk matrix.

2.3.1 Risk Identification and Description

The first step in the risk assessment process involves identifying and describing the potential risks (from both technical and financial perspectives), the causes and potential consequences. The aim of this step is to generate a comprehensive list of risks based on those events that might create, enhance, prevent, degrade, accelerate or delay the achievement of project objectives.

For ease of tracking, risks are organized by the stage of the project life cycle in which they are expected to occur including planning, procurement, design and construction and transition/commissioning of the project leading up to operations (herein referred to as Capital Risks).

During preparation of the business case, the project is in the planning stage. Technical and financial information about the project is gathered, analyzed and compiled into a comprehensive document that becomes the business case. The information is subject to intense due diligence at this stage, however there can be further refinement and modification throughout the project's life cycle. It is important at this stage to specify sufficient detail about each risk event, as a comprehensive description can help inform the risk quantification and the development of potential scenarios.

When preparing documentation in anticipation of the procurement stage, the risk matrix can be used to guide or confirm the risk allocation contained in the project's Contract.

2.3.2 Risk Allocation

Once the risks have been identified, each one is evaluated to determine which party (the Royal BC Museum or the private sector) is exposed under each procurement model and which party is best able to manage the risk at the lowest cost. From the perspective of the Royal BC Museum, a risk can be transferred to the private sector, shared with the private sector or retained. One of the key differences between procurement models is how risk is allocated between the parties and subsequently managed by the responsible party.

As the project progresses during the procurement process, it may become apparent that the initial risk allocation does not provide the best value for money for the Royal BC Museum, in which case the allocation may be amended as appropriate. For example, a geotechnical risk may initially be classified as transferred during the business case stage. Further geotechnical studies completed after the business case may reveal unexpected ground conditions. Rather than fully transfer the risk, it may be more cost-efficient at that point to share the risk exposure with the proponents. This example illustrates the importance of keeping a risk management plan up to date throughout a project's development.

The transferred risks, together with the portion of the shared risks expected to be transferred to the private sector, are incorporated into the draft Contract. Under the Competitive Alliance, the transferred risks are transferred to the Alliance and will be shared and collectively managed by all participants in the Alliance. Until negotiations with the preferred proponent begin, it is assumed that each shared risk will be "split" equally between the private sector and the Royal BC Museum. This assumed split is further refined during the procurement stage of the process as the contract is developed and comments are received from proponents during the Request for Proposals (RFP) stage.

The risks retained by the Royal BC Museum are used in part to assess the size of the project reserve necessary to protect against the risk exposure.

Project teams will typically not quantify risks that may be high impact, but have a very small probability of occurring. These include natural disasters and other "high impact, very low probability" events. Typically speaking, broader provincial emergency plans (which are beyond the scope of this analysis) would come into play under such circumstances.

2.3.3 Risk Treatment: Prevention and Mitigation

The risk allocation described above is part of an ongoing risk management process that enables parties to reduce the probability of a risk occurring as well as mitigating the consequences of a risk should it occur. A

primary objective of risk management is to reduce potential negative outcomes by identifying risks, analyzing them and implementing strategies to deal with them on an ongoing basis.

While risks are often thought of as events with only negative consequences, proactive risk management can create value. For example, a comprehensive investigative testing program carried out in advance of procurement may provide project teams with more complete information and less uncertainty. New information may reduce the probability of a risk materializing or may provide the project team with an opportunity to proactively deal with the issue at a lower cost.

The treatment strategies developed should be clear and realistic and involve the necessary project team resources. The risk management process should form an integral part of the project team's broader project management.

2.3.4 Risk Matrix

A risk matrix is the key document produced in the risk management process. Developed through a series of risk workshops, it consolidates and provides a record of the following information:

- The identification and description of all relevant risks;
- Risk allocation between the Royal BC Museum and the private sector;
- Identification of high level prevention and mitigation strategies; and
- Where possible, quantification of the risks based on the best available information at the time.

Infrastructure BC's risk process is one component of a broader enterprise risk management program that should be administered by the Royal BC Museum and its agencies. This risk process focuses specifically on the risks associated with the project's planning and implementation, but it does not address the effective delivery of government services, which should form part of a broader risk management program.

Attachment 1 illustrates how the risk matrix is organized and describes the information captured in the various columns. The risk matrix is a living document that informs the risk management strategies developed by the project team. It should serve as a key project management tool and be updated at key project milestones (e.g. before the release of the RFP, just after contract execution and regularly during design and construction, etc.).

2.4 RISK QUANTIFICATION

A comprehensive quantitative evaluation of risk presents a range of likely cost outcomes and provides a reliable means of testing value for money between procurement models. It also encourages bidding competition during procurement by creating confidence in the financial rigor of the Royal BC Museum's

risk-adjusted project cost estimate that was used to set the affordability ceiling to which proponents must bid.

Risk quantification occurs once the risk identification, description, allocation and categorization activities have been completed to a sufficient degree. Selected risks are quantified to ensure sufficient money in the all-in project budget to successfully deliver the project. The risk adjustment included in the project budget must account for both transferred risks (which the Contractor will include in its bid) and retained risks (which will form part of the Royal BC Museum's project reserve).

If a risk is transferred, it is quantified from the perspective of the Contractor and what the project team estimates would be included in a reasonable and competitive financial proposal. If a risk is retained, it is quantified from the perspective of the Royal BC Museum and the cost impact the risk would have on the project.

Risk quantification can be a time consuming exercise and should focus on the most material risks to the project. Typically, only 10 to 20 of the potentially hundreds of risks are quantified. In some cases, a single quantified risk can capture the potential impact of multiple risks. While risks are quantified individually, the total quantified risk values should be viewed from a portfolio perspective. It is expected that some risks will materialize, some will not and, of those that do occur, the impact may be greater or lower than expected. The expectation is that, by quantifying the key material risks, the project team will have a sufficient reserve in place to adequately address risk events within the project budget. The impact of individual risks on the total risk value is illustrated and described in section 3.3.1.

Project teams consider several factors in determining which risks to quantify. These may include:

- Materiality - If the risk were to materialize, would it have a significant impact (financial, schedule, public perception, program delivery)?
- Estimable – Can the risk impact be reasonably and accurately estimated?
- Risk Ranking - How high is the risk ranking (low/medium/high/extreme)?

The decision on which risks to quantify involves examining past precedent projects, as well as considering unique project-specific risks that warrant further attention.

Most risks are quantified using a triangular distribution which involves inputting three key variables: low/best case (5th percentile), most likely (50th percentile), and high/worst case (95th percentile). Using a triangular distribution is often regarded as a good proxy for a normal distribution but is much more straightforward in terms of obtaining the appropriate inputs Refer to section 2.4.2 for additional information.

2.4.1 Risk Quantification and the Project Contingency

The contingency is a critically important item in the project budget and should not be removed and replaced with the quantified risk value.

In traditional cost estimating, large design and construction contingencies are often added to the expected cost, reflecting the fact that unforeseen circumstances may arise that could result in additional costs or delays. These contingencies represent an initial estimate, based on the quantity surveyor (QS)'s experience, of the expected additional costs that may be attributed to risks usually associated with the level of uncertainty in design and construction at the time of the QS's estimate and often changes or unanticipated events.

Contingencies are not dealt with consistently across all QS estimates. The QS examines how developed the project planning is and bases the contingency on previous experience. When the QS creates the contingency for a project's indicative design/reference concept estimate, the QS assumes the contingency will be spent, which means the contingency cannot be regarded as a substitute for risk costing.

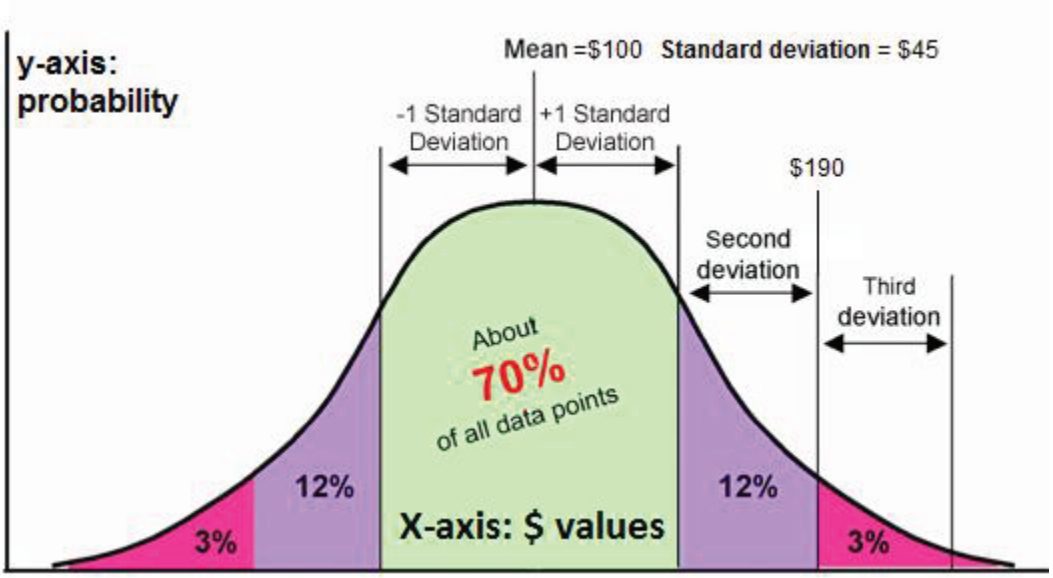
2.4.2 Monte Carlo Analysis and Risk Distributions

The expected value of each quantified risk is calculated based on the assumed distribution and the estimated probabilities and scenario outcomes for each risk. In order to quantify the overall risks and develop aggregated distributions, Infrastructure BC uses statistical software, called @Risk, to perform a Monte Carlo analysis[6]. Monte Carlo analysis provides a means of evaluating the effect of uncertainty using a large number of scenarios. It is a tool used to estimate the total variation of project risk resulting from the individual quantified risks. The Monte Carlo analysis takes the assumptions for each risk, aggregates them, and then runs thousands of simulations to produce a distribution of the total value of quantified risks.

The Monte Carlo analysis produces distributions that often approximate a normal distribution curve, also known as a bell curve, as illustrated in the figure below.

[6] Monte Carlo analysis involves a series of computational algorithms that rely on repeated random sampling to compute their results.

Figure 3: Example Normal Distribution Curve



To help understand the distribution, the mean of $100 refers to the average data point and the standard deviation of $45 refers to the amount of variability. Generally, most risks are expected to fall close to the mean as illustrated by the green section. Approximately 70 per cent of the risk outcomes are expected to fall between $55 and $145. If one refers to the three per cent indicated by the pink area on the far right (also referred to as the 97th percentile), one can say that there is an estimated 97 per cent chance that the risk values will be at or below $190. This is equivalent to saying there is an estimated three per cent chance that the risk values will exceed $190.

When developing the project budget, the percentile point selected on the risk distribution curve will depend on the level and quality of information available and the project team's level of risk aversion. This is discussed further in section 3.2.1.

3 MUSEUM PROJECT RISK PROCESS

3.1 RISK WORKSHOPS

The first step in the Museum Project's risk management process was to identify the risks. Four risk workshops, facilitated by Infrastructure BC, were held on June 16 and 18, 2021 and August 17 and 19, 2021. The risks that were identified and quantified were all classified as Capital Risks (e.g. approval, permitting, procurement, planning, design and construction).Financial and commercial risks were captured in the Capital Risks as appropriate.

A variety of professionals from the private and public sectors participated in the risk identification and quantification exercise. These participants are subject matter experts in one or more of the following areas: procurement, engineering, cost estimating, design and construction, and project management. .

Participants included representatives from: the Royal BC Museum, the Ministry, Infrastructrure BC, Deloitte, Transportation Investment Corporation, Spiegel Skillen & Associates (SSA), Turnbull Construction Project Managers, and BC Infrastructure Benefits. A list of participants can be found in Attachment 2.

The QS attended all of the risk workshops to ensure that risks being quantified were not already included in the Museum Project's contingency estimates. The risk values are calculated on the base costs before contingencies. Furthermore, risk estimates assume that prudent and reasonable mitigation, before and after risk events, has been or will be completed.

During the workshops, participants thoroughly reviewed a pre-populated list of Museum Project risks and updated it as appropriate for the Museum Project. Attachment 3 of this report contains the Museum Project's complete risk matrix.

After the initial risk assessment, various Project Team members were engaged to quantify certain risks to assess the initial cost implications to the Museum Project under both procurement models in the event the risks materialize.

Infrastructure BC reviewed the estimates with the Project Team and provided feedback to ensure the estimates included sufficient justification, and that the assumptions were reasonable and consistent with the Museum Project scope and risk description. This feedback resulted in further adjustments to the initial assumptions. The risks were then further reviewed through a series of due diligence meetings. The completed risk quantification results and worksheets are included in Attachment 3.

3.2 RISK RESULTS ANALYSIS

The Project Team quantified a total of 21 Capital Risks. Table 3 presents these risks and the anticipated allocation in both the Competitive Alliance and DB with CM models.

Table 3: Quantified Risk Allocation

No.	Risk Name	Competitive Alliance	DB with CM	
			DB Scope	CM cope
Capital Risks				
[redacted]				

The Monte Carlo analysis produced simulation results for the Capital Risks for the Competitive Alliance and DB with CM models, capturing the total, retained and transferred risk amounts. These results are discussed in section 3.3.

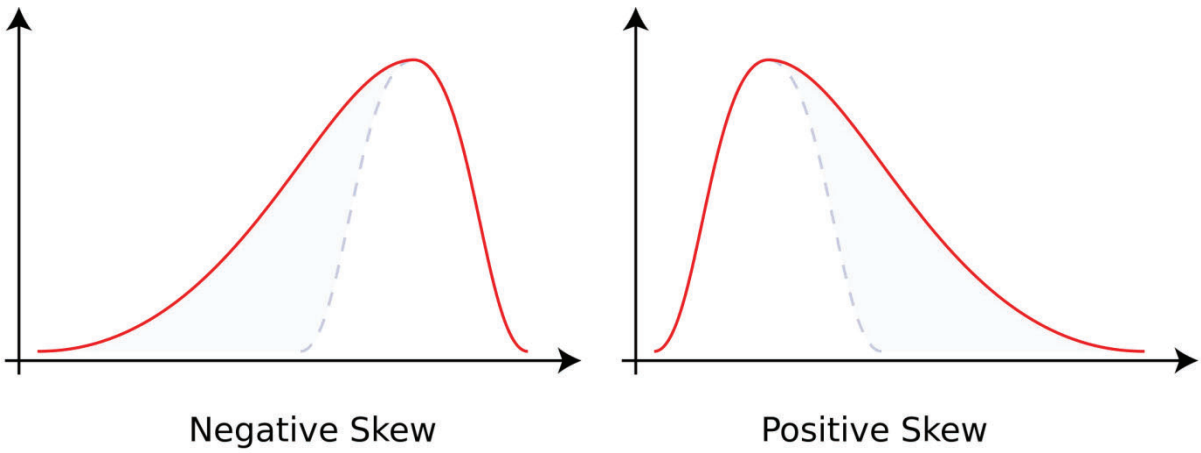
3.2.1 Selected Risk Percentile

The 67th percentile of the risk distributions was selected to reflect a prudent level of risk aversion given the stage of Museum Project planning and the large number of unknowns related to the Museum Project. Selecting the 67th percentile is equivalent to saying that the Museum Project has sufficient budget to manage risks approximately two of out every three times. As the Museum Project is further developed, the quantified risks and the risk percentile will be revisited as the level of uncertainty decreases.

3.2.2 Skewness Effect

Skewness is a statistic that measures the asymmetry in a distribution. Figure 4 illustrates the effect of negative and positive skew on a normal bell curve. Skewness causes a curve to appear distorted or skewed either to the left or the right and is common in quantified risks.

Figure 4: Skewness Effect



Skewness effect precludes simply adding together the retained and transferred distribution curves to get an accurate total risk value. Care was taken when determining the values of the risks entered into the financial model to account for the skewness effect and ensure the selected values summed to the 67th percentile of the total risk curve and not the 67th percentile of the individual retained and transferred risk curves.

3.2.3 Correlation

Correlation is a measure of the extent of interdependence between two or more variables. A positive correlation means that as one value increases, the other value increases as well. A negative correlation

means that as one value increases, the other value decreases. Correlation does not imply causation. While certain quantified risks are likely to be correlated, this risk analysis has not included any correlation assumptions. This is a conservative assumption and tends to understate the aggregate risk value.

3.3 QUANTIFIED CAPITAL RISK RESULTS

Figure 5 overlays the overall Capital Risk distribution (which approximates a normal distribution) for the Competitive Alliance and DB with CM models. The graph indicates the relative level of risk between the two procurement models, but does not differentiate between the risks retained by the Royal BC Museum and those transferred to the Contractor. The 67th percentile values were incorporated into the financial model and are summarized in Section 3.5.

As Figure 5 illustrates, the total Capital Risk value under a DB with CM model is [redacted] while under a Competitive Alliance model, the total Capital Risk value is expected to be [redacted] The figure also illustrates that there is an approximately [redacted] chance that Capital Risks will exceed [redacted] in the DB with CM model, whereas in the Competitive Alliance model, the chance of exceeding [redacted] is approximately [redacted]. Further, the DB with CM model has a narrower distribution with less variance as demonstrated through its lower standard deviation.

[redacted]

Figure 6 below presents an overlay of the retained Capital Risk distribution. It illustrates that there is an approximately [redacted] chance the retained risks under the DB with CM model will exceed [redacted] which is similar to the [redacted] chance under the Competitive Alliance model.

[redacted]

Finally, Figure 7 presents an overlay of the transferred Capital Risk distribution. It illustrates that there is a [redacted] chance that the transferred risks under the DB with CM model will exceed [redacted] compared to a [redacted] chance under the Competitive Alliance model.

[redacted]

3.3.1 Capital Risk Sensitivity Analysis

Figure 8 illustrates the individual quantified risks that have the most significant impact on the total Competitive Alliance Capital Risks. The most significant risk, in this case [redacted], is at the top, with other risks following in descending order of impact. The baseline value at the bottom represents the 67th percentile of the total Competitive Alliance Capital Risk. The top risk can be interpreted as saying that the [redacted] risk can cause the total Capital Risk value to change from the [redacted] carried to anywhere from approximately [redacted] to a total of [redacted] depending on whether the risk materializes and its impact if it does. The figure illustrates the wide impact that risk can have on a project budget and can inform the decision to allocate Project Team resources to the most material risks. The figure also demonstrates the importance of viewing the quantified risk from a portfolio perspective, recognizing that there is a wide range of potential outcomes for any particular risk.

[redacted]

Figure 9 presents the tornado graph for the total DB with CM Capital Risks. The risk exposure for the DB with CM differs from the Competitive Alliance as reflected by the different order of risks and different sized bars. However, the top three ranked risks are the same with [redacted] having the potential to impact the DB with CM Capital Risk value from the [redacted] carried to anywhere from approximately [redacted].

The other risks and the size of their bars illustrate the risk exposure differences between the Competitive Alliance and DB with CM model. For example, the [redacted] bar in the Competitive Alliance model has a range of approximately [redacted], while the same risk in the DB with CM model has a range of approximately [redacted]. These tornado graphs visually demonstrate the differences in the models' risk exposures.

[redacted]

3.4 UNQUANTIFIED RISKS

In addition to the quantified risks, there are a number of Museum Project risks that have not been quantified or included in the contingency, but should nonetheless be closely managed by the Project Team as the Museum Project progresses. One of the highest unquantified risks is Royal BC Museum's [redacted]

[redacted] Both procurement models would include frameworks to allow for designs to be evaluated and scored (e.g., 100 per cent scored elements for the DB) removing low cost from the equation[7].

The Project Team is aware of the risk mitigation strategies in the risk matrix and will be actively working to manage the risks to minimize the probability of occurrence and the impact if these risks do materialize.

3.5 RISK QUANTIFICATION SUMMARY

Table 4 summarizes the risk quantification amounts included in the financial analysis. As discussed in section 3.2.2, the retained and transferred risk totals were adjusted downward for both models so that the sum equals the 67th percentile of the total risk distributions.

These risk values will be incorporated into the overall Museum Project capital budget. The retained risk should form part of a reserve, while the transferred risk values should form part of the construction contract value.

Table 4: Risk Quantification Summary (Nominal, $000s)

Financial Model Risk	Competitive Alliance	DB with CM
Capital Risk		
Risks retained by the Royal BC Museum	[redacted]	
Transferred risk added to the construction contract by the Contractor (or to the Alliance)		
Total		

Both the Competitive Alliance and the DB with CM models present [redacted]

3.5.1 Project Reserve

The recommended procurement model in the 2021 Business Case is the DB with CM. To support the Project Team's effective implementation of risk management strategies and to help the team deal with the consequences of retained risks that materialize, a reserve should be established.

[7] The DB Price Ceiling would be a mandatory requirement of the financial submission.

Infrastructure BC recommends that the risk values be incorporated into the overall Museum Project capital budget. The retained risk should form part of a reserve, while the transferred risk values should form part of the construction contract value.

As part of the capital funding request, it is recommended that the Project Team includes [redacted] as a Project Reserve in the 2021 Business Case.

3.6 CONCLUSION

Moving forward, the Project Team should actively track the Museum Project's risk exposure and update the risk matrix at the following key milestones:

- During the affordability cost refresh prior to the release of the RFP. At this stage, the Project Team should create a transferred risk memo that examines whether the transferred risks identified in the risk matrix have been reflected in the proposed draft Contract;
- During the RFP process if there are material risk allocation issues (e.g. geotechnical); and
- Upon reaching contract execution in anticipation of the design and construction implementation activities. This would include an update of the transferred risk memo to confirm that the final Contract does in fact transfer the expected risks.

ATTACHMENT 1: RISK MATRIX SECTION DESCRIPTIONS

The following attachment explains the different sections of the template risk matrix. It is organized into categories, each of which is explained in the figures below.

Figure 10: First Portion of Risk Matrix

Category	ID#	Risk Name	Quantify (Y/N)	Description	Cause	Effect	L	C	Inherent Risk (Risk Rating)

Category: This categorizes the risks into sub-groups for ease of reference.

ID#: This is the number column for tracking the risks. The convention is to group related risks and assign a letter/number combination.

Risk Name: This column captures the assigned name for the risk.

Quantify (Y/N): There are a large number of risks in the matrix, many of which can't be quantified or, if quantified, the cost impact would be immaterial. The two possible letters for this column are "Y" for quantified and "N" for not quantified.

Description: This column is where the detailed description of the risk is inserted. It is important to specify sufficient detail about each risk event to develop appropriate and effective risk management and allocation strategies. A comprehensive description can help inform the risk quantification and the development of potential scenarios and outcomes.

Cause: Events that could cause the risk to materialize.

Effect: Potential impacts if the risk does materialize.

Risk Assessment: The last three columns in Figure 10 are described below in the tables.

Table 5: Likelihood and Severity of Consequence

Column	Description
L	Likelihood of occurrence
C	Severity of consequence
Inherent Risk (Risk Rating)	Inherent risk ranking and is a product of L X C. The possible outcomes are low, medium, high or extreme.

Table 6: Likelihood of Occurrence Description

LIKELIHOOD			
	Descriptor	Approximate Probability (range / single value)	Frequency (for example, in a 30-year context)
5	Almost Certain	.90 - 1.00 [.95]	e.g. Once a year or more
4	Likely	.55 - .89 [.72]	e.g. Once every three years
3	Possible	.25 - .54 [.40]	e.g. Once every ten years
2	Unlikely	.05 - .24 [.15]	e.g. Once every thirty years
1	Rare	.00 - .04 [.02]	e.g. Once every hundred years

Table 7: Severity of Consequence Description

CONSEQUENCE		
	Descriptor	Effect
5	Catastrophic	Project or program irrevocably finished
4	Major	Program or project re-design, re-approval; i.e. fundamental re-work
3	Significant	Delay in accomplishing program or project objectives
2	Minor	Normal administrative difficulties
1	Insignificant	Negligible effects

Table 8: Inherent Risk Ranking Description

RISK RANKING					
5	LOW	MED	HIGH	EXT	EXT
4	LOW	MED	HIGH	HIGH	EXT
3	LOW	MED	MED	HIGH	HIGH
2	LOW	LOW	MED	MED	MED
1	LOW	LOW	LOW	LOW	LOW
LIKELIHOOD	1	2	3	4	5
	CONSEQUENCE				

LIKELIHOOD (L) x CONSEQUENCE (C)		
Score	0 - 5 =	LOW
Score	6 - 10 =	MED
Score	12 -16 =	HIGH
Score	20 - 25 =	EXT

Figure 11 shows the next columns of the risk matrix. Each of them is explained in further detail below.

Figure 11: Next Portion of Risk Matrix

Initial Allocation under [Insert Procurement Model]	Initial Allocation under [Insert Procurement Model]	Treatment Description	Status

Initial Allocation: This refers to the initial allocation of the risk under the specific procurement models being analyzed. The possibilities are transferred, retained or shared.

Treatment Description: This is the field where potential management and mitigation strategies are described. These strategies are determined based on experience and knowledge pertaining to the risk event and relate to the Initial Allocation field. Even when a risk is transferred, this field needs to be completed as there still may be actions required in order to successfully transfer the risk at a reasonable price.

Status: This refers to the current status of the mitigation action. A risk can either be identified, active or treated, as described below.

Table 9: Status Option Descriptions

Options	Description
Identified	Risk that are known to exist but are expected to occur well into the future. The project has not yet moved forward into a phase where it makes sense to actively manage the risk.
Active	Risks that continue to exist and are being actively managed.
Treated	Risks that have been mitigated. Take a geotechnical risk, for example, where the mitigation strategy was to drill bore holes and distribute the data to proponents. Once this is done, the risk should be considered 'treated'.

In addition to the columns described above, project teams have the option of including additional information as they see fit to help make the risk matrix a more useful project management tool. For example, the following columns can be added at the Project Team's discretion:

- a 'Risk Owner' column to assign people to manage specific risks;
- a 'Project Agreement' column that can describe during the procurement where in the contract a particular risk is addressed; and
- a 'Treatment Option' column with three separate possibilities:
  - Accept and Influence: Refers to a risk that is best managed by the Royal BC Museum but is not under its direct control.
  - Accept and Control: Refers to a risk that cannot be transferred to the private sector or that is best managed and mitigated by the Royal BC Museum.
  - Transfer: Refers to a risk that can be transferred effectively to the private sector.

ATTACHMENT 2: RISK ANALYSIS PARTICIPANTS

Erika Stenson, Vice President of Museum Operations

Royal BC Museum

Erika has over 25-years of experience in providing vision and leadership in organizational development, community relations, international marketing, operations, government relations and business development in both the private and public sectors. Erika is an alumna of Harvard Business School, a Communications and Advertising Accredited Professional, and has a diploma in applied communications. Erika sits on the Board of Tourism Victoria, is a vice chair and chair of the Sales and Marketing committee and past chair of the finance committee, and sits on Destination BC's Tourism Marketing Committee. As Vice President of Museum Operations, Erika holds responsibility for a varied portfolio including Security and Risk, IMAX Victoria, marketing, communications, IMIT, Learning and Community Engagement, business development, museum and archives operations and VP responsibility for the Royal BC Museum Modernization project.

Diane MacKay, Project Director

Royal BC Museum

Diane Mackay has spent over 30 years providing project and program management and oversight in both the public and private sectors, and has been directly involved in the planning, procurement, and implementation of over $5 billion in projects in the healthcare, advanced education, parks and recreation, telecommunications, transportation and justice sectors involving a variety of procurement methodologies (DBB, DB, PDB, DBF, DBFM and CM). Diane's experience also includes, client relationship management, resource supervision and leadership, operations management, facilities management, and capital planning and development.

Tanya Duce, Project Coordinator

Royal BC Museum

Tanya Duce is a Project Coordinator at the Royal BC Museum (RBCM) and is responsible for assisting the RBCM Project Director and Working Groups. Tanya has over 13 years' experience providing Facilities and Project Management experience to the RBCM. Tanya completed her Certified Associate in Project Management Certification from the Project Management Institute in 2008 and her Facilities Management Administration Designation in 2013.

Brian Jonker, Executive Director

Ministry of Tourism, Arts, Culture and Sport

Brian Jonker is the Executive Director for the Arts, Culture and Sport Branch of the Ministry of Tourism, Arts, Culture and Sport. He is responsible for managing arts and culture policy development and

stakeholder relationships, the oversight of the BC Arts Council including strategic planning and program development as well as the day to day operations of the Branch which distributes over $30M in grants to the arts and culture sector. In addition to policy and program development and stakeholder relations Brian is responsible for Strategic Priorities which currently include two infrastructure projects, the Royal BC Museum Modernization and the Chinese Canadian Museum.

Hailley Honcharik, Project Director, RBCM Modernization
Ministry of Tourism, Arts, Culture and Sport

Hailley Honcharik is the Project Director for the Royal BC Museum Modernization Project, representing the Ministry of Tourism, Arts, Culture and Sport. Hailley works with the RBCM Project Team and consultants to validate proposed service delivery solutions ensuring they meet future demand, adhere to best practices and are integrated with Provincial directives, policies and networks. Hailley has over 5 years of capital experience with the BC Government, previously delivering major capital school projects across the Province totalling over $1B. Prior to joining the BC Government, Hailley was a Planner with the City of Edmonton.

Mark Harrison, Director in Financial Advisory
Deloitte

Mark Harrison is a Director in Financial Advisory and is part of the IA&PF practice with more than 21 years of infrastructure experience (and 25 years of financial experience). He joined Deloitte in 2012. Prior to joining Deloitte, he spent more than seven years working with Partnerships BC (now Infrastructure BC) both on staff and as a consultant, and an additional four years working in the private sector advising on infrastructure and project finance projects. Mark is active in leading all aspects of infrastructure procurements, including document development, procurement process management, evaluation process execution, and negotiation support. In addition, he has worked on a variety financial modeling, P3/Project Finance and due diligence assignments during that time.

Mark Hodgson, Partner and Infrastructure Advisory and Project Finance Lead
Deloitte

Mark Hodgson is a Partner and leads Deloitte's Infrastructure Advisory and Project Finance practice in western Canada. Mark has over 28 years' experience as a business advisor on large capital projects and procurements. Mark is a proven leader in Canada's infrastructure market having advised governments on the financing and procurement of some of the largest and most complex infrastructure projects in the country. His expertise is in developing and implementing procurements that delivery infrastructure with private sector involvement that provides value to owners by maximizing competition, optimizing risk allocation, fostering innovation and accessing new sources of capital. He has had a significant advisory

role in the delivery of over $15 billion worth of new infrastructure in Canada spanning all asset classes including highways, roads, transit, ports, water, power, solid waste, hospitals and health care as well as other public buildings including schools, libraries, sports venues, convention centres and accommodation.

Chris Baisley, Director, Infrastructure Advisory and Project Finance
Deloitte

Chris Baisley is a Director in Deloitte's Infrastructure Advisory & Project Finance practice with a focus on utilities, infrastructure, and government services with almost three decades of experience. He has provided financial, strategic, and risk analysis on project teams assessing business cases and running procurements for large capital investments in highways and roads, water and wastewater treatment, rapid transit, hydro generation, district heating/cooling, public buildings, and solid waste. Chris is a civil engineer with extensive consulting experience in long range capital planning, infrastructure monitoring and modelling, construction and service contract administration.

North Jones, Manager, Financial Advisory
Deloitte

North Jones is a Manager in Financial Advisory and is part of the Infrastructure & Capital Projects group in Vancouver. North spent the majority of his career working to create infrastructure in the mining industry. While working for a real estate developer, North forecasted cost escalation and implemented construction project controls. Following an MBA at UBC, North joined a tech start-up focused on debottlenecking projects for mining clients. Since joining Deloitte, North has advised across linear and vertical assets with a focus on modelling and risk allocation.

Kim Anderson, Executive Project Director
Transportation Investment Corporation

Kim Anderson has 25 years of experience in project design and delivery including leadership roles on major capital projects across a variety of building types to support clients in the education, justice and culture sectors. Prior to joining TI Corp to lead the Royal BC Museum Modernization, Kim was most recently an Assistant Vice President with Infrastructure BC where she led the accommodations sector and drew upon her 16 years of consulting engineering experience.

Jacob Helliwell, Assistant Project Director
Transportation Investment Corporation

Jacob Helliwell has over 10 years of experience in a project-based environment across the private and public sectors, with specific focus on financial and governance transformations. Most recently, Jacob

worked for the BC Public Service in a variety of roles including Treasury Board Staff, as the Financial Director for the $800 million public safety ministry, and as the Senior Director responsible for financial management of the Province's $1.4 billion investment into BC Housing, including developing the new oversight and governance framework for affordable housing projects.

Tony Valente, Risk Director

Transportation Investment Corporation

Tony Valente is a Risk Director at Transportation Investment Corporation with almost 20 years of experience. He has been involved in the procurement and delivery of large infrastructure projects in the hydroelectric and transportation sectors. Tony has extensive experience in risk management for infrastructure projects and is a PMI certified Risk Management Professional. He is also certified as both a Project Management Professional and in Change Management. He holds a Master of Business Administration and a Bachelor of Commerce degree from the University of British Columbia.

Greg Wharram, Executive Director, Enterprise Performance Analytics and Applications

BC Infrastructure Benefits

Greg Wharram is the Executive Director of Enterprise Performance Analytics and Applications at BC Infrastructure Benefits (BCIB). Greg has been with the relatively young Crown Corporation since its inception in 2019, where he's overseen technology, data, forecasting and analysis. He's in charge of monitoring BCIB's performance and its implications for the projects and the people working on them. For the Museum Project, Greg is assessing the supply of labour needed to deliver the project and forecasting the resources required to support the project labour. Greg has 30 years consulting experience, implementing analytical solutions and managing projects in government and the private sector in the UK, Canada and around the world.

Martin Fyfe, Executive Director, Major Projects and Contracts Support

BC Infrastructure Benefits

Martin Fyfe is the Executive Director, Major Projects and Contracts Support at BC Infrastructure Benefits Inc. He is responsible for BCIB's involvement with major projects procurement and contract management, as well as integration with owner teams and the Allied Infrastructure and Related Construction Council for projects delivered under the Community Benefits Agreement. Martin joined BCIB at the beginning of 2019 as part of the core team established to build the newly established Crown corporation. Prior to BCIB, Martin was the Senior Manager, Concessions at the Transportation Investment Corporation. Martin brings more than 10 years experience in major project development and construction, and OMR planning and implementation.

Grant Turnbull, President

Turnbull Construction Project Managers

Grant Turnbull is the founder and President of Turnbull Construction Project Managers, TCPM has provided professional Project Management/Owner's Representative services for both public and private sector clients for over 22 years. Grant has over 45 years of experience in design, construction, and project management for projects of all sizes including several in excess of $500 million. Grant has provided senior level direction on many major private and public sector projects in British Columbia, Alberta, and the United States over the course of his career.

Tim Spiegel, Senior Principal

Spiegel, Skillen & Associates:

Tim Spiegel has been practising as a Professional Quantity Surveyor for over 40 years and is considered to be one of the most accomplished and experienced Professional Quantity Surveyors in Canada. He has successfully worked on multiple vertical infrastructure projects as the Quantity Surveyor and has contributed to the success of these projects from concept through business case, procurement, design and construction. Mr. Spiegel has provided confidential third-party audits for both the BC Provincial Government as well as for the Auditor General of the Government of Ontario.

Jason French, Project Director

Infrastructure BC

Jason is a Project Director and is currently managing the day-to-day relationship on the Museum Project. He is responsible for managing client and stakeholder relationships, the development of concept plans and business cases, and executing procurement processes for major infrastructure projects. Jason brings more than 15 years of project management, design and construction experience as a project manager to his clients and Infrastructure BC.

Julien Bahain, Senior Associate

Infrastructure BC

Julien Bahain is a Senior Associate at Infrastructure BC and is responsible for assisting project teams in the development of concept plans and business cases for major infrastructure projects, as well as supporting procurement processes for major infrastructure projects. Julien has experience participating on health and accommodation projects at Infrastructure BC. Julien brings more than 10 years of project management, design and construction experience to his clients and Infrastructure BC. He received his designation in France as a mechanical engineer in 2011 and has experience in the transportation sector in France.