METROLINX

Business Case Manual Volume 2: Guidance

August 2021

This version of the Business Case Guidance ('The Guidance') was released in 2021.

Read the Guidance, and review past business cases here: http://www.metrolinx.com/en/regionalplanning/projectevaluation/benefitscases/benefits_case_analyses.aspx

Send your comments and questions by email to: businesscase@metrolinx.com

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Metrolinx has a mandate to advance an integrated multi-modal transportation network in the Greater Toronto and Hamilton Area (GTHA). Strong evidence-based decision-making is a key contributor to the design, selection and delivery of transport investments. The Metrolinx Business Case Guidance has been developed as a key component of an overall approach to evidence-based decision-making. This guidance provides a robust approach for assessing the benefits, costs, and impacts of a range of potential transportation investments.

Two documents have been prepared to describe the purpose of business cases and how to develop consistent and comparable business cases for a range of potential transport investments.

The two documents are:

Business Case Manual Volume 1: Overview
provides a concise summary of the overall business case approach used by Metrolinx to help stakeholders, decision-makers, and the public interpret business cases.

Business Case Manual Volume 2: Guidance
This document provides detailed information on how to lead the development of a business case and outlines the key business areas with the expertise to support or review specific content. This document also lays out the analytical methods and parameters to support the development of business case content.

Foreword

Transportation investment is a key part of the Government of Ontario's plan to strengthen the province's prosperity and competitive edge globally. In support of these investments, Metrolinx has a mandate to deliver transportation investments that support a higher quality of life, a more prosperous economy and a healthier environment.

This document - **Business Case Manual Volume 2: Guidance** (referred to as the Guidance) will help to deliver on this mandate. It draws on procedures used in international jurisdictions recognized for advancing high performing transportation infrastructure and provides a foundation for confident local, regional and Provincial decision-making.

The Guidance will ensure information on a transportation investment's strategic objectives, costs, impacts and implementation is available and presented in a consistent and clear manner over its lifecycle. Business cases are updated as the project progresses – a typical lifecycle includes idea inception, options analysis, optimization of a preferred option, final option definition, and finally a post-implementation or post-in service review. As a result, the Guidance has the potential to generate tremendous value – a more robust analysis that is more effectively embedded within more decisions to yield better results from the billions of dollars being invested in infrastructure.

This Guidance document is a platform for inter-departmental collaboration and a resource for improved analysis. It is a living document that will evolve with the state of transportation analysis, research and business processes and supports more efficient, evidence-based decision-making.

Contents

6. Financial Case

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Table of Acronyms

BAU	Business as Usual
BCA	Benefit Cost Analysis
BCR	Benefit Cost Ratio
BF	Build Finance
BRT	Bus Rapid Transit
C	Cost
CAC	Criteria Air Contaminant
CAD	Canadian Dollar
CM	Construction Management
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CPI	Consumer Price Index
D&O	Deliverability / Operations
DALYs	Disability-Adjusted Life Years
DBB	Design-bid-build
DBF	Design-build finance
DBFM	Design-build-finance-maintain
DBFOM	Design-build-finance-operate-maintain
GDP	Gross Domestic Product
GDV	Gross Development Value
GGH	Greater Golden Horseshoe
GGHM	Greater Golden Horseshoe Model
GHG	Greenhouse Gases
GTHA	Greater Toronto and Hamilton Area
HB	Health Benefit
HEAT	Health Economic Assessment Tool
IRR	Internal Rate of Return
IO	Infrastructure Ontario
KPI	Key Performance Indicator
kWh	Kilowatt Hour
LRT	Light Rail Transit
MND	Mobile Network Data

MPIP	Major Public Infrastructure Project
MTO	Ministry of Transportation (Ontario)
NPV	Net Present Value
NOx	Nitrogen Oxide
O&M	Operations and Maintenance
OD	Origin Destination
OECD	Organization for Economic Co-operation and Development
P3	Public Private Partnership
PBP	Pay Back Period
PM	Particulate Matter
PVB	Present Value of Benefits
PVC	Present Value of Costs
R/C Ratio	Operating Cost Recovery Ratio
ROH	Rule of a Half
ROI	Return on Investment
RTP	Regional Transportation Plan
SCC	Social Cost of Carbon
SMART	Specific, Measurable, Achievable, Realistic, Time-Related
SO_2	Sulphur Dioxide
TPAP	Transit Project Assessment Process
TTS	Transportation Tomorrow Survey
USRC	Union Station Rail Corridor
VfM	Value for Money
VKT	Vehicle Kilometres Travelled
VOC	Volatile Organic Compound
WEI	Wider Economic Impact
WHO	World Health Organization

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Business Case Manual Volume 2: Guidance Overview

How is the chapter structured?

Section	Content
Introduction	Includes a summary of document structure and information on how to use the Guidance
The Purpose of a Business Case	Includes an overview of what a business case is and its purpose within broader decision-making processes
Business Case Principles and Concepts	Provides an overview of key principles, terminology, and concepts to support managers in understanding the business case development process
The Business Case Development Process	Provides a summary of the business case lifecycle, including the different stages of analysis
Roles and Responsibilities	Provides a summary of roles and responsibilities for developing a business case

Introduction

A business case is a generic term for a collection of evidence assembled in a logical and coherent way, which explains the contribution of a proposed investment or project to organizational objectives. In the Metrolinx context, business cases are prepared to provide timely information on potential investments to inform decision-making and support investment optimization as the investment advances through planning, design, delivery and operation.

Introducing Business Case Guidance

This Guidance explains the steps and content required to complete a Metrolinx business case for any type of investment (including: projects and policies). It describes the approach and techniques required by project managers and analysts to develop a robust business case.

Every investment is unique, and while this Guidance aims to provide a standard approach that will be applicable to all types of investments, the business case development team will need to exercise discretion and professional judgment while completing each business case. Ultimately, business case development is a continuous process of update and review that is intended to identify and optimize high potential investments. Project managers should therefore always aim to ensure that information contained in business cases is useful and comprehensive in so far as it is proportionate to the scale of the investment under consideration.

As a result, the business case should remain a 'living document' throughout the investment lifecycle, receiving updates as the investment advances. This ensures decisions are based on evidence and strengthens accountability to the public and shareholders.

How to use Business Case Manual Volume 2: Guidance

The Guidance should be followed to develop all Metrolinx business cases.

The Guidance is composed of eight chapters, which have been developed to provide managers, analysts, and stakeholders with step by step instructions to complete each chapter of a business case.

Each chapter should be followed and reviewed when conducting analysis and preparing the business case document. For any support on this Guidance and clarification of inputs and parameters please contact Metrolinx at: *businesscase@metrolinx.com*

Business Case Guidance Development and Evolution

Business Case Guidance development is an ongoing process focused on:

- Defining approaches to assess benefits, costs, risks, and delivery requirements
- Defining values and parameters used to estimate benefits and costs

The 2021 version of Metrolinx's Business Case Guidance is the product of ongoing research and collaboration with regional partners and an international peer review panel to develop robust tools to assess potential transportation investments. Metrolinx will continue to refine this Guidance based on emergent research and practice in peer jurisdictions. This refinement cycle, at a maximum, will be conducted on a five-year basis aligned with the Canadian census period.

This time frame has been used because the census is used to:

- Directly derive numerous business case parameters used to estimate benefits; and
- Refine other models and forecasting tools use in regional transportation planning.

Under exceptional conditions – such as significant changes in economic or regional growth outlook an interim Guidance update may be issued.

All business cases completed between 2021-2022 must make use of this Guidance. In 2022, an updated version of the Guidance will be prepared with revised parameters and values as well as new best practice as relevant to transportation investment analysis in the Greater Golden Horseshoe (GGH).

Chapter 1 (this chapter) introduces key principles, concepts and governance processes to guide the project manager throughout the business case lifecycle. This chapter addresses the fact that each business case will be unique and will rely on the project manager (and supervisor) understanding the intentions underlying the design of the business case when using their professional judgment to complete the business case.

Chapter 2 describes the process used to set out the Case for Change for an investment based on existing conditions, future conditions, and a logical linkage between a problem and/or opportunity and a proposed general transport investment that can respond to the problem and/or opportunity and realize benefits to the region. .

Chapter 3 describes the development of options to be tested in a business case and a high-level description of the expected impacts.

Chapter 4 describes the Strategic Case chapter of the business case, what content is required and how it can be created. Long range forecasting is also a component of the Strategic Case where relevant.

Chapter 5 describes the Economic Case chapter of the business case. This looks at the impacts of the project on social welfare, including travel impacts and wider impacts.

Chapter 6 describes the Financial Case chapter of the business case and estimates the overall financial impact of the investment.

Chapter 7 describes the Delivery and Operations Case chapter of the business case. This chapter is concerned with how implementable each option is as well as how it will be operated over its lifecycle. Key questions include project management capacity, risks, stakeholders, construction phasing, and approvals.

Chapter 8 provides high-level guidance on how to develop the chapters of the business case that are typically finished last: Introduction, Summary, and Executive Summary.

The Purpose of a Business Case

A business case is a comprehensive collection of evidence and analysis that sets out the rationale for why a problem or opportunity should be addressed and what the core requirements are for addressing it. Business cases provide evidence to decision-makers, stakeholders, and the public as a crucial part of transparent and evidence-based decision-making processes. Broadly speaking, business cases should define a problem or opportunity and make the case (including strategic fit, benefits, and costs) for Metrolinx to deliver one or more potential investments to address it.

Metrolinx Business Case vs. Benefits Case Analysis

A business case is a collection of evidence assembled into four chapters or cases – *Strategic, Financial, Economic, Deliverability/Operations* – that explains the rationale for pursuing an investment. It is an evolution of the previous Metrolinx Benefits Case Analysis reports used between 2008 and 2015 for large transit projects, capturing additional economic impacts as well as strategic and delivery/operations evidence.

Business Case Structure

A business case should include eight chapters (as described in Figure 1.1) – including framing material (introduction, problem definition, and option development), a four-case evaluation that includes two cases that speak to the rationale for pursuing an investment (Strategic Case and Economic Case) and two that speak to the requirements for successful implementation of the investment (Financial Case and Deliverability and Operations Case), and a conclusion section that summarizes the investment's overall performance. A business case with each of these chapters follows best practice in investment evaluation. The Guidance provides a structured approach to defining the problem, generating options, and completing the four chapter analysis.

Figure 1.1:
The business case structure mapped against the chapters in Business Case Manual Volume 2: Guidance (V2)

Introduction (V2 Chapter 1)

Provides an overview of the business case

The Case for Change (V2 Chapter 2)

Sets out a problem and/or opportunity , the benefits of addressing it (at a high-level), and types of solutions that can realize these benefits

Investment Options (V2 Chapter 3)

Sets out a defensible set of options to be tested against the benefits and outcomes in Chapter 3

Strategic Case (V2 Chapter 4)

How does the investment achieve strategic goals and objectives?

- Determines the value of addressing a problem or opportunity based on regional development goals, plans, and policies
- Options are evaluated against objectives that tell a clear narrative of how the investment can address the problem or opportunity along with potential risks to investment performance
- Establishes 'why' an investment should be pursued from a strategic lens

Economic Case (V2 Chapter 5)

What is the investment's overall value to society?

- Assesses the economic costs and benefits of the proposal to individuals and society as a whole, and spans the entire investment's lifecycle
- Uses standard economic analysis to detail the investment's benefits, costs, and risks in economic terms
- Establishes 'what the benefit to society' is in economic terms

Financial Case (V2 Chapter 6)

What are the financial implications of delivering the investment?

- Assesses the overall financial impact of the proposal, its funding arrangements and technical accounting issues, and financial value for money
- Focuses on capital, operating, and revenue impacts and risks directly related to the investment and indirectly resulting from the investment
- Establishes 'how much the investment will cost' in financial terms

Deliverability and Operations Case (V2 Chapter 7)

What risks and requirements must be considered for delivering and operating the investment?

- Provides evidence on the overall viability of one or more options for addressing the problem/opportunity
- May consider procurement strategies, deliverability risks, operating plans and risks, or organizational risks
- Establishes 'what is required to deliver and operate' the investment

Business Case Summary (V2 Chapter 8)

Provides a summary of the core findings from each chapter along with recommendations for future investment development.

Business Cases, Decision Making and Investment Planning

Business cases provide evidence to decision-makers, stakeholders, and the public as a crucial part of transparent and evidence-based decision-making processes. They are used throughout any proposed investment's lifecycle, including planning, delivery, management, and performance monitoring in two major roles:

- **Appraisal:** to assess potential investment options to address a specific problem and/or opportunity by presenting evidence on the range of costs, benefits, risks, and delivery requirements in a clear and concise manner. For example, a business case may make the case for investment into a new rapid transit corridor and compare different modes or service patterns.
- **Evaluation:** to compare the realized benefits and costs of an investment and document key lessons learned during investment delivery and operations. For example, after a rapid transit service has operated for five years, Metrolinx may develop a Post In-Service business case to determine the extent to which the investment's performance is aligned with the full business case that justified it. Evaluation is used to identify opportunities to improve an investment once it is operational or augment on-going planning and development of future investments.

Business case analysis is used by Metrolinx as a sound and established method for evaluating potential transportation investments in a comprehensive manner. This type of analysis (determining which investment has the highest potential for a specific problem and/or opportunity) is different from analysis conducted to prioritize between high value and potential investments or 'solutions' identified within individual business cases. For example, once complete, a set of business cases for different problems and/or opportunities may be compared through a prioritization process to determine which ones should be considered first for further planning, analysis, and delivery. This process considers a range of broader factors, including:

- **Relative performance –** what range of benefits does each business case offer to the region relative to costs to deliver?
- **Required capacity to deliver –** what are the financial and organizational requirements to deliver the investments outlined in each business case?
- **Risk profiles –** what are the comparative risks between the proposed investment in each business case?
- **Procurement –** how procurement ready are the solutions proposed in each business case?
- **Interdependencies –** how dependent are the solutions proposed in each business case to other undelivered investments?

These broader factors are important components of Provincial and municipal project-selection processes, but are outside the scope of this Guidance.

External Advisors to the Business Case Process

In addition to the peer review process used to develop this Guidance, Metrolinx will establish an external review process including:

- A technical advisory panel to advise on business case development.
- A peer review process for business cases where relevant subject matter experts that were not involved in the development of a business case are asked to review and provide comments and considerations for improvement.

Metrolinx will convene the technical advisory panel and seek peer review on a regular basis for the scale of business cases under review.

Business Case Principles and Concepts

Key Principles

The following underlying principles should be taken into consideration in completing business case analysis:

Support robust decisions

Business cases are intended to add confidence to decisions and lead to the avoidance of re-opening decisions; to align and support decision-making as much as possible and to minimize total effort expended on projects.

Objective and evidence-based

Business cases should be free of bias and based on verifiable data, evidence and transparent assumptions.

Diverse information sources

Business case analysis should include both quantitative and qualitative data, be integrated with other forms of analysis to support decision making.

Adaptable and scalable

Individual business cases should be tailored to the size, expected level of impact, and risk of the investment.

Progressively elaborated

Analysis should be updated at certain stages of an investment's lifecycle as new, more robust, relevant material becomes available.

Universal and consistent

The same basic questions should be addressed by every business case, allowing the reader to easily locate information and enabling different business cases to be weighed against each other. Consistent standards periodically updated will be followed to ensure consistency.

Comprehensive and understandable

Each business case includes all material factors relevant to a realistically complete evaluation and should be communicated using plain language.

Transparent

Business cases should include sufficient detail to explain the basis of the business case evaluation.

Consider risk and business capacity

Business cases should consider the key risks of an investment and the business capacity required to deliver it.

Concepts

The concepts defined below aim to provide project managers with an overall understanding of the structure and organization of the business case.

Investment

This Guidance uses the term 'investment' to define an intentional change to the transportation system that is invested in by one or more government agencies. The term 'option' is used to refer to a specific investment under consideration and could include changes to the transport network's regulations/ policies, traveller experience, operations, or infrastructure.

Economic Analysis

This Guidance defines Economic Analysis as an approach to determine the value of the impacts of an investment to the welfare of individuals and society as a whole, presented in real terms (example: reduced emissions, improved health, increased productivity).

Financial Analysis

This Guidance defines Financial Analysis as the consideration of the ongoing expenses and revenues incurred by parties funding, delivering or operating the option. Future year expenses and revenues should incorporate growth projections and be presented in nominal terms.

Business as Usual

This Guidance defines 'Business as Usual' as the baseline against which options are compared where the investment has not occurred and existing business practices, committed plans and general trends continue into the future. Previously completed business cases may have used multiple terms to refer to this baseline – however, all future business cases should use consistent language using the term 'business as usual'. This baseline defines the 'future conditions' that an investment scenario should be compared against. This should include:

- Funded and committed major changes to the transport network (example: a funded rapid transit line);
- Minor changes to the transportation network (such as signal timing or frequencies on bus routes) based on changes to transport demand in future years; and
- Land use, population, and employment assumptions that are informed by official plans, policies and market trends.

Investment Grade Analysis

Investment grade analysis refers to modelling, design, and option development work that is conducted to the highest level of detail. This work supports decisions for which a significant level of investment is required and typically applies built for purpose or modified for purpose models and specific designs for investment options, whereas earlier stages of analysis may use general tools and high-level designs.

Proportionality

Proportionality of the evaluation process is important, to ensure best use of scarce resources in the evaluation process and in option development. Proportionality can be considered through three lenses:

- The greater the cost of an investment, the greater level of detail and certainty is required for benefits and costs (a $50m station enhancement investment is not expected to have the same level of effort expended as a $5bn subway extension).
- The elements that contribute more to the case for an investment should have greater effort expended than elements that contribute less (example: time savings are typically the largest element in the Economic Case and these should be more robustly scrutinized than auto accident savings).
- The level of effort required to reduce uncertainty to an acceptable level, identifying and addressing known risks, and avoiding spurious accuracy in analysis.

Base vs. Real vs. Nominal

Business cases present monetary figures differently depending on the case. For example, a capital cost figure may be different between the option definition section, the Economic Case, and the Financial Case. This is because each case is presenting costs for different purposes. The option definition section provides the base estimate for investment expenses independent of ‘how’ the money is spent (for example: spending capital costs over five years to deliver an investment). The Economic Case is concerned with the real value of costs in terms of a fixed evaluation year. These figures include a social discount rate and the effects of any value escalation (general price inflation is ignored) based on the timeline over which the expenditure is incurred. The Financial Case presents costs in nominal terms – meaning they are inflation adjusted. The Financial Case figures include general inflation, cost escalation, and a financial discount rate. These three types of costs are illustrated in Figure 1.2.

Figure 1.2: *Base vs. Real. Vs. Nominal*

The business case uses 3 types of costs:

Base costs, which are an estimate of the cost of the investment if the entire system was procured today, are used to scope the concepts.

Economic costs, which are used to understand the economic value of the investment to society in the Economic Case.

Financial costs, which are used to understand the financial cash flow impacts of the investment in the Financial Case.

Base costs

The expected cost to provide an investment including capital and operating costs.

Economic costs
(real costs)

Investments require capital and operating costs to be paid throughout the project lifecycle. Economic costs reflect the real price of these costs based on the year they are incurred and a social discount rate.

The social discount rate reflects a general 'time preference' for value – value today is seen as more valuable than value in the future so over time costs and benefits are discounted.

Financial costs (nominal costs)

Investments require capital and operating costs to be paid throughout the project lifecycle. Financial costs reflect the actual price in the year they are required.

Because the purchasing power of money generally declines over time, cost estimates need to be adjusted throughout the lifecycle to reflect the increase in money required to procure them compared to if they were produced in the base year.

Definitions

Inflation reflects the general increase in prices for goods and services over time.

Value escalation reflects the increase in prices for goods and services above the general increase in prices – for example, fleet may increase in price faster than other goods and services.

Nominal values, used in the Financial Case, reflect the expected cost of a good or service in the year of expenditure based on both inflation and escalation.

Real values, used in the Economic Case, reflect the value of the good or service based on escalation without general inflation.

Business Case Guidance Principles

The following principles were used to develop this guidance:

- Business case analysis should be supported by a consistent set of standards which are periodically updated based on a review of best practices.
- Review of best practices should be ongoing in nature however changes to standards should occur no more than once every two years.
- Business case analysis will support the successful development and implementation of Metrolinx's 2041 Regional Transportation Plan (RTP) and other plans and as such they should be consistent with such plans.
- Business case standards should be communicated through the development and maintenance of a policy with supporting guidance, and business case training should be provided to staff in the support of good practice in the completion of business cases.
- This Guidance was developed primarily for relatively large investments; however the principles and concepts can be applied to smaller investments.

The Business Case Development Process

The development of a business case should commence once a problem or opportunity has been identified. It must be able to inform decision-making at all stages of the investment's development, at all times considering the four cases – Strategic, Economic, Financial, and Deliverability/Operations – to a degree commensurate with the stage of analysis and availability of evidence. The business case will evolve as the investment is developed and should be considered as a continuous process.

Business Case and Project Lifecycles

Four business case stages are required throughout an investment's lifecycle:

- Initial Business Case
- Preliminary Design Business Case
- Full Business Case
- Post In-Service Business Case

Early stages of business case development are typically focused on the creation of sufficient evidence to select a preferred option from a group of realistic options, with later stages focused on the optimization of the preferred option. As a result, a business case supports investment development and enables accountability through the documentation of evidence used to inform decisions. How these stages are developed varies on the nature of the project.

Business case development based on project stages and common gateways for projects under existing project governance is illustrated in Figure 1.3.

Ultimately, project managers must use their professional judgment in consultation with senior management as to how best to align the business case development process to the relevant project approval processes and manage the shifting emphasis in business case content development throughout the lifecycle of the project.

The key content included in each stage of the business case lifecycle is defined in Table 1.1.

Typically, the gateway for a potential investment to enter the business case lifecycle is completion of a strategic assessment. Most projects that have a strategic assessment will be included in the 2041 Regional Transportation Plan (RTP). Other projects that emerge between regional planning phases may also be considered.

Benefits Management Framework

Metrolinx's Benefits Management Framework has been set out to improve the estimation, realization, and tracking of transportation investment benefits. This framework includes a stage-gate process (shown in Figure 1.3) where investments are reviewed by an Investment Panel composed of senior Metrolinx officials.

Approval by the Investment Panel to progress through stage-gates will be based on several factors, such as the business case, funding status, procurement or commercial issues, stakeholder and public input.

Figure 1.3: *Visualizing the Relationship between business case and Project Governance Lifecycles (stage-gate process)*

The Benefits Management Framework includes the Business Case and Project Lifecycle

Benefits management ensures that the initial benefits and value identified as the rationale for investing in a project are achieved through the project lifecycle. The process relies on the business case which serves as the evidence guiding decision-making. The framework includes stage-gates, approval points, and other accountability checks and balances.

1 Strategic Planning

Identifies problem statement and defines benefits that the project needs to deliver.

2 Feasibility and Options Analysis

Evaluates options and determines a preferred option. Typical point at which funding for planning and preliminary design is secured.

Initial Business Case

- The Initial Business Case compares investment options and selects a preferred option for further refinement and design.
- This business case is typically used to secure funding from the Province for planning and preliminary design.

3 Preliminary Design

Refines preferred option, further clarifying scope and cost. Typical point at which funding for procurement and construction is secured.

Preliminary Design Business Case

- The Preliminary Design Business Case takes the recommended option of the Initial Business Case and reviews different approaches to refine and optimize it.
- This business case is typically used to secure funding from the Province for procurement and construction.
- This stage of the business case lifecycle typically occurs in parallel with the Environmental Assessment process.

4 Design & Procurement Preparation

Develops project framework, designs and requirements used as the basis for procurement.

Full Business Case

- Full Business Case confirms a specific option (including benefits realization, financing, and delivery plans) for procurement.

5 Procurement

Procures the project.

Full Business Case

- Updated (if required).

6 Construction, Commissioning & Delivery

Delivers and commissions the project.

7 In Service

After the asset is in service, monitors the benefits and costs to identify opportunities for enhancements and lessons learned.

Post In-Service Business Case

- The Post In-Service Business Case reviews the actual costs and performance of the investment after the asset has gone into service. This business case provides lessons learned and opportunities to enhance the services being provided.

Table 1.1: *Business case lifecycle*

	Initial	Preliminary Design	Full	Post In-Service
What is the purpose?	The Initial Business Case reviews potential investments at a high-level that respond to a problem and/ or opportunity. This business case selects a preferred option for further refinement and design.	The Preliminary Design Business Case refines the preferred option from the Initial Business Case and reviews different approaches to develop or optimize it. This business case leads to a single preferred option for final development.	The Full Business Case defines a specific option (including benefits realization, financing, and delivery plans) for procurement.	The Post In-Service Business Case reviews the actual costs and performance of the investment.
Project lifecycle stage	Part of detailed planning work. Occurs in the Feasibility and Options Analysis stage.	Part of the detailed design process. Occurs during the Preliminary Design stage, along with the Transit Project Assessment Process. This is prior to Procurement and Construction approval.	Part of procurement and financial planning. Occurs during the Design and Procurement Preparation stage, prior to RFP release.	Post delivery/ implementation after the investment is operational.
Approximate level of design	0-10%	10%	10-30% (with updates as design reaches 100%)	100% (investment has been delivered)
What does the business case lead to?	Selection of a preferred option for further design and analysis.	Selection of a preferred option for detailed design, development, and Environmental Assessment.	Definition of a preferred option to allow for procurement.	This review supports ongoing investment optimization and also support future business case analysis for other projects.

Business Case Chapter Development Across the Project Lifecycle

At all stages of the business case lifecycle, all four cases are considered to a degree commensurate with the stage of evaluation and level of information available (as illustrated in Table 1.2 and Figure 1.4).

Figure 1.4: *Business case content across the business case lifecycle*

Table 1.2: *Business case content across the business case lifecycle*

	Initial	Preliminary Design	Full	Post In-Service
Context	Define a core problem and/or opportunity to be addressed by transportation investment, the types of benefits this investment can realize, and a range of potential solutions	Update as required.	Update as required.	Update as required and compare existing conditions to those forecasted in previous stages of the business case.
Investment Options	Define a set of investment options based on variations of the preferred option in the strategic business case.	Define specific refinements of the investment selected in the Initial Business Case.	Define a single option that is proposed for delivery.	Outline any differences between 'as built' and what was proposed in the Full Business Case.
Strategic Case	Detailed review of the strategic benefits of addressing a the problem with a proposed investment	Update based on how changes/refinements to the option may alter performance. Note where performance increases or decreases and why. Update based on changes to base case, risks to achieving strategic performance, or other project shaping factors.		Review annual and to date performance against strategic objectives to determine how accurate the business case was and what could be done to improve performance. Data collection should be used where possible.
Economic Case	Appraisal of each option including, at a minimum: costs, user, external, and some wider benefits (as relevant).	Update based on changes to option specification (runtimes, frequencies, reliability, costs). Note where performance increases or decreases and why. Update based on changes to base case, risks to project achieving economic performance, or other project shaping factors.		Review annual and to date performance against proxy indicators for economic benefits/costs to determine how accurate the business case analysis was and what could be done to improve performance. Data collection should be used where possible.
Financial Case	Appraisal of each option including, at a minimum: costs, direct revenue impacts, and indirect financial/ revenue impacts.	Update based on changes to option specification and emergent risks. Review range of financing approaches and their impact.	Update based on changes to option specification and risks, and define financing approach.	Review actual costs to deliver annual and to-date performance for all key financial metrics. Review benefits of selected financing program.
Deliverability and Operations	High-level appraisal of risks and implementation requirements.	Detailed review of specific delivery requirements and risks. Review of different procurement programs and their benefits/risks.	Update risks based on option specification. Detail final delivery approach, risk management plan, and benefits realization plan.	Review risk management, governance structure, and benefits realization plan.

Post In-Service Business Case Considerations

All projects require a Post In-Service Business Case (PIBC) to be completed within two years from the time the project is operational.

The PIBC is the last stage in the project lifecycle. It is recommended for the PIBC to be undertaken by an independent party, which can act more objectively in determining how the project was implemented. This provides project stakeholders the confidence to know that the objectives of the project were either missed or met successfully.

The purpose of this type of a business case is to provide lessons learned and identify opportunities to enhance the services being provided. The PIBC reviews the actual costs and performance of the investment two years after the project is operational. The PIBC lists the expected project outcomes as specified in the Full Business Case (FBC), reports on variances from these outcomes and then provides recommendations and lessons learned.

For the purpose of the PIBC, it is important that the planning context and assumptions are well defined and documented early in the FBC stage to avoid misinterpretation of data and double counting during the post in-service evaluation.

As best practice, project leads should incorporate (at the FBC stage) a plan for monitoring and evaluating project performance once in use. This will ensure that objectives are measurable and help identify how to evaluate key impacts of the measure(s).

At the FBC stage of the project, one should:

- Identify key assumptions that influence benefits
- Establish a governance structure: management of scope changes
- Establish a reporting body/working group: measurement of parameters such as ridership, GHG emissions, revenue to be used in the PIBC analysis
- Establish grading criteria for qualitative measures
- Establish evaluation methods that will be used for the PIBC – Cost-benefit analysis, surveying, desktop research, site visits

The PIBC should document what was learned from the review, whether there are actions required in order to get the beneficial results anticipated and list the lessons learned, noting how the performance of the project can influence future projects, so that project teams can build on successes and avoid mishaps.

The following include key areas and questions the PIBC must address:

Strategic Case

- *Project Strategic Outcomes:* Did you achieve the goals of your project? Are problems being addressed? Did the planned goals align with results?
- *Stakeholders:* How satisfied are your stakeholders? Were user needs met? What effect did the project have on them? If there is dissatisfaction, why might that be and what can be done to resolve it?

Financial Case

- *Cost:* How much did the project end up costing? What are the costs involved in operating the project?
- *Revenues:* Are costs aligned to project revenues? If this is not the case, how can cost estimates be improved next time (if applicable)?

Economic Case

- *Benefits:* Did the project achieve the benefits projected, and if not, why and how can this be improved? What opportunities are there to increase benefits? Are there other changes you could apply to help maximize project benefits?

Deliverability and Operations Case

- Did the project's deliverables, schedule and budget all meet expectations, and if not, why?
- Are your deliverables functioning as planned? Can the deliverables adjust to changes in the market?
- Are there any issues that you foresee occurring in the future operations of the project that have yet to materialize?

Conclusions/Lessons Learned

- What were some of the issues that arose during the execution of the project and how could they be avoided for the next project?
- What went well, and what can be learned from this experience and applied to future projects?

Roles and Responsibilities

Responsibility for the Business Case Framework

Metrolinx Planning Analytics is responsible for developing, managing, and updating this Guidance.

Roles and Responsibilities in developing a Business Case

Project managers should draw together a diverse group of staff with expertise in the problem or case material to be created. Departments directly impacted by the investment or with direct experience with the problem should also participate in the working group. While the level of involvement of different participants can vary during the lifecycle of the business case, all staff should be involved at the project kick-off meeting where roles, requirements, resources, and timelines should be described at a high-level.

Sponsor

The Sponsor is responsible for ensuring an investment moves through the project lifecycle (Figure 1.3) - including the completion of the Initial, Preliminary Design, Full, and Post In-Service Business Cases. To do so, the Sponsor will coordinate business case content development through a cross-department team or working group that includes business units that have specific expertise relevant to the business case, or that may be impacted by the investment.

Business Case Working Group / Team Participants

This assembly of an interdepartmental team should occur prior to finalizing a problem statement, Business as Usual scenario, or the options to be considered and organized ensuring sufficient coverage of the four cases within the business case: Strategic, Economic, Financial, and Deliverability and Operations.

From the relevant departments typically responsible for specific corporate information, with detailed knowledge of the problem or those that will be directly impacted by the investment should be identified by the Sponsor to assign staff to the Business Case Working Group. A guide helping Sponsors identify relevant directors is presented in Table 1.3.

This Guidance is intended to enable the project manager to lead the development of the business case while collaborating with other departments, who may provide data, review, or sign-off of elements of the business case related to their area of responsibility. However, for larger, more complex investments, greater involvement from other departments may be required. The expected level of involvement should be agreed to at an early stage in the project (for example: following the initial kick-off meeting) through consultation between departments.

Table 1.3: *Business Case Working Group Roles and Responsibilities*

Role/Case	Primary Department	Responsibility
Business Case Sponsorship	Sponsors Office, Planning and Development	• Realizing benefits, as described in the business case, throughout the project lifecycle • Recognizing the inception of an investment • Authorizing and championing business case activity • Assembling a team to develop a business case • Meeting mandatory business case requirements as set out in the business case and supporting guidance • Gaining overall approval for the business case
Strategic	Planning and Development business units for long range plans, 5-year plan and ridership forecasts *Others:* Relevant business planning and individual business unit strategy representatives	• Supervising planning analysis resources, tools and techniques to be applied • Ensuring relevant plans and policies are considered in relation to options • Quality control of ridership forecasts and associated travel behaviour impacts • Sign-off of the Strategic Case
Economic	Planning and Development – typically Planning Analytics staff	• Supervising economic analysis resources, tools and techniques to be applied • Ensuring comprehensiveness of impact analysis and appropriate level of detail (for example: order of magnitude/uncertainty.) • Quality control and presentation of case • Sign-off of the Economic Case
Financial	Finance business units responsible for budgeting and accounting processes *Others:* business analysts, cost centre experts from the relevant operating business units or cost estimators from the Capital Projects Groups	• Supervising financial analysis resources, tools and techniques to be applied • Ensuring accuracy and quality control of all financial figures presented in case • Sign-off of the Financial Case
Deliverability and Operations	Delivery Business Unit, including: *Capital Projects Group, I&IT, Procurement (Finance), Realty (Planning and Development), Legal* Operating Business Unit, including: *GO Transit, PRESTO, UP Express* *Others:* relevant business unit from Strategic Communications, external delivery partners (if required)	• Supervising resources, tools, and techniques to be applied to the case • Reasonableness of cost estimates, timeline, construction/implementation phasing • Comprehensiveness of approval process and level of detail provided for operating and stakeholder plans • Sign-off of the Deliverability and Operations Case

2

The Case for Change

What does the Problem Statement Chapter cover in a business case?

What is the role of this chapter of the business case?

Providing a robust summary of a problem and/or opportunity that should be addressed by investment and the value the region could realize by addressing it.

What analysis is included in the chapter?

Analysis of data, evidence, and policy that confirms the problem and/or opportunity should be considered further - including alignment with policies and plans, external and internal drivers for change, and comparative experience.

How is the guidance structured?

Section	Content
Introduction	Includes an overview of the section with a summary of the guidance's structure to support the development of a robust problem statement
Defining the Problem and/or Opportunity	Sets out a framework to define problem and/or opportunity statement(s) focused on: • Providing a concise description of the problem or opportunity • Defining factors internal and external to the transport network that drive the problem and/or opportunity • Articulating a value proposition that defines the benefits the region will realize by investing in this solution to address problem and/or opportunity
Defining the Solution	Provides an overview of the proposed general solution to address the problem and/or opportunity, including: • Articulating a general solution to the problem/opportunity • Identifying relevant experience from the GTHA and other jurisdictions that have addressed a similar problem or opportunity using a similar solution • Defining a benefits framework to guide investment option development and evaluation

Introduction

Overview

This section is focused on providing the overall context for considering the investment. The considerations included in this section are used to guide the development of options in Chapter 3 Investment Options and their evaluation in the Strategic, Economic, Financial, and Deliverability and Operations cases.

This work should be completed at the onset of the business case process and may be revisited as an investment evolves. In the case of business cases completed over longer timeframes (typically over one or more years), the context may change due to shifts in policy and transport programs. In the event of significant changes, the context section may be revisited multiple times over the course of an investment.

Determining the case for change should be an iterative process as a business case develops. Consulting core stakeholder groups is an important step in this process.

Context Section Output

Once complete, this section of a business case should:

- Clearly state the problem and/or opportunity that is being explored with the business case and demonstrate its importance (the case for change).
- Define the problem and/or opportunity in the context of the GTHA's transportation network and plans or policies for urban, regional, and economic development.
- Define the general approach(es) to investment (example: expand rapid transit on a corridor) that are reviewed within the business case and the benefits the region could realize by investing in the transportation network.

Developing the Problem Statement Chapter

This chapter includes three sections:

- An introduction to the chapter outlining its structure and key content (Section 1)
- Developing a robust understanding of the problem and/or opportunity (Section 2)
- Articulating a solution and how it realizes values and benefits to the region by addressing the problem or opportunity

Each context section should include the core content outlined in Table 2.1. The process used to develop this section is visualized in Figure 2.1.

Problem Statement Section 1

Introduction

The introduction section should provide an overview of the background for addressing the investment and provide an overview of the problem or opportunity and vision development process.

Table 2.1: *Core Content for a Problem Statement Chapter*

Section	Sub-sections	Requirements
1. Introduction		
2. Define the Problem and/or Opportunity	What is the Problem and/or Opportunity and where did it originate?	Provides a concise definition of a problem and/or opportunity to be addressed by investment in the transportation network
	What is driving the Problem or Opportunity?	Defines the key issues that underpin the problem and/opportunity
3. Define the Proposed Solution	How does addressing the problem and/or opportunity benefit the region?	Sets out a vision for the outcomes and benefits that the region will realize if the problem and/or opportunity is addressed
	What changes to the transportation network could address this problem and/or opportunity?	Sets out high-level actions that can be taken to change the transportation network to realize benefits by addressing the problem and/or opportunity
	What experience is there in addressing a similar problem or opportunity?	Identifies relevant experience addressing similar problems and/or opportunities in the GTHA or in other jurisdictions

Figure 2.1: *Analysis to Develop a Problem Statement Chapter*

Problem Statement Section 2

Define the Problem and/or Opportunity

This section defines the case for considering investment to address a problem or opportunity. The core content in this section is a problem and/or opportunity statement (a concise summary of the rationale to change an element of the GTHA's transport network) and supporting evidence in the form of 'key drivers' (transportation and external factors that shape the problem or opportunity).

This section covers steps 1 and 2 within the development of a Case for Change chapter.

Step 1: What is the Problem and/or Opportunity and where did it originate?

A problem or opportunity statement is a concise summary of the case for change being considered in the business case. It describes the central issues that should be addressed and, in most cases, should be 'investment agnostic' - this means it does not state that a specific investment is required. In other words, the problem or opportunity statement should not be that the region needs a specific transit investment or project, but instead focuses on central issues facing communities, institutions, or the region as a whole.

Approach – Developing a Problem and/or Opportunity Statement

The development of the problem or opportunity statement should include the following considerations:

- State the problem/opportunity.
- Clearly set out the circumstances leading to the consideration of the problem/opportunity and the timescales for doing so.
- Focus on underlying causes of the problem/opportunity first, and symptoms second.
- Identify the geographic extent of the problem/opportunity and which populations benefit from addressing it.
- Clarify why the problem/opportunity should be addressed.
- Describe the boundaries of the problem or opportunity - these boundaries should keep potential investments from expanding beyond what is needed.

Step 2: What is driving the Problem or Opportunity?

A 'key drivers' framework is used to define and describe the issues that shape the problem or opportunity. This analysis should consider a range of data and evidence sources to articulate both the existence of the problem or opportunity and the impetus to address it. Two types of drivers should be identified and clearly articulated as described in Table 2.2.

Approach – Setting Out Key Drivers to the Problem or Opportunity

Figure 2.2 (internal drivers) and Figure 2.3 (external drivers) outline the types of issues that should be considered when conducting a key driver assessment. Tables 2.3 and 2.4 elaborate on the types of analysis that can be conducted to support problem definition based on key drivers. Each business case may select different considerations for review – the examples included in these tables are not mandatory, nor are they an exhaustive list of all considerations.

Table 2.2: *Problem or Opportunity Drivers*

Problem/Opportunity Driver	Description
Transport Network (Internal Drivers)	• The transport network is defined as the components that make up the network, and the resulting traveller behaviour. • It includes: the state or condition of infrastructure, technology, and services, and how customers use the network. • Analysis is conducted with a consideration of existing and future conditions.
Drivers External to the Transport Network (External Drivers)	• External drivers are defined as the factors that influence or direct travel behaviour and transport infrastructure/technology. • They include stakeholder input, government policies, and economic activity, land use, and demographics.

Figure 2.2: *Key Factors for Internal Drivers*

Transport Network

Descriptions

Travel behaviour

- Traveller behaviour describes how the transport network is used and can be a strong indicator of key challenges and opportunities

Transport Service Provision

- The state of provided service is a key driver of transit system performance
- This factor considers operational issues associated with providing transport

Transport Infrastructure and Technology

- The state of infrastructure is a key driver of transit system performance
- As infrastructure, including rolling stock, right of way, and operation and maintenance facilities change over time, they impact the performance of the transport network
- Over time, new technologies become available that support the development and use of transport network
- These can include changes in customer facing technologies (example: ticketing, travel tools) or types of rolling stock or physical infrastructure (example: electric vehicles)

Examples

Travel behaviour:

- Congestion resulting from travel demand
- Underutilized services
- Unbalanced modes split in corridors, cities, or regions

Transport Service Provision:

- Changes in reliability
- Changes in runtimes
- Changes in operating costs the options

Transport Infrastructure and Technology:

- Need for replacement, decommissioning, repair, or upgrade of assets
- Availability of new technology to support service provision or traveller satisfaction
- Opportunity to reduce costs of provision by updating rolling stock

Figure 2.3: *Key Factors for External Drivers*

Table 2.3: *Key Internal Drivers to the Transport Network*

Driver	Analysis Approach	Potential Information Sources
Travel behaviour	• Describe the problem or opportunity in terms of how travellers use the transport system • Quantify travel demand related to the problem or opportunity • Discuss symptoms and root causes of travel behaviour related to the problem or opportunity	• Transportation Tomorrow Survey (TTS) Data • Greater Golden Horseshoe Model (GGHM) • Corridor counts or other specific travel data
Transport Service Provision	• Describe the state of transport service and how it connects to the problem or opportunity • Quantify service provision/performance factors related to the problem or opportunity (example: reliability, frequency, provided capacity, travel time, costs) • Discuss symptoms and root causes of poor/positive performance related to the problem or opportunity	• Corridor data • Service plans
Transport Infrastructure and Technology	• Describe the quality of the infrastructure or technology related to the problem or opportunity • Quantify key issues related to not pursuing the problem or opportunity (example: cost of business as usual, risks) • Discuss symptoms and root cause of the issue as it pertains to infrastructure	• Summary of new technology performance • State of good repair, operations, or maintenance reports • Past studies or business cases related to the infrastructure or technology

Table 2.4: *Key External Drivers to the Transport Network*

Driver	Analysis Approach	Potential Information Sources
Government Policy	• Describe the problem or opportunity in terms of how government policy relates to the transport network • Describe changes in Metrolinx or Government of Ontario policy that specify a problem or opportunity that should be addressed	• Policies and announcements • Reports, internal memos, past business cases • Budgets
Economic Activity, Land Use, and Demographics	• Describe the economic, land use, or demographic conditions that are aligned with addressing the problem or opportunity • Describe desired economic or land use outcomes that are aligned to addressing the problem or opportunity	• Corridor data, Government statistics
Stakeholder Input	• Identify stakeholders who are implicated in the problem or opportunity	• Policies, press releases, plans • Reports, internal memos, past business cases • Feedback on Government policy

Problem Statement Section 3

Define the Proposed Solution

This section of the Case for Change chapter outlines a benefits framework that connects the benefits of addressing the problem and/or opportunity (grouped into outcome areas) to specific actions – or solutions – that can be taken to change the GTHA's transportation network to realize these benefits. Once complete, this benefits framework will serve as a 'roadmap' (which illustrates the overall logic of a potential investment) that will be used to develop specific investment options from the 'actions' (Chapter 3: Investment Options) and evaluate them through the Strategic, Economic, Financial, and Deliverability and Operations Cases based on the inputs, outputs, and outcomes that each investment should be analyzed against (Chapters 4-7).

This benefits framework takes a standard form inspired by logic models used in project, infrastructure, and economic development planning and is illustrated in Figure 2.5. This framework is intended to streamline investment development and evaluation by explicitly linking a problem and/or opportunity to a set of actions (or solutions) that can address it, while also articulating the benefits realized by addressing the problem and/or opportunity.

Each step in Section 3 of the Case for Change chapter outlines how to address the elements of this framework in the Case for Change chapter, beginning with outcomes and benefits.

Step 3: What is the benefit of addressing the problem and/or opportunity and what happens if it is not addressed?

This step of the Case for Change chapter establishes the types of benefits the region can expect to realize by addressing the problem and/or opportunity. This is called a 'value proposition' and in most cases it should be solution agnostic. Solutions are means to realize the ends defined in the proposition by way of realizing the benefits of addressing the problem and/or opportunity (for example: making progress towards the 2041 RTP vision). In other words, the proposition describes the reason to identify an investment option but should not presuppose a specific solution.

A strong value proposition should outline both a vision statement and a set of outcomes and benefits that can be realized for the region. In addition, this section should also articulate how the vision and outcomes align with specific regional goals or policies.

Approach – Defining the vision statement

The proposition should be a focused statement on the relation of the problem or opportunity to the 2041 RTP vision. It should also be:

- **Concise –** provide one to two cohesive sentences around a major idea.
- **Aspirational –** inspires and requires exceptional efforts and resources while being achievable.
- **Focused on outcomes –** do not point towards a specific option or solution but rather focuses on key outcomes or impacts that are realized by addressing the problem or opportunity.
- **Clear/simple –** easy to understand and free of technical jargon.

Figure 2.5: Metrolinx Business Case Benefits Framework

	Outcomes Outcomes represent the value a transportation investment can realize for the region.	**Outputs** The direct measurable results from delivering the investment	**Actions (means)** The core changes to the transportation network	**Inputs** Resources required to deliver the investment
Role in business case	Outcomes are used to communicate the high-level positive changes the investment can realize in Chapter 2 and to quantify and qualify the benefits of an investment in the Strategic Case (Chapter 4) and the Economic Case (Chapter 5)	Outputs are used in to estimate benefits throughout the business case	Actions are defined generally in Chapter 2 (definition of the types of actions that will address the problem and/or opportunity) and specifically in Chapter 3 (defining a set of investments and how they change the transport network)	Defined in Chapter 3 and used in the Economic Case (Chapter 5), the Financial Case (Chapter 6), and Deliverability and Operations Case (Chapter 7) to determine the costs and requirements to deliver an investment
Areas of focus in business cases	Outcomes are sorted into four themes or outcome areas: • Transportation • Quality of Life • Economic and Regional Development • Environmental Sustainability	Specific targets that relate general actions to the realization of benefits and outcomes	Infrastructure, policy, customer experience, and service changes	Costs to deliver, operate, and maintain organizational capacity, staffing, supporting works
Examples	Each investment should realize benefits within one or more of these outcome areas Example benefits include: • Transportation – increased network resilience • Quality of life – increased physical activity • Economic and Regional Development – increased connectivity to jobs • Environmental Sustainability – reduced emissions	Example outputs include: • Change in ridership • Change in automobile vehicle kilometres travelled (VKT) • Customer service metrics	Example actions include: • Add new service • Make services faster • Provide new stations • Provide more capacity • Changes to customer experience	Example inputs include: • Capital Costs • Operating Costs • Full time equivalents required over the course of the project
Other Uses	Regional planning Communicating investment benefits Public and stakeholder engagement		Procurement specifications Output based design specifications Public and stakeholder engagement	Capital and investment planning

What is required in the business case?

A clear vision statement should be provided for the project alongside a narrative of the key issues from the key driver review section that were considered in developing it.

Approach – Setting out Outcomes and Benefits

The second element of the value proposition is setting out the benefits of addressing the problem and/or opportunity based on outcomes. Metrolinx business cases focus on four key outcome areas:

- **Transportation**
- **Quality of Life**
- **Economic Development**
- **Environmental Sustainability**

Not all business cases will address all four outcome areas, but each business case should focus on at least one of these outcomes. A set of outcomes, benefits, and key performance indicators is shown in Table 4.2 in the Strategic Case Guidance (Chapter 4 of this document). This table can be used to outline the potential benefits of addressing the problem and/or opportunity in this chapter. Additional guidance is provided below for setting out benefits.

Outcomes vs. Benefits

Outcomes can be considered as goals or high-level value propositions for the how transportation investment supports regional growth and policy. In business cases they are not assessed directly. Instead investment performance is assessed based on the benefits realized by individual travelers, communities, whole cities, specific stakeholder groups, or the region as a whole. Each business case should identify specific benefits within each outcome area to illustrate the case for change. For example, a transportation benefit of addressing fare integration opportunity may be attracting and retaining new passengers through improved travel experience.

Benefits can be considered as specific objectives within each outcome area for how the investment will support the outcome. Benefits generally provide specific targets that if achieved will contribute to the outcome and aid in realizing the vision. In other words, while goals relate to the "big picture" or desired end-result, benefits provide the specificity necessary to evaluate and design investments.

Setting Benefits

To support option development and evaluation, benefits must be stated as precisely as possible, which in turn allows them to be associated with specific outputs against which the investment can subsequently be monitored. A useful tool to set out benefits is to follow the SMART approach. SMART is a mnemonic acronym giving criteria to guide the setting of clear objectives in any investment – because benefits are a form of objective this framework is applicable. Table 2.6 defines the application of the five (5) criteria required to set meaningful objectives according to the SMART approach.

Table 2.6: *Using the SMART Objectives Approach to Define Benefits*

SMART Approach Criteria	Definition and Application
Specific	The objective should target one specific and relevant area or item for improvement under the broader goal. The objective needs to be specific about the result, not the way it is achieved. This criterion stresses the need for clear and unambiguous objectives. An objective is specific if the six following questions can be answered: • What should be accomplished with this objective? • Why should this objective be pursued (specific reason and purpose)? • Who is involved? • Where is this objective applied? • What are the requirements and constraints linked to this objective?
Measurable	The objective should quantify or suggest an indicator of progress. In other words, it is essential to define objectives and outputs against which the project can be monitored. Measuring progress toward the attainment of the goal helps to reassess the effort required to stay on track and reach it. With measurable objectives there is evidence that can prove a goal is achieved. Quantifiable indicators are preferred and less ambiguous.
Achievable	The objective should be achievable rather than extreme. Achievable objectives should specify who is responsible for implementing it and identify from which partners or stakeholders buy-in is desirable.
Realistic	The objective should state realistically achievable outcomes and results given the available resources and constraints. While setting up objectives, it is important to determine the ways they can come true. Setting realistic objectives considering the constraints helps to identify the resources required and financial capacity to reach them.
Time-Related	The objective should specify when the result(s) can or should be achieved in order to allocate the required resources during that period. Without a realistic deadline, an objective cannot be measurable.

What is required in the business case?

Analysts should provide a narrative that addresses the following:

- The outcomes that will be realized by addressing the problem and/or opportunity and the specific benefits that the region will realize – this should answer the question "how will the region benefit if the vision statement is achieved?"
- Logical linkages between the problem and potential outcomes and benefits.
- What happens across these outcome areas if the problem and/or opportunity is not addressed (example: transport networks will become more congested, limiting regional growth opportunities).

Approach – Connecting the Value Proposition to Regional and Stakeholder Plans

Supporting material should be provided alongside the value proposition (vision and set of outcomes and benefits), including direct linkages to Metrolinx's 2041 RTP (including if the proposed investment is already discussed in the RTP or aligns with the RTP's priority actions and strategies) and the plans and policies of relevant stakeholders.

Stakeholders include technical stakeholders, who may shape the planning, delivery, and operation of an investment, along with those who may be impacted by investment outcomes or delivery. Stakeholders may include:

- Municipal governments
- Municipal service providers
- Provincial government agencies
- Federal government agencies
- Non-profit organizations
- Businesses
- Communities or specific populations

What is required in the business case?

The RTP, investments, policies, and plans should be reviewed to identify their relationship to the problem or opportunity or solution. The relationship of stakeholder plans/policies to the problem or opportunity or solution should be defined as one of three types, as illustrated in Table 2.7. This review can be summarized using the template in Table 2.8. If addressing the problem and/or opportunity will achieve partner goals or policies, they should be noted using this template and an accompanying narrative.

Table 2.7: *Relating the Problem or Opportunity to Stakeholders*

Relationship to problem/ opportunity	Description	What should the business case do?	Example
Synergistic Approach	Problem or Opportunity is related to or addressed in stakeholder plans, policies, or preferences	Clarify how the plan or policy defines the problem/opportunity	The problem/ opportunity is directly mentioned in a municipality's official plan
Rationalization Approach	Challenge/opportunity is currently being addressed by one or more stakeholder projects or programs	Clarify the extent to which the program or projects will address the problem/opportunity and identify gaps between existing performance and the desired outcomes for the 2041 RTP goals/objectives	The problem/ opportunity is directly mentioned in a municipality's official plan and they are implementing key programs to address it
Divergent Approach	Project proponent interests and stakeholder interests are divergent. Pursuing the challenge/ opportunity may adversely impact the stakeholder or hinder their plans or policies	Clarify the types of negative impacts that are to be expected and how they may be mitigated	Addressing a problem may cause problems in other locations or disturb quality of life for stakeholders

Table 2.8*: Stakeholder Review Template*

Stakeholder	Organization strategy, policy or plan	Link to Problem/ Opportunity	Relationship Type(s)
Name	Title of the strategy, policy or plan. Brief description	Brief explanation	Define relationship

Step 4: What changes to the transportation network realize these benefits?

This step identifies a set of actions – or changes to the transportation network - that address the problem and/or opportunity. These solutions should not refer to a specific investment (example: a BRT with a frequency of eight buses per hour - which is the focus of Chapter 3), but instead refer to key changes in the transport network that could address the problem and/or opportunity (example: provide faster service on a parallel corridor to unlock development and reduce crowding). Analysts may refer back to the problem statement drivers to refine scoping and differentiate investments. The goal of this exercise is to illustrate how transportation changes can benefit the region while Chapter 3 will focus on specific investment options that make use of these actions identified in this chapter.

Approach – Defining the Solution

A high-level solution should be defined based on actions, outputs, and inputs. These are defined at a high-level in this chapter. The focus of this step is to ensure that Chapter 2 includes a complete benefits framework that demonstrates to the reader that:

- There are actions that can be taken to realize the benefits and outcomes.
- The inputs required to deliver the actions (example: capital investment) are logically understood.
- There are measurable performance outputs that connect a benefit to the action (for example: an action of improving bus service could result in an output of decreased automobile use, which in turn connects to an environmental benefit of reduced emissions).

What are actions, outputs, and inputs?

Actions are changes that characterize the solution and should be mapped out considering four major components of the transport network:

- **Rules, Regulation and Policies**
- **Travel Behaviour**
- **Transport Services**
- **Transport Infrastructure/Technology**

Each action can be thought of as a 'lever' that can be used to achieve meaningful change against the problem or opportunity, and should be:

- **Action Oriented** – refer to a specific change that addresses the problem or opportunity
- **Descriptive** – clearly define the change based on specific components of the transport network
- **Problem or Opportunity Oriented** – directly linked to the problem or opportunity

Outputs are the measurable changes to the transportation network that an action will lead to. For example, an action of providing a new station could lead to a reduction in auto trips.

Inputs are measurable requirements to deliver an action. They include monetary inputs and organizational capacity to deliver, such as staffing.

What is required in the business case?

This stage of the business case should provide a general 'solution' to the problem and/or opportunity that is defined as a set of actions, inputs, and outputs that are directly linked to the problem and/or opportunity and the set of benefits and outcomes defined in Step 4.

In an initial business case, these considerations (actions, inputs, outputs) may be defined generally and are likely solution agnostic. However, in later stages of the business case lifecycle, these considerations may be better defined and thought out as a preferred solution is developed.

The content developed in this section will be expanded upon in future chapters:

- Performance standards for actions will be developed during option definition, design, and evaluation (example: this chapter could say 'action – expand transit service in western Toronto', while Chapter 3 will define different approaches to delivering this change for review such as 'Increase bus frequency to eight buses per hour on all routes').
- Estimates for inputs, such as cost estimates, will be developed during the scoping of specific options (example: this chapter could say 'input – capital investment', while Chapter 3 would say 'capital investment in a bus garage of $100 million').
- Estimates for outputs, such as forecasted ridership changes, will also be developed during option definition (example: this chapter could say 'decrease automobile vehicle kilometres travelled (VKT)' while the next chapters will define the quantity each option reduces auto VKT and then estimate benefits from this output).

Step 5: What experience is there in addressing a similar problem or opportunity?

Step 5 is a supplement to Step 4 of this process and may not be used in all business cases. Where possible, experience from within the GTHA or from other jurisdictions may provide insight into ways to address the problem and/or opportunity or provide justification for exploring a solution in Chapters 3-7. When relevant, this section of the business case should provide a summary of experience within the GTHA and from other jurisdictions related to the problem and/or opportunity.

Approach – Identifying Relevant Experience

Past experience can be useful to understand how to scope, design, plan, and evaluate potential investment options that are aligned with the problem and/or opportunity. For example, if a problem is managing congestion on a subway line, experience from other jurisdictions may reveal a wide array of solutions to reduce congestion. Alternatively, experience from delivering new transport investment within the GTHA may also be relevant for understanding an effective way to advance a problem and/or opportunity. Finally, a review of other investments can provide useful benchmarking for scoping investments and conducting evaluation in later chapters of the business case.

What is included in the business case?

Investments from the GTHA or elsewhere that are relevant to the problem and/or opportunity should be explained with a brief overview including the key performance metrics and logic that demonstrate their connection to the problem and/or opportunity under consideration in the business case. For example, if peak fares were used to manage demand, this section of the business case should articulate how they contribute to alleviating crowding. Potential sources of relevant experiences are noted in Table 2.9.

Questions the analyst should consider when reviewing other experiences include:

- What was used to address the problem and how successful was it?
- What key performance benchmarks were recorded and are they relevant for the GTHA?
- What was the context (based on the jurisdiction's governance, transport network, economy/land use, and geography) and how is it similar to or different from the GTHA?

Table 2.9: *Potential Sources for Investment Experience*

Database / Journal	Description
Transportation Research Board	North American research and practitioner journal and resource for transit and transportation agencies.
Association for European Transport	Published and peer-reviewed papers on transportation topics and innovation, focused on Europe.
Canadian Transportation Research Forum	Canadian research forum into transportation topics.
Canadian Urban Transit Association	Comprehensive collection of transit reference materials

3

Investment Options

What does the investment options chapter cover in a business case?

What is the role of this chapter in the business case?	Providing a set of defensible investment options for review in the four chapter of the business case
What factors are included in the analysis?	Options should be scoped to support the four chapter evaluation, including: costs, impacts to the network and customers, relevant engineering design or policy development, and core dependencies
How is evidence summarized and communicated?	This section should provide relevant details on the scoping process and the set of alternatives put forward for analysis in the Strategic, Economic, Financial, and Deliverability and Operations cases

How is the guidance structured?

Section	Content
Introduction	Includes an overview of the section with a summary of the guidance's structure to support the development of a long list of potential options that is narrowed down to a short list
Developing an Investment Options Chapter	Provides an overview of the structure of the Investment Options Chapter
Option Development Guidance	Includes guidance for developing the key content of the options chapter: • Option development • Option refinement

Introduction

Overview

This chapter is concerned with providing relevant scoping for a set of defensible options. This scoping section may vary depending on the problem or opportunity under consideration, but will typically include content to reflect the two stages of investment option design and planning as shown in Figure 3.1:

- **Option Development** – content that explains how options were generated to meet the actions and outcomes specified in Chapter 2.
- **Option Definition** – content that explains the specific options put forward for evaluation in the business case.

Section Output

This section provides a short list of defensible options for consideration and evaluation in the Strategic, Economic, Financial, and Deliverability and Operations Cases. These options are developed to respond to the context section of the business case.

Figure 3.1: *Option Development Process*

Option Development

Set out a long list of options that illustrates the range of potential approaches to addressing the problem or opportunity

Option Definition

Define a specific set of investment options (or option in the Full Business Case) for review in chapters 4-7

Developing an Investment Options Chapter

This chapter should communicate both a robust option development process and a set of options for review to stakeholders and decision makers. The focus of this chapter is to ensure that the option development process (shown in Figure 3.1) is documented and that the core options proposed for evaluation are well scoped and defined. Core design work content should be included in an appendix or accompanying work paper.

When complete, the Investment Options chapter should include four sections (described in Table 3.1).

Table 3.1: *Core Content Required to Complete an Investment Options Chapter*

Section	Sub-sections	Description
1. Introduction	N/A	A summary of the chapter's structure and guiding assumptions
2. Option Development	Option Development Process	Summarizes the approach used to design/ develop options considered in the business case
	Option Review	Outline the sifting process used to develop a short list of options
3. Option Definition	Subsection per option	For each option define: • Impact on customers (including base level demand change) • Costs and design assumptions • Interdependencies

Option Development and the Business Case Lifecycle

A business case must evaluate more than one option that could address the problem or opportunity being studied.

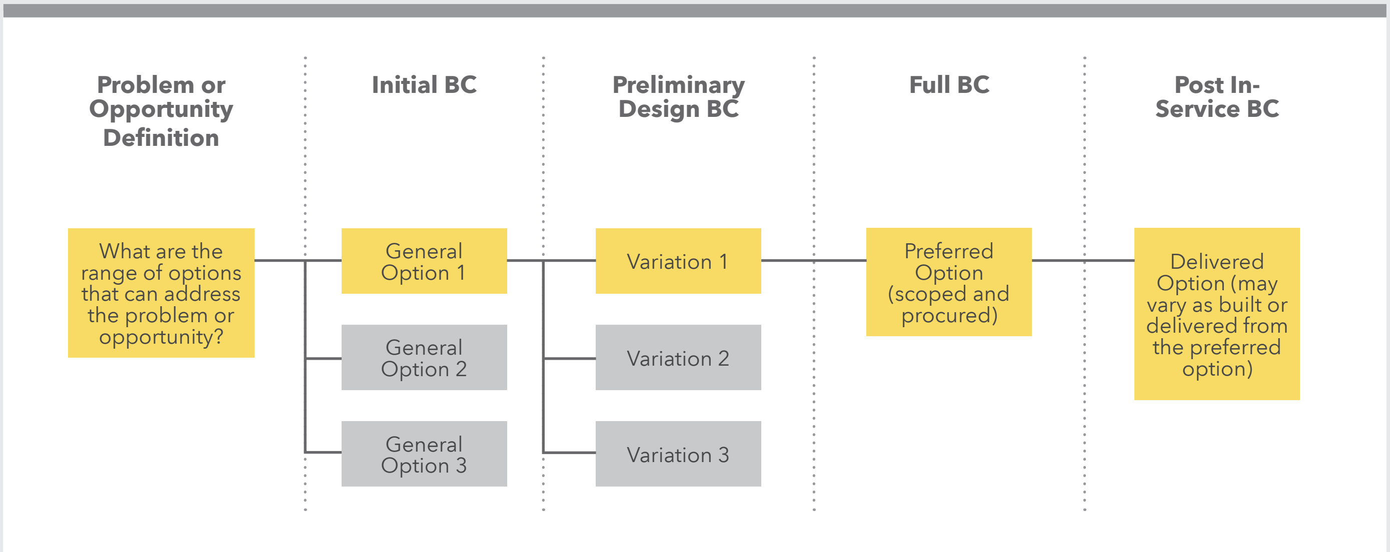
What is considered an "option" varies over the business case lifecycle. Figure 3.2 outlines the types of options that should be considered and developed during the business case process.

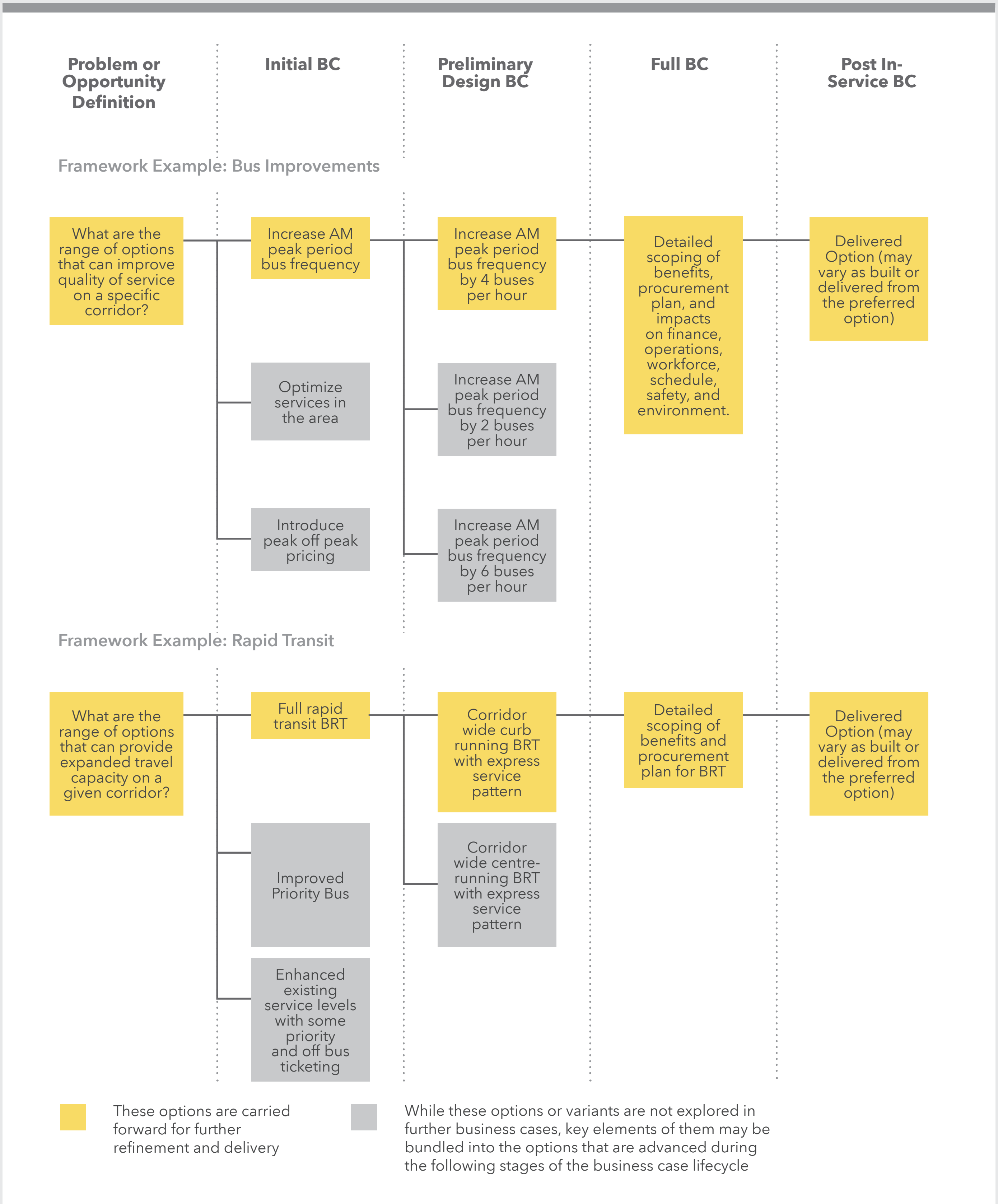
Each stage of the business case life cycle requires a different degree of specificity in options. In general:

- For an Initial Business Case, options should focus on different options with one or more investment types identified in the strategic business case. For example, each option on a major transit intervention should consider a major change in alignment or technology.
- For a Preliminary Design Business Case, options considered should be considered 'sub-options' of the best performing option(s) from the Initial Business Case. These options should be similar in most major respects in terms of the service or infrastructure concept and order of magnitude costs, benefits and timeline to implement.
- For a Full Business Case, there should be only one option examined that is identical to that planned to be invested in, allowing for the business case to provide sufficient detail to make the evidence 'investment-grade.'
- For a Post In-Service Business Case, the delivered option is outlined, and examines the variations from the Full Business Case.

As the business case process continues, options will become more focused and, in many cases, will be variations on a common theme (example: different types of fare by distance structures with specific pricing approaches). Figure 3.2 provides for an example of a sufficient variety of options presented for an Initial Business Case. Table 3.2 provides further guidance on the level of definition that each option should be scoped to by stage of the business case lifecycle.

Figure 3.2: *Illustration of Appropriate Options over the Business Case Lifecycle*





Note: each stage may advance more than one option for further consideration. Within each stage, option development typically includes significant iteration of analysis and reporting to ensure a robust development process. In many cases, evaluation and development may occur simultaneously.

Due to emergent considerations, options that are not progressed at an earlier stage may be reconsidered or reintroduced later in the project lifecycle.

Table 3.2: *Level of Detail Required for Option Development Throughout the Business Case Lifecycle*

	Level of Design	Inputs (cost required capacity to deliver)	Actions (changes to the transport network)	Performance Objectives	Assumptions
Initial Business Case	0-10% Potential Concepts – a set of investment concepts that represent mutually exclusive ways to address the problem or opportunity	Inputs should be defined at a high level throughout the option development process and use ranges where possible to reflect uncertainty	Actions should be defined generally (example: introduce a new service rapid transit service on the corridor)	Performance objectives should be defined generally (example: the new rapid transit system is faster than existing bus service)	Major guiding assumptions should be outlined for each option
Preliminary Design Business Case	10% Comparator Concepts – a set of preliminary designs illustrating multiple ways to deliver a single overarching option identified in the IBC	Inputs should represent a best estimate and a narrowed range of potential costs based on preliminary design	Actions should be defined specifically across the range of sub options (example: provide a new high frequency BRT on the corridor that is either side or centre running)	Performance objectives should be defined in ranges based on what is achievable for the specific investment in order to 'right size' performance to maximize benefits relative to costs	Assumptions that have the highest influence on option inputs, action, and performance objectives should be detailed
Full Business Case	10%-30% Reference Design Concept – a representative concept used to advance procurement and confirm expected benefits, costs, requirements to deliver and risks	Inputs required to deliver the investment should be developed through detailed design and analysis	Specific changes to the transport network should be defined	These performance objectives are used to set procurement requirements and should be specific and achievable based on best available evidence (example: deliver a service with 20 articulated buses, a capacity of 2,400 passengers per hour per direction, and an end to end runtime of 40 minutes)	Detailed assumptions related to all inputs, actions, and performance objectives should be clearly communicated

Option Development Guidance

This part of the guidance outlines key concepts and ideas to be used to complete each part of the Investment Options Chapter. This includes a description of how option development varies over the business case lifecycle, along with specific guidance for each section of the Investment Options chapter.

Investment Options Section 1

Introduction

The introduction section of the options chapter should introduce the reader to the core content of the chapter and the option development process. Key assumptions and issues should be identified and articulated.

Investment Options Section 2

Option Development

The option development section describes how options were generated for the business case. Its length may vary between business cases and vary across the business case lifecycle. This sub-section is intended to ensure the business case demonstrates a transparent and accountable process was used to identify potential options to address the problem or opportunity.

This subsection should describe the process used to develop a long list of options and sift down to a short list. However, the actual long list and sifting process do not need to be included in the main business case document, and may be discussed in an appendix or separate discussion paper.

Option Definition

Options may include changes to policy, an improvement to traveller experience, operational changes, or a new infrastructure project (as shown in Figure 3.3) or a combination of these changes. The process may vary depending on the nature of the problem or opportunity. However, all cases should establish:

- Origins of option (example: past studies, plans, or stakeholders)
- Interdependencies or potential conflicts with existing and/or planned changes to the transport network
- Clarifying 'how' the option is expected to address the problem and/or opportunity by setting out how it triggers the actions discussed in Chapter 2

Figure 3.3: *Project Types*

Policy

Projects that change rules and regulations shaping the delivery of transport services in the GTHA

Example: new integrated fare structure

Travel Experience

Projects that augment traveller experience – including improvements to customer information, comfort, and safety

Example: new wayfinding and trip planning app

Operations

Projects that change operating plans for any component of the transport network

Example: new express service

Major Infrastructure

Projects that expand the transport network through delivering new infrastructure

Example: new subway line

Developing a Long List

The long list of options is used in the initial business case and may be revisited during option design refinement in later stages of the business case lifecycle. This process ensures that options are sufficiently differentiated and cover enough breadth to enable any other options not explicitly investigated to be considered 'sub-options.'

Factors to consider when developing options that the project manager can use to stimulate discussion with the working group / team include:

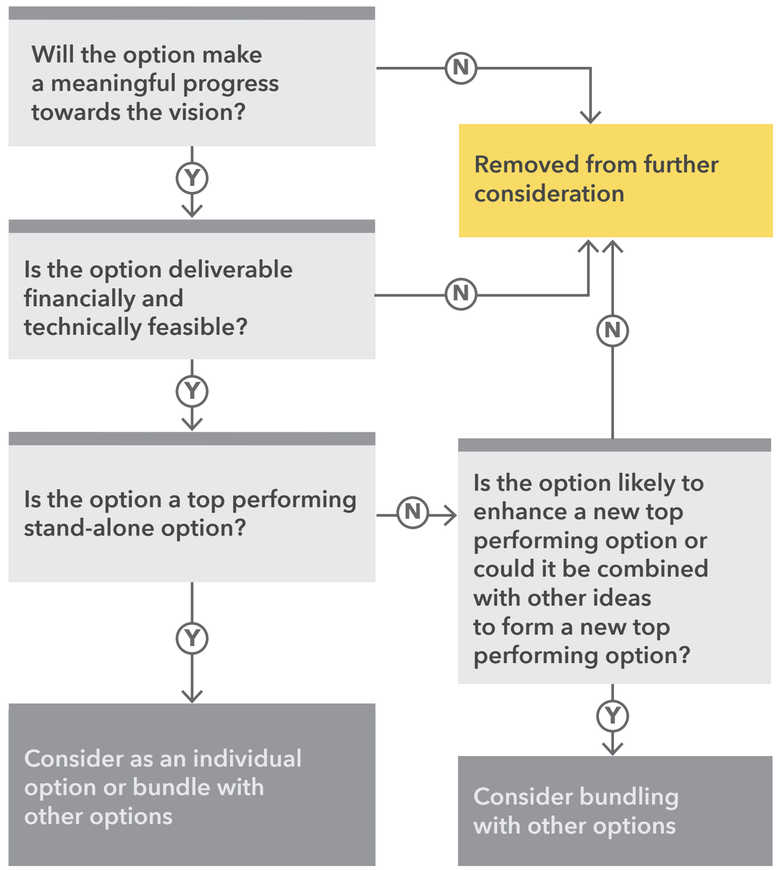
- **Changes –** enhancements compared to the base.
- **Timing –** deferring or bringing forward implementation dates.
- **Scope –** cutting back on full implementation.
- **Standards –** enhancing or reducing specification.
- **Synergy –** in combination with other projects some options may perform particularly well or, alternatively, simultaneous implementation at a site could create problems. Business cases can help identify the opportunities for synergy.
- **Consensus –** reflect the preferences of stakeholders and likely public support.
- **Reputation –** corporate image and the value of company-wide or corporation-wide consistency.

Moving from the Long List to the Short List

For problems and/or opportunities with a long list of potential options a screening process may be used to ensure that only options that are expected to have a significant strategic impact and are financially and technically feasible are evaluated and further refined or scoped. This process is outlined in Figure 3.4.

To ensure the number of options selected for a business case is manageable, creating a matrix/table showing the analysis of a long list of options against a variety of criteria can be useful in developing a short list. To increase the robustness of the shortlisting, the project manager should ensure the correct stakeholder groups are involved in the process.

Figure 3.4: *Sample Screening Framework*



Investment Options Section 4

Option Definition

Options that are selected for evaluation and included on the short list must be refined and scoped in a consistent manner to allow for evaluation in chapters 4-7 of the business case. Options should be defined with five considerations in mind:

1. **Demonstrating that a workable solution exists.**
2. **Setting performance objectives for the actions or changes the option will make to the transportation network**
3. **Estimating required inputs**
4. **Estimating outputs to be used in benefit analysis**
5. **Defining the Business as Usual (BAU) scenarios and how the proposed option(s) is different**

This process may vary depending on the type of option, but typically will include definition of:

- **Impacts on customers and communities –** including changes to customer experience and corresponding increase in ridership, drawing upon modelling where appropriate.
- **Option design and design assumptions –** including engineering or policy development to a stage appropriate for the business case. Design may consider the physical layout of a desired change to the network or the key changes that a new policy will require to be successful. Option design should revisit interdependencies or conflicts and also consider responsibilities for planning, implementing, and operating the option and what the required capacity will be.
- **Costing –** including capital, operating, and renewal cost for the option. Costs may be developed on a project by project basis, but all adhere to a similar and robust set of estimation guidelines.
- **Business as Usual and Interdependencies –** outlining how the option changes the transportation network compared to the BAU transportation network and how the option may impact or be impacted by other investments.

Each business case should include base information across these three considerations along with proposed delivery timelines. This information is considered the ‘core evidence’ that is evaluated within the four cases (strategic, economic, financial, deliverability and operations).

Impact on Customers: Forecasting Option Performance

Predicting the future impacts of an investment is a key aspect of the business case process. This involves qualitative reasoning to outline the 'logic' of how an option will benefit or impact customers, along with the use of forecasting tools (where relevant) to determine how these customer impacts will impact use of the transport network. Qualitative analysis of customer experience should be presented clearly, outlining how customers will make use of the investment and how the design can be optimized to meet customer needs.

Short Term (1-5 years) Business Strategies

For investments related to shorter term investments, forecasts should be drawn from historical trends and take into account existing planned actions listed in the 5-year Metrolinx Strategic Plan (for example: the base case). The forecasted impact of the investment on these existing trends should draw either from examples of similar experiences at Metrolinx or elsewhere, or be conducted using ranges to give a sense of what the impact would be at different impact levels (for example: very small percentage change vs. very large percentage change).

Short-Medium Term (1-10 years) Ridership Forecasting

For investments related to changes in ridership in the short term, a direct demand approach may be most appropriate for the scale of the investment. Direct demand uses changes in travel costs (out-of-pocket, perceived costs) and changes in journey characteristics (travel time, travel comfort, travel time reliability) to forecast how existing levels of demand are expected to change. Using this approach is best for projects on specific routes or corridors with established demand patterns.

Long Term (15+ years) Ridership Forecasting

For longer term ridership forecasting, several transportation demand models have been developed in the GTHA to take into account changes in land use patterns and the transportation network to more accurately estimate ridership over a longer horizon. These models are also useful for forecasting network effects of investments that direct demand approaches do not easily capture.

For short-medium term and long term ridership forecasting, a ridership ramp up period should be applied to reflect the delayed response in ridership uptake (Table 3.3). A project is assumed to reach its full ridership potential by the fourth year of operation.

Table 3.3: *Ridership Ramp-Up*

Year 1	Year 2	Year 3	Year 4
60%	75%	90%	100%

Long Term Forecasting Using the Greater Golden Horseshoe Model V4

This section provides high level guidance on the use and application of modelling tools, including Metrolinx's core network modelling tool the Greater Golden Horseshoe Model Version 4 (GGHMv4), comparable models, and other modelling approaches (example: elasticity based frameworks, unimodal models). This guidance is:

- Intended to support sponsors, business case analysts, and project managers in understanding the role of modelling in business case development; and
- Not intended to act as a detailed modelling manual or methodology.

The section includes:

- **The Role of Transportation Demand Models** – a summary of how demand models are used in business cases;
- **Transportation Demand Model Background** – a high-level summary of the key principles for demand modelling, including the types of models that may be used and choice model structures;
- **Applying Transportation Demand Models to Business Case Analysis** – key considerations for making use of demand models when developing business cases; and
- **Model Deep Dive: GGHMv4** – high level guidance and considerations for making use of the regional transportation demand model when developing business cases.

Role of Transportation Demand Models

Business cases require a robust evidence base on future impacts of an investment. As a result, modelling – or forecasting – travel demand typically forms a core input to the design and evaluation of transit Investments. Models can be used for a range of purposes throughout the business case lifecycle, including estimating:

- Potential ridership and revenue changes;
- Benefits arising from the project (example: user benefits and external benefits from changes in travel times, vehicle kilometres travelled.); and
- Sensitivity tests, which assess how a change in input variables changes model outputs and overall investment performance.

Models may also be used to inform the optimization of project definitions (example: stop location, stopping patterns, vehicle capacities, frequencies). When applying models, analysts should:

- Be clear on time periods and units of forecasts, modes and applicable year; and
- Consider making use of aggregate statistics as well, which are useful to provide overview of forecasts and impacts, when reviewing model runs.

Transportation Demand Model Background

Model Types

For the purpose of business case development, Metrolinx considers two types of transportation demand models:

- **Network models** – 4-stage, activity based, tour based, multi-modal, land use inputs required, representation of auto/transit/AT networks
- **Direct demand models/unimodal models** – single mode models that are either elasticity or econometric based and typically rely on comprehensive records on modal demand over time

Modelling can also encompass operational modelling (such as for traffic operations at intersections or of fixed track rail systems) – as these tools play project specific roles, they are not the focus of this section of the guidance.

In both approaches the following key principles are used:

- Models reflect time and cost of travel for different transportation options or modes;
- Demand is split into zone systems (geographic, external or 'point' zones, such as PnR / station zones) and typically, total volume of trips, time of travel, and demand patterns are fixed (although some models may aim to capture induced demand);
- Assignment determines the best paths through the network for each trip;
- Journey time is a core element of assignment algorithm – car times will reflect congestion, transit times include walk/wait at stop/interchange points, with weightings applied to non-vehicle time to reflect preference for riding in-vehicle (typically walk/wait value at 2-3 times in-vehicle time (IVT)); and
- Cost can be included in assignment, although typically restricted to higher level only (mode choice, distribution) only and not applied to lower levels of the model structure.

Importantly, most demand models have an implicit assumption – behavioural relationships are fixed through time in a given model. This can present a challenge for new modes/services (such as car sharing or transportation network companies) and changing preferences/ influences by exogenous factors (new technology – phones/apps, car ownership costs, softer intangibles – improved bike networks improving safety/urban realm improvements, more broader perceptions changed through media, and other behavioural considerations). This assumption is a key reason why all business case modelling should consider sensitivity tests on model inputs (such as auto operating costs) to determine how changes in behavioural model inputs could impact investment performance.

Choice Model Structure

A central feature of multi-modal models is the choice model. Based on the network travel times and costs between zones, the choice model forecasts how demand is split between the alternatives (such as auto and transit). Most models use the logit function:

$$P = \frac{e^{-\lambda GT}}{\Sigma\, e^{-\lambda GT}}$$

Where:

P = the proportion forecast for that alternative

GT = the generalized time of travel between zones (time and the time equivalent of any monetary cost incurred, such as transit fare, with time being perceived time)

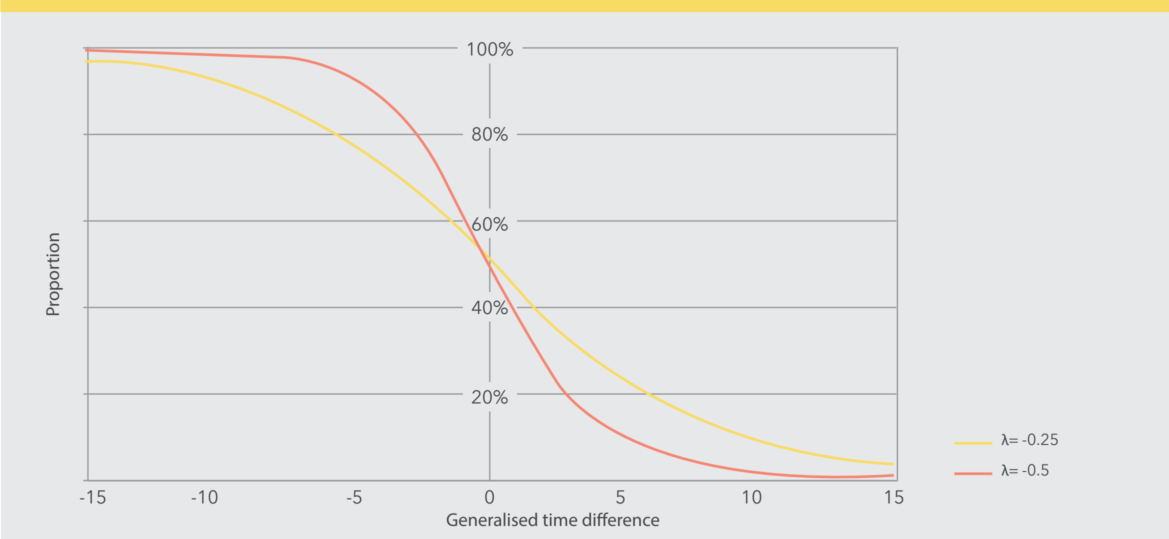
λ = the scaling parameter, which governs the sensitivity to GT differences.

For a simple two way (binary) choice, the model produces a choice proportion curve as shown below in Figure 3.5. Where the generalized times are equal, the zero-difference results in an 50% share to both. As one alternative becomes faster (say by 5 minutes), the proportion increases (to near 80% in this example); conversely, the proportion of the other alternative falls.

The use of logit models should be informed by three key characteristics.

- Firstly, the curve is asymptotic to the 0% and 100% proportions, meaning all alternatives will be allocated a (small) proportion, irrespective of how unattractive they may be. In some cases, this may result in a material proportion of overall demand for a given alternative coming from a very large number of ODs with very low demand; however, in practice, such demand is not realistic. In such cases, the model can be modified to ignore very small proportions (say less than 5%), with demand allocated to the valid alternatives.

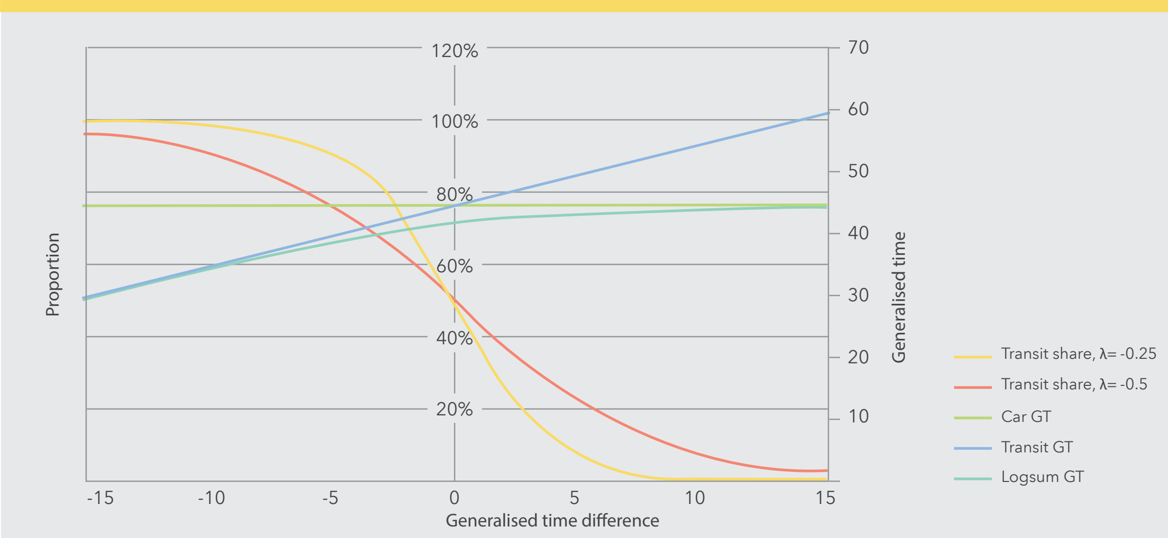
Figure 3.5: *Impact of Generalized Time Differences on Mode Split in a Choice Model*



- Secondly, the model is based on generalized time differences, meaning changes in time should be considered in relative terms. In practice, a given generalized time difference will produce different trip changes depending on the trip duration: a 10 minute difference will have a material difference to a 20 minute journey, whereas on a three hour journey the impact will be less significant. The value of λ is typically estimated to provide the best fit across the set of observed journeys, and consequently, the fit is poorer for trips at the margins of the trip length range. In such cases, this can result in under and over allocating to the best alternative for short and long trips respectively. It is possible to estimate a decay function for λ to correct for this potential issue.
- Finally, given the use of generalized times to forecast the demand split by alternatives, the logsum function which is the log of the denominator of the logit function, can be employed to derive an overall perceived average. This value is not a simple weighted average (which would fall somewhere in the range of generalized times), but rather reflects the perception of true generalized costs that gives rise to the logit curve in the first place. The logit curve, used with tangible measures of time and cost, reflects the variance of behaviour and perception of all travellers, with some not choosing the 'best' option (e.g., some people will still choose a rail option of 100 minutes over a car option of 80 minutes, even though the latter is rationally the best option). Those travellers choose the other options since they perceive it to be the 'best' option and hence lower than the rational best option in some way. The logsum function therefore captures this and produces an overall generalized time that will always be less than the lowest generalized time used in the logit model.

This is illustrated in Figure 3.6 below, where car has a constant 45 minute GT and the transit GT varies between 30 and 60 minutes; the logsum is always less than the lowest GT (but close to the lowest GT when the alternative is materially higher).

Figure 3.6: *Logsum Estimation of Generalized Time*



Role of Transportation Demand Models

Business cases make use of a focused set of model outputs to generate evidence as input into the four evaluation cases. Three key types of outputs an analyst should extract by geographic origin and destination pairs and time of day (at a minimum, peak and off-peak) are:

- Demand (which can be used to generate revenue);
- Change in generalized time for all modes; and
- Change in vehicle kilometres travelled (VKT), kilometres walked, and kilometres cycled.

When extracting these outputs, analysts should conduct a robust sense checking process before using outputs in the business case. This process can confirm benefits and also support the development of a narrative for the Strategic and Economic Cases. Key considerations are:

- Distribution of time savings by band (example: frequency distribution of time savings by trip demand);
- Average benefit per user;
- Sector analysis of distribution of benefits (for example: what benefits are in project corridor and are any off corridor?); and
- Mode shift sensibility (in other words, does mode shift occur where it is expected?).

Evaluation is typically conducted at the main mode level – auto, transit, walk/bike (if active transportation only). As a result, some business cases may require analysts to combine/aggregate sub-modes (for example: GGHMv4 has 5 transit modes – the analyst may need to combine them using logsum times/costs to a single transit mode).

The GGHMv4 should be used for all Metrolinx business cases unless a strong case can be made that a direct demand model is more appropriate. In these situations, the direct demand model should:

- Have clear documentation on assumptions and inputs;
- Make use of modelling factors and considerations drawn from the GGHMv4 (including those documented in Economic Case) wherever possible and providing rationale for any areas where different factors are used;
- Draw upon international best practice; and
- Be peer reviewed both by internal Metrolinx staff and independent experts from the field of research or practice as appropriate for the project (for example, a direct demand model for a large investment may require more substantive peer review than a smaller investment).

If GGHMv4 is used to study a transit intervention, a base year project simulation should be done to inform a project-specific ridership growth rate. If a direct demand model is used instead, a generic ridership growth rate should be derived using a generic prject simulation. This ridership growth rate is used to interpolate ridership and project benefits to the project opening year, as well as extrapolate ridership and project benefits beyond the forecast year.

In the absence of a ridership growth rate, 2% can be used as a generic assumption for ridership growth in the GTHA.

Model Deep Dive: Greater Golden Horseshoe Model V4

Background

The GGHMv4 is the latest version of the GGHM family of models and was released in 2015. It was developed for the MTO using 2011 TTS data, with the forecast horizon typically being 2041. Unlike previous versions of the model, it represents a full 24-hour weekday period, enabling integrated peak and off-peak modelling and analysis. While v3 was partially tour based, v4 uses population synthesis to model intermediate stops while making daily tours across all journey purposes. The total number of zones is 3,484 in the 2041 RTP In-Delivery model network (representing all funded projects).

The network model covers the Greater Golden Horseshoe, including the GTHA, and beyond covering the Niagara Peninsula, through Waterloo region, to Barrie and Simcoe, and Peterborough in the east. Network improvements from v3 include:

- More detailed road network, with refined coding conventions;
- Transit routes derived from GTFS feeds (where available), with development of a 24-hr daily network, enabling abstraction of time period specific networks;
- Detailed transit station files, including parking capacity and charging regime, and walk times to platforms;
- Improved peak period transit assignment algorithm to reflect capacity, crowding and reliability; and
- Disaggregate airport zoning and a custom air passenger model.

Model Time Periods

Modelled and assigned time periods are set out in Table 3.4. Of note, the main demand model considers five time periods and these are reflected in the auto assignment. However, transit assignment is limited to the AM peak and a combined period covering the entirety of the non-peak periods (the PM peak is not assigned).

Table 3.4: *Modelling Time Periods in the GGHMv4*

Hour beginning	Modelled period	Auto assignment	Transit assignment
12 am	Deep night (overnight)	Average hour	Combined 17 hours off-peak
1 am			
2 am			
3 am			
4 am			
5 am			
6 am	AM Peak	Peak hour	Peak 2 hours (6:45-8:45)
7 am			
8 am			
9 am	Midday	Average hour	Combined 17 hours off-peak
10 am			
11 am			
12 am			
1 pm			
2 pm			
3 pm	PM peak	Peak hour	Not assigned
4 pm			
5 pm			
6 pm			
7 pm	Evening	Average hour	Combined 17 hours off-peak
8 pm			
9 pm			
10 pm			
11 pm			

Demand Matrices

Demand matrices are used to generate key model outputs such as ridership and benefits. Demand split into matrices as follows:

- **Auto (10)** – split by 1, 2 and 3+ occupancy, each having toll and no-toll versions, and 2 and 3+ also having HOV/no-HOV versions
- **Transit (5)** – is split by the 5 mode choice model modes of GO train, subway/LRT, express bus (essentially GO bus), rapid bus and local bus. Note that GO train and subway/LRT are NOT true OD, rather they are station-station only; in addition, express bus is a mix of true OD and park and ride site OD (see 'other' below for access/egress matrices).
- **Other (4)** – including walk only, bike only (walk and bike are not assigned), and two related to park and ride trips (drive to and from stations, and zone to station for non-drive access)

Given the mix of true OD and leg based matrices, care is needed to interpret demand impacts across the matrices to account for both omission and double counting of trips as well as mix of person and vehicle matrices.

Key Considerations for Using the GGHMv4 in Business Case Analysis

When applying the GGHMv4, analysts should consider the following when working with model outputs (including strengths, weaknesses, and key influences on modelling outputs):

- The GGHMv4 is a large scale regional model, calibrated/validated at a regional level – results should be robust for broad policy testing and material network changes.
- As the impact area/scale of the policy/project becomes smaller, the model will become less robust, both in absolute (in comparison with observed network demand/conditions) and relative (model sensitivity) terms, and as a result model outputs should be reviewed to understand this and make post model adjustments if appropriate.
- The model can provide full demand response to infrastructure projects – demand, boardings/alightings and associated stop-stop pattern and car demand changes.
- The model can be used to review and refine project definition (for example: transit service patterns and headways), which allows for project optimization prior to conducting a final evaluation run.
- The 2041 network uses the 2011 local bus network as a default (even for 2041), so analysts should review/update as required for study specific requirements (especially in new development areas where there is currently no bus network).

- Bus times use road times, with allowance to reflect stops – for bus projects this may mean modelled buses do not necessarily reflect planned route run times:
- Auto network is link only, based on volume delay functions to estimate times:
    - Freeflow links (400 series) reflect associated capacity (1,800 vehicles/hour); suburban/urban network has capacity reduced to reflect intersection impacts (700-900 vehicles/hour).
    - No inclusion of specific intersection delays or capacity constraints, so in highly congested conditions, the model will likely underestimate network conditions/times.
- Walk mode is allowed across entirety of road network (except 400 series), which can result in excessive (demand/length) walk trips where transit is sparse/non-existent (which is then a potential issue when project fills such gaps and may result in significant travel benefits).
- Car impacts – model can provide forecasts for mode shift and associated attributes (change in traffic flows, veh/kms, speeds), which can then be used to evaluate external economic impacts as discussed in Chapter 5. Model information can be used in more detailed traffic analysis (intersection operation), preferably using model data to factor observed flows.

Option Design and Cost Development

A range of design and cost estimation techniques may be used, depending on the stage of the business case and the stage of design. Table 3.5 outlines the level of detail expected at each business case stage and a suitable technique to generate costs.

Cost estimation should include the following components, at a minimum as appropriate:

- Project development and design
- On-corridor infrastructure
- Off-corridor infrastructure
- Customer facing project components
- Supporting costs (example: marketing)

Cost development should consider long range changes in key cost inputs, such as cost of fuel, energy, and labour as inputs into operating costs. In addition, costing should also consider design features included to prepare the project for long term changes or be retrofitted for major changes (example: designing with climate change in mind).

There are three main components of a costing estimate:

- **The Base Cost –** The basic costs of the project option. These are estimated before incorporating risks and optimism bias. These costs should still reflect the expected real costs of projects.
- **The Risk Adjustment –** The risk adjustment process should incorporate all identifiable risks into the project option. The process should quantify and monetize all possible risks, and incorporate them into the risk-adjusted cost.
- **The Optimism Bias –** Adjusting for optimism bias should be done after the risk adjustment process. This process incorporates the expected systematic bias into the cost estimate. Realized costs have been proven to be systematically higher than the expected budget – adjusting for optimism bias accommodates that systematic bias.

Table 3.5: *Cost Estimation Techniques*

Business Case Lifecycle	Level of Design	Sample Estimation Technique	Description
Initial	0-10%	Parametric	Uses variable and fixed unit costs
Preliminary Design	10-30%	Investment Grade or Bottom up Estimates	Uses smallest appropriate individual units comprised in the option to estimate costs.
Full	30%		
Post In-Service	N/A	N/A	Reviews actual capital costs and operating costs.

Business as Usual and Interdependencies

The business case should clearly articulate the assumed BAU scenario. The BAU should be drawn from existing commitments (for example: the in-delivery 2041 transit network or the 5-year operating strategy) and established trends (for example: population and employment growth rates). All investment options should be scoped based on how they incrementally add to the transportation network defined in the BAU. Investments are incremental to what exists today and what is currently funded, committed, or in-delivery. The BAU should be articulated based on the same dimensions as the proposed investment (customer behaviour and costs). The BAU should be articulated within the business case using key transport metrics, such as level of growth in congestion or transit ridership.

The final step in scoping explores the assumptions that support the option's inclusion in the analysis and its interdependencies, and conflicts with existing and future conditions or other projects. These factors are defined as:

- **Assumptions –** key considerations that are made in positioning the option as a potential solution to the problem/opportunity (example: assuming that land is available for purchase on a complicated alignment or that crowding will continue to be an issue on a transit corridor).
- **Interdependencies –** key factors in the transport network or other planned investments that may be impacted by or impact the performance of the investment under consideration in the business case (example: fares will allow seamless use of multiple types of transit service or a new subway will integrate with another planned rapid transit line). Some interdependencies may be considered 'non-negotiable' core elements of the investment. For example, a transit program may be reliant on fare integration or improved station access. In these cases, interdependencies should be clearly discussed in each relevant evaluation chapter (Strategic, Economic, Financial, and Deliverability and Operations Case) based on their impact on investment perfromance.
- **Conflicts –** potential issues that the project will need to overcome if developed further (example: congested railway corridors that limit further development).

4

Strategic Case

What does the Strategic Case chapter cover in a business case?

What is the role of this chapter in the business case?	Rationale for pursuing an investment - details how the investment options contribute to public policy goals as articulated in the Case for Change chapter
What factors are included in the analysis?	Strategic outcome and benefits that indicate how the investment will address the problem statement and realize benefits to the region.
How is evidence summarized and communicated?	The Strategic Case is used to articulate how each option can achieve public policies, goals, or plans through a concise but detailed strategic narrative.

How is the guidance structured?

Section	Content
Introduction	Includes an overview of the Strategic Case and what is included in the guidance
Developing a Strategic Case	Outlines the structure every Strategic Case should follow
Strategic Case Analysis	Provides detailed guidance for: • Setting out strategic narratives • Communicating strategic performance based on how each option performs against each benefit or objective • Developing a summary of strategic performance for each option

Introduction

Overview

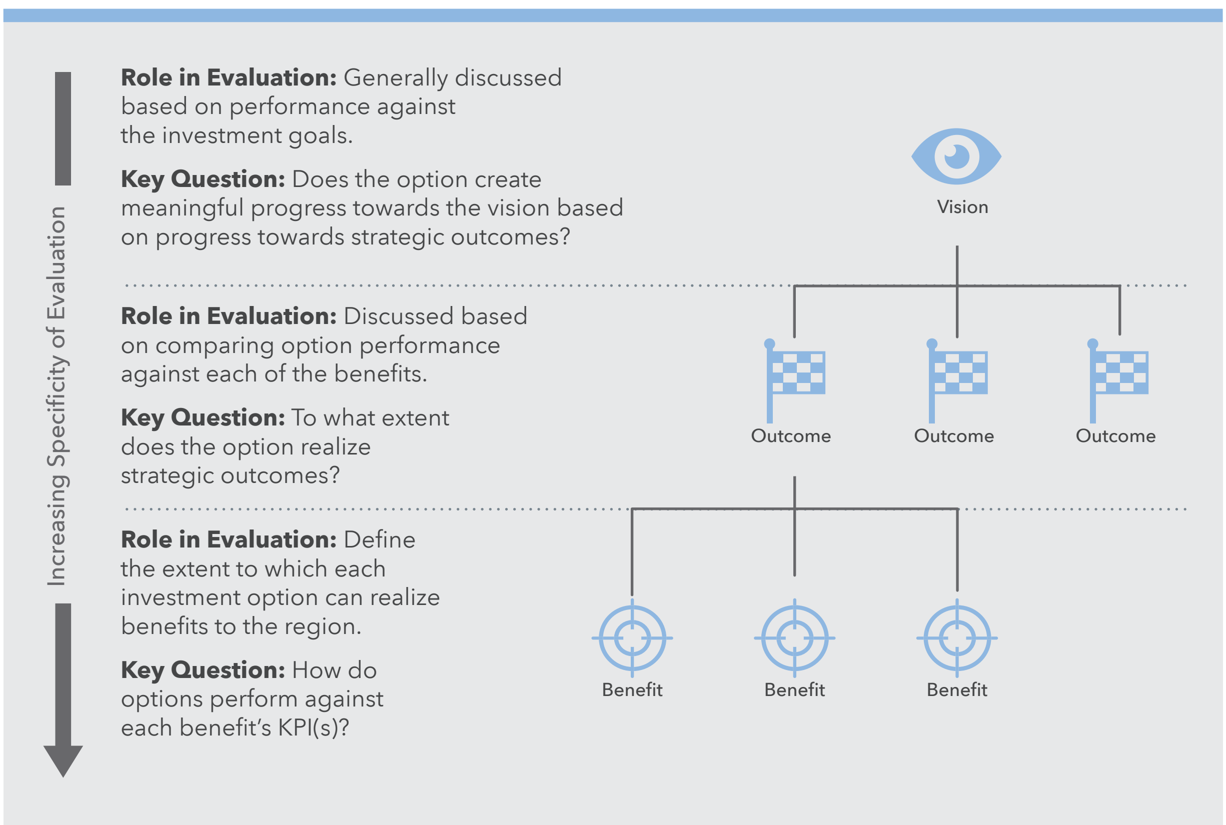
The Strategic Case summarizes the performance of each option against the strategic objectives to indicate if the investment supports addressing the problem or opportunity and the goals of the 2041 RTP. Because evaluation varies depending on the types of options and nature of the problem/opportunity and corresponding objectives, this section provides a general structure to be followed. Evaluation techniques may vary between objectives and business cases. However, every Strategic Case should set out a strategic narrative as it relates to the visions, outcomes, and benefits illustrated in Figure 4.1.

Chapter Output

The types of questions that the Strategic Case will typically seek to answer include:

- What strategic benefit is envisaged?
- How do options contribute to strategic objectives?
- What constitutes project success?

Figure 4.1: *Strategic Case Evaluation Structure*



Developing a Strategic Case

The Strategic Case should provide a detailed account of how each option supports the vision and goals. The core content required to complete a Strategic Case is outlined in Table 4.1.

Table 4.1: *Core Content Required for a Strategic Case*

Section	Subsections	Description
1. Introduction	N/A	Overview of chapter
2. Strategic Evaluation by Outcome Area	One subsection per outcome	Articulate how the option(s) perform against each benefit within each outcome area, with a narrative of how performance against each benefit supports progress towards the outcome area
3. Strategic Evaluation Summary	Option Comparison	Identify key factors that lead to different performance between the options (Initial Business Case and Preliminary Design Business Case only)
	Risks and Uncertainty	Identify key risks and uncertainties that may limit the option from achieving the performance noted in the evaluation
	Recommendations	Identify key recommendations for each option

Conducting Strategic Analysis

Strategic Case Analysis over the Business Case Lifecycle

Initial Business Case

- Conduct a detailed analysis of each option using quantified information and detailed rubrics for qualitative indicators
- Provide descriptive narratives for each option, supported by evidence, for how each option supports the strategic vision for the investment

↓

Preliminary Design Business Case

- Update the analysis conducted in the Initial Business Case based on any changes to investment specification or detailed design
- Analytic tools may be updated to ensure all analysis and forecasting is commensurate with the level of specification and scale of the investment

↓

Full Business Case

- Update the analysis conducted in the Preliminary Design Business Case based on any design refinements
- Analytic tools may be updated to ensure all analysis and forecasting is aligned with updates to investment scope and specification

↓

Post In-Service Business Case

- Review strategic narrative and compare estimated objective performance against collected data
- Develop a report on how much progress has been made for each goal and the vision with clear benchmarks

This part of the guidance outlines how to conduct and structure a strategic analysis and complete the four sections required for a Strategic Case.

Strategic Case Section 1

Introduction

The introduction section should outline the structure of the Strategic Case and provide the reader an overview of the key assumptions and processes used to conduct the evaluation.

Strategic Case Section 2

Evaluating Option Contribution to Outcomes

The Strategic Case evaluation should summarize performance against each strategic outcome that is relevant to the proposed investment and problem and/or opportunity it intends to address. However, because the vision and outcomes are broader ‘value propositions’ these are evaluated based on the ability of each option to realize benefits that contribute to outcome areas.

Instead, each option is evaluated against benefits (as discussed in Figure 4.1) that can be realized by addressing the problem and or opportunity).

A typical outcome section should include:

- Overview of the outcome
- Performance review of each option against each benefit with the outcome area (multiple subsections)

Benefit Sub-sections

Strategic benefits are used in the business case to understand how each option performs against the outcomes and vision defined in the context section.

Benefits are evaluated directly by setting out meaningful performance measures. Each benefit may have one or more performance measures that are used to quantify or qualify the extent to which an investment realizes benefits. Benefit performance is then used to infer overall performance against a broader outcome, and the aggregate performance against outcomes is used to answer the question: does this option realize the investment vision?

Within the business case, quantitative performance measures and qualitative rubrics may be used. Performance measures should be concise, meaningful, and focused on measurable outputs.

The following list of criteria is provided to guide the selection of performance measures:

- **Data availability –** Current capacity to collect and provide data to support a specific measure.
- **Analytical capability –** Capacity to analyze data to support a specific measure and to forecast performance or progress under various scenarios or strategies in order to compare future options.
- **Clarity –** Degree to which a measure provides meaningful and easily understandable output and information.
- **Specific –** Degree to which a measure provides meaningful information to the objective.
- **Reporting value –** The value of a measure can communicate effectively what is important and a priority to the public, politicians, and stakeholders.
- **Management value –** Degree to which a measure can support accountability and other management and financial tools.

Some objectives are not amenable to quantification. Objectives with qualitative performance measures should be evaluated using a rubric. A rubric is a tool that translates qualitative performance into a standard scale that allows for clear comparison between options. Rubrics should be developed to be:

- **Clear –** avoid use of vague descriptions;
- **Consistent –** the rubric should be consistently applied by all analysts; and
- **Objective –** the rubric should not favour any particular option.

Potential benefits against the four key strategic outcomes used in this guidance and Metrolinx business cases are outlined in Table 4.2. These benefits and performance measures are not an exhaustive list.

Metrolinx has standardized the quantitative performance metrics to be reported in business cases. This was done to ensure consistent reporting among business cases, enable benchmarking of projects, and understand how various investments contribute to the long-term goals of the 2041 RTP. The standard performance measures are noted with an asterisk in Table 4.2.

Summarizing Each Outcome Section: the strategic narrative

Each outcome section should summarize the overall strategic narrative for the outcome and the 2041 RTP goal(s) it relates to based on how the option achieves each objective. A sample strategic narrative is outlined in Table 4.3.

Table 4.2: *Sample Benefits and Performance Measures by Strategic Outcome*

Outcome	Example Benefits	Example Performance Measures
Transportation	Transit Ridership	• Total ridership • New Transit Users* • Passengers per service km • Ratio of ridership growth to population growth • Peak period directional load factor
	Faster Travel Time	• Travel time savings (measured in units of time)* • Average travel time on corridor
	Travel Reliability	• Percent on-time arrival • Headway or frequency • Distance or time between vehicle failures • Number of mechanical failures in a given period
	Network Connectivity	• Average waiting time for transfers • Number of multimodal connections on the network • Number of terminals served by two or more modes
	Comfort and Capacity	• Average volume to capacity ratio* • Peak period directional load factor • Level of service rating (best to worst)
	Customer Information	• Information availability at stations and through online or call centres
	Network Resilience and Sustainability	• Total revenue and revenue/operating cost ratio • Longevity of the investment (for example: how long until the investment becomes crowded) • Network ability to manage and mitigate shocks or disruptions
Quality of Life	Access to Residential Areas	• Distance to transit from communities served by investment* • Number of homes or people living within access distance to transit • Level of connectivity to new residential developments or areas targeted for revitalization
	Access to Public Services, Spaces, and Institutions	• Quality of connection to hospitals, universities, green spaces, and other cultural institutions • Number of hospitals, universities, green spaces, and other cultural institutions accessible by transit
	Vibrant Public Spaces	• Investment impact on urban realm • Investment impact of heritage buildings
	Healthier Communities	• Number of trips using active modes • Number of collisions or incidents resulting in injury or death • Criteria air contaminant emissions
	Equity	• Transit accessibility for marginalized communities and travelers* • Access to jobs for low income persons*

Table 4.2: *Sample Benefits and Performance Measures by Strategic Outcome*

Outcome	Example Benefits	Example Performance Measures
Economic and Regional Development	Connecting Commuters to Jobs	• Travel time for commuters on transit • Number of jobs within access distance of transit*
	Catalyzing Urban Land Development	• Increased connectivity to areas planned for land use intensification or major development
	Supporting Innovation and Prosperity	• Level of connectivity between major employment hubs, academic institutions, and other centres of innovation • Level of connectivity between existing and planned or future employment hubs
	Employment Creation and Economic Impact	• Input/output model estimates for jobs and GDP impacts from investment
Sustainable Environment	Energy Use and Efficiency	• Fuel or energy consumption by passenger vehicles • Number of auto vehicle trips reduced* • Percentage of fleet vehicles transitioned
	Improved or Protected Natural Environment	• Natural land impacted by transport network • Impact on protected areas (parks) • Impact on agricultural land
	Reduced Emissions	• GHG or CO_2 emissions*

Table 4.3: *Sample Strategic Narrative per Option*

Instructions	Outcome and 2041 RTP Goal	Benefit	Actions	Outputs/ Objectives Measure Performance	Outcomes/ Progress towards 2041 RTP goal	Overall Impact/Progress Towards 2041 RTP Vision
What is included in the table?	A statement of the outcome under consideration and how it contributes to the 2041 RTP goal	A statement of each objective	A summary of how the option realizes the benefit	A summary of performance against each performance measure	A statement of the extent to which objective performance supports the realization of the goal	A statement based on synthesizing all outcome/goal performance (one per set of objectives under each goal)
Example	The project improves service quality, increases transit choice and ridership, increases network flexibility and meets local and regional transit travel needs for existing and new passengers	**Benefit 1:** Transit Crowding Relief	Mechanism: draw demand south of Bloor and east of Yonge to reduce crowding on Line 1 due to Line 2 transfers Action: provide a new rapid transit corridor between Line 2 and downtown at Pape Station	6,000 peak period passengers switch from Line 1 to the new subway	Moderate improvement in overall crowding for customers travelling south of Bloor-Yonge Station	Moderate progress towards vision by reducing crowding on Yonge; however, the option does not allow for a significant mode shift from auto to serve the downtown core and does not build the transit market compared to the status quo
		Benefit 2: Transit Network Efficiency	Mechanism: draw demand south of Bloor and east of Yonge to reduce crowding on Line 1 due to Line 2 transfers Action: provide a new rapid transit corridor between Line 2 and downtown at Pape Station	Offers new journey opportunities to Line 2 passengers heading south, as well as downtown core residents connecting to the eastern portion of Line 2; however, there is not a significant change in mode split to downtown	Minimal improvement	

Strategic Case Section 3

Evaluating Options Performance Towards the Strategic Value Proposition

How an option performs against the value proposition should be summarized concisely with an impact statement derived from the overall performance against each goal (which in turn is informed by objective performance) as noted in the preceding sections and their logic frameworks. This statement should:

- Indicate the option's overall performance based on the outcomes and benefits.
- Suggest the extent to which the option's performance can realize the value proposition and address the problem or opportunity based on the logic framework summaries for each goal – and therefore contribute to the 2041 RTP vision.

The structure shown in Table 4.3 can be used to articulate performance for each option.

Strategic Case Section 4

Strategic Case Summary

The summary should clearly address:

- What are key factors that led to a difference in performance between the options for the overall Strategic Case?
- What are key areas of uncertainty or risks that may limit the option from achieving its performance? How can these risks be managed?
- What are the strategic recommendations for each option?

If useful, a summary table (as shown in Table 4.4) should be developed to communicate the Strategic Case in a concise manner.

Table 4.4: *Strategic Case Summary Template*

Outcome		Option 1	Option 2	Option 3	Option z
Transportation	**Benefit 1**	Key numeric indicator or brief qualitative statement			
	Benefit 2				
	Benefit 3				
Quality of Life	**Benefit 4**				
	Benefit 5				
Economic Development	**Benefit 6**				
	Benefit 7				
Sustainable Environment	**Benefit 8**				
	Benefit 9				
Overall Pros		Brief summary of pros			
Overall Cons		Brief summary of cons			
Overall Strategic Benefit		Statement on recommendations based on strategic performance			
Key Strategic Risks and Dependencies		Statement on level of risk to strategic benefits realization			

5

Economic Case

What does the Economic Case chapter cover in a business case?

What is the role of this chapter of the business case?

Rationale for pursuing an investment – the Economic Case details the overall benefit of the investment to society by using a standardized economic appraisal

What factors are included in the analysis?

Key Economic Metrics:

- Cost to deliver/operate
- User impacts
- External impacts
- Wider impacts

How is evidence summarized and communicated?

The Economic Case communicates the overall benefit to society of the investment based on:

- Net present value = total benefits – total costs
- Benefit cost ratio = total benefits/total costs

How is the guidance structured?

Section	Content
Introduction	Includes an overview of the Economic Case and a summary of what is included in the section
Developing an Economic Case	Provides instruction on: • Key Considerations for Developing an Economic Case • Economic Appraisal Using Benefit Cost Analysis • Economic Case Analysis Over the Business Case Lifecycle
Economic Case Analysis	Provides detailed guidance for: • Assessing cost impacts of the investment • Assessing user impacts • Assessing external impacts • Assessing wider impacts • Assessing land value and development impacts • Summarizing economic appraisal

Introduction

Overview

The Economic Case is one of two chapters focused on the rationale for pursuing an investment (the other being the Strategic Case). While the Strategic Case evaluates options based on a project specific policy/plan oriented evaluation framework, the Economic Case evaluates benefits and costs to articulate the overall benefit to society (including travellers, people, firms, and government) of pursuing each investment option. Each Economic Case is completed using a similar set of economic appraisal tools and assumptions.

Unlike the Financial Case, all analysis completed in this section uses real values and a social discount rate, as opposed to nominal values and a financial discount rate. Real values do not include the impact of general inflation, but must consider real growth. A social discount rate reflects society's value of time preference for consumption – a benefit or cost incurred tomorrow may be less 'valuable' than the same benefit or cost incurred today.

The types of questions that the Economic Case will typically seek to answer include:

- What are the benefits and resource costs associated with the investment option(s) in real terms?
- What is the overall impact to society, as indicated by the Benefit Cost Ratio (BCR) and Net Present Value (NPV) of the investment option(s)?
- How sensitive is economic performance to key assumptions used in option definition and evaluation?
- Will the investment have an impact upon productivity and economic performance?

Guidance Structure

The Economic Case guidance is composed of two sections:

- **Developing an Economic Case –** a summary of the key requirements for completing an Economic Case; and
- **Conducting an Economic Analysis –** a summary of the analysis required to complete the Economic Case.

Economic Case vs. Financial Case

The Economic Case and Financial Case both present information in dollar terms, but reflect different ways to understand investment impact. The Economic Case considers society-wide impacts and the resource costs to deliver an investment. In the Economic Case, impacts such as reducing user travel time, air pollution, or car accidents are monetized as benefits. The Financial Case focuses on the financial resources required to implement the investment and the cash flow impact for Metrolinx or the agency responsible for the investment. Each case uses different assumptions and input parameters and care should be taken to differentiate the cases as the business case is completed.

Developing an Economic Case

This section summarizes the underlying narrative and structure of the Economic Case, along with the key parameters and considerations that should be used in the analysis.

It includes:

- Purpose of Economic Appraisal
- Key Considerations for Developing an Economic Case
- Economic Appraisal Using Benefit Cost Analysis
- Economic Case Narrative Structure
- Different Approaches to Appraisal
- Economic Case Core Content
- Economic Case Analysis Over the Business Case Lifecycle

Purpose of Economic Appraisal

From an economic point of view, transportation investment is justified when the investment meets an economic demand and realizes an economic or social surplus – for example, before investment a transport system may be behaving inefficiently and changes to the system may generate benefits that exceed costs. The investment is therefore intended to correct inefficiencies by changing services, policies, or infrastructure.

The Economic Case is intended to illustrate how an investment realizes benefits to society and the resource costs required to do so. For the Initial and Preliminary Design Business Cases, the Economic Case will review a range of potential alternative investment options and compare their economic merits.

In a Metrolinx business case, Economic Appraisal is used to:

- confirm that proposed investments have economic value; and
- determine which option out of a range of considered investments is the most economically sound for the GTHA.

Central to this evaluation are two key concepts:

- **Generalized Costs -** used in transport demand models to represent the cost of travel and allocate demand between the region's transportation services and modes. Each mode or service in the GTHA has a cost composed of perceived travel times and direct user costs (fares or tolls), which determine if an individual will travel. Transport investments can change demand by changing the generalized cost of transport – either by providing a new service or modifying an existing one. When the generalized cost 'paid' by travellers decreases beyond what they were willing to pay, they benefit (example: a traveller was willing to use transit when the trip was 10 minutes - under an investment the trip is now 8 minutes, realizing a 2 minute benefit to the user.) If the generalized cost increases, users receive a disbenefit. Generalized cost changes are captured in the Economic Case as 'user impacts' and can be expressed in units of time or money.
- **Social Costs -** each transport service has a social cost to society based on the impacts it creates. Common transport social costs include collisions resulting in property loss, injury, or death; emissions resulting in health impacts; and climate change. Investments may change the overall social costs of the transport system by reducing the overall social cost of travel in the GTHA (example: a new subway attracts demand from a highway, reducing greenhouse gas emissions).

Key Considerations for Developing an Economic Case

The Economic Case is developed using models and estimates to understand the overall economic potential for the investment. As a result, this analysis includes significant risk and uncertainty. Throughout the business case lifecycle, economic analysis should consider two approaches to manage risk and uncertainty:

Presenting Economic Values in Ranges

At all business case stages (Initial, Preliminary Design, Full), costs and impacts should be estimated quantitatively using ranges that are narrowed as the project progresses and the level of certainty increases.

Key Economic Risks and Benefits Dependencies

The narrative included within each section of the Economic Case should clearly identify key risks and dependencies that shape overall investment performance.

Economic Appraisal Using Benefit Cost Analysis

Economic Appraisal uses Benefit Cost Analysis (BCA) to quantify and monetize economic impacts for the purpose of understanding and comparing projects and policies. This analysis is a partial equilibrium analysis that is focused only on the impacts and costs of the proposed investment and its relationship to the transportation network and transportation demand. All other assumptions (example: land use, level of demand) in this analysis remain static (aside from change to base assumptions in sensitivity tests). Partial equilibrium analysis also assumed that all costs will be spent efficiently and benefits realized efficiently.

BCA allows Metrolinx to review a range of alternatives under a consistent set of input assumptions to determine which option is strongest from an economic point of view. For an investment alternative to be acceptable, it should have the highest economic performance out of a set of reasonable mutually exclusive alternatives and also have overall positive economic performance (sum of benefits exceed the sum of costs). BCA includes all impacts which have an effect on societal welfare – not only the financial impacts. BCA measures changes in welfare using an established set of economic methods, which are elaborated upon in the "Conducting Economic Analysis" section.

BCA is commonly undertaken by public transportation agencies and other public institutions to estimate the economic value of a potential investment.

Key principles for BCA include:

- Discounting
- Inflation
- Business as Usual vs. Investment Case
- Key BCA Metrics

Discounting

Discounting is a process to convert benefits and costs that occur in future years into present value. The discounting process reflects people's "time preference", which is their widely-observed preference for consumption today rather than in the future. People and firms typically value $10 received today more highly than $10, received in the future. This is due to a general, widespread preference in the population,, government, and private sector. In Ontario, discount rates incorporate the opportunity cost of private capital, the cost of government borrowing, and the social rate of time preference. Risk premiums are not included in these discount rates. Discounting is to be applied after prices have been adjusted to real terms.

Discounting estimates the present value of a stream of benefits and costs over the whole evaluation period. The present value is calculated by discounting each year's benefits and costs, and then summing all the benefits in each year. This can be represented by the following formula, where the $\sum$ symbol represents the sum over the evaluation period from year 0 to year n and the $\prod$ symbol represents the product of $(1 + r_i)$ over the range shown. This approach is summarized in Equation 5.1.

Equation 5.1: *Discounting Equation*

$$PV = \sum_{y=0}^{n} B_y / \prod_{i=base}^{y} (1 + r_i)$$

PV : The Present Value

B : The Benefit or Cost (C) Under Analysis

r : Social Discount Rate

Inflation

The general increase in prices over time is known as inflation, and is reflected in the declining purchasing power of money over time. Canadian inflation is measured by the Consumer Price Index (CPI – a measure of inflation), with the Bank of Canada policies targeting an inflation rate of 2% a year. Under conditions of inflation, $1 today could not purchase what $1 could purchase last year, and $1 in the future will purchase even less. When prices are given in 'nominal' terms, these are the actual or expected prices, at face value, of that good or service in that particular year. The 'real' prices of goods and services are the prices after general price inflation has been removed. Economic BCA measures the expected changes in the real prices of goods and services. As a result, prices given in nominal terms must be converted to real terms before their use in the Economic Case.

Change in value of costs or benefits due to 'escalation' (the relative increase in the value of a good or service beyond the average increase captured in the CPI) should be captured in the Economic Case. Escalation should be considered when developing estimates for capital and operating costs. In the absence of sufficient data to estimate escalation, an assumed rate of 1% may be used until 30 years from the base year of project evaluation.

Business as Usual vs. Investment Case

BCA considers a set of forecasted future scenarios, scenarios with a proposed investment (investment case) and one without the project (business as usual). Because the project exists in the future, the impacts of the project must be isolated from other impacts that may result from general trends not related to the project. For instance, population growth in the GTHA may lead to greater ridership irrespective of any project. To properly evaluate a project, all trends like this must be accounted for. To do this, a “Business as Usual” (BAU) case is created as a reference point that includes future trends but not the impacts of the project. BCA then examines the difference between the BAU and the investment scenario, so the only differences between the future scenarios should be due to the project.

In most cases the only difference between the future scenarios will be the specific investment, but in some cases, especially large investments, consideration of how the transit network will be reconfigured to improve the efficiency of the network is required (for example: a rapid transit line replacing bus routes may warrant reconfiguring the bus network). In this case, it will be acceptable to change some parts of the network other than the main investment; however, all major network changes should be documented. If changes are made to the network aside from the investment, impacts from the network changes should be included in the overall investment benefits and costs.

Key BCA Metrics

The Economic Case includes multiple key output metrics from the BCA: The benefit-cost ratio (BCR), the Net Present Value (NPV), and the Net Present Value divided by capital costs (NPV/k). These three metrics should be reported in the economic account of the business case.

Benefit Cost Ratio

The Benefit Cost Ratio (BCR) is calculated by dividing the present value of the total benefit by the present value of the total cost. It is:

$$BCR = \frac{PVB}{PVC}$$

BCR : Benefit Cost Ratio

PVB : Present Value of Benefits –
The real, discounted value of the stream of benefits

PVC : Present Value of Costs –
The real, discounted value of the stream of costs

The placement of impacts into costs and benefits is crucial for BCR calculation. Considering that a positive benefit could be construed as a negative cost, and vice versa, an accounting and reporting standard is required.

The present value of costs should only include the operating, maintenance, and capital costs of the transport project without any indirect tax impacts on other parts of the government. This will enable decision makers to understand the ‘value for money’ proposition of the investment within Metrolinx's budgetary constraints. If the BCR of an investment is greater than or equal to 1, it is considered economically viable.

In rare cases, the calculated BCR of an investment could be negative. This can happen under one of the following circumstances:

- The project generates negative benefits
- The project generates cost savings

When a project generates negative benefits, "All Loss" should be reported instead of a negative BCR.

$$All\ Loss = \frac{-\ PVB}{PVC}$$

When a project generates positive benefits, but there are also cost savings generated over the life of the project, "All Gain" should be reported instead of a negative BCR.

$$All\ Gain = \frac{PVB}{-\ PVC}$$

Net Present Value

The NPV is the total present value of all future benefits minus the total present value of all future costs:

$$NPV = PVB - PVC$$

The NPV is complementary to the BCR. It communicates value for money in an alternative way by showing overall the net benefit from the project in absolute terms. It is important to consider both the BCR and NPV in tandem when examining projects. It is common to focus on the BCR, but both are important. If a project's NPV is greater than 0, it is considered economically beneficial.

The use of BCRs and NPVs in a business case

The BCR and NPV are both useful measures for determining the value of an investment relative to its costs. Decision makers will review both as evidence of economic performance. The BCR is useful for understanding how benefits compare to costs in relative terms, while the NPV communicates the total value of the investment minus its costs. Both should be used to provide a robust picture of the investment's performance.

NPV/Capital Costs

The NPV/Capital Costs (or NPV/K) is a third metric for projects which have a high capital cost budget, but still have considerable benefits per dollar spend of a capital budget. As a third metric, it offers improved illustration of the benefits for different options.

Return on Investment

Return on Investment (ROI) is equivalent to the (PVB - PVC)/(PVC). It communicates the relative value of an investment's benefits to the resources required to deliver it. A positive ROI indicates the project's benefits exceed its costs.

Internal Rate of Return

The Internal Rate of Return (IRR) reflects the discount rate at which the investment will have a NPV of 0. IRR can be useful for understanding the impact of the assumed discount rate on investment performance.

Sensitivity Tests

Projects should have analysis and time commitments commensurate with the scale of costs and benefits of the project. Sensitivity tests should be focused on uncertainties that have a substantial impact on the business case, rather than parameters which are uncertain but have a marginal impact on the outcomes.

Small Scale Projects (<$50 million)

Sensitivity analysis is not required for projects of this scale, but is encouraged for any parameters that have a low degree of clarity.

Medium Scale Projects ($50 million to $500 million)

The low-end of medium scale projects align with the definition of Major Public Infrastucture Projects (MPIP) by the Government of Ontario. MPIP's are defined as "projects with a total cost equal to or in excess of $50M for expansion type projects, or $75M for rehabilitation type projects, and/or demonstrates high risk of adverse effects on project objectives or a high degree of uncertainty regarding impacts on project’s scope, cost, or timing."

Projects of this scale with economic impacts should perform sensitivity tests specified in Table 5.1.

Optimism bias is not treated as a sensitivity at this stage, but instead is included in the base costs of the project. Wider Economic Impacts (WEIs) are also not to be conducted as a sensitivity test, but as part of the standard economic appraisal process.

In total, five sensitivity tests are recommended for medium scale projects, as outlined in table 5.1.

Any additional sensitivities that are project-specific are encouraged but are at the discretion of the project lead and are not required.

Table 5.1: *Sensitivity Tests for a Medium Scale Project*

Sensitivity Test	Rate(s)
VOT Growth Rate	0.75% (real)
Economic Discount Rate	2.5% (real)
Ridership Growth Rate	+/- 1% point from the base ridership growth rate
Operating Cost Growth Rate	0%, 3% for a 2% base, 2%, 3% for <2% base (real)

Large Scale Projects (>$500 million)

Large scale projects require additional time and consideration for reporting on results. These projects begin at $500 million, which is an approximation of the scale at which investments requiring multi-year planning begin at Metrolinx. For this scale of projects, the use of Monte Carlo analysis is recommended to account for uncertainties associated with land use and implementation costs. "High" and "Low" rates should represent an extreme that is theoretically possible, but is an unlikely outcome.

In addition to modelling the most likely land use scenario, a "low" and a "high" land use scenario should be modelled for the project. The low, medium, and high estimates should be studied in a business case model with Monte Carlo functionality. Ridership growth rates associated with each land use should be used in the Monte Carlo Analysis.

Expansion factors used to convert ridership and benefit forecasts for the peak period to annual impacts should also be based on the best available information and include a standard deviation for Monte Carlo analysis.

Capital costs will be adjusted using an optimism bias uplift based on the level of design, and will utilize appropriate standard deviations based on level of project design for purposes of Monte Carlo analysis. If a range of cost estimates is provided, it can be used to better determine the expected value for capital costs in the Monte Carlo simulation.

Operating cost should have a low, medium, and high growth rate. For a typical transit infrastructure project, these are set at 0%, 2%, and 3% respectively.

The Monte Carlo tests required are summarized in Table 5.2.

All costs and modelling assumptions should be run through Monte Carlo analysis and reported as a range with an 80% confidence interval. In addition, the probability that the project has positive net benefits (BCR >1) should be reported.

Large scale projects should perform sensitivity tests specified in Table 5.3 to determine the impact on the reported ranges and probabilities described above.

For large scale projects greater than $1 billion analyzed using GGHM, the impact of reduced auto operating costs should be studied, simulating a potentiall uncertain future with automated vehicles.

Monte Carlo Simulation

Monte Carlo Simulation is a computational method that uses repeated random sampling to understand how variation in different variables can effect a modeled or estimated outcome. For example, a cost estimate could draw from a range of uncertainties for cost inputs to determine the likelihood of investment costs being above or below a threshold value.

Table 5.2: *Monte Carlo tests for Large Scale Projects*

Monte Carlo Parameter	Rate(s)
Land Use and Ridership Growth Rate	"Low", "Medium", and "High" model runs
Annualization	Determined by project characteristics; includes standard deviation
Capital Costs	Include optimism bias with standard deviation; opportunity to include multiple costing estimates
Operating Costs	0%, 2%, 3% (real)

Table 5.3 *Sensitivity Tests for a Large Scale Project*

Sensitivity Test	Rate(s)
VOT Growth Rate	0.75%
Economic Discount Rate	2.5%
Reduced Auto Operating Costs (For BCs >$1B)*	Reduced fuel costs, no parking costs, and vehicle access for all users in the model

*This test is optional.

Optimism Bias

Optimism bias (OB) is one of three main components to cost estimates: base cost, risk adjustment and optimism bias adjustment.

OB is intended to address systematic biases in cost estimation. Realized costs have been shown to be systematically higher than the planned budget – adjusting for optimism bias accommodates this discrepancy.

- Optimism bias will be applied to the economic case for Medium and Large scale projects based on level of design
- Metrolinx follows UK's Department for Transport (DfT) guidance on applying optimism bias rates to capital costs (excluding operating costs) based on percent design completion, as outlined in Table 5.4, until local data becomes available.
- Optimism bias will not alter or be included in Treasury Board Submissions or budgets; it is only intended for economic project appraisal in the Economic Case.

Table 5.4: *Proposed business case requirements of Optimism Bias (OB) in Medium and Large Scale projects*

Medium Scale (Capex $50-$500M)	Large Scale (Capex >$500M)
• Capital Cost Adjustment = Capital Cost + Optimism Bias as a point estimate • OB included in economic case only • Provides capital cost without OB as sensitivity test line item • Additional sensitivity tests applied on top of capital costs with OB	• Capital Cost Adjustment = Capital Cost + Optimism Bias w/ Stdev using Monte Carlo as range estimate • OB included in economic case only • Not required to provide capital cost without OB as sensitivity test, this is reflected in the range estimate • Additional sensitivity tests applied on top of capital cost with OB

Defining Optimism Bias

Optimism bias refers to the tendency to misestimate the outcomes of planned projects, by underestimating costs and overestimating benefits, and has been found to be a systematic and persistent phenomenon amongst large infrastructure projects.[1] Misestimation can distort evaluations to be more favourable than can likely be realized, and international literature has found optimism bias as commonplace in underestimating project costs.

In one of the most robust studies on cost overruns of 258 megaprojects in 20 countries, Bent Flybjerg et al. (2004) found 90% of rail projects were under costed, with an average cost over-run of 45%.[2]

Reasons for optimism bias is suggested to be partially caused by projects' wider political-institutional frameworks, with specific funding and incentive structures that promotes the interests of actors, adherence to budget, and rules and procedures to be conducive to cost overruns.[2]

Traditional explanations have tried to link cost-overruns to project uncertainty rather than optimism bias. However, this is found to be insufficient[1], suggested by:

1) A significantly skewed distribution in project samples towards cost overruns whereas truly unexpected factors should produce non-skewed distributions (normal distribution);

1 Semtyaki, M. (2015). Cost Overruns on Infrastructure Projects: Patterns, Causes, and Cures. IMFG Perspectives.

2 Flyvbjerg, B. (2004). Procedures for Dealing with Optimism Bias in Transport Planning. The British Department for Transport.

2) The ability to account for uncertain factors would mature over time, however cost overruns have generally not improved over time

Thus, given the systematic observed phenomenon of optimism bias, project evaluations may adjust for optimism bias to better anticipate true project performance. Optimism bias adjustment rates can be derived through statistical analysis of historic project samples, where statistical clusters of project types are identified with an associated uplift percentage between estimated and actual costs.[1]

Given Metrolinx's current project evaluation practices closely align with those of UK DfT, Metrolinx will follow UK DfT guidance on optimism bias adjustment until a more local factor is determined.

Not all leading transport jurisdictions adjust for optimism bias. Of international agencies surveyed, New Zealand and Australia maintain that, ideally, increased accuracy from quantitative cost risk analysis (QCRA) can omit the need for optimism bias uplifts. DfT guidance agrees, yet finds continued but diminished optimism bias in UK projects despite improved QCRA[1], suggesting improvements to QCRA remain.

1 Flyvbjerg, B. (2004). Procedures for Dealing with Optimism Bias in Transport Planning. The British Department for Transport.

2 De Reyck et al. (2015). Optimism Bias Study: recommended adjustments to optimism bias uplifts. UK Department of Transport

Research on Optimism Bias Guidance by UK Department for Transport (DfT)

Optimism bias inversely correlates with design progression, with increased certainty of design decreasing cost overruns. Design completion is differentiated by progress through UK GRIP Stages (Guide to Rail Investment Projects), a project governance mechanism comparable to Metrolinx Stage Gate Process. However, DfT guidance does not present design percent completion per GRIP Stages, thus DfT optimism bias per GRIP stages are mapped to Metrolinx Stage Gates with defined percent design completions to relate optimism bias with design progressions.

Capital Cost vs. Operating Cost

Metrolinx only adjusts capital costs for optimism bias. Operating costs are not subject to an optimism bias adjustment.[1]

Using International Research

A significant challenge for optimism bias studies in transport is a lack of major local transport projects. Metrolinx will reference available guidance from the UK with greater sample size of projects completed. Using UK guidance is not expected to be problematic at this time. Literature reviewed suggests insufficient evidence thus far that optimism bias is geography dependent; UK studies too have included international projects to supplement domestic samples. A local optimism bias may be developed as Metrolinx increases its project sample size.

1 *Mott MacDonald. (2002). Review of Large Public Procurement in the UK. HM Treasury*

Small vs. Large Scale Projects

DfT guidance includes a significant number of small projects used to inform optimism bias guidelines for all project scales. Some evidence exists suggesting smaller scale projects exhibit less cost overruns[1], but the distinction is not conclusive. The potential impact of relying on small scale projects are lower optimism biases applied to large projects.

1 *Mott MacDonald. (2002). Review of Large Public Procurement in the UK. HM Treasury*

Application of Optimism Bias

The general rules of applying optimism bias are as follows:

1) Contingencies are applied either based on a Quantitative Cost Risk Analysis (QCRA) or as percentage uplifts over capital costs.

2) OB uplifts are applied over and above contingency determined using the methods described in Tables 5.5 and 5.6.

3) OB uplifts are applied to capital costs only, and the economic case only, using corresponding uplift adjustments based on level of design (%), or an alternatively derived uplift to match or exceed DfT OB guidelines.

4) Negative OB can result during Monte Carlo simulation and is permitted, due to the standard deviation used. This represents the possibility of a project coming in cheaper than expected.

5) Project appraisals may use OB uplifts different from DfT's OB uplifts as warranted by the project.

Small Scale Projects (<$50 million)

Small scale projects are not required to include an OB uplift at this time.

Medium Scale Projects ($50 million to $500 million)

Medium scale projects will report costs as point estimates with an OB uplift without standard deviation (stdev).

Large Scale Projects (>$500 million)

Large scale projects will report costs as range estimates with an OB uplift and stdev processed through a Monte Carlo simulation, with a standard deviation as a normal distribution on the OB.

In tables 5.5 and 5.6, mean OB uplift is shown with OB stdev. OB uplift applied is dependent on type of capital costing supplied, and level of design completion. OB uplift percentages are based on DfT guidelines, with suggested stdevs modified from Flyvbjerg (2008). OB magnitudes decrease as percent design completion increases, corresponding to increased certainty of design. Note that stdev is not required for medium scale projects ($50-500M).

Table 5.5: *Optimism Bias and Standard Deviation Parameters by level of project design*

Optimism Bias Uplift and Standard Deviation parameters based on Level of Design	Stage Gate 0-1	Stage Gate 2	Stage Gate 2	Stage Gate 3
Metrolinx Stage Gate / Business Case Equivalents	IBC	PDBC	PDBC	FBC
Level of Design Completion	0-10%	11-20%	21-30%	31-100%
OB Uplift and (Stdev)	OB 64% (Stdev 55%)	OB 18% (Stdev 15%)	OB 9% (Stdev 8%)	OB 4% (Stdev 3%)

Table 5.6: *Application of Optimism Bias and Standard Deviation based on availability of a QCRA*

Optimism Bias Uplift and Standard Deviation application based on Level of Design	Stage Gate 0-1	Stage Gate 2	Stage Gate 2	Stage Gate 3
Metrolinx Stage Gate / Business Case/Level of Design Equivalents	IBC 0-10%	PDBC 11-20%	PDBC 21-30%	FBC 31-100%
Contingency Supported by QCRA	QCRAMean* (1+64%) (Stdev 55%)	QCRAMean* (1+18%) (Stdev 15%)	QCRAMean* (1+9%) (Stdev 8%)	QCRAMean* (1+4%) (Stdev 3%)
Absence of a QCRA (contingency is included as a % uplift on capital costs)	OB uplift must be adjusted to account for the contingency uplift to derive OB uplift and Stdev to match DfT guidelines.*	(Point Estimate+% contingency uplift) * (1+18%) (Stdev 15%)	(Point Estimate+% contingency uplift) * (1+9%) (Stdev 8%)	(Point Estimate+% contingency uplift) * (1+4%) (Stdev 3%)

**Note - to adjust OB uplift and Stdev, given a contingency uplift is applied on capital costs, the following approach should be used:*

Adjusted OB Uplift % = (1+Contingency Uplift %)/(1+Project Stage OB Uplift)-1
Adjusted Stdev = (0.38/0.44)((1+ Project Stage Stdev)/(1+ Contingency Uplift %)-1), where;*

Contingency Uplift % = determined by the Metrolinx Contingency Policy
Project Stage OB Uplift = from Table 5.5
Project Stage Stdev = from Table 5.5

Level of Design Completion

Recommended OB uplift should be independent of project types as AFP or DBB, but inversely correlate to design completion. Business case types may not fully indicate design completion, which may vary even between costing components, and are thus not presented.

Types of Capital Cost Estimates

1) Contingency supported by a QCRA

A QCRA enhances the accuracy in cost estimation relative to non-QCRA estimates. However, QRCAs are predicated on risk registers that may remain pre-mature during early design stages. For this reason, QCRAs may deliberately not be conducted at minimal levels of design completion.

A conservative approach suggests QCRAs at minimal design progression produce no better results than non-QCRA estimates. Based on this approach, the same OB uplift applied to a capital cost point estimates is also applied to a QCRA mean estimate at 0-10% design completion. For design completion >10%, the recommended practice is to match DfT guidelines when applying an OB uplift to the QCRA mean estimate as per Table 5.6.

2) Absence of a QCRA

At 0-10% design completion, DfT applies OB uplifts to the capital cost point estimate. However, other agencies including Metrolinx often apply a contingency uplift to their capital cost point estimates at this level of design completion. It is recommended that at this level of design, the difference in OB is added to the existing contingency uplift to match overall DfT guidelines.

At design completion >10%, DfT applies OB uplifts to the QCRA mean estimate while other agencies including Metrolinx may not always conduct a QCRA. The addition of a contingency uplift to the capital cost point estimate enhances the costing accuracy, partially achieving the function of a QCRA. Therefore, the OB uplift treatment is similar to a QCRA mean estimate with no contingnecy, and the uplift is applied on the point estimate with contingency.

Standard Deviation of an OB Uplift

The Stdev derived from Flyvbjerg (2008)[1] is based on international large-scale rail projects which observed an optimism bias of 44%, with standard deviation of 38%. For DfT OB uplift adjustments, an interim method is derived using the ratio of Stdev 38% / Mean 44% from Flyvbjerg (2008). DfT's research sample contains mostly small-scale projects, with a small Stdev. A more appropriate Stdev will be needed, and Metrolinx intends to conduct localized studies.

With the proposed standard deviation, negative optimism bias uplifts are possible. This is permitted, given projects occasionally complete under-budget, and is reflected in the low probability of occurrence (~15% of OB uplifted cost distribution, or ~5% of distribution when limited to 80% confidence interval).

1 *Flyvbjerg, B. (2004). Procedures for Dealing with Optimism Bias in Transport Planning. The British Department for Transport.*

Illustrative Example: Yonge Subway Extension

The following analysis was conducted on the preferred option identified for the Yonge North Subway Extension (YNSE), during the Initial Business Case completed in 2013.[1]

In this illustrative example, treated as a Preliminary Design Business Case (PDBC) on the preferred option. The results of this analysis are used for illustrative purposes only, and are independent of any work on the Yonge North Subway Extension currently underway.

The Yonge Subway Extension is a 7.4 km addition to the existing Line 1 Subway. The project extends from the current Finch Station terminal, in an underground alignment beneath Yonge Street, to a terminal at Richmond Hill Centre.

The proposed methodology for including Optimism Bias, as outlined in the Guidance was utilized as follows:

1. Optimism bias was applied to infrastructure cost components in accordance with the level of design completion (Table 5.5), using the recommended application for capital cost estimates presented in the absence of a QCRA.

2. Tunnels were identified at a higher level of design completion, with a lower OB uplift applied.

3. YNSE is a 'large-scale' project (>$500 million), and optimism bias and stdev are processed through a Monte Carlo simulation with a normal distribution and unbounded lower limits, allowing for negative optimism bias.

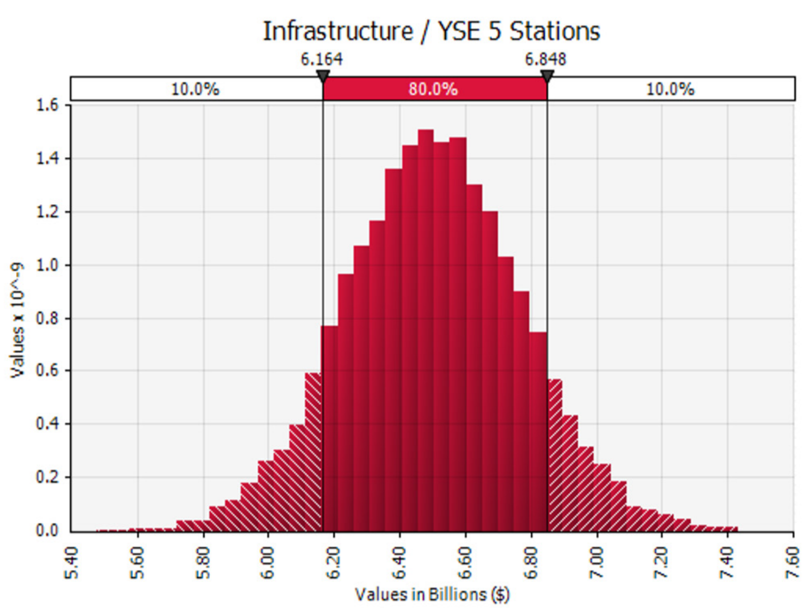
1 *http://www.metrolinx.com/en/regionalplanning/projectevaluation/benefitscases/Benefits_Case-Yonge_North_Subway_Extension_2013.pdf*

Table 5.7: *Costing example, with optimism bias applied to select components of the capital cost according to level of design*

Line Item	Cost Point Estimate + Contingency	Level of Design Completion	Optimism Bias Added (Uplift, Stdev)	Final Adjusted Cost, Expected Value ($)
Finch Modifications	67.3 M	PDBC, Low (<20%)	18%, 15%	79.4 M
Cummer/Drewry Station	240.0 M	PDBC, Low (<20%)	18%, 15%	283.2 M
Steeles Station	538.7 M	PDBC, Low (<20%)	18%, 15%	635.7 M
Clark Station	204.8 M	PDBC, Low (<20%)	18%, 15%	241.7 M
Langstaff Station	242.6 M	PDBC, Low (<20%)	18%, 15%	286.3 M
Richmond Hill Centre Station	320.3 M	PDBC, Low (<20%)	18%, 15%	378.0 M
Train Storage Facility	396.6 M	PDBC, Low (<20%)	18%, 15%	468.0 M
Tunnels	754.1 M	PDBC, Hi (<30%)	9%, 8%	822.0 M
Utilities/Traffic Control	100.0 M	PDBC, Low (<20%)	18%, 15%	118.0 M
Systems	339.0 M	PDBC, Low (<20%)	18%, 15%	400.0 M

Results of the Monte Carlo Simulation::
Point estimate (w/ contingency): $5.65B
With optimism bias applied to select components of capital costing: Pmean @ $6.5B , or $6.16B - $6.84B with 80% confidence

Figure 5.1: Monte Carlo Simulation using data from Table 5.7:



Standard Economic Case Parameters

The standard parameters that should be used in the Economic Case are described in Table 5.8. Any variation to these parameters must be explicitly agreed upon during business case development, with a clear justification for the variation.

Table 5.8: *Economic Parameters*

Parameter	Purpose	Value
Social Discount Rate	Over time, the value of a cost or benefit will decrease – as a result, a social discount rate is applied. The social discount rate reflects society's time preference for money.	3.5%
Growth Cap	In the absence of input specific guidance, growth in all inputs to the evaluation (example: user benefits) should be capped after 30 years from the base year of project evaluation to reflect uncertainty.	After 30 years from the base year of project evaluation
Evaluation Period	Different evaluation periods are used for different levels of investment and scales of options.	5 to 60 years (depending on project lifecycle/impacts)
Dollar Value	All values should be discounted and escalated to a common year defined at the onset of the study, typically this will be the year the evaluation takes place in.	Real, year of evaluation
Unit of Account	All impacts in the economic case measured in the market price unit of account (mainly user impacts) should be adjusted to the factor cost unit of account to ensure consistency between costs and impacts..	Factor Cost
Value of Time	A factor used to monetize changes in generalized time to determine the overall welfare benefit to transport network users.	$18.79 (2021 $)
Value of Time Growth	A parameter used to escalate the Value of Time across the investment lifecycle..	0% per year, with 0.75% per year (based on real growth in GDP per capita) used as a sensitivity test based

**Note: Business case factors used in the Guidance have been updated in line with research and development into Economic Appraisal. Business cases completed prior to the release of this guidance may have used different values. As discussed in Chapter 1, the values in this Guidance should be used for all business cases complete beyond 2021 until the next Guidance update.*

Economic Case Narrative Structure

The Economic Case should communicate economic analysis in a logical and concise manner that:

- Shares quantitative evidence to illustrate the range of impacts; and
- Develops an overall narrative on costs, benefits, and impacts that can inform decision makers and project stakeholders on the economic prospects of the investment.

The logic based narrative (or logic framework) shown in Figure 5.2 is recommended as the basis for presenting and interpreting economic analysis.

This framework includes:

- **Costs –** reflecting the resource costs of the investment (typically divided into “capital” and “operating and maintenance”)
- **Transportation User Impacts –** reflecting the benefits to travellers that are realized when the investment changes the generalized cost of travel (example: the investment improves travel time and reliability)
- **External Impacts –** analyzing the benefits of reducing the social cost of transport (example: the investment shifts travel demand off automobiles to transit, which typically has a lower social cost per passenger km travelled)
- **Wider Economic Impacts –** analyzing how the investment in the transport network impacts economic activity (for example: triggering agglomeration benefits by reducing the generalized cost of travel between two major employment centres)

Further information on how to conduct analysis for each of these types of economic evidence is presented in the Conducting Economic Analysis section.

Figure 5.2: *Economic Case - Inputs, Actions, and Outcomes Narrative Framework*

Investment Inputs and Actions

Costs: Costs are the key economic input required to deliver an investment. In the Economic Case, costs should represent all resource costs required to deliver the investment in real terms:

- **Capital costs:** including initial spend and renewal costs for all infrastructure, rolling stock, and technology.
- **Operating costs:** all costs required to operate the investment and provide day to day maintenance.

Investment in the transport network changes the 'generalized cost' of travel for users, which in turn impacts their travel behaviour.

Transportation User Impacts from Reducing the Generalized Cost of Travel

Focus: Measuring how an investment's mobility improvements generate welfare benefits for travellers.

User benefits represent the direct benefits of the investment to users of the transportation network. These benefits are typically monetized based on how different investments change the generalized cost of travellers.

Typically, generalized cost is reduced by improving:

- Crowding.
- Amenity.
- Accessibility.
- Travel Speed.
- Reliability.
- Frequency.

Transportation user benefits are generated by:

- Existing transit users whose generalized cost decreases due to the investment.
- Travellers who change to the transit mode improved/delivered by the investment based on reductions to generalized cost.

As the 'generalized cost' of travel decreases, the investment can also change how people and firms interact within the regional economy.

Investment in the transport network can reduce the 'social cost' of travel, which reduces the negative side-effects of transportation on society.

External Impacts from Reducing the Social Cost of Transportation

Focus: Measuring how an investment's changes to the transport network reduce the cost to society.

Each trip taken produces negative externalities to society such as emissions, transport related injuries or deaths (car crashes), or congestion that takes an economic toll on society. This is called the 'social cost' of transportation. External benefits can be realized in two ways:

- Investments that reduce the social cost of existing trips (example: fleet replacement for lower emission vehicles or new station safety measures).
- Investments that encourage travellers to use a new mode/service with a lower social cost than their current travel mode (example: a fare strategy that shifts demand from cars to transit, a new efficient rapid transit line that shifts demand from cars to transit).

Investment in the transport network changes the 'generalized cost' of travel for users, which in turn impacts their travel behaviour. If travellers switch to a mode with a lower social cost, they generate external benefits.

Wider Economic Impacts

Focus: Measuring the benefit of the investment's improved mobility to wider society.

Transportation investments that change the cost of travel in the region can lead to wider economic impacts. These impacts measure how the investment connects people and places to generate economic activity. Unlike the other two categories of impacts that focus on the cost of transport to users and society, Wider Economic Impacts reflect the overall impact of mobility on society. These impacts include how reduced cost of travel affects economic activity, land use and spatial development, labour markets, and economic competition.

Investment Output (green)

Investment Outcome (white)

Economic Case Core Content

Table 5.9 outlines the key sections for an Economic Case

Table 5.9: *Core Content for an Economic Case*

Section	Sub-sections	Requirements
1. Introduction	N/A	Overview of chapter
2. Costs	Capital Costs	Summary of capital cost impacts and cost drivers
	Operating Costs	Summary of operating cost impacts and cost drivers
3. User Impacts	User Impacts by Mode	Summary of impacts to transit user and automobile users (and active modes if relevant)
4. External Impacts	Wellbeing Impacts	Summary of wellbeing impacts by type (health, safety)
	Environmental Impacts	Summary of environmental impacts by type (GHG, air quality, noise)
5. Wider Economic Impacts	Productivity	Summary of productivity impacts
	Imperfect Competition	Summary of imperfect competition impacts
	Labour Markets	Summary of labour market impacts
6. Land Value and Development	Sub-sections can be set out at the analyst's discretion	Summary of land value and development impacts
7. Economic Analysis Summary	Economic Appraisal Summary	Complete a key metric table showing present value of: costs, external impacts, user impacts, and wider economic impacts. Include conventional (excluding wider economic impacts) and expanded (including wider economic impacts) key economic metrics
	Option Comparison	Identify key factors that lead to different performance between the options
	Risks and Uncertainty	Identify key risks and uncertainties that may limit the option from achieving the performance noted in the evaluation
	Recommendations	Identify key recommendations for each option

Conducting Economic Analysis

This section of the guidance provides direction and parameters for use in completing each part of the Economic Case. In general, each subsection of the Economic Case should answer the following questions:

- What are the costs, benefits, or disbenefits incurred?
- What are the key dependencies and risks associated with the investment and its estimated costs, benefits, and disbenefits?

Economic Case Analysis Over the Business Case Lifecycle

Initial Business Case

- Conduct an analysis of each option, including modelling analysis and economic narratives
- Conduct sensitivity testing to understand the key performance drivers and level of uncertainty for each option

↓

Preliminary Design Business Case

- Update the analysis conducted in the Initial Business Case based on any changes to investment specification or detailed design
- Analytic tools (such as demand or benefit models) may be updated to ensure all analysis and forecasting is commensurate with the level of specification and scale of the investment

↓

Full Business Case

- Update the analysis conducted in the Preliminary Design Business Case based on any design refinements
- Analytic tools may be updated to ensure all analysis and forecasting is commensurate with the level of specification and scale of the investment

↓

Post In-Service Business Case

- Review economic narrative and compare estimated performance against collected data

Economic Case Section 1

Introduction and Assumptions

This subsection should frame the Economic Case and confirm its overall content and structure. It should also state the specific assumptions and parameters used to conduct the analysis. Where these parameters differ from values used in this guidance, agreement must be made with the Metrolinx sponsor, with variations clearly noted in the Economic Case.

Economic Case Section 2

Costs

Background

The comparison of the costs incurred to deliver a transportation investment to the benefits accrued is central to the Economic Case.

Costs should be broken into two categories:

- **Capital costs –** including all costs to implement the option (with appropriate contingencies) and all lifecycle or renewal costs incurred over the working life of the option to replace lifecycle expired assets
- **Operating and Maintenance costs –** all day to day costs to operate the investment and provide maintenance

These costs capture all new allocation of value – or true resource costs – required to deliver a transport investment, meaning:

- All costs considered should be above and beyond those considered to be 'Business as Usual'
- Care should be taken to identify future spending assumed in the 'Business as Usual' case, which should not be included in the costs for the investment
- Economic analysis is funding source agnostic and should consider all costs carried to deliver the investment

The analyst should ensure sunk costs are not included in the appraisal. Sunk costs are costs that have already been paid. At the point of evaluation, only costs going forward should be included in the cost equation. All costs that may have previously been paid (example: planning studies, feasibility reports) should not be incorporated in the cost of the project. In a Post In-Service Business Case, the actual resource costs of the project should be included (which may vary from those in the Full Business Case). While these costs have already been incurred/paid, they should not be considered as sunk costs at the Post In-Service Stage.

Capital Costs

Capital costs are fixed one time costs incurred during the implementation of the investment. All capital costs should be estimated in the investment options section with consideration of an appropriate contingency, and can include the categories outlined below:

- Stations
- Route infrastructure
- Communications
- Rolling stock
- Track
- Software development
- Power Supply
- Signalling
- Land Acquisition Costs
- Legal Transaction Costs
- Project Management Costs
- Consulting Engineering Work
- Design Costs
- Project planning (including public consultation and business case development)
- Lifecycle Renewal Costs (costs to replace lifecycle expired assets)

The analyst should outline the capital costs over the project lifecycle based on the social discount rate. A year-by-year profile should be generated along with the present value of all capital costs.

If the investment is assumed to mitigate committed and funded projects that would otherwise be included in the BAU scenario (example: a relief subway mitigating the need to renovate and expand Bloor-Yonge Station), these 'reduced costs' should be clearly noted.

Land Acquisition Costs

In the Economic Case, costs associated with the acquisition of land are evaluated based on the opportunity cost of the land being occupied using the real, risk free bond rate as a proxy for the opportunity cost of the land. The risk-free bond rate is based on the real return on long-term government savings bonds.

In the economic analysis, a fraction of the cost of land will accrue on an annual basis for as long as the land is occupied (typically, for the life of the project) and cannot be used for the purposes of any other intervention.

The cost of land is assumed to grow annually in real terms for 30 years from the base year of project evaluation. The growth in the cost of land in real terms is derived by taking the average real annual dwelling growth rate in the GTHA using census data. The assumptions used in the derivation of an annual opportunity cost of land can be found in Table 5.10. The annual opportunity cost of land is calculated using the assumptions in Table 5.10 and equation 5.2.

Table 5.10: *Opportunity cost of land parameters*

Parameter	Rate(s)
Risk Free Bond Rate (real)	0.82%
Growth Rate (real)	2.80%

Equation 5.2: *Annual Opportunity Cost of Land*

$$Land\ Acquisition\ Cost\ x\ Real\ Risk\ Free\ Bond\ Rate\ x\ (1 + real\ growth\ rate)$$

Operating and Maintenance Costs

Once the transport investment is operational, there will be some level of costs associated with operating and maintaining it. The level of such costs will vary with the nature and scale of the investment, but can include:

- **Staff –** drivers, guards, station staff, maintenance, management
- **Materials and supplies –** cleaning, maintenance, office
- **Energy –** diesel, electricity, or other fuel sources

In broad terms, maintenance covers the day-to-day requirements to maintain service (for example: minor repairs, frequently recurring maintenance of equipment or infrastructure). Lifecycle renewal costs (included in Capital Costs) are concerned more about material or complete replacement of assets (for example: track, signalling systems, bridges). Care should be taken to ensure that maintenance and lifecycle costs are clearly delineated to avoid both double counting and omission of costs.

If the investment is assumed to mitigate or reduce operating costs below those in the business as usual scenario (example: introducing a more cost-effective bus fleet and maintenance facility) these reductions should be accounted for as a 'cost reduction' and clearly noted.

Communicating Costs

Costs in the Economic Case should be communicated in summary form as shown in Table 5.11. Note - the level of detail used in the Economic Case may vary by investment type, but a minimum two fields should be included: (1) capital and (2) operating and maintenance costs. The categories included in this template should be replaced by line items that form the overall capital or operating and maintenance costs. This allows decision makers to understand how different elements of the project drive resource costs.

Table 5.11: *Summary of costs in categories*

	Cost Category	Present value ($ in year of appraisal)
Capital Costs	Capital Costs category 1	
	Capital Costs category 2	
	Capital Costs category 3	
Operating and Maintenance Costs	Operating Costs category 1	
	Operating Costs category 2	
	Operating Costs category 3	
Total Present Value of Costs		

Note: All costs used in the Economic Case should include contingency and risk. Where appropriate, base costs (those without contingency and risk) can be included to illustrate the level of contingency applied, but not used in BCA. Contingency should be assessed based on the stage of design and type of project.

Economic Case Section 3

User Impacts

Overview

Typically, the main impacts detailed in a business case for a transportation investment are those related to direct impacts on users – or travellers. User impacts are determined by estimating the change in 'generalized travel cost' for travellers. The generalized cost of a journey includes a range of factors (travel time, reliability, amenity, user costs, and crowding) that reflect the perceived journey time, and influence whether or not a traveller chooses a given mode. Investments that improve these 'factors' are said to improve the welfare of travellers. User impacts are visualized in Figure 5.3.

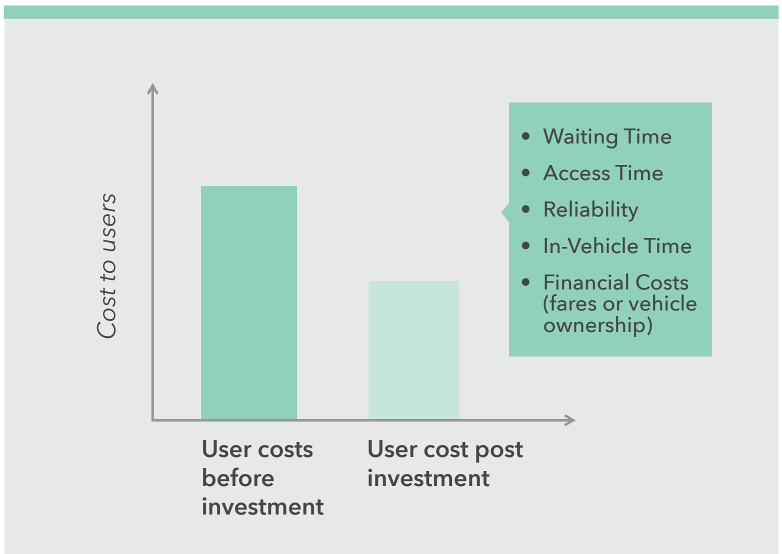
Estimating User Impacts

Background

Individuals decide how to travel based on their perception of the cost and time associated with doing so. Twenty minutes spent standing on a crowded train, for example, will be perceived to take significantly longer than sitting on a relatively less crowded one. A highway journey with a predictable journey time will be perceived to be faster than one with the same average journey time but with significant day-to-day variability in journey time.

Welfare benefits arising from transport investments are primarily captured through the reduction in the perceived 'cost' of individuals' journeys – such as a faster journey time, reduced level of crowding, improved reliability or reduction in wait time for transit. Since travel time typically represents the largest element of the 'cost' of a journey, 'cost' may be defined in terms of 'generalized journey time', with any financial costs (such as fares or fuel costs) converted into a time equivalent using values-of-time.

Figure 5.3: *User Impacts from Transport Investment*



What factors are included in User Impacts?

Key values and inputs for measuring user impacts are listed in Table 5.12 with additional guidance following in subsequent subsections. A robust demand model will include all factors within the generalized cost equation for mode choice, and allow the analyst to estimate change in consumer surplus directly. The impact specific subsections allow analysts to ensure all analytic methodologies consider the full range of user impacts based on best available practice and evidence. There are two stages of user benefit calculation in the subsequent subsections:

- Generalized journey time change benefits/disbenefits; and
- Unperceived cost benefits/disbenefits.

Table 5.12: *Technical Guidance for Valuing User Impacts Based on Change in Generalized Cost or Time*

Benefit Category	Factor	Description	Estimation Process
Generalized Travel Time	**Travel Time Change**	The overall change in travel time including in-vehicle, access, and waiting time. Increased travel time is a disbenefit, while decreased travel time is a benefit.	Typically estimated by transportation demand models.
	Reliability	How punctual the transport service is. Reliability is the variability in all elements of journey travel time. Improvements to reliability are a benefit, while reduced reliability is a disbenefit.	Typically estimated in model by applying a weighting to value of time: • A multiplier of 1.76 applied to the standard deviation of reliability (minutes).
	Crowding (transit)	The level of crowding impacts user perception of the service – increased crowding is considered a disbenefit, while reduced crowding is considered a benefit.	Typically estimated in model by converting into units of time either within the GGHMv4 model or through the application of an equation that is consistent with the GGHMv4.
	Amenity (Service/ Urban Realm Quality, Station Area, and Quality of Design)	Improvements to amenity also deliver user benefits by reducing the perceived impact/cost of travelling through areas. This can include improvements to streetscapes, facilities, stations, stops, or vehicles related to a transport trip. Improved amenity is a benefit, while decreased amenity is a disbenefit.	Requires a suitable approach for investment under consideration, current guidance does not have parameters or specific estimation processes.
	Change in Congestion *(usually captured as the change in travel time on the road network, sometimes used as an approximation of auto generalized travel time if changes to reliability and travel time cannot be estimated)*	The change in the average travel time on the auto network should be applied as an impact to users remaining on the auto network and captured for interventions that significantly affect road capacity (e.g., removal of a lane). In cases where this cannot be calculated, and a project only marginally affects road capacity, a congestion impact can be calculated instead using hours per change in automobile VKT. A decrease in congestion is a benefit and an increase is a disbenefit.	Typically estimated by transportation demand models by applying the average change in travel time on the auto network to remaining auto users. OR only in special cases, a decongestion value is used instead based on a change in auto VKT in a specific time period: • Peak period: 0.01 hours/ change in auto VKT. • Off-peak period: 0.00125 hours/ change in auto VKT.
	User Costs	The financial costs paid by users to make use of transport infrastructure.	Typically financial costs are a transfer and are used for demand modelling and not for benefit estimation, except in the case of Resource Adjustments.
Unperceived Travel Costs	**Unperceived Auto Operating Costs**	Marginal costs related to owning and using a vehicle that are not factored into day-to-day trip choices.	Estimated at a rate of $0.10 per automobile VKT change.

Estimating User Impacts from Changes in Generalized Time

Change in generalized time or cost can be calculated in two ways, as shown in Figure 5.4.

Figure 5.4: *Two Approaches to Calculating Change in Generalized Time*

Is the GGHMv4 used to calculate demand?

YES

Most core user benefits for a Metrolinx business case are included as an output from the GGHM v4 and a three step process should be followed:

1. Monetize the change in generalized time as estimated by the GGHMv4 using the value of time in this Guidance. This includes travel time, reliability, and crowding benefits.
2. Amenity values are not calculated in the GGHMv4 and must be estimated separately if relevant.
3. Monetize the change in auto travel time as estimated by the GGHM (applied only to remaining auto users) using the value of time in this Guidance.
4. Monetize unperceived auto operating costs using auto VKT.

NO

Develop a methodology that is fit for purpose and, where relevant, aligned with the GGHMv4 using the factors and approach defined in this Guidance. This process should include all benefits defined in Table 5.12 as appropriate.

If the GGHMv4 model is used to directly estimate the change in generalized time for transit users it will include all elements in Table 5.12 with the exception of unperceived user costs and amenity improvements, which may be developed separately. The change in generalized time output from the GGHMv4 can then be monetized by multiplying it by the value of time.

The methodologies included for travel time, reliability, and crowding should be reviewed while conducting the user impact analysis using the GGHMv4 - however, the methods outlined in these sub-sections are already applied by the GGHMv4 and will not need to be applied again during the economic analysis process.

If the GGHMv4 is not used, then the following user impact specific sub-sections should be followed to ensure user benefits are calculated in a manner consistent with the GGHMv4.

These sub sections include:

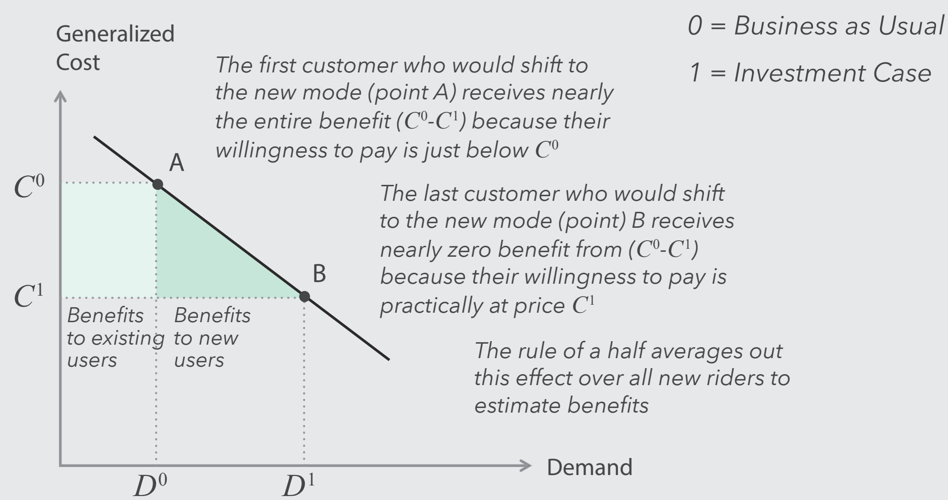
- Generalized Travel Time change estimation and monetization techniques for Transit Users
- Congestion Impacts in place of Auto Travel Time Impacts
- Reliability
- Crowding
- Amenity
- User costs
- Unperceived Costs Estimation

Calculating Change in Generalized Journey Time

Regardless of the demand model used, change in generalized time or cost (or change in consumer surplus) should be calculated in a disaggregate manner, considering changes in cost (C) and demand (D) by mode (x) between each origin (j) and destination (k). Generalized time or cost changes should include the factors represented in Table 5.4 (travel time, reliability, crowding, amenity, direct costs). Additional guidance on each of these factors is presented in subsequent sub sections.

The change in consumer surplus can be estimated using the rule of a half as shown in Equation 5.3 (which shows the sum of rectangle D^0, C^0, and C^1 with triangle C^0D^0, C^1D^0, C^1D^1). The rule of a half is typically applied to calculate the user benefits for new users – a description of the rule of a half is shown in Figure 5.5.

Figure 5.5: *Rule of a Half*



Equation 5.3: *Change in Consumer Surplus Using Rule of a Half*

$$\text{change in consumer surplus} = \frac{1}{2}\sum_i \sum_j \left(D^0_{jkx} + D^1_{jkx}\right)\left(C^0_{jkx} - C^1_{jkx}\right)$$

When the investment is either a new mode or is likely to have significant change in generalized cost or time, the rule of a half may not be an appropriate tool to estimate benefits because the inverse demand curve is unlikely to behave linearly (a linear curve is shown in Figure 5.5). In these instances, alternative estimation techniques (example: integration) should be considered.

Changes in Travel Time

Travel time typically represents the largest component of the generalized journey time, with travel time reductions typically generating the largest benefits within transport business cases.

Travel time includes several elements, all of which are perceived differently by transport users. Different weightings are applied to each element to account for how, for example, time spent walking to a transit stop is perceived differently to that spent on board a transit vehicle.

These values are outlined in Table 5.13.

A two step process is used to estimate user impacts from a change in travel time:

Step 1 - Estimate New Travel Time

Step 2 - Estimate Change in Travel Time

Table 5.13: *Inconvenience Factors, by Trip Purpose*

Travel Time Element	Weighting	
	Business	Non-Business (including commuting trips)
In-vehicle time	1.0	1.0
Walk Time (on level ground without crowding)	2.0	2.0
Wait Time	2.5	2.5
Interchange*	5 minute penalty	5 minute penalty

**Note: As with all time changes for new users which are estimated using the rule of a half, interchange made by new users to transit is subject to the rule of a half, or a 2.5 minute penalty.*

Construction Delays

Some transportation investments may impact travellers during construction. These impacts can be captured as delays or changes in travel time due to construction related impacts such as road or lane closures. Modelling tools can be used for a high-level approximation of impacts, while for major changes to the network appropriate simulation tools may be required for a robust estimation.

For small projects or at the IBC stage, this analysis can be conducted based on assumed delays or impacts. For a PDBCs or FBCs, an understanding of construction phasing should be developed provide a more precise impact.

If construction impacts are included in the analysis, efforts should be made to also include the cost of mitigating them through new programs or policies (example: transport demand management programs, construction phasing). In such a case, dis-benefits may be partially or completely mitigated; however additional mitigation costs should still be included in the analysis.

Travel Time Perception by Mode

The perception of time spent travelling does not just vary by the different components of the journey as seen in Table 5.13, but it also varies by mode. Metrolinx applies travel time perception factors to GO Rail, Subway and Auto (access/egress time only). These mode-specific perception factors capture the comfort-related aspects and general preference for using certain modes over others and their values are outlined in Table 5.14.

A direct application of the mode-specific perception factors involves multiplying the existing and new user passenger-minutes by the transit sub-mode with the perception factor for that sub-mode, resulting in perception-adjusted user impacts. The new perception-adjusted passenger minutes are then monetized using the standard equity VOT.

For a mode-specific perception factor that is less than 1 – this will have the net effect of reducing benefits for that mode if there is a decrease in passenger minutes while also reducing disbenefits when there is an increase in passenger minutes.

The perception factors used in business case analysis going forward are summarized in Table 5.14 below.

Table 5.14: *Travel Time Perception Factors, by mode*

Mode	Perception Factor
Bus/ Streetcar IVT	1
GO Rail IVT	0.85
Subway IVT	0.9
Drive Access/ Egress IVT	2.48

Step 1: Estimate New Generalized Travel Time

The analyst should define the new travel times for each mode and origin destination (OD) pair impacted by the investment.

Generalized travel times are calculated by multiplying the relevant weighting by each element of the total travel time and summing them. An example is outlined in Table 5.15.

Individuals are expected to make decisions regarding their route or mode on the basis of the weighted travel time, and select the route that minimizes the weighted time rather than absolute travel time.

Step 2: Estimate Change in Generalized Travel Time

Time savings within transport business cases should always be based on the generalized journey time, since that is the journey time that is perceived by individuals and best captures their travel decisions. The change should consider the BAU vs. the investment scenario and apply the ROH.

Table 5.15: *Example of Estimation of Generalized Journey Time*

Travel Time Element	Weighting	Option 1 (mins)	Option 1 (generalized mins)	Option 2 (mins)	Option 2 (generalized mins)
In-vehicle Time (mass transit)	1.0	10.0	10.0	20.0	20.0
Walk Time	2.0	15.0	30.0	8.0	16.0
Wait Time	2.5	5.0	12.5	5.0	12.5
Interchange	1 interchange	5.0	5.0	5.0	5.0
Total Travel Time (absolute)		35.0		38.0	
Total Travel Time (weighted)			57.5		53.5

Reliability

Reliability reflects the unexpected variation in an individuals' journey time (example: highway congestion, accidents or delays to transit services). Reliability can act as a major determinant of individuals' route choices, since users will typically prioritise a route with more certainty of arrival time than one which is often marginally faster, yet has a significant likelihood of being delayed.

OECD (2009) reports that reliability benefits can be equivalent to 12-13% of the transport user benefits, and including reliability within the estimation of generalized journey time ensures it best reflects users' travel experiences. There are two approaches to quantifying reliability, dependent on the mode and/or frequency of the transit service. Additional approaches may be used for high-level reliability benefit estimation if these approaches are not feasible within an early stage business case.

Approach A: Impact to Automobile and High Frequency Transit Services (service headway is less than 15 minutes)

Highway trips are made without consulting a schedule, and based on a reasonable expectation of journey time, while frequent transit services tend to attract 'turn-up-and-go' trips, where users do not check the timetable in advance of travelling.

Reliability should therefore be estimated using a 'mean-variance' approach. This approach calculates the standard deviation for journey times from average journey times for automobile trips or scheduled times and/or expected headways for transit.

This can be calculated using the Equation 5.4.

Equation 5.4: *Change in Reliability*

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2}$$

where

$$\mu = \frac{1}{N}\sum_{ij=1}^{N} x_{ij}$$

and

- σ: The standard deviation of the trip's reliability measured in minutes;
- i: The Origin;
- j: The Destination;
- k: The Mode;
- x: observed travel time; and
- N: the number of observations.

After the standard deviation has been estimated, the value of reliability – equivalent to the additional travel time perceived by users due to service reliability – can be estimated using Equation 5.5. This equation uses the existing measure of reliability along with an estimate of how the investment will improve reliability to estimate the overall reliability impact.

Equation 5.5: *Reliability Impact*

$$\textit{Reliability Impact} = RR * (\sigma_{ijk}^{0} - \sigma_{ijk}^{1})$$

where RR is the reliability ratio (a unitless weighting factor to convert a minute of reliability impact into perceived time) – this is assumed to equal 1.76. This factor should be used for analysis outside of the GGHMv4. The reliability impact can be converted into dollar terms by multiplying it by a value of time.

Approach B: Low Frequency Services (service headway is every 15 minutes or greater)

Reliability should be estimated using a 'mean-lateness' approach which calculates the average delay of transit services against scheduled arrival times using Equation 5.6. In this equation the change in expected delay represents understanding of the current delay for low frequency services compared to the improvement to expected delay due to the investment.

Equation 5.6: *Lateness Impact*

$$Lateness\ Impact = LM * RR * (ED^0_{ijk} - ED^1_{ijk})$$

- Where LM is the lateness multiplier (the unitless relative weighting of delay compared to reliability impacts) applied to RR and ED is the expected delay (the mean delay experienced by transit services relative to the timetable measured in minutes).
- The lateness impact can be converted into a monetized value by multiplying it by a value of time. The lateness modifier is currently under review and development.

When service improvements change a transit service from 'low' to 'high' frequency, the reliability metrics should be measured with the 'mean lateness' approach. This will allow for consistency between measurements in the pre- and post- intervention scenarios.

Data Requirements

Estimation of reliability benefits will require journey time data over an extended period which allows the variability in journey times to be quantified. Observations should be recorded for specific periods (such as the weekday morning peak) which correspond to the periods used for the transport modelling underpinning the assessment of changes in travel time.

The requirement for data across extended periods (at least 100 observations) is likely to require data from alterative or non-traditional data sources, such as mobile network data (MND) or operations data from bus and/or rapid transit services.

Crowding

Crowding represents the discomfort to transit users of travelling in crowded conditions or being required to stand. It can act as a key driver of route choice, whereby individuals travel via an alternative route or a different mode (such as car) due to high-levels of crowding. Penalties can be included within the estimation of generalized travel time to reflect the negative perceptions of crowding on individuals' journeys.

Crowding impacts are typically quantified by multiplying the travel time spent travelling under crowded conditions (for seated and standing passengers respectively) with a multiplier to represent the discomfort associated with doing so.

Passengers perceive crowding differently based on a range of factors, including:

- Their experience with transit, with less regular users or those who typically travel by automobile more sensitive to travelling in crowded conditions.
- Their mode, with some modes (e.g. conventional bus) likely to be more associated and better designed for standing passengers than others.
- Time-of-day and location, with passengers travelling at peak times to/from downtown areas predisposed to crowding on a daily basis, and are conditioned to expect to travel in crowded conditions, in contrast to off-peak users.
- Time spent / distance travelled, with users more sensitive to crowding the longer they are exposed to it.

Consequently, crowding multipliers can vary significantly by traveller and trip characteristics.

Approach – Calculate Crowding

If the GGHMv4 is used, the crowding factors within the model already account for crowding in the change in generalized time. Otherwise, a formula consistent with calculating crowding in the GGHMv4 should be applied as shown in Equation 5.7.

Equation 5.7: *Calculating crowding impacts*

$$\mathit{Crowding\ Factor} = \left[\frac{\left(\gamma_1 + \alpha_1 . \left(\frac{V_t}{C_t}\right)^{\beta_1}\right) \times N_{seat} + \left(\gamma_2 + \alpha_2 \left(\frac{V_t}{C_t}\right)^{\beta_2}\right) \times N_{stand}}{N_{seat} + N_{stand}}\right]$$

where

- V_t = transit segment volume;
- C_t = transit segment capacity;
- N_{seat} = number of seated passengers;
- N_{stand} = number of standing passengers;
- γ_1, γ_2 = IVT weights under ideal conditions for seated (1.0) and standing (1.4) passengers;
- α_1, α_2 = additional IVT weights at full capacity for seated (0.1) and standing (0.2) passengers; and
- β_1, β_2 = curves for seated (1.4) and standing (3.4) passengers.

The level of crowding, should be estimated for each service under an investment scenario and in the BAU, with Crowding Factors applied to travel time spent on crowded services for both cases.

Journey Amenity

Journey amenity includes many factors relating to service quality and comfort not quantified through journey time, reliability or crowding. They relate to 'softer' factors which impact on perceptions of travel, such as the cleanliness of transit services, provision of information and wayfinding, improved pedestrian walkways or bicycle paths, or the security of station stops and services.

Such factors have traditionally been difficult to quantify or monetise, yet form an important aspect of the travelling experience and an individual's modal choice, and form an important aspect of the generalized travel time. They are typically applied as multipliers to the travel time of the relevant segment of the journey, or alternatively as a constant change to the generalized travel time (in minutes per journey). Ambience improvements can be assessed individually, or collectively where a package of measures is intended to increase the overall quality of a mode or transit line.

Journey amenity constants or multipliers to apply to changes in generalized travel costs for appraising transport investments will be developed for the GTHA.

Illustrative Example of Amenity Analysis using Best Practice

Extensive research has been undertaken into how amenity improvements are valued by passengers in different geographies, which may be applied to Metrolinx appraisals where appropriate.

Table 5.16 outlines a set of ambiance factors developed by Wardman (2014) in an international context, which may be suitable for business case development.

These values are shown for illustrative purposes only to outline how amenity of facility or vehicle can significantly impact the perceived generalized cost of a journey.

Table 5.16: *Ambience Factors Summary*[3]

Ambience	Constant/ Modifier	Suggested Factor
Waiting in Crowded Conditions	Modifier	2.5 - 4.0
Walking in Crowded Conditions	Modifier	2.0 - 3.5
On-Vehicle Information	Constant	< 1 minute
Off-Vehicle Information	Constant	< 1 minute

3 *Wardman M. (2014), Valuing Convenience in Public Transport*

Change in Auto Travel Time/Decongestion

Similar to transit users, automobile travel time changes should be calculated based on changes to overall perceived travel time on an origin destination (OD) basis. Typically, a transit investment (such as an improved rail line, or a new subway) will not directly impact the costs and times for automobile travel. Instead, changes to automobile generalized cost or time will be associated with 'decongestion', which occurs when travellers chose to use transit instead of driving. The reverse effect – travellers driving more due to an investment is also possible.

For most projects evaluated using the GGHMv4, the impact to auto users can be calculated directly through the model by looking at the average change in travel time on the auto network. These impacts may be positive (reduced average travel time) or negative (e.g., increased travel time due to a lane being removed). In instances where these changes may not be readily calculated, for instance if the project is evaluated outside of GGHM, the impact to automobile travellers can be estimated through an approach based on change in congestion as measured by a reduction in auto VKT. This approach should only be used if the demand model is unable to estimate automobile user surplus adequately or if the project does not significantly affect road capacity, and care should be taken to avoid double counting (e.g., the model outputs changes in travel time for the automobile network and, incorrectly, the analyst also calculated impacts due to changes in congestion). Only one approach should be used. This alternative VKT-based approach is not suitable in cases where a project significantly affects road capacity (e.g., a project replaces a lane).

Note for highway investments:

It should be noted that highway investments within urban areas will typically be justified on the basis of reducing congestion by adding new highway capacity (such as additional lanes or grade-separated intersections), which increases the speed of all traffic, rather than reducing the number of vehicles on the highway.

Since they do not reduce highway traffic, the impact of the investment on reduced congestion is captured within the transport user benefits, and valuing the time savings to transport users. Such investments do not have external decongestion benefits, as highway users do not benefit from a reduction in highway trips.[4]

4 *Where a highway investment attracts additional traffic, there is potential for decongestion disbenefits if new trips extend outside the modelled area, since this generates additional vehicle-km, and in effect acts to worsen congestion outside of the immediate area of influence.*

Impact due to Change in Congestion

The travel time for automobile users is heavily shaped by congestion, which refers to where traffic flow is no longer free-flowing, with the presence of other vehicles resulting in additional journey times for all highway users. Congestion can be considered a user impact since each highway user makes the decision to travel along a particular route based on the journey time they experience in doing so, irrespective of the wider impact to other highway users.

If a transport intervention results in highway users along a congested route switching to transit or active modes, this will generate benefits for the remaining highway users, who benefit from decongestion and a faster journey time. However, if an investment increases congestion, all travellers on the road network may have a disbenefit from increased travel time.

Congestion therefore represents an additional 'cost' for all highway users. Each individual's decision to drive in congested conditions increases the journey time of others, leading to reduced leisure time and longer commutes, together with additional costs for businesses who now take longer to make freight deliveries or travel to meetings.

Change in congestion captures the impact to highway users, which occur through two mechanisms:

- Changes in journey times, as congestion decreases highways may offer improved travel times – as congestion increases, so too may travel time.
- Changes in vehicle operating costs, as cars are typically most efficient at approximately 90 km/h, and are especially inefficient in stop-start traffic conditions – therefore, changes that increase congestion may increase operating costs, while changes that decrease congestion may lower operating costs.

Approach – Using Reduced Automobile Vehicle-Kilometre Travelled to Estimate Congestion

This approach focuses on estimates of changes to VKT to determine the impact to automobile users. Automobile VKT change when:

- An investment shifts demand from the auto network (decongestion) to other modes or discourages trip making; or
- An investment shifts demand to auto (increasing congestion) or induces more automobile trips.

The analyst should note this approach is an alternative to capturing travel time savings on the auto network through GGHM and is only applicable with a relatively static automobile network in the BAU and investment cases. If the investment has significant impacts on the automobile network (for example: adding new lanes, or taking lanes away for an LRT project) then the GGHM should be used instead.

The decongestion benefit should be quantified by multiplying the change in automobile VKT travelled by the factors in Table 5.17 and the VoT.

Table 5.17: *Congestion Impacts by Period of Travel*

Period	Value (hours/VKT reduced)
Peak	0.01
Off-Peak	0.00125

Note: Metrolinx is currently working on deriving more accurate decongestion factors through the V4 of the Greater Golden Horseshoe Model which is capable of directly extracting the number of hours saved on roads from a reduction in VKT by time period.

User Costs

User costs refer to the Financial Costs of travel incurred by transport users. These costs are included as a user impact because they are perceived by users and influence their choice of mode. There are also unperceived costs, which are discussed in this section as a potential user impact.

Direct costs include:

- **Transit –** cost of fares or tickets
- **Automobiles –** fuel costs, tolls, and (per mile) vehicle maintenance

Direct costs are perceived by travellers, and influence their choice of whether to travel and the attractiveness of a specific mode. They should be considered in the appraisal analysis if relevant to the investment's expected impact.

Step 1: Calculate Transit User Cost Changes

Direct public transport costs include the value of fare charged to customers and will influence mode choice. Analysts should consider the change in fare as it pertains to mode shift and traveller decision making within Step 2 - Transit User Cost Resource Adjustment.

Step 2: Transit User Cost Resource Adjustment

User costs are included in the user generalized time or cost function as travellers perceive the monetary cost of travel when making decisions. Therefore, the consumer surplus calculation will include transit fares paid.

While fares and user costs are a transfer payment, they are not perceived as one when a user makes a choice. In order to close the transit fare transfer between the user and the provider, an adjustment must be made in the BCA by adding the transit fare change as an impact in the numerator of the BCR. This impact should be based on the incremental change in revenue to transit providers. The resource cost required to deliver the transit intervention should be captured in the denominator of the BCR.

In assessing if a resource adjustment is required, it is imperative to ensure a common and robust approach to benefit and cost estimation is used. This includes ensuring that the forecast demand be consistent with the level of transport capacity provided, along with the associated capital and operating costs. For example, if the forecasted demand for the investment exceeds the scoped capacity, operating costs should be revised. Conversely, costs should also be revisited if the demand is lower than expected and lower resource costs can be applied to reduce the scoped capacity. This will ensure that the incremental revenue captured as a resource adjustment is balanced out by changes in the resource cost of delivery.

Note - if the GGHMv4 model is used to estimate benefits, fares are included in a user's utility function for transit and a resource adjustment is required. An incremental fare revenue resource adjustments is also required if other direct-demand models are used that consider fare in their generalized cost elasticity used to estimate changes in demand.

Step 3: Calculate Vehicle Operating Cost Changes for Auto Users

Change in vehicle operating costs apply to investments where drivers are expected to see a significant change in distance or speed of travel. There are two approaches for estimating direct vehicle operating costs:

- **'Bottom-up' –** estimating the total operating cost by estimating the fuel consumption from vehicle speed, distance and vehicle type
- **'Top-down' –** estimating the operating cost using a unit rate approach

The first approach (bottom-up) should be used where investments are expected to result in a significant change in the volume or (in particular) speed of traffic, such as major highway investments. Changes in vehicle speed, such as additional lanes or grade-separated intersections, would be expected to result in significant changes in vehicle operating costs which should be captured within the estimation of generalized travel cost within the appraisal. The second approach should be used where changes in vehicle flows and/or speeds are minor, such as where a transit or active travel investment results in modal shift away from automobile.

Note - these benefits are only realized by drivers who continue to drive after an investment. Travellers who switch from automobile to transit or other modes do not realize these benefits.

Direct Vehicle Costs Change When Travel Speed Changes

Fuel costs form the largest element of the direct costs of automobile travel. These can be estimated through equation 5.8:

Equation 5.8: *Fuel cost*

$$L = \frac{a+bv+cv^2+dv^3}{v}$$

where

- L = fuel cost, expressed in litres per kilometre;
- v = average speed in kilometres per hour; and
- a, b, c, d are parameters defined for each vehicle category.

For cars, the following parameters are appropriate:

- a = 1.11932
- b = 0.04400
- c = -0.00008
- d = 0.00002

Per-kilometre values for maintenance and tires can be derived from the Canadian Automobile Association, at $0.05 for maintenance and $0.02 for tire costs.

Direct Vehicle Costs Change When Travel Speed Change is Negligible

Where changes in vehicle speeds are negligible, there is unlikely to be a change in the (per user) generalized cost of travel by automobile. In this case, fuel consumption can also be estimated using the unit rate of $0.12 per km, sourced from the Canadian Automobile Association.

By multiplying these costs by the distance of the trip in kilometres, the direct cost can be calculated and included within the overall generalized travel cost for the trip in question.

Unperceived User Costs

Unperceived costs - or costs that are not modelled - refer to those which are 'hidden' or 'sunk' with respect to each trip, such as the cost of insurance or vehicle depreciation. Non-business travellers are assumed not to consider these costs when making an individual trip, as they are largely unaffected by small changes in vehicle mileage. Therefore, unperceived costs should not be included within the estimation of generalized travel time.

However, in certain circumstances a reduction in unperceived costs can be realised as a benefit, such as where an individual switches mode from automobile to transit for their commute over an extended period. Here, they will likely benefit from a reduction in insurance and depreciation caused by an annual significant reduction in highway kilometres, or will no longer require a private vehicle at all.

Additional benefits can therefore be included where this occurs as a 'windfall', outside of the measure of generalized travel cost. This should be included separately within the assessment of investment benefits, and not captured within the reduction in generalized travel cost associated with a transport intervention.

Unperceived Auto Operating Costs

Unperceived auto operating costs per km are estimated at $0.10 (2021$).

BCA is concerned with capturing the marginal costs and benefits that a transportation investment can realize and as a result costs that do not directly vary with vehicle usage (including: insurance, licensing, and financing) are excluded. This leaves depreciation as the only unperceived cost used in BCA. Metrolinx recommends capturing only the distance-based vehicle depreciation cost saving of $0.10/km. This $0.10/km is equal to approximatively 40% of the total depreciation costs of $0.23/km as estimated in CAA's Cost of Driving Manual.

Reporting User Impacts

Each relevant direct transportation user impact should be individually reported and a brief description of the impact and underlying assumptions should be provided. Any risks or uncertainty in estimating the impact should be clearly articulated.

User Impacts should be clearly communicated with:

- A narrative outlining how specific elements of the investment (actions taken) lead to user impacts (example: investment in a faster rail link leading to travel time savings). This narrative should articulate key elements of the investment that drive overall performance as well as key factors that lead to differentiation between options.
- A summary table outlining the user impacts by mode for each option (example shown in Table 5.18). Note: not all investments will realize all types of user impacts, nor will all analysis be able to estimate each benefit category individually.

Table 5.18: *Communicating Present Value of User Impacts*

User Type	Impact Type	Option 1
Transit	**Travel Time**	
	Reliability	
	Crowding	
	Amenity	
	Direct Costs	
Automobile*	**Travel Time**	
	Reliability	
	Crowding	
	Amenity	
	Direct Costs	

User Impact Estimation Examples

The following pages provide examples of how to conduct user benefit estimation for a range of different transit projects.

General User Impacts Template

User Type	Generalized Journey Time	Direct User Costs	Resource Adjustment	Other Considerations
Existing Transit	(BAU transit GJT – New transit GJT) x Existing Users			Converting user impacts to the Factor Cost UOA using a downward adjustment of (1+13%)
New Transit	½ x (BAU transit GJT – New transit GJT) * New Users		(Average weighted fare x New Users) + (VKT * IFTA) + (VKT * AOCTA)	Converting user impacts to the Factor Cost UOA using a downward adjustment of (1+13%)
Auto	(BAU auto GJT – New auto GJT) x Existing Users + ½ x (BAU auto GJT – New auto GJT) * Change in Users OR (Peak Decongestion Factor x Change in Peak Auto VKT) + (Off Peak Decongestion Factor x Change in Off Peak Auto VKT)	(BAU fuel cost – New fuel cost) x Existing Users + ½ x (BAU fuel cost – New fuel cost) * Change in Users + Change in Auto VKT x Unperceived Auto Operating Cost rate per VKT OR Change in Auto VKT x Unperceived Auto Operating Cost rate per VKT (where there are negligible changes to network routings and hence fuel costs)		Converting user impacts to the Factor Cost UOA using a downward adjustment of (1+13%)

**Note: IFTA is the indirect fuel tax adjustment and AOCTA is the auto operating cost tax adjustment, described in more detail on pages 166-168.*

Case Study 1*: Increased bus service (speed, reliability, and frequency improvements)*

User Type	Generalized Journey Time	Direct User Costs	Resource Adjustment	Other Considerations
Existing Transit	(BAU GJT – New GJT) x Existing Users			Converting user impacts to the Factor Cost UOA using a downward adjustment of (1+13%)
New Transit	½ x (BAU Transit GJT – New Transit GJT) * New Users		(Average weighted fare x New Users) + (VKT * IFTA) + (VKT * AOCTA)	Converting user impacts to the Factor Cost UOA using a downward adjustment of (1+13%)
Auto	(Peak Decongestion Factor x Change in Peak Auto VKT) + (Off Peak Decongestion Factor x Change in Off Peak Auto VKT)	Change in Auto VKT x Unperceived Auto Operating Cost rate per VKT		Converting user impacts to the Factor Cost UOA using a downward adjustment of (1+13%)

Case Study 2*: Reduction in Fares*

User Type	Generalized Journey Time	Direct User Costs	Resource Adjustment	Other Considerations
Existing Transit	n/a			Converting user impacts to the Factor Cost UOA using a downward adjustment of (1+13%)
New Transit	n/a		(Average weighted fare x New Users) + (VKT * IFTA) + (VKT * AOCTA)	Converting user impacts to the Factor Cost UOA using a downward adjustment of (1+13%)
Auto	As a fares reduction is likely to have widespread, but modest impacts: (Peak Decongestion Factor x Change in Peak Auto VKT) + (Off Peak Decongestion Factor x Change in Off Peak Auto VKT)	As a fares reduction is likely to have widespread, but modest impacts: Change in Auto VKT x Unperceived Auto Operating Cost rate per VKT		Converting user impacts to the Factor Cost UOA using a downward adjustment of (1+13%)

Case Study 3: *A Reduction In Fares with Increased Bus Service*

User Type	Generalized Journey Time	Direct User Costs	Resource Adjustment	Other Considerations
Existing Transit	(BAU GJT – New GJT) x Existing Users			Converting user impacts to the Factor Cost UOA using a downward adjustment of (1+13%)
New Transit	½ x (BAU Transit GJT – New Transit GJT) * New Users		(Average weighted fare x New Users) + (VKT * IFTA) + (VKT * AOCTA)	Converting user impacts to the Factor Cost UOA using a downward adjustment of (1+13%)
Auto	Unless the impact is material: (Peak Decongestion Factor x Change in Peak Auto VKT) + (Off Peak Decongestion Factor x Change in Off Peak Auto VKT)	Unless the impact is material: Change in Auto VKT x Unperceived Auto Operating Cost rate per VKT		Converting user impacts to the Factor Cost UOA using a downward adjustment of (1+13%)

Case Study 4: *A New BRT System (speed, reliability, and frequency improvements) that Removed a General Purpose Auto Lane (speed and capacity disbenefits)*

User Type	Generalized Journey Time	Direct User Costs	Resource Adjustment	Other Considerations
Existing Transit	(BAU transit GJT – New transit GJT) x Existing Users			Converting user impacts to the Factor Cost UOA using a downward adjustment of (1+13%)
New Transit	½ x (BAU transit GJT – New transit GJT) * New Users		(Average weighted fare x New Users) + (VKT * IFTA) + (VKT * AOCTA)	Converting user impacts to the Factor Cost UOA using a downward adjustment of (1+13%)
Auto	(BAU auto GJT – New auto GJT) x Existing Users + ½ x (BAU auto GJT – New auto GJT) * Change in Users	(BAU fuel cost – New fuel cost) x Existing Users + ½ x (BAU fuel cost – New fuel cost) * Change in Users + Change in Auto VKT x Unperceived Auto Operating Cost rate per VKT		Converting user impacts to the Factor Cost UOA using a downward adjustment of (1+13%)

Case Study 5*: Delivering a New Subway Line*

User Type	Generalized Journey Time	Direct User Costs	Resource Adjustment	Other Considerations
Existing Transit	(BAU transit GJT – New transit GJT) x Existing Users			Converting user impacts to the Factor Cost UOA using a downward adjustment of (1+13%)
New Transit	½ x (BAU transit GJT – New transit GJT) * New Users		(Average weighted fare x New Users) + (VKT * IFTA) + (VKT * AOCTA)	Converting user impacts to the Factor Cost UOA using a downward adjustment of (1+13%)
Auto	(BAU auto GJT – New auto GJT) x Existing Users + ½ x (BAU auto GJT – New auto GJT) * Change in Users	(BAU fuel cost – New fuel cost) x Existing Users + ½ x (BAU fuel cost – New fuel cost) * Change in Users + Change in Auto VKT x Unperceived Auto Operating Cost rate per VKT		Converting user impacts to the Factor Cost UOA using a downward adjustment of (1+13%)

Economic Case Section 2

External Impacts

This subsection articulates the impacts of the investment on the external costs of travel. This refers to the broader social cost of users' travel choices, which capture the wider costs to society of transport use that are not borne by the transport user.

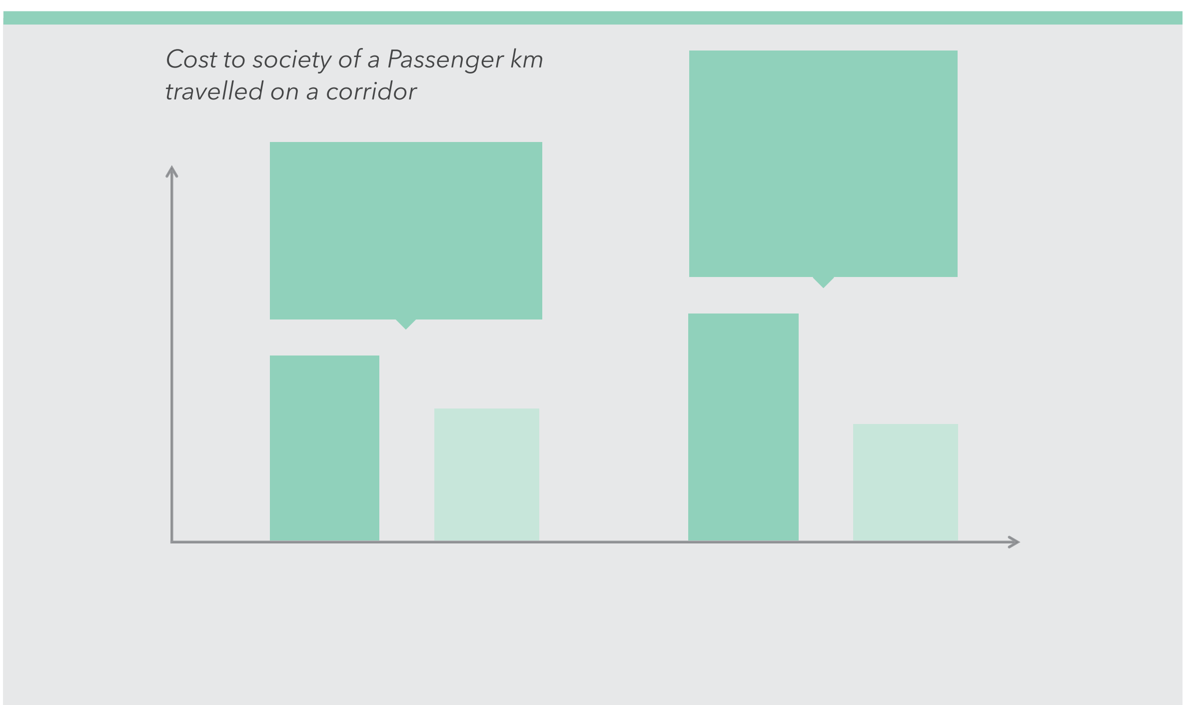
Every trip carries a social cost, which varies dependent on the mode and type of trip being made. Each mode has different social costs based on a variety of factors such as vehicle design, fuel source, right of way, or level of congestion. Transport investments often aim to reduce the social cost of travel, and thereby reduce the negative impacts of travel on wider society.

This section of the Economic Case therefore focuses on how investments can:

- **Reduce the social costs of existing modes without behaviour change** – improve an existing mode such that its social costs decrease (such as introducing new energy-efficient buses with reduced emissions)
- **Encourage shift to a new or existing mode with lower social costs per trip** – invest in services such that travellers change away from modes with high social costs (such as reduced transit fares which attract passengers from single-occupancy cars to transit, or a new walking route which encourages active travel).

These two types of investment are shown in Figure 5.6.

Figure 5.6: *Reducing the Social Cost of Travel*



Types of External Benefit

There are several different social impacts of transport which can be reduced by transport investment. These include: wellbeing and environmental impacts as shown in Table 5.19

Table 5.19: *External Impacts Parameters*

Category	Impact	Description	Value (2021 $)
Wellbeing	Health Benefits (Active Travel)	Value is delivered per new km of travel on active modes. This includes switching entirely from automobile to biking/walking or to new feeder trips (example: bike to a train station) being made.	$4.08/km walked $1.83/km cycled
	Road Safety Benefits	Value is based on foregone accidents resulting in death or injury.	$0.09/auto VKT reduction (note: this value reduces at a rate of 5.3% per year)
Environment	Green House Gas (GHG) Emissions (Global Warming)	Change in GHG emissions should be estimated based on travel behaviour. This includes estimating new emissions from new services and also reduced emissions from mode shift.	$0.01/auto VKT reduction or bespoke analysis
	Local Air Quality (CACs such as NOx, PMs)	Change in air quality emissions should be estimated based on travel behaviour. This includes estimating new emissions from new services and also reduced emissions from mode shift.	$0.002/auto VKT reduction or bespoke analysis
	Noise	Change in noise may be monetized.	Under development

Wellbeing Impacts

Wellbeing refers to the impact of transport on the health and happiness of wider society. Transport can impact on a persons' wellbeing via two mechanisms:

- **Encouraging healthy lifestyles** (such as where a transport investment encourages active travel such as walking and cycling).
- **Reducing accidents** (such as where a road safety investment reduces the number of accidents, or people change from a 'less' to a 'more' safe mode of transport, such as private car to train).

Health impacts

Overview

Different transport modes involve and/or encourage different levels of physical activity, which is associated with a range of positive health outcomes. Improved transit, for example, will encourage people to walk and cycle more in accessing transit stops, relative to a car-dependent lifestyle. Better walking and cycling infrastructure will encourage active travel trips, which, by their nature, require more physical activity than other modes.

The quantity of health benefits arising from a transport investment is dependent on:

- The base level of physical activity of the users of the investment;
- The age of users and subsequently their relative risk of mortality; and
- The uplift in physical activity resulting from the investment.

Appraisal of health benefits is most appropriate where an investment is intended to have significant impact on the level of physical activity. Health benefits are anticipated to form a significant proportion of the benefits where an investment is focused on walking and/or cycling facilities.

The benefits of walking and cycling in the context of the Greater Toronto region are set out in a 2012 report by Toronto Public Health.[5] The range of benefits includes:

- Increased lifespan (mortality);
- Improved quality of life due to reduced likelihood of disease/reduction in years spent with disease (morbidity);
- Oncreased economic output due to reduced absenteeism (productivity); and
- Reduced direct medical costs.

The value of health benefits in this guidance considers the impacts listed above in aggregate.

5 *Toronto Public Health, (April 2012) Road to Health: Improving Walking and Cycling in Toronto.*

Benefits Appraisal

Health benefits are dependent on two key variables, which should be forecasted and estimated using a methodology proportionate to the value of the investment and anticipated value of health benefits:

- Number of trips by active modes; and
- Trip distance.

Parameters for use in the appraisal of health benefits are set out in Table 5.20. The following steps should be applied to calculate the annual health impacts of the investment. Where necessary steps 1-3 can be applied to individual sub-sets of users or OD pairs and summed together to get total annual health benefits.

Table 5.20: *Health Impact Appraisal Parameters*

Parameter	Value	Notes	Source
Walking Health Benefit (HB)	$4.08/km walked	(2021$)	Metrolinx Research
Cycling Health Benefit (HB)	$1.83/km cycled	(2021$)	Metrolinx Research
Average walking speed	5.3 km/h	Used to adjust from travel time to trip distance where necessary	Kahlmeier et al. (2017) [4]
Average cycling speed	14 km/h		
Time needed to obtain full annual health impacts (year A)	5 years	Can be adjusted on an investment specific basis where justified	Kahlmeier et al. (2017) [4]

6 *Kahlmeier, S et al. (2017). Health economic assessment tool (HEAT) for walking and for cycling - Methods and user guide on physical activity, air pollution, injuries and carbon impact assessments, World Health Organisation Regional Office for Europe.*

Step 1:
Estimate the number of trips in the reference and comparison cases

For larger investments, trip numbers may be outputs of a transport model. Where no model data exists, census journey to work data, the Transportation Tomorrow Survey, other population level datasets, surveys and counts from other similar investments can be used to inform assumptions. Dependent on the size of the investment it may be appropriate to solicit investment-specific data. Health benefits are applicable to habitual behaviours only, e.g. commuting and regular leisure activities.

This methodology is not applicable to one-off events and/or one-off user types e.g. tourists.

Trip numbers in the comparison case (do-something scenario) must be reduced to account for users who:

- Have been reassigned from the same activity on a different route; or
- Are substituting active travel for other types of physical activity undertaken in the reference case.

Step 2:
Estimate the mean trip distance

Mean trip distances must be calculated to determine the value of increased active travel. Means should be reflective of the annual mean. Where seasonal variations are anticipated these should be accounted for. Similar sources as in step 1 and knowledge of the distances between origins and destinations served by the route can be used in this calculation. If change in travel time is the only known variable, the values in Table 5.20 can be used to convert into kilometres. Walking and cycling activity is not evenly distributed across Toronto, this should be considered when applying regional or national data to a local investment.

Note: *In reality, the value of health benefits accrued follows a non-linear dose-response curve with the per kilometer health benefit decaying as trip lengths increase. Therefore, the value of benefits is capped for long trips. Where long trip distances are anticipated they should be capped at 41km/week/user for walkers and 104km/week/user for cyclists[4]. Mean trip distances used in the calculation should be adjusted to ensure all considered trip lengths fall below these caps, applying reasonable assumptions for trip frequency.*

Step 3: Calculate value of annual health impacts

Equation 5.9 applies the parameters in Table 5.20 to provide an annual health impact value to be taken forward in the investment appraisal. These equations should be applied separately for walking and cycling. Due to uptake time involved in reaching the full potential of an investment, the full annual benefit should only be applied from 'year A', as specified in Table 5.20. For the years preceding 'year A' the annual benefit should be prorated evenly back to zero. Equation 5.9 shows an approach to calculate annual health impact.

Note: *Care should also be taken when applying this approach to populations who have an above average level of physical activity, the health benefit values assume a base level of activity which includes a mix of sedentary, inactive and active users. The approach is also less reliable where applied to children and elderly people. Research and data informing the health benefit values is based on adult populations and samples.*

Equation 5.9: *Annual Health Impact*

$$Annual\ Health\ Impact = V_{health} \times \left((distance_{c\ mean} \times trips_c) - (distance_{ref\ mean} \times trips_{ref})\right)$$

Where:

- V_{health} is the health benefit for the relevant active mode from Table 5.20
- $distance_c$ mean is the mean trip distance in the comparison (do-something) case in kilometres
- $distance_{ref}$ mean is the mean trip distance in the reference case in kilometres
- $trips_c$ is the number of annual trips in the investment case, adjusted for reassignment from other routes and substitution for other types of physical activity
- $trips_{ref}$ is the number of annual trips in the BAU

Road Safety Benefits

Overview

Road safety benefits occur where an intervention reduces the number of vehicle collisions. Collisions occur across all transport modes, and changes to the risk of being involved in a collision has an impact on both users and non-users (wider society). Road safety impacts include:

- Pain, grief and suffering
- Lost economic output (due to death or injury and delay to other road users due to disruption)
- Medical costs
- Property damage
- Police costs
- Insurance administration
- Legal and court costs

This guidance provides a road safety methodology where a rate is applied to the change in auto VKT induced by the investment. This is suitable for investments where the focus is not on road safety but significant changes in VKT are anticipated.

Approach – Estimate Change in the Social Cost of Accidents

Where an investment is anticipated to significantly impact traffic volumes the likelihood of a collision is also impacted. This impact is calculated based on the change in VKT between the reference and comparison cases.

The change in VKT should be multiplied by a suitable unit rate for vehicle collisions using the values in Table 5.21.

Table 5.21: *Accident Costs ($ per km)*

Vehicle Type	Value (2019$)
Car	$0.09/auto VKT reduction (note: reduced by 5.3% per year)

Environmental Impacts

Environmental impacts refer to the broad cost of transport on local surroundings and the Earth's atmosphere. This includes:

- The impacts of greenhouse gas emissions from different types of transport on the Earth's atmosphere, which have been demonstrated to cause climate change.
- The impacts of vehicle usage and emissions on local air quality (such as NOx or PM10s, or tire particulates) which have negative health impacts for local people.
- The impacts of noise generated by cars and transit vehicles on their surroundings.

Greenhouse Gas Impacts

Overview

Greenhouse gas (GHG) emissions, such as carbon dioxide, are the main contributor to global warming, and regarded as a major challenge for the global community. GHG emissions contribute towards an overall warming of the Earth's climate system, which has been proven to result in rising sea levels, changes in rainfall and precipitation, and more extreme weather events, all of which impose major costs on society.

Changes in emissions are regarded as external welfare impacts, since their impacts are felt across Canada and the world, and not confined to transport users. Transportation – including automobile, public transit and freight – is responsible for 24% of Canada's GHG emissions.[7] It is therefore essential that the impacts of transport investments on GHG emissions is included within the transport appraisal consistently and transparently.

Transport appraisal aims to capture the whole-life change in GHG emissions, including:

- Vehicle and transit operating emissions (such as those caused from burning fuel whilst driving); and
- Emissions caused from construction and decommission of transport infrastructure (such as those included during the construction of a new highway bridge).

7 *Greenhouse gas emissions by Canadian economic sector (https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/greenhouse-gas-emissions/canadian-economic-sector.html)*

Social Cost of Carbon

GHGs impose a social cost, based on their contributions to climate change. Environment and Climate Change Canada uses a Social Cost of Carbon (SCC) approach to value the negative impacts of GHG emissions of the Earth's climate. It is a monetary measure of the global damage expected from climate change from the emissions of an additional tonne of carbon dioxide (CO_2) in the atmosphere in a given year.[8] This is intended to allow GHG emissions to be valued within cost-benefit analysis, with the goal of providing informed analysis to decision makers.

Table 5.22 outlines the social value of carbon to be used for estimating external impacts.

8 *Archived Content: Technical Update to Environment and Climate Change Canada's Social Cost of Greenhouse Gas Estimates (http://ec.gc.ca/cc/default.asp?lang=En&n=BE705779-1#SCC-Sec1)*

Table 5.22: *Social Cost of Carbon Emissions*

Year	C$ 2012 per tonne CO_2	C$ 2013 per tonne CO_2	C$ 2014 per tonne CO_2	C$ 2015 per tonne CO_2	C$ 2016 per tonne CO_2	C$ 2017 per tonne CO_2	C$ 2018 per tonne CO_2	C$ 2019 per tonne CO_2
Cumulative Inflator	1.000	1.016	1.036	1.027	1.034	1.06	1.08	1.094
Annual Inflation		1.6%	1.9%	-0.8%	0.6%	2.5%	1.9%	1.3%
2010	34.1	34.7	35.3	35.0	35.3	36.1	36.8	37.3
2013	37.4	38.0	38.7	38.4	38.7	39.6	40.4	40.9
2015	39.6	40.3	41.0	40.7	40.9	42.0	42.8	43.3
2016	40.7	41.4	42.2	41.8	42.1	43.1	44.0	44.5
2020	45.1	45.8	46.7	46.3	46.6	47.8	48.7	49.3
2025	49.8	50.6	51.6	51.2	51.5	52.8	53.8	54.5
2030	54.5	55.4	56.4	56.0	56.3	57.8	58.9	59.6
2035	59.6	60.6	61.7	61.2	61.6	63.2	64.4	65.2
2040	64.7	65.8	67.0	66.5	66.9	68.6	69.9	70.8
2045	69.7	70.8	72.2	71.6	72.1	73.9	75.3	76.3
2050	74.8	76.0	77.5	76.9	77.3	79.3	80.8	81.8

Source: Environment Canada (2012 Social Cost of Carbon); CANSIM Table 380-0102 (inflation factors); Ministry of Transportation, Transportation Economics Office (2017). Note: 2019 inflation assumed annual inflation between 2012 to 2018.

Emission Benefit Calculation

Changes in GHG emissions should be estimated for transport projects as follows:

Step 1: Estimate the Change in Energy Consumption

GHG emissions from transportation can be assumed to be proportionate to the number of litres of fuel or the number of (kWh) of electricity used. Fuel and electricity usage should be estimated for the investment and BAU scenarios using Equation 5.10:

Equation 5.10: *Change in Energy Consumption*

$$L = \frac{a + bv + cv^2 + dv^3}{v}$$

where

- L = fuel consumption (expressed in litres per kilometre);
- v = average speed (km/hr); and
- a, b, c and d are parameters defined for each vehicle category.

For cars, the following parameters are appropriate:

- a = 1.11932
- b = 0.04400
- c = -0.00008
- d = 0.00002

Figures for rail or bus investments should be derived from local evidence.

Care should be taken to develop a robust estimate reduced emissions due to investment that improve fuel or energy efficiency (example: fleet replacement) or ensuring the new emissions from a new transport service are captured (example: a subway extension will require more operating electricity and therefore will lead to more emissions from transit).

Step 2: Estimate the Impact on Greenhouse Gas Emissions

GHG emissions for each scenario can be estimated from the fuel / electricity consumption by multiplying by the fuel consumption by the quantity of carbon dioxide equivalent (CO2e) emissions estimated to be released from one litre of fuel burnt / kWh consumed and the total distance travelled.

From these two steps, the total GHG emissions for the investment and BAU scenarios can be determined. The investment scenario GHG impacts should be calculated based on:

- Emissions due to the investment (example: the emissions to operate a new subway, or reduced emissions due to procurement of more energy efficient buses).
- Emissions changes due to travellers changing mode (example: choosing transit instead of auto).

Equation 5.11: *Change in GHG Emissions*

$$\begin{matrix}\textit{Change in} \\ \textit{GHG emissions}\end{matrix} = \left(\begin{matrix}\textit{new emissions from} \\ \textit{the investment}\end{matrix}\right) + \left(\begin{matrix}\textit{changes in emissions from} \\ \textit{the existing network}\end{matrix}\right)$$

Example:

$$\begin{matrix}\textit{Change in} \\ \textit{GHG emissions}\end{matrix} = \left(\begin{matrix}\textit{new emissions from} \\ \textit{subway extension}\end{matrix}\right) + \left(\begin{matrix}\textit{change in emissions from} \\ \textit{travellers switching from} \\ \textit{auto to transit, which is} \\ \textit{typically negative}\end{matrix}\right)$$

Step 3: Estimate the Monetary Value of the GHG impacts

The total welfare impact of the change in GHG emissions can then be calculated, based on applying an appropriate social cost of carbon to the change in total GHG emissions between the investment and BAU scenarios.

This calculation should ideally be undertaken for all modelled years, but as a minimum once for the investment and BAU scenarios.

Air Quality Impacts

Overview

Many emissions from vehicle engines (including automobile, bus, truck and transit) are damaging to human health, and have been linked to breathing difficulties such as asthma, heart disease and cancer. These pollutants – known as CACs – include:

- Carbon Monoxide (CO)
- Nitrogen Oxide (NO_x)
- Sulphur Dioxide (SO_2)
- Volatile organic compounds (VOCs)
- Particulate matter finer than 10 microns (PM_{10}s)
- Particulate matter finer than 2.5 microns ($PM_{2.5}$s)

Poor air quality impacts those living or working in close proximity to transport infrastructure. Since impacts are not perceived by transport users, they represent an external impact, and the benefits from improved air quality can be considered as welfare benefits to wider society.

Social Cost of Air Quality

Table 5.23 outlines the recommended values for the estimation of the external cost of transport emissions in Canadian dollars per tonne, by pollutant.

These values are informed by Health Canada's Air Quality Benefits Assessment Tool (AQBAT)[9] model to estimate the impact of poor air quality on health outcomes, calculated from local air quality and population data and the application of established relationships (or Concentration Response Functions) between specific pollutants and adverse health impacts. Each health impact is valued within AQBAT, endorsed by Health Canada, and can therefore be used to estimate the total impact of poor air quality of the health of Canadians by province. It also includes the negative impacts of air pollution on reduced crop yields (determined by agricultural modelling) and reduced visibility / increased haze (determined through stated preference research).

From this, the total costs of transport-related emissions on a per tonne basis, as outlined in Table 5.23, can be estimated. This provides an indication of the benefits of reducing air pollution for any transport-related activity. These figures should be assumed to increase in line with GDP per capita.

9 *AQBAT, developed by Judek and Stieb, is a computer simulation tool designed to estimate the human health and welfare benefits or damages associated with changes in Canada's ambient air quality.*

Table 5.23: *Unit Costs for CACs in Ontario*

	Value (2021$/tonne)
PM 2.5	$37,007
SO_2	$8,292
NO_x	$7,553
VOC	$1,113

Source: Marbek Consulting, 2007 (costs uplifted to $2021)

Approach – Local Air Quality Benefits Calculation

Where investments are expected to lead to significant changes in local air quality (such as significant changes in traffic flows within an urban area), the values provided in Table 5.23 can be used to estimate the air quality impact. This will require, as a minimum, an estimate of the change in tailpipe emissions, although for larger investments should involve bespoke air quality models which better capture the volume and type of emissions and how they are expected to disperse.

Where the impact on local air quality is expected to be limited, an approach based on the change in vehicle kilometres should be adopted. This should multiply the change in vehicle kilometres expected per year by $0.002 (2021$) to estimate the air quality impact.[10]

Equation 5.12 illustrates how to calculate the change in CAC emissions.

Equation 5.12: *Change in CAC Emissions*

$$\begin{matrix}\textit{Change in}\\ \textit{CAC emissions}\end{matrix} = \left(\begin{matrix}\textit{new emissions from}\\ \textit{the investment}\end{matrix}\right) + \left(\begin{matrix}\textit{changes in emissions from}\\ \textit{the existing network}\end{matrix}\right)$$

Example:

$$\begin{matrix}\textit{Change in}\\ \textit{CAC emissions}\end{matrix} = \left(\begin{matrix}\textit{new emissions from}\\ \textit{subway extension}\end{matrix}\right) + \left(\begin{matrix}\textit{change in emissions from}\\ \textit{travellers switching from}\\ \textit{auto to transit, which is}\\ \textit{typically negative}\end{matrix}\right)$$

10 *This figure is informed by Marbek Consulting (2007)*

Noise Impacts

Overview

Exposure to noise can have negative effects on individuals' health, wellbeing and productivity. Research by the World Health Organisation (2011) highlighted how exposure to environmental noise can increase the risk of heart disease, hypertension, stroke, cognitive impairments in children, sleep disturbance and tinnitus, as well as representing a significant annoyance to those affected. It estimated that at least 1 million healthy life years are lost every year from traffic-related noise in Western Europe.

Noise impacts are felt by those living or working in close proximity to transport infrastructure, and since they are not directly felt by transport users, they are considered as externalities. Benefits from reduced exposure to noise largely accrue from:

- **Improved health –** valued through the reduction in Disability-Adjusted Life Years (DALYs);
- **improved amenity –** valued through improved sleep disturbance and reduced annoyance; and
- **improved productivity –** arising from a healthier workforce and reduced distraction, fatigue and disturbance at work.

International Best Practice for Estimating the Social Cost of Noise

Research into the social cost of noise arising from transportation is at an early stage. UK Department for Transport WebTAG guidance forms one of the most comprehensive sets of guidance to date, and quantifies the social impacts of changing noise levels from highway, rail and air traffic for several health and amenity impacts.

These are presented in Table 5.24, in £ 2010 prices per household per year, for a change in noise level from highway traffic from <45dB (negligible) to 76dB (equivalent to a freeway 50ft away).

Table 5.24: *Social Cost of Increasing Noise from <45dC to 76dB Per Household Impacted*

Noise impact	**Reference Value (2010 GBP)**	Illustrative Canadian Value (2019$ CAD)
Amenity (annoyance)	£35.11	$66.80
Direct AMI	£12.76	$24.30
Stroke	£2.41	$4.60
Dementia	£3.63	$6.95
Sleep Disturbance	£49.52	$94.15

These values are informed by *World Health Organisation* research (WHO, 2011) into the health impacts of environmental noise, and places a value of £60,000 on a Quality-Adjusted Life Year. Values are assumed in WebTAG to increase over time in line with real GDP per capita. This approach is shown for illustrative purposes. Note: illustrative values have converted the UK value to Canadian Dollars based on the 2010 average exchange rate.

Noise Benefit Calculations

Noise impacts are typically difficult to quantify, as they require bespoke modelling or analysis to estimate noise levels from forecast traffic flows or transit operations on local households. This will require a proportionate approach to be undertaken, often as part of an investment's Environmental Assessment.

Qualitative approach

For investments which are expected to have negligible impacts on noise, or smaller investments where a full appraisal would not be appropriate, a qualitative assessment can be used. For example, an active travel intervention which increases walking and cycling use, resulting in a minor mode shift from automobile, could be expected to have a small positive impact on noise levels along the corridor affected.

Quantitative approach

Where investments result in significant noise impacts, such as new highway or rail corridor which results in a significant (>1dB) change to the noise experienced by households, a full quantitative approach can be adopted. This assigns a monetary value for each 1dB change in the noise level experienced by a household for amenity (annoyance), acute myocardial infarction, dementia, stroke, and sleep disturbance. There is currently no accepted methodology for appraising other noise impacts (such as productivity at work impacts).

This requires the change in noise levels or dB 'bands' over the surrounding area to be explicitly modelled, which is only likely to be proportionate for a small number of investments.

Research by the *WHO* (2011) provides evidence of the impact of changes in noise on these health outcomes. This is based on the evidence-based probability of an individual experiencing these outcomes, since the impact of noise on an individual is subjective, and not all individuals will experience the same adverse health impact at a given level of noise. These figures can be used to estimate the change on the number of DALYs lost or gained, which can then be quantified.

Currently, values for the social cost of noise ($/dB reduction) in the GTHA have not been developed. Business cases should discuss noise impacts where relevant (in particular at the Preliminary Design and Full Business Case stages when Environmental Assessment data may be available)/

Communicating External Impacts

External Impacts should be clearly communicated with:

- A narrative outlining how specific elements of the investment (actions taken) lead to external impacts (example: investment in a faster rail link leading to users switching to rail instead of auto, leading to GHG savings). This narrative should articulate key elements of the investment that drive overall performance as well as key factors that lead to differentiation between options.
- A summary table outlining the external impacts by mode for each option (example shown in Table 5.25, all values should be presented in present value terms for the year of the appraisal).

Table 5.25 illustrates how external impacts can be communicated.

Table 5.25: *Communicating Present Value of External Impacts*

Impact Type	Impact	(Present year $)
Wellbeing	Health	
	Safety	
Environment	Greenhouse gases	
	Air Quality	
	Noise	

Economic Case Section 5

Wider Economic Impacts

This section of the Economic Case focuses on articulating how the investment will lead to Wider Economic Impacts (WEIs) in the region. Each transport investment has the opportunity to offer benefits to society beyond those afforded to travellers (user impacts) and those realized by reducing the social cost of travel (external impacts).

New mobility investments can improve accessibility to work, leisure, customers and suppliers, which in turn can trigger new economic activity. WEI analysis is focused on the follow on economic impacts of the investment – not the specific user or external benefits discussed previously in this guidance. WEI analysis should be conducted carefully to avoid double counting with user and external benefits.

Because WEIs can speak to issues beyond transport, they can have an appeal to a wider array of decision makers and stakeholders. As a result, WEIs are becoming an increasingly prominent component of transport evaluation.

How to Consider WEIs in Economic Appraisal

WEIs have emerged as a key part of Economic Appraisal in other jurisdictions. They are considered as 'second order' impacts of transport investment and are positioned as a form of expanded appraisal or sensitivity test. WEIs should always be presented as an additional analysis with assumptions and methods clearly illustrated.

Within the emergent Economic Case guidance, WEIs should estimated if they are relevant to the proposed investment (not all investments will be expected to realize WEIs).

Introducing Wider Economic Impacts

Traditional BCA captures the benefits of transport investment which accrue to transport users, largely through changes in generalized journey times. Under perfect market conditions, these will capture the entire economic impacts of a transport intervention.

WEIs occur as a result of 'distortions' or 'market failures' within local economies, such as:

- **Imperfect Competition –** Perfect competition is primarily a theoretical construct, with a particular market that enjoys the highest level of competition (generally measured by the ability to price discriminate) considered to be perfectly competitive. In reality, distance and transportation costs confer localized monopoly rents: if you are the only store in a town you can afford to charge higher prices than you would if there were competitors nearby. If transportation investment increases accessibility, this will reduce the ability of businesses to charge monopoly or above-market prices, and hence generate WEIs.
- **Non-constant Returns to Scale and the Presence of External Effects –** If production of a good or service is assumed to have constant returns to scale, an increase in inputs always yields a similar increase in output. When an increase in inputs yields a greater than proportional increase in output then the output increase might be due to technology or due to external effects. However, ample evidence suggests that external effects are widespread and that under some conditions the constant returns assumption is not valid. For example, organizing production in a dense setting with extensive interplay between firms and workers is shown to yield higher productivity through mechanisms defined below. To the degree transportation investments can accommodate greater concentration of economic activity they can facilitate some degree of increasing returns to scale.
- **Taxation effects –** Economic agents (businesses and households) make decisions about how much to supply and demand on the basis of the private costs and benefits (which in turn determine wages and profits). Taxation may, therefore, distort the incentives of businesses and households and thereby affect the competitive market equilibrium. For example, in the market for labour, employment taxes may reduce the returns to work and therefore limit the quantity of labour that households are willing to supply. In the general economy this may result in inefficiently low levels of production and investment.

Such distortions mean that changes in generalized travel costs do not capture the entire economic impact of transport interventions, and there are additional WEIs to consider. If these WEIs are to be included, the business case should provide supporting evidence for the existence of these distortions as relevant to the investment. The range of WEIs considered in project appraisal are noted in Table 5.26.

Table 5.26: *Wider Economic Impacts*

Wider Economic Impact Category	Description	Examples
Productivity (Agglomeration and Clustering)	Agglomeration refers to the tendency for firms and workers to benefit from proximity. Transport investments reduce the cost/time to travel between locations, which in turn improves the 'effective' or perceived density of a region. As proximity over time and space increases, there is an allowance for improved choice of inputs in production; greater exchange of information between workers and firms, and faster learning from increased face-to-face contact. These factors in turn can lead to more productive firms.	One part of a region has a high number of high tech jobs. A second part of the region is known for its financial sector. Currently the travel time between these two locations is an impediment to economic development. The rail line between the locations is improved, reducing the travel time substantially. As a result these two industries have greater collaboration potential and agglomeration benefits are realized.
Imperfect Competition	Imperfect competition results in higher prices for specific goods or services. Transport investment can improve competition by connecting new markets or reducing the cost of travel within existing markets leading to increased accessibility and choice for consumers.	A transport network or geographical feature (example: a lack of a rail link or a topographical barrier such as a river) artificially separates two parts of the region that are otherwise close together. Over time this barrier leads to two separate functional economic areas which are likely to be less efficient than if there was free movement across the barrier and direct competition between the firms.
Labour Markets	Transport investments can expand the 'commute shed', which is the amount of employees that can reach a destination in a given time frame. This has benefits to both employees and employers: • Employees have access to a wider range of employment opportunities outside of their current location and may consider relocating to a new location based on the new commute options provided by the investment, taking up more productive opportunities that better match their skill set or, in some cases, choosing to enter the labour market. • Employers have access to a deeper and larger pool of labour with more diverse skills.	The commute between some communities and the downtown core may take too long for residents. A transport investment reduces the travel time to these communities from the core, which adds the residents to the core's 'commute shed.' As a result, the core has greater access to potential employees.

Productivity Impacts due to Agglomeration Economies

Background

Broadly, agglomeration benefits refer to the productivity gains resulting from firms being located close to one another typically, but not exclusively, within urban areas. Key to the concept of agglomeration is the notion that businesses and resources can take advantage of a number of efficiencies by being located within close proximity to one another – either physically, or through good transport connectivity. Agglomeration benefits arise through:

- additional competition amongst firms and suppliers, both for their labour and their products, which places additional incentives on firms to be more productive and innovative;
- better access to larger, thicker labour markets, resulting in an increased ability to better match people to jobs and fill vacancies with specific skills requirement;
- greater specialization and division of labour, enhanced economies of scale, and increased opportunities for firms and workers to specialise and innovate; and
- access to larger customer markets, increased 'knowledge spillovers', and the consequent exchange of ideas.

Such factors are argued to account for the tendency for larger, denser cities to be more productive than smaller ones. OECD research of productivity per capita within developed nations indicates that, typically, a doubling of city size increases productivity by 2% - 5%.[11]

Even if firms do not interact with others nearby, or make use of new transport infrastructure, all firms benefit from the productivity advantages of being located 'closer' to one another. Agglomeration impacts are an economic externality, in that while firms make decisions of where to locate based on what represents the most efficient decision for themselves, their decision to locate in proximity to others benefits all firms by increasing the density of economic activity – and hence productivity per capita – within the local area.

11 *"The Metropolitan Century", OECD (2015) Cited from https://www.citymetric.com/business/cities-productivity-proportional-their-size-unless-theyre-british-782*

Theories of agglomeration

Agglomeration economies are broadly regarded as occurring through two mechanisms external to the firm: localisation and urbanisation economies. In his Principles of Economics (1920), Marshall first described the role of agglomeration in increasing the productivity of an industry, region or economy due to factors outside the control of individual firms. Marshall's work focused on the so-called 'localisation' (or Marshallian) economies, in which an increase in the size of an industry in a city leads to an increase in the productivity of a particular activity within the same industry.

For example, the high concentration of life sciences firms within Toronto exemplifies industrial localization. Despite the significantly higher wages and rent associated with an urban location, life sciences firms continue to locate due to the additional benefit they receive due to their proximity to a high-skilled pool of labour, their clients and customers.

'Urbanization' (or Jacobian) economies, by contrast, arise when the size of the city itself leads to an increase in productivity. Firms which locate in urban centres benefit from the common resources (such as roads, buildings and power supply) and large labour pool found in the city, regardless of which sector they are in. Moreover, through the preponderance of potential customers, urbanization economies allow firms which serve niche markets (example: specialist financial services in Toronto to operate at a scale that would be unviable in other more disperse locations).

Urbanization and localization economies can be experienced at the same time. Diversity and scale of markets are crucial to urbanization economies, whereas specialization and density of specific sectors within an economic cluster are key to localization economies. Agglomeration elasticities do not typically distinguish between the two effects and provide a combined estimate for both urbanization and localization impacts.

Static and dynamic clustering

Transport investment can increase agglomeration – and hence generate additional productivity impacts – through both localization and urbanization effects. These can occur through two mechanisms:

- **Static clustering** (also referred to as 'first-order' or 'productivity') impacts occur as transport investment, in effect, brings firms, people and places closer together by reducing the travel times between them. The ease of making a journey within the cluster is improved which can, in turn, facilitate additional economic interactions. Static clustering occurs through:
  - Sharing common resources
  - Increased scale and specialization
  - Knowledge spill-overs
- **Dynamic clustering** (also referred to as 'second-order' or 'employment and investment') effects refer to the subsequent effects that attract more productive resources – such as firms or labour – into the local economy. In contrast to static clustering, the quantity or density of activity (or economic mass) in each place changes. Dynamic clustering operates through:
  - Attracting high-skilled workers to the affected area
  - Incentivizing local people to invest in education and skills
  - Stimulating business investment

Provided the transport investment leads to time savings, the static first-order effects will always lead to a productivity gain and a WEI. Whether this is significant, the transport user benefits and investment costs – and should hence be considered in an appraisal – is a function of the nature of the transport investment and the affected area. They will typically be significant where:

- investments result in a significant change in the accessibility of an area (through changes in generalized travel costs);
- the area subject to the transport improvement is urban in nature, and home to dense concentrations of economic activity; and
- journeys which benefit from accessibility improvements are short in nature (Rice et al[12] estimate that agglomeration benefits tail off sharply from journeys beyond 45 minutes' drive time).

Second-order effects can further increase agglomeration (by increasing the number of workers and firms in the cities) which may, in turn, trigger further dynamic clustering. However, part of this effect can be relocation of economic activity from other non or less-affected areas, who suffer from disbenefits from a reduced concentration of economic activity. The net effect is the sum of gains and losses, which is context-specific and a function of both the investment and the socio-economic and industrial make-up of the affected areas.

Second-order effects are typically only associated with larger, more transformational transport infrastructure, which generate sufficiently large changes in accessibility to encourage the displacement of economic activity.

12 *Rice, Venables and Pattachini (2006)*

Quantifying agglomeration

Agglomeration, or productivity impacts, are calculated using data from previous stages of economic analysis and transportation demand forecasting. It is assumed that agglomeration impacts will be estimated using a zone-based transportation demand model (such as the GGHMv4).

Analysts will require the following data:

- Employment (broken into goods producing and services producing industries) at a disaggregate zonal level (such as Transportation Analysis Zones in the GGHMv4) for the forecast year.
- Minimum generalized journey time between all zones (or origin-destination pairs) by mode including private and public transit (which includes all transit modes).
- Level of demand by trip purpose between all zones (or origin-destination pairs) by mode. The trip purposes considered should be commuting (home-based work) and business (work-based other) categories.
- Assumed GDP per worker.
- Assumed GPD per worker growth rate.
- Agglomeration elasticities and decay parameters by industry.

The general process for calculating agglomeration is described in subsequent sections, and includes:

- Step 1- Calculating Generalized Journey Cost between Each Zone.
- Step 2 – Estimating Effective Density for Each Zone.
- Step 3 – Estimating Productivity Impact.
- Step 4 – Integrating Productivity Impacts into the Economic Case

Parameters and Methodology Overview

Agglomeration impacts are estimated by applying an elasticity of productivity with respect to effective density at a zonal level, which is then multiplied by the average GDP per worker in each industry to calculate the productivity impact which accrues to that industry. This is then multiplied by employment to estimate the total zonal value of the productivity impact, with the productivity impacts for each industry and zone summed to give the overall agglomeration impact. The values in Table 5.27 are used for this estimation process

Table 5.27: *Agglomeration Appraisal Parameters*

Type	Agglomeration Elasticity (Rho)	Decay Parameter (Alpha)
Economy	0.046	1.8
Goods-producing industries	0.104	1.8
Services-producing industries	0.03	1.9

Step 1: Estimate the Average Generalized Travel Cost

Firstly, the average generalized cost of travel (weighted across all journey purposes p) between each area *i* and area *j* should be estimated using the equation:

Equation 5.13: *Estimating Average Generalized Travel Cost*

$$Average\ Generalized\ Cost\ of\ Travel_{i,j}(S,m,f) = \frac{\sum_p Generalized\ Cost_{i,j}\ (S,m,f) \cdot Number\ of\ Trips_{i,j}(S,m,f)}{\sum_p Number\ of\ Trips\ \ (S,m,f)}$$

This calculation should be undertaken for each scenario S and forecast year f, and for modes (m) auto and transit. The generalized cost and number of trips data should be provided by GGHMv4 model runs or an appropriate transport demand model, for the Business as Usual and investment scenarios.

Areas i and j should be at TAZ level or at a spatial scale that allows the change in generalized cost to be robustly captured, and for where sufficient local employment data is available. All zones scoped in the model should be considered.

Step 2: Estimate the Effective Density

Effective density is a measure of a single zone's economic mass – it represents the extent to which individual jobs can are 'connected' to other jobs, and how these connections impact productivity. Generalized journey costs can be considered an 'impedance' to agglomeration – for a given level of employment in a neighboring zone, lower costs will mean a higher effective density. Generalized journey cost is raised to the power of a 'decay parameter' that reflects the 'diminishing agglomeration' of higher cost connections – for example, consider a TAZ (TAZ A) with 1,000 jobs. This TAZ is connected to two other TAZs: TAZ B with 500 jobs that is 45 minutes away and TAZ C with 500 jobs that is 90 minutes away. TAZ C is 90 minutes away from TAZ A and will have a significantly lower contribution to TAZ A's effective density than TAZ B. The decay parameter is used to capture this non-linear relationship between travel cost and effective density.

Effective density should be estimated using equation 5.14:

Equation 5.14: *Estimate Effective Density*

$$Effective\ Density_i(S,k,f) = \sum_j \sum_m \frac{E_j(S,f)}{g_{i,j}(S,m,f)^{\alpha^k}}$$

Equation 5.14 will calculate the effective density for all zones i, undertaken for each scenario S, economic sector k and forecast year f. The process for applying this equation includes:

- For each individual TAZ, the analyst will calculate effective density by considering the employment in each TAZ it is connected to by at least one mode.
- Effective density is calculated on a TAZ to TAZ basis (origin destination pair basis) and modal basis (auto and public transit) – for example, for TAZ A, which is connected to TAZs B and C, the analyst will:
    - Take the employment in Zone B divided by the minimal generalized journey cost of automobile raised to the power of the decay parameter and sum it with the employment Zone divided by the minimum transit generalized journey cost raised to the power of the decay parameter.

- Take the employment in Zone C divided by the minimal automobile generalized journey cost raised to the power of the decay parameter and sum it with the employment Zone C divided by the minimum transit generalized journey cost raised to the power of the decay parameter.

A set of example parameters for this simplified three zone example are provided in Table 5.28, with worked calculations provided in Table 5.29. Under this example an improved busway is provided to reduce travel times between three zones.

Table 5.28: *Three Zone Example Input Data for the Services-producing industry in 2041*

Zone	BAU Generalized Journey Costs	Investment Generalized Journey Costs	Employment
A	A-B Auto: $10 A-B Transit: $15 A-C Auto: $5 A-C Transit: $7.50	A-B Auto: $10 A-B Transit: $12 A-C Auto: $5 A-C Transit: $6	1,000
B	B-A Auto: $10 B-A Transit: $15 B-C Auto: $22.5 B-C Transit: $30	B-A Auto: $10 B-A Transit: $12 B-C Auto: $22.5 B-C Transit: $25	200
C	C-B Auto: $22.5 C-B Transit: $30 C-A Auto: $5 C-A Transit: $7.50	C-B Auto: $22.5 C-B Transit: $25 C-A Auto: $5 C-A Transit: $6	4,500

Table 5.29: *Three Zone Example Effective Density Calculations*

Zone		Effective Density Business as Usual	Effective Density post Investment
A	$Effective\ Density_A(BAU\ /Investment, Services, 2041) = \frac{Jobs\ B}{\text{A} - \text{B auto GJC}^{Decay\ services}} + \frac{Jobs\ C}{\text{A} - \text{C auto GJC}^{Decay\ services}} + \frac{Jobs\ B}{\text{A} - \text{B Transit GJC}^{Decay\ services}} + \frac{Jobs\ C}{\text{A} - \text{C Transit GJC}^{Decay\ services}}$	$= \frac{200}{10^{1.9}} + \frac{4{,}500}{5^{1.9}} + \frac{200}{15^{1.9}} + \frac{4{,}500}{7.5^{1.9}} = 313$	$= \frac{200}{10^{1.9}} + \frac{4{,}500}{5^{1.9}} + \frac{200}{12^{1.9}} + \frac{4{,}500}{6^{1.9}} = 365.3$
B	$Effective\ Density_B(BAU\ /Investment, Services, 2041) = \frac{Jobs\ A}{\text{B} - \text{A auto GJC}^{Decay\ services}} + \frac{Jobs\ C}{\text{B} - \text{C auto GJC}^{Decay\ services}} + \frac{Jobs\ A}{\text{B} - \text{A Transit GJC}^{Decay\ services}} + \frac{Jobs\ C}{\text{B} - \text{C Transit GJC}^{Decay\ services}}$	$= \frac{1{,}000}{10^{1.9}} + \frac{4{,}500}{22.5^{1.9}} + \frac{1{,}000}{15^{1.9}} + \frac{4{,}500}{30^{1.9}} = 37.6$	$= \frac{1{,}000}{10^{1.9}} + \frac{4{,}500}{22.5^{1.9}} + \frac{1{,}000}{12^{1.9}} + \frac{4{,}500}{25^{1.9}} = 43.6$
C	$Effective\ Density_C(BAU\ /Investment, Services, 2041) = \frac{Jobs\ A}{\text{C} - \text{B auto GJC}^{Decay\ services}} + \frac{Jobs\ B}{\text{C} - \text{A auto GJC}^{Decay\ services}} + \frac{Jobs\ A}{\text{C} - \text{B Transit GJC}^{Decay\ services}} + \frac{Jobs\ B}{\text{C} - \text{A Transit GJC}^{Decay\ services}}$	$= \frac{1{,}000}{5^{1.9}} + \frac{200}{22.5^{1.9}} + \frac{1{,}000}{7.5^{1.9}} + \frac{200}{30^{1.9}} = 69.6$	$= \frac{1{,}000}{5^{1.9}} + \frac{200}{22.5^{1.9}} + \frac{1{,}000}{6^{1.9}} + \frac{200}{25^{1.9}} = 81.2$

Step 3: Estimate the Productivity Impact

Productivity impacts are realized at a zonal level of origin, based on the total change in effective density. The total productivity increase for each zone i and economic sector k, should be estimated using Equation 5.15.

Equation 5.15: *Estimating Productivity Impacts*

$$Productivity\ Impact_i(k,f) = \left(\left(\frac{Effective\ Density\ (with\ investment,k,f)}{Effective\ Density\ (without\ investment,k,f)}\right)^{\rho} - 1\right)_i \cdot (GDP\ Worker\ (S,k,f))_i \cdot (Employment\ (S,k,f))_i$$

Different sectors of the economy are more dependent on agglomeration for their day-to-day operations than others, and hence, the relationship between the change in effective density and he the associated change in productivity is captured by the industry-specific agglomeration elasticity parameter Rho. The greater this parameter, the greater a given change in effective density will translate into increased productivity.

This Guidance currently recommends the use of two industrial sectors – Goods-producing industries and Services-producing industries, based to NAICS 2017 Version 3.0 naming conventions. Summing these impacts across destination zones (i) and employment sectors (k), yields the agglomeration benefit for each origin zone.

Static and dynamic effects should be appraised separately. For static clustering effects, the total employment should be identical between the with-investment and without-investment scenarios. Dynamic clustering impacts will require a bespoke land-use transport interaction model to estimate the change in employment density and commuting trips between these scenarios, which is only likely to be proportionate for the largest transport investments.

After evaluating productivity impacts for all zones i, the analysis should filter out the zones that are outside the scope of the project and that are not expected to receive productivity impacts from the intervention. This filtering is intended to reduce propagation of transportation demand model noise through to agglomeration impacts and will typically consider:

- Filtering out benefits realized in TAZs that do not have any trips using the investment or any net increase in trips (if the investment modifies an existing service).
- Filtering out benefits realized in TAZs that are geographically distant from the investment (example: filtering out all TAZs that are more than 2.5 km away from a station that is improved by the investment).

Step 3: Profiling Over the Appraisal Period

Productivity impacts should use the same discount rates and price base suggested in this Guidance. If several forecast years are used, impacts should be interpolated in between.

Productivity impacts are expected to grow by the annual growth rate of real GDP per Capita and Employment background growth and capped at the Growth Cap period (Table 5.30).

Table 5.30: *Agglomeration Profiling Parameters*

Parameter	Value
Annual growth rate of real GDP per Capita	0.9%
Employment Background Growth	1.06%

Imperfect Competition

Transport investment can result in increases in the level of economic 'output' and GDP – through a reduction in transport costs for local businesses. Local haulage companies, for example, may be able to increase the number of deliveries they make in a given timespan; 'briefcase' workers may be able to attend more meetings with clients.

Traditionally, these benefits have been assumed to be fully captured within the transport user benefits of an investment. Within a perfectly competitive market, the value of the additional output is equal to the cost of producing that output. Any reduction in generalized travel costs lowers the costs of production, which raises the return on capital and induces investment, with the value of the resulting increased output exactly equal to the magnitude of the change in generalized travel costs.

However, perfect competition is primarily a theoretical construct. Distance and transportation costs can confer localized monopoly rents: if you are the only store in a town, you can afford to charge higher prices than you would if there were competitors nearby. Within an imperfectly competitive market, the value of the output is greater than the cost of production, with a consumers' willingness to pay for the increased output exceeding the cost of producing it, and there is an additional WEI to consider.

Approach – Quantifying Output Change in Imperfectly Competitive Markets

Imperfect competition impacts are typically measured by estimating the change in the price-cost margin, multiplied by the elasticity of demand, using the equation 5.16:

Equation 5.16: *Estimating Imperfect Competition Impacts*

$$\text{Imperfect Competition} = \text{Value of Business Time Savings} \times \left(\frac{P\text{-}MC}{P}\right) \times E_d$$

where

- *P*: Price;
- *MC*: Marginal Cost;
- *Ed*: Elasticity of Demand with respect to price for the market; and
- *P-MC/P*.

Employment Impacts

Investment in transport can have important effects upon the labour market. An accessibility improvement is equivalent to an increase in the effective return to labour and capital. Changes to the effective return to labour, by reducing the 'costs' of commuting in terms of journey time, financial cost and level of over-crowding or congestion, can change the supply of labour by:

- Inducing inactive individuals to join the labour market by increasing the perceived difference in the benefits of work versus non-work (assuming there is sufficient demand for labour);
- inducing a change in the number of hours worked by those already active within the labour market; and/or
- making more distant (and perhaps more productive and higher paying) jobs more accessible, resulting in a shift in employment towards more productive activity.

Changes to the effective return to capital, by contrast, may influence the demand for labour, through:

- Increased demand for labour as firms seek to expand production; and/or
- reduced demand for labour as firms seek cost efficiencies.

In some circumstances the local economy may operate below full employment. In these cases, a transport investment could potentially help to relieve structural and temporary barriers to employment. However, as discussed previously, traditional BCA assumes that the economy is operating under perfect market conditions.

Under these conditions, only transport investments which influence the supply of labour can increase the number of jobs at the national level. Therefore, in the absence of labour supply impacts, changes in the demand for labour will lead to displacement of employment at the national level; employment would be displaced from other sectors or locations. In order for employment to increase, there needs to be a supply response accompanied by a change in demand.

Note - this WEI analysis is distinct from direct/indirect impacts from construction, which are typically derived from Input-Output models.

Approach – Labour Supply Impacts

Labour supply impacts arise when the quantity of employment is affected by a transport investment. As set out above, transport investment may induce individuals who are economically inactive to enter the labour market by influencing the effective return to labour, or by encouraging those already employed to work more. For example, the commute between some communities and the downtown core may take too long for residents. A transport investment reduces the travel time to these communities from the core, which adds the residents to the core's 'commute shed'.

Labour supply impacts imply land use change. However, for most investments it would be disproportionate to quantify the land use change, as the labour supply impacts will be small relative to the overall benefits of the transport investment. Therefore, it is common practice to quantify and value labour supply impacts without explicitly quantifying land use change. Quantifying labour supply impacts relies upon several simplifying assumptions regarding:

- The elasticity of demand for labour
- The elasticity of labour supply
- The relationship between changes in the generalized cost of commuting and the effective net wage

Valuing labour supply impacts further depends upon simplifying assumptions, regarding:

- The competitiveness of the local and regional labour market
- The relative productivity of labour supplied at the margin

When using such an approach the number of people entering the labour market are not represented in the associated transport model and standard BCA user benefits for those entering employment are assumed to be equal to zero, and the impacts of these new transport users are assumed not to significantly impact existing transport users.

This method is appropriate where it can be demonstrated that associated land use change is not significant. However, if the labour supply impacts (and by extension, land use impacts) are significant, the associated land use change and feedback effects into the transport market should be considered and reflected in the analysis.

Approach – Estimating Employment Relocation Impacts

Changes to the effective return to labour can also affect the location of employment. This relocation, in turn, can lead to changes in economic output through the spatial inequality of productivity. These place-based effects are influenced by a location's specific characteristics, such as natural resource endowments which confer productivity advantages on firms and individuals.

However, productivity may not change in response to a relocation of economic activity. In addition, firms may also be subject to people based effects, may lead to changes in which employee characteristics, such as skills, influence productivity. Moreover, firms may relocate in order to expand, which may have associated productivity impacts. When considering relocation impacts, therefore, it is important to isolate place based effects that are influenced by changes to transport connectivity, from people based effects which are not.

Even in instances of 100% displacement there may still be a net national productivity impact as a result of place-based productivity differentials. However, standard methods for estimating employment relocation impacts typically use data on local average productivity differentials which do not control for non-placed based effects. As a consequence, the methodology could lead to misleading results, with the magnitude or direction of the productivity impact incorrect.

The relocation of employment can be estimated using either a land use transport interaction model or, in cases where this is not proportionate, using a scenario-based approach. The latter provides a simple method for estimating employment impacts as a direct consequence of a transport intervention, and is intuitive in linking transport improvements to jobs created and local economic impacts. However, the causal chain that the transport investment is solely (or even partly) responsible for encouraging changes in the labour market is consequently difficult to establish.

Valuing employment relocation impacts relies upon a number of simplifying assumptions, including:

- the change in productivity is a function of the average productivity differential of each area gaining and shedding employment from the national average; and
- the output change associated with changes in productivity is valued by GDP per worker.

The valuation of employment relocation impacts resulting from an investment can, therefore, be calculated in terms of GDP using Equation 5.17, where PI represents the productivity index.

Equation 5.17: *Estimating Employment Relocation Impacts*

$$GDP = GDP\ per\ worker\ x \sum (Employment_i^A - Employment_i^B)\ PI_i$$

This should be undertaken for each scenario (A, B) and forecast year. Areas (i) should be at a spatial scale which allows the change in generalized travel cost to be robustly captured, and for where sufficient data regarding geographical productivity differentials is available.

The associated welfare change, which is additional to user benefits, is equivalent to the increase in tax revenue (income tax, national insurance contributions and corporation tax) generated by the change in GDP. They can be calculated as a simple proportion of the GDP uplift estimated above.

Communicating WEIs

A summary table should be provided to communicate each type of WEI considered in the business case. This table should be accompanied by a narrative explaining the assumptions used and the nature of WEIs that can be realized by the investment.

Positioning WEIs in Economic Analysis

Similar to user and external impacts, all WEI analysis should include a narrative linking the inputs, actions, and outputs of the investment to any WEIs included in the economic analysis. This narrative should be project specific and clearly speak to how the investment contributes to the WEIs, the quantity of the expected WEIs, and risks associated with realizing the WEIs. WEIs should be considered as 'expanded analysis' meaning they should not be used to reflect the core conventional economic performance of an investment.

Economic Case Section 6

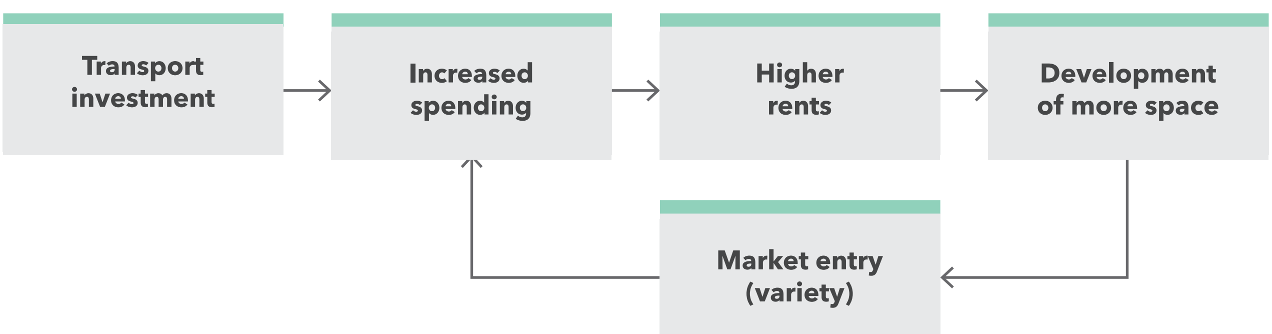
Land Value and Development

This section provides an overview of the approach used to estimate land value and development impacts. Transport investments that improve accessibility may also influence value of land and the level of investment or development that occurs at a given location. Moreover, having observed the economic benefits from the productivity, competition and labour market effects described above, firms may choose to relocate.

This process of encouraging private development is often put forward as one of the major impacts of transport projects. The investment response is driven by the user-benefits experienced by residents, workers, and firms. Figure 5.7 provides a simplified schematic of the mechanisms through which commercial development may be induced by transport investment.

As shown in Figure 5.7, the transport improvement increases spending in a place, as the number of visits increases in response to lower travel costs. Higher expenditure raises the profitability of commercial ventures and hence the landlord is able to charge higher rents. This makes it profitable to develop more space, redeveloping the site (improving quality), or perhaps by building at a higher density. This expansion creates more floor space and induces the entry of more firms, in turn making the place a more attractive destination and creating the feedback loop illustrated.

Figure 5.7: *Visualizing Transport Investment's Impact on Commercial Development*[13]



13 Incorporating Wider Economic Impacts within Cost-Benefit Appraisal, Venables. A.J., International Transport Forum Discussion Paper (2016-05)

Induced investments are therefore associated with changes in the purpose or intensity of land use, the impacts of which will be context-specific. For example, the nature and scale of economic impacts which occur will depend on the investment type, and may be affected by local attributes, such as workforce skills and the availability of developable land.

Induced investments will have direct impacts upon the transport-user benefits of an investment, since they are likely to affect the intensity of network use in the vicinity of the new residential or commercial development. However, in circumstances where displacement is less than 100%, they may also have additional economic benefits not captured within transport user impacts.

This may be the case where either there are significant feedback effects into the transport market as a result of land use change, or in the presence of distortions which mean the market for land and property is not functioning efficiently. There are a number of potential market failures and distortions, which may occur in specific local contexts, including land-rationing, private sector co-ordination failure, imperfect externalities and tax incentives.

In addition to increasing the level of economic output through additional activity e.g. new jobs, private-sector investment may further increase economic activity through:

- **Dynamic clustering –** increases in economic activity near existing economic clusters may generate further agglomeration benefits.
- **Employment relocation impacts –** new commercial development may be associated with a further employment relocation effect.
- **Place-quality effects –** changes in accessibility and the investment responses they induce will bring about land use changes that generate additional place based benefits for households and businesses which value:
    - the presence of a variety of services and consumer goods;
    - aesthetics and physical characteristics; and
    - the quality of public services.

Approach – Calculating Land Value Uplift

There is a range of techniques for capturing the benefits of induced investment, including housing, commercial development and land-based interventions. The most common approach is to the Land Value Uplift methodology, which reflects the location and use of the land pre- and post intervention.

The Gross Development Value (GDV) of a site is the estimated total revenue a developer could obtain from the land. A developer will also incur costs and would expect a minimum level of profit from developing a site. The residual method of land valuation gives the maximum price a firm is willing to pay for the land. In a competitive market, the firm will pay a price that gives a normal level of profit.

As set out in equation 5.18, the subsequent land price then reflects the value of the land in its new use. In appraisal terms, the difference between this new value and its previous value is the Land Value Uplift and this represents the net private benefits of a development.

Equation 5.18: *Estimating Land Value Impact*

Land price = GDV - (development costs + fees + profit)

The value to society of a change in use of the land may be separated into the private benefit associated with the change in land use (as represented by the uplift in land value) and the net external impact of the resulting development such as any amenity impacts from changes in land use. The net social impact is then the summation of these two impacts.

Note: these calculations should only be applied to the uplift estimated due to the investment above and beyond the BAU. Other uplift factors unrelated to the investment (such as background trends) should not be included. At this time the Land Value Uplift should be calculated as a metric for consideration but should not be included in the expanded or conventional BCR or NPV calculations.

Economic Case Section 7

Economic Analysis Summary

This subsection of the Economic Case should present a table summarizing the overall case for each option based on the key performance indicators shown in Table 5.32. Standardized inputs and Key Performance Indicators (KPIs) are used to allow for different options and business cases to be compared to one another on an equal footing in economic terms.

The results of the evaluation of each direct and indirect impact of the option over the project lifecycle can be rolled up into combined key performance indicators. These include the NPV, representing the absolute value created by the option, and the BCR, representing the efficiency of the option in generating value for each dollar invested. IRR, which is the discount rate for which the NPV of the project is zero should also be calculated and presented. ROI, which is calculated as the NPV/Total Costs, should be calculated as another means to calculate the overall economic efficiency and performance of each investment option. Costs used in these measures should be capital expenses and incremental operating expenses in the year they occur over the evaluation period matching the project lifecycle, discounted to the present year.

The analysis should note the relative comparison of each option to help stakeholders and decision makers understand the merits of each option. In general this section should articulate:

- Which options have strong economic performance and which do not?
- What are the overall key risks and performance drivers?
- Are there key differences between the options that could be used to refine a preferred alternative?
- How are benefits, costs, and disbenefits distributed across the region?

A table (template shown in Table 5.33) should be provided as part of the Economic Case Summary.

Guidance for Reporting Precision and Rounding Policy

All impacts estimated in the Economic Case including costs, user and external impacts, CBA adjustments and the NPV metric should be reported to two significant digits. Examples of metrics transformed to two significant digits can be found in Table 5.31.

Ratios including BCR and ROI should be reported to two decimal places to ensure differences in performance across options are visible, especially as the business case moves through the lifecycle and options become less distinct from one another.

Table 5.31: *Rounding Policy Examples*

Impact	Value
Benefits	$7,526 --> $7,500
NPV	$(5.37) --> $(5.4)

Table 5.32: *Economic Key Performance Indicators*

KPI	Formula
Conventional NPV	= PV User Impacts + PV External Impacts - PV Costs
Conventional BCR	= (PV User Impacts + PV External Impacts) / (PV Costs)
Conventional Capital Utilization (NPV/k)	= Conventional NPV / PV Capital Costs
Expanded NPV	= PV User Impacts + PV External Impacts + PV WEIs - PV Costs
Expanded BCR	= (PV User Impacts + PV External Impacts + PV WEIs) / (PV Costs)
Expanded Capital Utilization	= Expanded NPV / PV Capital Costs
Economic ROI	= For conventional and expanded Return on Investment (ROI): (PV Net Impacts - PV Costs) / (PV Costs)
Economic IRR	= For conventional and expanded Internal Rate of Return, calculate the discount rate required for the NPV to be $0

Table 5.33: *Economic Case Summary Template*

Impact Type	Option 1	Option 2	Option 3
Total Costs (Present Year $)			
Capital Costs			
Operating and Maintenance Costs			
Total Impacts (Present Year $)			
User Impacts			
External Impacts			
Wider Economic Impacts			
CBA Adjustments (Present Year $)			
Conventional BCR			
Conventional NPV (Present Year $)			
Conventional Economic IRR			
Conventional Economic ROI			
Expanded BCR			
Expanded NPV (Present Year $)			
Expanded Economic IRR			
Expanded Economic ROI			

CBA Adjustments

After project impacts are estimated, a few adjustments to the analysis are required.

Incremental Fare Revenue

The incremental fare revenue adjustment is a post user impact estimation adjustment that converts user costs into societal costs relevant in a CBA context, i.e., net of transfer payments and taxes. A transit fare is perceived as a financial cost during a user's mode choice decision-making and therefore makes up a user's utility for transit and determines transit ridership. Fare as a user cost impacts modelling estimates for ridership and consequently benefits but is irrelevant in CBA because it is merely a transfer between the transit user and the service provider. To make this adjustment, the regional average weighted fare is multiplied by the number of new users to transit throughout the project evaluation.

Indirect Taxation

The indirect taxation adjustment is a post user impact estimation adjustment that capture the indirect impact on government fuel tax revenue as a result of changes in fuel consumption brought by a transportation intervention.

Changes in the government's indirect fuel tax revenue from a project's impact on fuel consumption, either through inducing mode shift or changes in VKT should be accounted for. An indirect fuel tax adjustment factor is derived using the auto operating cost assumption in GGHMv4 which is equivalent to $0.1428 in $2011. The fuel component makes up approximately 69% of the total variable auto operating cost assumption. Together with information on fuel taxes and fuel consumption rates in 2011, an indirect fuel taxation factor of $0.035/km has been derived and is used to capture the changes in the government's fuel tax revenue brought by a transportation intervention.

Unit of Account

User impacts accrue *in* the Market Price Unit of Account, i.e., inclusive of taxation, while project costs accrue in the Factor Cost Unit of Account, i.e., net of any taxes.

User travel costs, whether on transit or auto, whether actual monetary travel costs or the time spent travelling in crowded conditions are perceived by users as tax inclusive travel costs, while taxes associated with estimated project costs are typically excluded from project evaluation.

In order to evaluate project impacts and project costs on a comparable scale, user impacts are converted to the factor price unit of account. In this conversion, a project's estimated direct user benefits are subject to a downward tax adjustment equivalent to Ontario's HST using an indirect tax adjustment of (1+0.13) as in Equation 5.19.

Equation 5.19: *Unit of Account Conversion*

$$Estimated\ user\ impacts\ in\ factor\ cost\ unit\ of\ account = \frac{Estimated\ direct\ user\ benefits\ in\ market\ price\ unit\ of\ account}{(1+0.13)}$$

A project's user impacts subject to this adjustment include:

- Travel time impacts (transit and auto)
- Crowding, reliability and ambience impacts
- User Costs (Incremental Fare Revenue Adjustment)

This adjustment should be made directly to the summary project impacts (i.e., present value of each impact specified above).

Other variables subject to a 13% downward tax adjustment include:

- Auto Operating Cost assumption in GGHMv4 (maintenance component)

In order to evaluate project impacts and project costs on a comparable scale, the maintenance component of the GGHM auto operating cost mode choice decision assumption, which is subject to HST, is converted to the factor cost unit of account. In this conversion, HST on the maintenance component of auto operating cost is subtracted from the total project impacts for every vehicle kilometre saved.

Users of the transportation network perceive variable auto maintenance costs in the market price unit of account, i.e., inclusive of HST. The total variable auto operating cost is equal to $0.1428/km in $2011. It is comprised of fuel and maintenance and is based on CAA's 2011 Cost of Driving Manual. This variable is used in the mode choice decision making stage of GGHM for purposes of ridership and benefits estimation.

Variable auto maintenance cost makes up approximately 31% of the total variable auto operating cost, and is equivalent to $0.044/km. HST on the maintenance portion of the auto operating cost variable is therefore equivalent to $0.005/km (i.e., 13% of $0.044/km).

Table 5.34 summarizes all CBA adjustments and their application.

Table 5.34: *Economic Case Summary Template*

CBA Component Impacted	Adjustment Factor	Reason for adjustment	Application
• Transit/Auto Travel Time • Crowding and Reliability • User Costs (Incremental Fare Revenue)	(1+13%)	Presenting impacts in CBA using a single Unit of Account, i.e., factor cost unit of account, net of HST.	Applied directly to the summary pro-ject impacts, i.e., NPV of each impact
GGHM Auto Operating Cost (maintenance)	$0.005/km	Presenting impacts in CBA using a single Unit of Account, i.e., factor cost unit of account, net of HST.	Applied to annual VKT
GGHM Auto Operating Cost (fuel)	$0.035/km	Accounting for government indirect taxation impacts brought by a transportation investment (i.e., impact of changes in VKT/mode shift on fuel tax revenue)	Applied to annual VKT
Fare	Average weighted fare	Converting user costs into societal costs for purposes of CBA	Applied to new transit users

Conventional and Expanded BCA

Two sets of Economic Case Key Performance Indicators should be calculated: conventional and expanded. Conventional indicators consider how an investment impacts the transport system. They therefore focus on the direct impacts of the investment to transport users and the external impacts of transport on society. The expanded indicators include WEIs to capture how transport investment can have broader impacts to society that are not related to the direct impacts to users or the reduction of transport social cost (external impacts). Both sets of indicators are useful tools for decision makers and stakeholders to understand the economic impact of an investment.

Distributional Analysis

Metrolinx is actively developing methods to incorporate principles of social sustainability within the business case framework. Distributional Impacts should be considered in the overall Economic Analysis based on which members of society receive the benefits, disbenefits, and costs of the investment. Transportation investments are inherently spatial, meaning that the costs and benefits related to the impacts of projects will be unevenly distributed across the region. These costs and benefits will have different impacts depending on the groups impacted, particularly those already identified as 'vulnerable.' These typically include individuals from low income households, recent immigrants, racialized groups, children, LGBTQ groups, seniors, First Nations communities and individuals with different physical abilities. The Economic Case should present information on the distribution of impacts particularly among these more vulnerable populations.

The Economic Analysis subsection should include a information on Distributional Impacts, including:

- Are there any significant changes occurring in the distribution of the following impacts related to the investment: generalized journey time (travel time, ambience, reliability); noise; air quality; accidents; security and safety; severance; accessibility; affordability (travel cost)?
- Are any vulnerable groups being disproportionately impacted by any of the impacts listed in the question above?
- What is the estimated change in the number of the following destinations accessible to residents of the GTHA within 30 minutes of travel time in the future baseline year (for example: 2031): jobs, hospitals, educational institutions?[1]

12 *Metrolinx has developed an accessibility analysis tool that can directly estimate changes to accessible destinations. This tool should be considered within Distributional Analysis.*

Table 5.35: *Economic Case Parameters Summary Table*

Economic Parameter	Value
Discount Rate	3.5%
Growth Cap	30 years from the base year of project evaluation
Evaluation Period	5 to 60 years (depending on project lifecycle/impacts)
Dollar Value	Real, year of evaluation
Unit of Account	Factor Cost
Value of Time	$18.79 (2021 $)
Value of Time Growth Rate (real)	0%
Capital Cost Growth Rate (real)	1%
Operating and Maintenance Cost Growth Rate (real)	1%
Risk Free Bond Rate (real)	0.82%
Land Cost Growth Rate (real)	2.8%
IVT Weight	1.0
Walk Time Weight	2.0
Wait Time Weight	2.5
Interchange Penalty	5 minutes
GO Rail IVT Weight	0.85
Subway IVT Weight	0.90
Bus/Streetcar IVT Weight	1.0
Auto Access Weight	2.48

Economic Parameter	Value
Reliability Ratio	1.76
Decongestion Impact (peak)	0.01 hours/km
Decongestion Impact (off-peak)	0.00125 hours/km
Road Safety	$0.09/km
Road Safety Growth Rate (real)	-5.3%
Walking Health Benefit	$4.08/km
Cycling Health Benefit	$1.83/km
GHG Emissions	$0.01/km
Air Quality (CACs, NOx,, etc)	$0.002/km
Agglomeration Elasticity (Economy)	0.046
Agglomeration Elasticity (Goods Industries	0.104
Agglomeration Elasticity (Services Industries)	0.03
Decay Parameter (Economy)	1.8
Decay Parameter (Goods Industries)	1.8
Decay Parameter (Services Industries)	1.9
Annual growth rate of real GDP per capita	0.9%
Employment Background Growth Rate	1.06%
GGHM fuel cost indirect taxation adjustment	$0.035/km
GGHM maintenance cost taxation adjustment	$0.005/km

6

Financial Case

What does the Financial Case chapter cover in a business case?

What is the role of this chapter of the business case?	Requirements to successfully deliver the investment - details the financial impacts and requirements for delivering each option
What factors are included in the analysis?	Key Financial Metrics: • Capital Costs • Operating and Maintenance Costs • Revenue Impacts • Labour Force Requirements impacts
How is evidence summarized and communicated?	The Financial Case communicates the overall financial impact of the investment

How is the guidance structured?

Section	Content
Introduction	Includes an overview of the Financial Case and a summary of what is included in the section
Developing a Financial Case	Provides instruction on: • The structure of the Financial Case • The approach used for inflation and discounting • The key parameters that should be used to conduct an analysis • The role of sensitivity analysis
Financial Case Analysis	Provides detailed guidance for: • Assessing revenue, operating expense, capital expense, and full time equivalent impacts of an investment • Summarizing the Financial Case

Introduction

Overview

The Financial Case assesses the overall financial impact of proposed investment options. While the Strategic Case and Economic Case outline how an investment achieves organizational goals and social value, the Financial Case is one of two cases (the other being the Deliverability and Operations Case) that focuses on the requirements to successfully deliver an investment. Typically, this includes a review of the total changes and year over year change in revenue and expenditure over the lifecycle of the investment.

The types of questions that the Financial Case will typically seek to answer include:

- How much does the investment cost every year? What are the capital costs, operating costs, revenues, net financial effect, and financial cost recovery ratios?
- How will costs be allocated between project stakeholders?
- Are there identified risks in the funding sources?
- What cost of finance is assumed?
- Have any sensitivity tests and/or risk analysis been completed and what are the results?
- How robust are the financial estimates and forecasts?
- What is the source of funding for the investment (example: provincial or federal funding)?

Since most investments ultimately lead to increased expenditure, the Financial Case should be developed such that it can be integrated into future stages of investment planning, workforce planning, and capital planning.

Guidance Structure

This guidance is composed of two sections:

- **Developing a Financial Case –** a summary of the key requirements for the Financial Case analysis
- **Conducting Financial Analysis –** a summary of the key points of analysis for the Financial Case

The Financial Case is different from the Economic Case in that it does not consider society-wide benefits of an investment. Instead, the Financial Case focuses on the financial resources required to implement the investment and the cash flow impact for Metrolinx or the agency responsible for the investment.

Developing a Financial Case Analysis

This section summarizes how to structure the Financial Case and the key inputs that should be included.

Financial Case Structure

When complete, the Financial Case should include all content specified in this guidance and noted in Table 6.1.

Financial Appraisal Techniques

Conducting Financial Appraisal includes applying financial case parameters, inflation, discounting, and sensitivity tests.

Table 6.1: *Core Content Required to Complete a Financial Case*

Section	Sub-sections	Requirements
1. Introduction	N/A	Overview of chapter
2. Capital Costs	Subsections can be set out at the analyst's discretion	Summary of capital cost impacts and cost drivers
3. Operating and Maintenance Costs	Subsections can be set out at the analyst's discretion	Summary of operating cost impacts and cost drivers
4. Revenue Impacts	Fare Revenue	Summary of fare revenue impacts
	Non-Fare Revenue	Summary of non-fare revenue impacts
5. Labour Force Requirements	Subsections can be set out at the analyst's discretion	Summary of labour required over the investment lifecycle
6. Funding Sources	Subsections can be set out at the analyst's discretion	A description of the proposed funding sources for the investment
7. Financial Analysis Summary	Financial Impact Summary	Complete a key metric table showing financial NPV, total operating expense, and revenue/operating cost ratio
	Option Comparison	Identify key factors that lead to different performance between the options
	Funding Sources and Risks	Identify the assumed funding sources for the investment along with key risks and uncertainties that may limit the option from achieving the performance noted in the evaluation
	Recommendations	Identify key recommendations for each option

Financial Case Parameters

Each Financial Case should use prevailing Metrolinx assumptions for financial discount rate and inflation. The current values are shown in Table 6.2.

Applying Inflation

Financial analysis should be conducted in nominal terms (which means all costs and revenue changes should include the impact of inflation). Inflation reflects that over time, the value of money changes. Under conditions of inflation, 1 dollar today could not purchase what 1 dollar could purchase last year, and 1 dollar in the future will purchase even less. When prices are given in 'nominal' terms, these are the actual or expected prices, at face value, of that good or service in that particular year. This change in price is typically captured by changes to the Consumer Price Index (CPI) – with the Bank of Canada policies targeting an inflation rate of 2% a year. Therefore, all financial impacts included in the Financial Case should include an annual inflation rate of 2%.

Similar to the Economic Case, changes in price due to escalation (the relative change in the value of a good or service relative to the average increase captured in the CPI) should be captured in the Financial Case. Escalation should be considered when developing estimates for capital and operating costs. In the absence of sufficient data to estimate escalation, an assumed rate of 1% may be used until 30 years from the base year of project evaluation, which should be applied on top of the assumed 2% inflation rate.

Table 6.2: *Financial Case assumptions*

Parameter	Value
Discount rate	5.5%
Inflation Rate	2%
Capital and Operating and Maintenance Cost Escalation (real growth)	1% until 30 years from the base year of evaluation, 0% after in absence of detailed cost forecasts
Amortization	Straight Line based on useful lifecycle
Financing Costs	FY 2016/17 and beyond = 5.78% for any capital costs paid for by the Province of Ontario.
Labour Benefits	25% of salaries
Avg. Fare Price	Calculated on an investment by investment basis
Capping all growth	In the absence of specific guidance per input, cap all growth after 30 years of operations
Evaluation period	5 to 60 years (depending on investment lifecycle/impacts)
Dollar value	Nominal, year of expenditure
Unit of Account	Market prices

Discounting Costs and Revenue

Discount rate, in the context of discounted cash flow analysis, is the interest rate used to determine the present value of future cash flows. It is used to calculate the current worth or Net Present Value of future cash flows of a project.

Similar to inflation, the financial discount rate should be applied to all financial impacts included in the Financial Case. This discount rate is applied annually to all costs and revenue changes. Note: the financial discount rate is a different value than the social discount rate used in the Economic Case.

The discounting process is represented by the following formula, where the $\sum$ symbol represents the sum over the evaluation period from year 0 to year n, and the $\prod$ symbol represents the product of $(1+r_i)$ over the range shown, which can be sumarized as shown in Equation 6.1.

Equation 6.1: *Discounted Value Calculation*

$$\textit{Discounted Value} = \sum_{y=0}^{n} I_y / \prod_{i=base}^{y} (1 + r_i)$$

I : The Impact (Cost or revenue)

R : Financial Discount Rate

Sensitivity Tests

Risk and uncertainty are embedded within each cost and revenue estimate. As a result, the Financial Case should include sensitivity tests to understand how the financial impact varies based on changes in expenditure or revenue. A general approach is to test high and low estimates for costs and revenues, and represent these in summary tables. At the initial stages of investment, there can be tendencies for optimism or pessimism bias, and estimating the range of possible costs is best practice. As the investment progresses and better information is known, these ranges can be narrowed down.

Financial Case Analysis Over the Business Case Lifecycle

Initial Business Case

- Conduct an analysis of each option using best available cost and revenue estimates
- Conduct sensitivity testing to understand the key cost and revenue drivers and level of uncertainty for each option

↓

Preliminary Design Business Case

- Update the analysis conducted in the Initial Business Case based on any changes to investment specification or detailed design
- Analytic tools may be updated to ensure all analysis and forecasting is commensurate with the level of specification and scale of the investment

↓

Full Business Case

- Update the analysis conducted in the Preliminary Design Business Case based on any design refinements
- Analytic tools may be updated to ensure all analysis and forecasting is commensurate with the level of specification and scale of the investment

↓

Post In-Service Business Case

- Review financial narrative and compare estimated performance against collected data
- Update costs and revenue and re-forecast where relevant

Conducting Financial Analysis

Financial analysis is concerned with four overall factors based on their incremental impact over the BAU scenario:

- **Capital Costs –** changes in expenditure to procure/deliver infrastructure or core systems required to deliver the investment, including major lifecycle renewals
- **Operating and Maintenance Costs –** changes in expenditure to operate and maintain the investment (example: cost of operating a bus)
- **Revenue –** changes to revenue from fares (or other customer ticketing products) and non-fares (example: revenue from property)
- **Labour Requirements –** changes to the level of staffing to deliver and operate the investment

Financial Case Section 1

Introduction

This section should frame the Financial Case and confirm its overall content and structure. Each Financial Case should clearly identify the assumptions and process used to develop quantified estimates for each of the financial factors. The methodology may vary between business cases based on the nature of investment but should be conducted to a level of detail appropriate for the stage of business case.

Financial Case Section 2

Capital Costs

Capital costs includes any expenditure to deliver the investment's key infrastructure and systems. Generally, this analysis should consider the categories outlined in Table 6.4 Costs should be incremental to the BAU scenario. Where appropriate, the total BAU, investment, and incremental costs may be used to illustrate financial impacts.

This section should communicate:

- A summary table (based on Table 6.4) with all relevant capital costs for each option across the investment lifecycle
- A summary graph showing the expected capital expense profile for the investment from start of evaluation until end of construction

Land Acquisition Costs

In financial analysis, project land acquisition costs are captured in full in their year of expenditure. A residual value is assigned at the end of the project evaluation period recognizing the remaining value of the land at the end of the project's life. The residual value of the land is derived using the initial land acquisition cost, a real annual growth rate and annual inflation. In the Financial Case, there is no need to cap real growth in land costs. A real growth in land should be applied over the life of the project.

The assumptions used in the derivation of a residual value of land at the end of the project's life can be found in table 6.3 below.

Table 6.3: *Land Acquisition Assumptions*

Parameter	Value
Annual growth rate, land (real)	2.8%
Inflation Rate	2%

Table 6.4: *Capital Expense and Asset Considerations*

Line Item	Description	Assumptions
Amortization	The useful life used to calculate amortization should be included in the assumptions for all capital expenses	Please contact an appropriate finance counterpart to assist with this requirement
Cost of Borrowing	This is the cost to the province to borrow capital funding on our behalf	Please contact an appropriate finance counterpart to assist with this requirement
Capital Labour	The amount should reflect all capitalized salary costs that are directly spent on a specific capital project	Estimated salaries should include an uplift of 25% to account for employee benefits (example: healthcare)
Land Acquisition	Costs to acquire land (note: these costs are not amortizable)	
Property	Costs that are associated with, but not limited to, buildings, stations, storage facilities, maintenance facilities and leasehold improvements	
Capital Construction Cost	Costs that are associated with improvements to right of way, railway plant, grade separations, trackwork, parking lot and supporting structures	
Design and Planning Costs	Costs associated with project design, planning, environmental assessment, project management and permits	
Enabling Work	Pre-construction work required at the site, including land improvements, land remediation, and other pre-construction works	
Financing Cost	Costs including interest during construction and long-term financing cost (note: interest during construction is capitalized)	
Vehicle and Rolling Stock	Costs that are associated with locomotives, other railway rolling stock, buses and vehicles	
Equipment Costs	Including computer, equipment, software and other I&T costs (for example: wifi)	
Other Capital Costs	Including, but not limited to, procurement costs, non-recoverable HST, ancillary / transaction costs and energy efficiency / sustainability costs (for example: energy efficient retrofits, ventilation, thermostats, energy storage devices)	
Contingency	Calculated as a % of capital costs during option scoping	
Lifecycle Cost	Costs that are associated to keep assets in a state of good repair, including capital repairs and rehabilitation	

Financial Case Section 3

Operating and Maintenance Costs

Operating and maintenance costs represent the expenditure required to operate and maintain the investment over its lifecycle and on a year over year basis. Each investment may include different operating costs changes including both new costs and potential savings in network terms (example: a new LRT line replacing an intensive bus service will save the cost of the bus service and replace it with the cost of operating the LRT service). Generally, each business case should consider the costs outlined in Table 6.5.

Each type of operating cost incurred by the investment should be calculated annually with a total operating cost value estimated for the investment's lifecycle – including discounting and inflation. This section should communicate:

- A summary table (based on Table 6.5) with all relevant operating costs for each option across the investment lifecycle
- A summary graph showing the expected operating cost profile for the project from start of operations until the end of the appraisal period

Table 6.5: *Operating Expenses*

Line Item	Descriptions	Assumptions
Labour and Benefits	The amount should reflect all operating salary costs expected to operate the investment	Estimated salaries should include an uplift of 25% to account for employee benefits (example: healthcare)
Supplies and Service	Includes professional services, advertising and promotions, financial fees and services, uniforms, office supplies and equipment, software, and staff development	
Maintenance	Includes facilities and track maintenance (for example: corridor, stations, facilities, rent, utilities, telecommunications, contracted services) and equipment maintenance (for example: inspection and cleaning, consumable parts, yard operations, bus storage, bus satellite services, other support services)	
Operations	Includes costs associated with rail operations, bus operations, crew operations, PRESTO operations, fuel, power and communications, road charges, insurance and claims, and farecard stock and commissions	
Other	Anticipated operating expenditures outside of the categories listed above	

Financial Case Section 4

Revenue Impacts

Revenue impacts should be quantified and accompanied with a narrative explaining the impacts and the methodology used to derive them (for example: using change in ridership multiplied by the expected average fare). Revenue impacts include two considerations (shown in Table 6.6), which may be estimated differently depending on the nature of the investment.

Revenue impacts should be calculated on an annual and lifecycle basis including inflation and discounting. They should be communicated in two ways:

- A table (based on Table 6.6) illustrating the lifecycle total revenue impacts by category
- A graph showing the annual revenue impact from start of operations until the end of the appraisal period

Financial Case Section 5

Labour Force Requirements

The financial impact of labour is included in the operating and capital expense analysis. This section of the financial analysis is focused on clearly defining the number of part and full time equivalents represented in the capital and operating expense sections. Two types of labour should be outlined:

- **Existing -** The count of staff that will work on this initiative who are already part of the Metrolinx workforce plan
- **Incremental -** The count of staff that will need to be hired to work on this initiative

Table 6.6: *Revenue Impacts*

Line Item	Descriptions	Assumptions
Fare revenue	Fare revenue includes revenue resulting from changes in fare paid and number of trips taken	Assumptions on ridership growth and fare growth rates should be clearly stated in the assumptions row below the input cells.
Non-fare revenue	Non-fare revenue includes, but is not limited to: parking revenue, commercial space rent, cash contribution and value-in-kind contribution	A description of revenue and methodology of calculation should be provided in the assumptions row. A description of what drives the assumptions can be included in the Notes and Assumptions column.

Financial Case Section 6

Funding Sources

Typically, interventions will draw from a number of sources that should be identified in the business case. These include new fare revenues, new non-fare revenues, reallocated operating funding or capital contributions from the Province of Ontario, other government bodies as well as potential third party contributions. Showing the diversity of streams, the proportion each stream is contributing as well as any constraints/ uncertainties related to funding sources will allow decision-makers to determine the risk associated with project funding.

Financial Case Section 7

Analysis Summary

The Financial Case should include an overall summary of the financial impact on a year by year basis and over the investment's lifecycle. It is recommended that the year over year impact be represented graphically and include total operating, capital, and revenue impacts for each year.

A lifecycle summary table should also be generated that includes the metrics outlined in Table 6.8. This table should be accompanied by a narrative that describes the key findings of the Financial Case:

- How does the investment's revenue compare its ongoing operating and maintenance costs (operating cost recover ratio)?
- How does the investment's revenue compare to the overall costs of the investment (net present value)?
- What is the investment's internal rate of return (IRR) and return on investment (ROI)?

Guidance for Reporting Precision and Rounding Policy

All impacts estimated in the Financial Case including costs, revenues, the NPV and net operating cash flow metric should be reported to two significant digits. Examples of metrics transformed to two significant digits can be found in Table 6.7.

Ratios including R/C and ROI should be reported to two decimal places to ensure differences in performance across options are visible, especially as the business case moves through the lifecycle and options become less distinct from one another.

Table 6.7: *Rounding Policy Examples*

Impact/KPI	Value
Revenue	$756 --> $760
NPV	$(58.78) --> $(59)

Table 6.8: *Financial Case Summary Table*

Financial Case Metric	Description
Total Revenue Impacts	Sum of lifecycle revenue impacts
Total Capital Costs	Sum of lifecycle capital expenses
Total Operating and Maintenance Costs	Sum of lifecycle operating expenses
Net Operating Cash Flow	Revenue impacts minus operating expenses (note: if this value is negative, it represents the required subsidy for operating the service)
Net Present Value (NPV)	Sum of total revenue impacts, operating and maintenance costs, and capital costs
Internal Rate of Return (IRR)	The interest rate (or discount rate) when the NPV is equal to zero
Payback Period (PBP)	The amount of time it takes for an investment to pay for itself
Return on Investment (ROI)	The surplus (or return) generated from the investment, calculated as: (change in life cycle revenue - total costs) / total cost
Operating Cost Recovery Ratio (R/C Ratio)	The percent to which the annual revenues generated by the project recover the annual operating costs associated with the project

Financial Risks

Financial risks should be explained using a narrative along with sensitivity testing. The narrative should explain risks to option performance (such as risks to attaining estimated revenue) and any core dependencies for the project to attain its overall estimated Financial Impact. Sensitivity tests should be conducted to identify 'switching values' – key variables that would cause the financial performance or the financial cost benefit / net present value calculations to change enough to affect a decision-makers' decision. The impacts of these tests should be included in the Financial Case, with appropriate sensitivity tests determined at the onset of the business case process.

7

Deliverability and Operations Case

What does the Deliverability and Operations Case chapter cover in a business case?

What is the role of this chapter of the business case?	Requirements to successfully deliver the investment - Details the technical and institutional requirements to deliver the investment
What factors are included in the analysis?	Key Financial Metrics: • Delivery • Operations/Maintenance • Procurement Plan
How is evidence summarized and communicated?	Descriptive narrative of requirements to deliver/operate/procure the investment and the key risks that must be mitigated

How is the guidance structured?

Section	Content
Introduction	Includes an overview of the Deliverability and Operations Case and a summary of what is included in the section
Developing a Deliverability and Operations Case	Provides an overview of the key analytic content included in the case and how it varies over the lifecycle of a business case
Deliverability and Operations Analysis	Provides detailed guidance for: • Delivery requirements • Operations and Maintenance requirements • Procurement Planning

Introduction

Overview

The Deliverability and Operations Case is an analysis of the technical and commercial feasibility of an investment or transportation improvement. This includes delivering the project from original concept through to planning, design, environmental assessment and stakeholder engagement, procurement, construction and operations. The Deliverability and Operations Case is one of two cases (the other being the Financial Case) focused on requirements for delivering a transport investment.

The term 'commercial' is used here to refer to the feasibility of undertaking the project and delivering the expected outcomes in practice. It does not refer to the financial performance of a project, which is captured in the Financial Case.

The core questions that the Deliverability and Operations Case seeks to address are shown in Table 7.1. Note - this list is not exhaustive and is intended as framing to support analysts and sponsors in developing and reviewing this case.

Table 7.1: *Deliverability and Operations Case Core Questions by Business Case Stage*

<table>
<tr><th></th><th>Initial Business Case</th><th>Preliminary Design Business Case</th><th>Full Business Case</th><th>Post-In Service Business Case</th></tr>
<tr><td>Has a procurement strategy been developed?</td><td>Identify key procurement issues and opportunities</td><td>Define a specific set of procurement options</td><td>State and review procurement strategy</td><td>Revisit and evaluate the success of the procurement strategy</td></tr>
<tr><td>What formal role will each stakeholder play?</td><td>Identify key stakeholders and potential roles</td><td>Define key roles each stakeholder should play</td><td></td><td>Assess stakeholder involvement</td></tr>
<tr><td>What are the arrangements for project governance and decision making? What risk do these arrangements introduce or mitigate?</td><td rowspan="7">Identify high-level considerations and note key differences between potential investment options</td><td rowspan="7">Define a more detailed delivery approach for the investment and note key differences between potential investment options</td><td rowspan="7">Define a specific delivery approach and provide evidence for its selection</td><td rowspan="7">Revisit and evaluate the success of the delivery approach</td></tr>
<tr><td>What approvals and reporting processes apply to the project? What is the current approval status of the project?</td></tr>
<tr><td>What is the service plan (if applicable) and is it realistic? Are delivery timeframes envisaged realistic?</td></tr>
<tr><td>Has the critical path been identified? Has phasing been considered?</td></tr>
<tr><td>What contractual strategies are being considered?</td></tr>
<tr><td>Are there any significant political or stakeholder risks that could affect delivery?</td></tr>
<tr><td>What is the reporting and approvals mechanism?</td></tr>
<tr><td>What project and program dependencies exist? Have these been mapped?</td><td>Clarify high-level dependencies</td><td colspan="2">Identify key dependencies and state their impact on project delivery and long term delivery</td><td>Identify if the dependencies assessment supported robust delivery</td></tr>
</table>

In order to improve the decision-making process for selecting a preferred alternative, this guidance seeks to clarify delivery and operations practices for major investments and improvements and to incorporate these into the Metrolinx Business Case Guidance. In the past, deliverability and operations analysis were usually undertaken on the preferred alternative (for example: after the selection of a preferred alternative). This guidance intends to bring forward initial elements of the deliverability and operations analysis to contribute to the selection of the preferred alternative. This does not necessarily mean that the alternative with the greatest deliverability and operations potential should be the preferred alternative. However, when two or more alternatives have similar results in their respective Strategic, Financial and Economic Cases, the Deliverability and Operations Case could potentially influence the choice of preferred alternative. In addition, early consideration of deliverability and operations implications can reduce surprises later in the process.

Developing Deliverability and Operations Case

Each Deliverability and Operations Case includes:

- **Introduction –** an introduction summarizing the purpose of the case and the approach used to complete it (Section 1)
- **Project delivery –** a review of how the investment can be delivered including project governance, major project components, project management plan, environmental assessments and construction impacts (Section 2)
- **Operations and Maintenance –** a review of the operations and maintenance plan, including roles and responsibilities, changes in service provision and maintenance, trade-offs between the capital and operations and maintenance phases, project dependencies and human resources (Section 3)
- **Procurement Plan –** a review of the investment's procurement plan, including the role of Infrastructure Ontario, industry capacity to deliver the project, procurement options and the evaluation of these, risk management issues and future-proofing of projects (Section 4)
- **Conclusion –** summarizing the key findings, risks and issues related to investment, delivery and operations (Section 5)

Deliverability and Operation Case Analysis Across the Business Case Lifecycle

Initial Business Case

- Conduct a high-level review of investment delivery, operations and maintenance, and procurement requirements for each option
- Key risks and deliverability considerations should be noted for further review and design in future stages of investment development

↓

Preliminary Design Business Case

- Complete a detailed review of investment delivery requirements,develop an operations and maintenance plan and outline key procurement considerations for each option
- This content should help decision makers see any key differences in delivery requirements and risks between the options

↓

Full Business Case

- Refine content from the Preliminary Design Business Case to provide a detailed specific investment delivery, operations and maintenance, and procurement plans for the investment
- This content should be prepared at a level to support procurement

↓

Post In-Service Business Case

- Review key risks and risk mitigation strategies and comment on effectiveness
- Detail any variance from the investment delivery, operations, and procurement plans outlined in the Full Business Case and what has been delivered

Conducting Deliverability and Operations Analysis

Guidance has been prepared to support the completion of each section of the Deliverability and Operations Case. This guidance provides an overview of the key questions that should be answered and the types of content that should be generated to complete a robust case.

The core content requirements for the Deliverability and Operations Case is shown in Table 7.2.

Table 7.2: *Content Required to Complete a Deliverability and Operations Case*

Section	Sub-sections	Requirements
1. Introduction	N/A	Overview of chapter
2. Project Delivery	Subsections can be set out at the analyst's discretion	Describe the following project delivery aspects of each investment option: • Identification of project sponsor(s) and governance arrangements • Description of major project components, incl. constructability review • Project management plan, including schedule, phasing and potential community benefits if applicable • Environmental assessment requirements • Construction impacts • Operations and maintenance overview
3. Operations and Maintenance Plan	Subsections can be set out at the analyst's discretion	Describe the technical and commercial feasibility of the operations or service delivery stage for each investment option, including: • the relevant operations and maintenance roles and responsibilities • any changes in the service plan and maintenance plan • any material trade-offs between the capital and operations and maintenance phases of the project • project dependencies • required changes in regulations or legislation • human resource implications
4. Procurement Plan	Subsections can be set out at the analyst's discretion	Describe how the investment is best procured and any differences in the procurement approach or approaches deemed feasible or desirable for each alternative under consideration. The analysis should take into account: • Role of Infrastructure Ontario • Assessment of industry capacity and experience to deliver the project • Feasible procurement options • Risk management • Future-proofing and long-term contracts • Evaluation of procurement options
5. Deliverability and Operations Case Conclusion	Risk Review	Identify key risks and uncertainties that may limit the option from achieving the performance noted in the evaluation
	Recommendations	Identify key recommendations for each option

Deliverability and Operations Case Section 1

Introduction

The introduction to the Deliverability and Operations Case should clearly articulate the chapter's structure and the key assumptions made to conduct the analysis.

Deliverability and Operations Case Section 2

Project Delivery

The project delivery component of the Deliverability and Operations Case covers the technical and commercial feasibility of each investment option, with the level of detail increasing as the investment progresses through the business case lifecycle (example: an Initial Business Case may have a high-level analysis for all proposed investment options, while the Full Business Case, which only considers one option, will have a more detailed review). This entails covering all aspects of project delivery except the choice of procurement model which is made at Stage 2 of the Province's two-stage approval process for major public infrastructure projects. Project delivery considerations must cover the following:

- Identification of project sponsor(s) and governance arrangements (if not already covered elsewhere in the business case)
- Description of major project components, including a constructability review
- Project management plan, schedule, phasing and community benefits realization
- Environmental assessment, where relevant
- Construction impacts
- Operations and maintenance overview

Project sponsor(s) and governance arrangements

As part of the importance of clear governance across the entire business case, it is necessary to identify the project sponsor(s) and governance arrangements. At the Initial Business Case stage, this involves identifying the main project sponsor(s) for each option, including the owner(s) of the assets under consideration and/or the public transportation authority responsible for advancing the project.

It is also necessary to identify the governance arrangements for each project, including the relationship between the owner(s) of the assets, the relevant transportation authorities, operating companies and project funders, where these are different entities. These governance arrangements can be identified at the Preliminary Design Business Case stage, including:

- Which entities are the project sponsor(s) and/or owner(s)?
- Which entities are responsible for project delivery (for example: Infrastructure Ontario), funding and operations?
- Are formal agreements required between different entities, and if so, between which entities and at what stage?

These governance arrangements can be described either in one of the earlier cases (for example: Strategic, Financial or Economic Cases) or in the Deliverability and Operations Case.

Major project components

A description of the key components is required for each project option, distinguishing between:

- Civil infrastructure, including any corridor, fixed guideway, stations, and maintenance facilities
- Rolling stock
- Signalling, train control, traction power, communications and any other systems, including interfaces with existing systems
- Property access and acquisitions, including air rights

The description should include a constructability overview which describes the degree of construction complexity and any physical constraints or modifications to existing assets required to accommodate the new project.[14] The property section should describe any challenges associated with property acquisitions required for the project option, including with securing access to property owned by third parties (for example: freight rail corridors). Table 7.3 is a sample constructability overview conducted for the new GO RER rail stations.

14 Construction complexity depends on several factors including the physical constraints imposed by existing facilities within which any new structure is built, including existing utilities and any adjacent facilities, as well the inherent complexity of the new structure itself.

Table 7.3: *Sample Constructability Overview for Potential New Stations*

New Station	Construction Complexity	Rationale
Station 1	Low complexity	• Site located off-line within existing facilities. • Track alignment and grade generally consistent with that of existing yard tracks.
Station 2	Low complexity	• Surrounding area fairly flat with low density properties. • Portion of track within length of platform to be relocated to reduce degree of curvature, superelevation and land acquisition requirements. • All track work would occur within the existing right-of-way or within the main station site. • Large site east of corridor is opportunity to stage track realignment. • Station can be built with little disruption to other transport facilities.
Station 3	Moderate complexity	• Can be constructed within the existing rail corridor. • Existing track may need to shift westward on the southern approach to accommodate the platforms. This could be accommodated within the existing right-of-way with minimal track curvature. • Temporary lane closures may be required to accommodate rail overpass widening work.
Station 4	Moderate complexity	• Vertical track alignment may need to be re-profiled to accommodate the station. • Vertical curve within site that should be relocated. • Site is located on a terrain with a significant slope downward towards the rail corridor. Grading and drainage will likely be key design constraints for the station. • Presence of designated environmental and natural heritage features could create a constructability constraint.
Station 5	High complexity	• Platforms to be located along a straight section of the rail corridor and will require grade separations to limit impact on adjacent transport facilities. • May require adjustments in track geometry to accommodate two side platforms, and potentially to protect for a future third mainline track. • Two vertical curves may need to be removed, and the vertical alignment re-profiled, in order to ensure tangent gradient along the length of the station platforms. • Three culverts located within the proposed station site and two of which may need to be extended to accommodate the site platforms. • Presence of hydro facilities adjacent to the proposed station site could create a constraint on station construction staging. • Station could impact the design of the electrification system due to the short distance separating the proposed station and a future substation required for electrification.

Project management plan

A description of the project management plan, including the schedule, key milestones and any critical path issues required for each option. The project management plan should include a description of any project phasing implied by any one of the alternatives (for example: where one or more parts of the project are delivered in a later time period). If the investment includes a Community Benefits Program[15], the proposed benefits and plan to realize them over the project lifecycle should be outlined. The plan should also indicate if the impact of any constructability challenges noted in *major project components* section are incorporated into the schedule; as well as the interaction between any required project approvals and the project timelines. A sample critical path issue is described for the Eglinton Crosstown project in the box on the right.

Environmental assessment

A description of the environmental assessment process is required for each project alternative, including the status of any completed or outstanding requirements.

In Ontario, environmental assessments are required for all large-scale projects with potential to impact the environment. In 2008, the Province of Ontario passed a regulation called the **Transit Project Assessment Process (TPAP)** to accelerate the delivery of critical transit expansion projects (Ontario Regulation 231/08). The TPAP is a sponsor-driven, self-assessment process that provides a framework for focused consultation and objections to the proposed project.

The TPAP regulation does not require proponents to look at the rationale and planning alternatives or alternative solutions to public transit or the rationale and planning alternatives or alternative solutions to the particular transit project.[16]

Crosstown tunnel alignment – Sample critical path issue:

The tunnel alignment was a critical path issue for the Eglinton Crosstown project, impacting most other components of the project, including station design and the design for the at-grade portion of the alignment. Hence, the tunnelling component of the project was designed and procured before the rest of the project through a design-bid-build (DBB) approach. Yet, this also created the potential for some additional risks in the interface between the two tunnel contracts (East and West of Yonge St.) issued in 2012 and the subsequent design-build-finance-maintain (DBFM) contract procured in 2015.

15 *Community benefits refer to local employment, training and apprenticeship opportunities as well as opportunities for local suppliers and social procurement. See link for a description of the Metrolinx community benefits framework for the Toronto Transit Projects: http://www.thecrosstown.ca/sites/default/files/pdf/communitybenefitsframework.pdf.*

16 *Ministry of Environment, 2014. Guide to Environmental Assessment Requirements for Transit Projects. Accessed 13 July at: https://www.ontario.ca/page/guide-environmental-assessment-requirements-transit-projects.*

Construction Impacts

A description of the impacts of each investment option during the construction phase is required. These impacts include:

- Maintenance of traffic, including travel time delays
- Continuity of transit operations, including any reductions in service levels
- Impacts on retail activity for nearby businesses

Operations and Maintenance

An overview of how each option is to be operated and maintained (for example: scheduled maintenance) is required. This includes a description of service levels and the location of maintenance facilities. It also includes how the operations are expected to interface with other transit networks and with other travel modes (for example: multi-modal interchanges, car parking, pick-up drop-off facilities).

At the Initial Business Case stage, the operations and maintenance overview should also include a qualitative review of the risks associated with each option. For example, Table 7.4 is a sample overview of the operations risks associated with each selected new GO RER rail stations and an assessment of impacts on operations (for example: minor, moderate impacts). This analysis should either be undertaken for each investment option or it can be undertaken for one alternative, with a discussion of variations implied by the other alternatives.

Deliverability and Operations Case Section 3

Operations and Maintenance Plan

The operations and maintenance plan examines the technical and commercial feasibility of the operations or service delivery stage for each investment option, including the *BAU scenario* if relevant (for example: the option in the absence of the project). This requires a description of the relevant operations and maintenance roles and responsibilities, any changes in the service plan, maintenance plan, project dependencies, required changes in regulations or legislation, human resource implications, and any material trade-offs between the capital and operations and maintenance phases of the project.

Roles and responsibilities

A description of the roles and responsibilities for the operations and maintenance activities is required. The description must indicate which organization is responsible for operations and maintenance activities, allowing for at least one organization to be designated for each of the two areas of responsibility. The organization responsible for operations may be the incumbent transit service provider; an outsourced service provider (as for GO Rail fleet operations and maintenance); or another transit service provider (for example: for services which cover more than one municipality). When multiple entities have operations or maintenance roles, these should be clearly delineated with respect to the assets operated or maintained by each entity.

Table 7.4: *Sample Overview of Operations Risks for Selected Potential New Rail Stations*

Station	Operating Impacts	Rationale
Station 1	Moderate impacts	• Concept requires trains to use the USRC B Track. This may affect the scheduling of other trains using the B Track and B Track extension to and from Union Station. Potential effects on platform allocation at Union Station and delays and/or conflicts with the UP Express due to frequent service in the USRC. • Concept requires removal of three yard tracks, reducing the storage capacity of the Bathurst North Yard from seven to four 12-car consists.
Station 2	Minor impacts	• No potential for an express train service to bypass the station, which would result in schedule impacts for stations upstream, impact currently estimated at 2 minutes per train.
Station 3	Moderate impacts	• Concept assumes that local trains will be on GO Weston Subdivision tracks 1 and 2 when passing through the station. As a result, express trains on the Kitchener and UP Express lines will need to be diverted to tracks 3 and 4 or otherwise scheduled so as not to be delayed by local trains stopping at the station.
Station 4	Minor impacts	• Concept does not provide the capability for an existing VIA train to bypass a GO train stopping at the station. There appears to be sufficient room within the right-of-way to add a third mainline track if it is deemed to be a requirement for VIA operation.

Changes in service provision

A description is required of all the material changes in services provided under each option (relative to the BAU). This includes new services, services made redundant, and changes in service routes, station locations, frequency of services, journey time (in-vehicle) and travel-time reliability, if relevant. It also includes any changes in how operations are organized in order to deliver the identified services (for example: due to changes in work shifts, depot locations or other factors which affect operations). For a new service offering, this includes an overview of how service levels are expected to evolve during the ramp-up period. This period can extend several years – from the start of operations up to the point where the services reach the steady-state growth rate of the rest of the network.

The changes in service provision may also include requirements to adjust feeder services or other connecting services not necessarily under the direct control of the designated operator.

Note that the definition of services is not limited only to transit services. It consists of all outputs resulting from an improvement or an investment decision (for example: a new or refurbished station, fare collection services, customer response inquiries). The key is to define the service in terms of the desired output (for example: percent availability of the station, fare collection transactions per time period, processing time for customer inquiries).

Changes in maintenance plan

A description is required of all the material changes in the maintenance plan under each option (relative to the BAU). The maintenance plan covers all the assets associated with the project, including any rolling stock, station facilities, track bed, and systems. The maintenance services cover both “soft services” (for example: cleaning) and “hard services” (for example: capital maintenance) and should include provisions for access to the equipment (for example: work windows during service downtimes) and provision for additional equipment (for example: spares) to avoid service reductions during repairs or refurbishment.

Trade-offs between capital and O&M phases

The Operations and Maintenance plan should describe any material trade-offs between the operations and maintenance plan costs or schedule and the scope or components of the capital phase. For example, investment in selected equipment or software during the capital phase can result in automation of certain labour-intensive tasks as well as service improvements. The description should include the trade-off between the two project phases and the assumption about how the trade-off is resolved for any option (for example: the actual decision point which is included in the option).

Project dependencies

The Operations and Maintenance Plan should describe any project or program dependencies. These refer to service levels or maintenance outcomes associated with each option which depend on the prior delivery of other projects in the region or on prior implementation of significant changes to timetables of other related services.

In the case of new or innovative service offerings (for example: micro-transit services, autonomous vehicle services for first/last mile access to rapid transit), project or program dependencies may also include prior changes in regulations or legislation required to ensure that services can be delivered in conformity with health and safety and other legal and regulatory frameworks.

Human resources and change management implications

Any changes to the operations and maintenance plans under each option may have significant human resource implications as well as change management implications. The required changes in human resource arrangements should be described fully, including any expansion or contraction in the workforce, the type of workers affected (for example: drivers, station operators). This includes any transfer of legacy staff from an existing transit service provider to a new entity and any potential labour relations challenges. There may also be change management implications in the absence of significant changes in workforce levels, if work roles or processes are subject to reorganization as a result of one or more options. These implications should be described and any potential requirements for change management services associated with one or more options should be highlighted.

Deliverability and Operations Case Section 4

Procurement Plan

The procurement plan describes how the project is best procured and any differences in the procurement approach or approaches deemed feasible or desirable for each option under consideration. The requirements for such a plan will differ depending on the stage of the business case.

For an Initial Business Case, it is necessary to consider the role of Infrastructure Ontario (IO) as the delivery organization for major public infrastructure projects in the province and the capacity of the local industry to deliver on the project. It is also necessary to identify the list of potential procurement options considered feasible; identify the project risks, including any interface risks between different contracts; and any future proofing considerations. Each of these analyses should be undertaken for each investment option.

At the Preliminary Design Business Case stage, the procurement plan is developed with input from IO, beginning with the capacity of the industry to deliver the project; the procurement options under consideration; the risk assessment and mitigation; and future-proofing. Each of these analyses is undertaken for each investment option, as in the Initial Business Case stage, but at a more in-depth level given the greater availability of data for the project.

At the Full Business Case stage, where the focus is on a single, preferred option, the procurement plan is developed based on input from IO. In this case, the plan covers all the items of analysis identified for the Preliminary Design Business Case above as well as an evaluation of the procurement options using the IO methodology for a Value for Money (VfM) analysis.

Role of Infrastructure Ontario and assessment of industry capacity

IO is the Province of Ontario's delivery organization for major infrastructure projects where the Province is the infrastructure owner.[17] This means not only managing the procurement process, but also the VfM analysis discussed below. The guidance here is not intended to supplant the IO VfM report, but to incorporate the results into the procurement plan. IO is the mandatory provider of procurement analysis and the Province of Ontario requires that a complete evaluation of procurement options be submitted to Treasury Board for the approval to start project construction.

Industry capacity and experience to deliver project

An assessment is required of the local industry capacity and experience to deliver the project, including all the options, where relevant. Industry capacity refers to the availability of local construction and engineering industry labour, and especially the skilled trades, required to deliver the project, given other infrastructure projects which are competing for the same labour resources.

17 IO also provides procurement services and advice to local governments on major infrastructure projects.

At the Preliminary Design Business Case and Full Business Case stages, this can be done through a market sounding of the local contractor firms. Industry experience refers to whether or not contractors in the GTHA have delivered similar projects in the recent past and whether or not they have the staff expertise to deliver on the type of project.

Procurement options

A description is required of all the potential options available to procure the project, including any differences between the investment options. The description should focus on the feasible procurement options, given the ownership structure of the assets under consideration.

Multiple procurement options are available in principle as alternative ways to procure projects including traditional and Public Private Partnership (P3) approaches. A typical way of presenting these options is in terms of extent of risk transfer to the private sector proponents. The main procurement options typically considered in Ontario in recent years include (in order of increasing risk transfer to the private sector):

- **In-House Provision –** this is the procurement option where the public sector retains all the risks, almost by definition. It is fairly common for transit service operations and maintenance.
- **Design-Bid-Build (DBB) –** which is known as the conventional approach for infrastructure delivery, where design is procured and completed before proceeding with construction; and where both phases are characterized by multiple contracts to different private sector firms. The public sector retains most of the risks in this procurement approach.
- **Build-Finance (BF) –** this procurement model was used early in the history of IO projects, when certain projects had already been designed (or where design was substantially complete). The construction and financing (during construction only) risks for these projects were transferred to a single private sector proponent.
- **Design-Build Finance (DBF) –** this procurement model adds the design component to the concession and thereby transfers to the private sector the bulk of design, construction and financing risks (with financing limited to the Design-Build stage). In this model, there is a significant overlap in the schedule of the design and build components. That is, the two components are planned and executed jointly rather than sequentially as under the DBB option.
- **Design-Build-Finance-Maintain (DBFM) –** this procurement model transfers additional risks to the private proponent during the service life of the asset, because the proponent also takes responsibility for the maintenance of the new asset (and possibly any pre-existing assets). Unlike the models above, this is a longer-term concession – usually in the range of 20-30 years, and hence, includes explicit conditions for the state of the assets upon return to public ownership.
- **Design-Build-Finance-Operate-Maintain (DBFOM) –** this procurement model transfers the most risk to the private proponent, compared to the other options, since the proponent is also responsible for operations, in addition to design, construction, financing and maintenance.

There are also variations in a number of these options in practice. For example, DBB approaches also include Construction-management (CM) or CM at-risk, where there is greater risk transfer to the private sector as compared to DBB. Design-Build (DB) – that is, without transferring financing risk – is also an option that has been used by Ontario's Ministry of Transportation (MTO) for smaller highway and bridge projects. IO has typically included the financing component in P3 projects, because this component is seen as an effective vehicle for transferring schedule and related risks to the private sector. However, P3 procurement options tend to be feasible only for large projects (for example: at minimum $50M in project costs), due in part to significant transaction costs. On the other hand, DB projects can be smaller than $50M.

The Province's Directive for Major Public Infrastructure Projects requires that an analysis of procurement options is completed when making a Stage 2 request (that is, a request for construction approval) valued at over $100 million. IO provides guidance and support when conducting this analysis and should be consulted early in the development of the business case. Ultimately, the Province's Treasury Board makes the final determination of which procurement model to adopt, based on advice from Metrolinx, the MTO and IO.

It is necessary to recognize from the start that not all procurement options are feasible. For example, in-house provision is not typically feasible for civil construction projects.

Moreover, some construction projects are carried out on property not owned by Metrolinx or the Province (for example: property owned by freight rail carriers), in which case the feasible procurement options are usually limited to Design-Bid-Build. These and other relevant considerations should be taken into account in developing a list of feasible procurement options for an Initial Business Case. At the Preliminary Design Business Case stage, a more extensive analysis of feasible procurement options can incorporate the results of a market sounding of contractors and investors. At the Full Business Case stage, there should be a clear short list of procurement options for the purpose of the VfM analysis.

Detailed analysis of VfM for procurement options should occur after a preferred investment option has been selected. In earlier business case stages where there are multiple competing investment options a high-level review of procurement options is sufficient. As the business case process narrows down the investment to a preferred option then detailed procurement option analysis should be undertaken.

Commercially confidential material that is generated in the procurement planning process will not be released within the business case.

Risk management

The procurement plan should include an identification, assessment and mitigation of risks, including interface risks, and how they differ across investment options.

All material risks should be identified and assessed at least in a qualitative manner, covering the entire project lifecycle from the environmental assessment (if relevant) to operations. This includes any compliance issues with respect to technical standards of a regulatory nature.

At the Initial Business Case stage, only a preliminary identification and assessment of risks is required for each option. At the Preliminary Design Business Case stage, a more robust risk review covering the identification, assessment, and mitigation of risks for each option should be prepared. This review should also provide an initial assessment of whether or not each risk can be transferred to a private sector entity. For retained public sector risks, it would indicate how those risks should be mitigated and managed throughout the project lifecycle. The Full Business Case stage requires a completed risk management plan.

The risk management plan should cover interface risks, which arise between the different contracts required to deliver on a project. These risks can arise for a whole host of reasons when the owner of one contract relies on conditions which are not within their direct control (for example: access to premises, timing of activities), but within the control of another entity (or that require coordination with one or more other entities). Interface risks can also arise over time, when a project has two or more phases delivered under separate contracts.

Even in a case where only one contract is envisaged to deliver on all components of the project, there are potential interface risks between the assets within the contract and any adjacent or connected assets outside the contract. The rationale for identifying these interface risks early on is that they are typically borne by the project owner and are difficult to transfer cost-effectively to the private sector.

Future proofing and long-term contracts

When long-term contracts are envisaged as a procurement option (for example: including operations within a P3 contract), the procurement plan should consider whether there is a significant risk that the project requirements (for example: as driven by user needs, public preferences, government policies) are likely to change substantially over the term of the contract. In such cases, the plan should consider whether the output and performance specifications in the long-term contract can be adapted to accommodate the changes (or whether there is a significant risk that the contract becomes an encumbrance which precludes addressing such changes). This is particularly relevant in areas with rapidly changing technologies or processes (for example: micro-transit services for last/first mile access to rapid transit), where performance specifications can become obsolete within a few years.

Future-proofing also requires considering if any of the investment options may preclude or create significant obstacles to other future projects.

This is especially relevant for any new region-wide projects, which could preclude or create obstacles to the expansion of other legacy networks.

Evaluation of procurement options

The procurement plan requires an evaluation of procurement options identified. These refer to the feasible procurement options discussed under Section 1 above. The evaluation is called a VfM analysis, which essentially compares the risk-adjusted costs of delivering a project through one or more feasible P3 options against one conventional delivery option (usually DBB).[18] The Initial Business Case would need only a preliminary and qualitative evaluation of procurement options, but this would need to include a discussion about how the evaluation differs across each option. The Preliminary Design Business Case requires a complete evaluation of procurement options for the preferred option , while the Full Business Case should clearly communicate the preferred option and procurement approach.

As required by the Province's Directive for Major Public Infrastructure Projects (MPIP), a complete evaluation of procurement options must be provided with a request to Treasury Board for Stage 2 approval (for example: construction approval).

Deliverability and Operations Case Section 5

Analysis Summary

The conclusions subsection should summarize the preceding analysis for project delivery, operations and maintenance, and procurement. Key risks that shape the overall success of the investment should be clearly noted, along with recommended areas for further focus.

This risk assessment should include at a minimum:

- Interface risk the need to get agreements from other infrastructure owners and operators to realize the benefits of the investment
- Regulatory Risk- The level of permission and certainty that is provided by the regulatory environment for the proposal and the approvals that are yet needed to deliver on the benefits of the program
- Scope Risk – the risks associated with unknown future scoping issues or project evolution

18 *See Infrastructure Ontario, 2015. Assessing Value for Money: An Updated Guide to Infrastructure Ontario's Methodology, March 2015.*

8

Business Case Summary

How is the guidance structured?

Business Case Chapter	Overview
Introduction	A summary of the rationale for the business case and where it fits into the project and business case lifecycles
Summary	A summary of the key findings across the analytic chapters of the business case. The summary should also discuss next steps for the investment planning process
Executive Summary	A concise summary of the analytic content and key findings in the business case

Overview

This chapter of the Guidance: Business Case Guidance outlines how to structure the "Summary" chapter and describes what should be included in the introduction, summary, and executive summary chapters of the business case. These chapters are crucial to developing a coherent business case. Because these sections will not typically focus on analytical content, this guidance focuses more on how to structure these chapters.

Introduction Chapter

Each business case should include a concise introduction chapter that explains the rationale, structure, and content of the document. The introduction chapter will typically:

- Explain the rationale for developing the business case
- Outline the status of the business case and which part of the lifecycle it is in (example: Initial, Preliminary Design, Full or Post In-Service)
- Identify key drivers for the business case process – such as board recommendations, mandate letters, official plans, or previous business cases
- Provide an overview of the business case and its structure (Context, Investment Options, Strategic Case, Economic Case, Financial Case, Deliverability and Operations Case, and Summary)
- State how different stakeholders and Sponsors have been involved in the business case

The introduction chapter should not focus on sharing evaluation material or exploring contextual information. Rather, it should be a brief chapter that ensures readers understand why the business case has been completed and where it fits into the investment planning process.

Summary Chapter

The Summary Chapter is the final chapter of a business case. This chapter focuses on being a 'book end' to the business case by synthesizing the insights and key lessons learned identified in each preceding chapter. Typically, the Summary Chapter:

- Provides an overview of the key findings across each of the four cases for each of the options (including pros, cons, challenges, risks)
- Outlines the comparative performance of each option compared to business as usual
- Describes any emergent differences in the performance of each option
- Details key performance drivers for each option and their relevance to future work
- Summarizes key lessons learned/findings that are relevant to advance work on the problem or opportunity and investment that the business case is focused on
- Identifies next steps for the investment's analysis process

Summary chapters do not need to identify a single preferred option. Rather they should focus on providing the key information that will assist decision makers and stakeholders to understand the merits and potential drawbacks related to the investment and its options. Summary sections may suggest refinements to options based on key lessons learned from each of the four cases.

Introduction/Executive Summary

Each business case should prepare a concise executive summary that is placed prior to the Introduction Chapter. While positioned at the start of a business case, this section is typically prepared last. The Executive Summary is intended to provide decision makers and the public a concise version of the content of the business case. The goals of the Executive Summary are to:

- Communicate the key narrative of the business case: why the problem or opportunity is relevant, the range of options that may address it, and their overall performance against the four chapters
- Illustrate key findings and next steps for continued investment development

Typically, this section should provide a high-level overview of each content chapter (context, option development, the four cases, and summary). If appropriate, some chapters may be summarized with a brief paragraph of infographic. To ensure the Executive Summary is concise, only the key elements of the business case narrative should be included. Additional contextual, background, and methodological information should not be a focus of the Executive Summary.

Glossary

Business Case	A generic term for a collection of evidence which, when assembled in a logical and coherent way, explains the contribution of a proposed investment to organizational objectives. It supports decision-making process to sift options, select a preferred option, and optimize the preferred option.
Business Case Framework	A four chapter approach to assembling business case evidence that is based on international best practice. It requires the integration of strategic fit, economic and finance, and deliverability and operations evidence.
Business Case Review	The concept of evaluating options and selecting a preferred option is enshrined within international best practice of business case development. However, there are situations when a simple business case "health check" is required to assess the business case performance of a single option, typically for an investment that has already been approved. This type of study is known as a Business Case Review.
Benefit Cost Analysis	Analysis that is undertaken to describe an economic and/or financial cost benefit ratio.
Business as Usual Scenario	The baseline against which options are compared where the intervention has not occurred and existing business practices, committed plans and general trends continue into the future.

Economic Benefit Cost Ratio	The ratio of societal benefit to societal cost, this ratio describes the benefit to society in economic terms, expressed as a return per dollar invested.
Economic Net Present Value	The Present Value of Benefits minus the Present Value of Costs.
Future Year Transportation and Land Use Baseline	Forecasting exercises typically use a future year that is 15 to 30 years in the future. The intervention under consideration is assessed against this future year understanding of land use and transportation networks. As there is considerable uncertainty surrounding these forecasts (and because there are iterative interactions that the intervention under consideration may trigger), it is good practice to assess alternative future year baselines.
Investment	Business cases are applicable to assess the case for anything that requires investment including projects, programs, and policies, both small and large. For the purpose of this guidance, all such investments are referred to as "interventions".
Multiple Account Evaluation	Metrolinx previously used a Multiple Account Evaluation Framework to structure economic analysis of transportation investments. The business case framework incorporates a modified version of this framework within the Economic and Financial chapter

Glossary Table 8.1: *Economic Parameters*

Parameter	Purpose	Value
Social Discount Rate	Over time, the value of a cost or benefit will decrease – as a result, a social discount rate is applied. The social discount rate reflects society's time preference for money.	3.5%
Growth Cap	In the absence of input specific guidance, growth in all inputs to the evaluation (example: user benefits) should be capped after 30 years to reflect uncertainty.	After 30 years from the base year of project evaluation
Evaluation period	Different evaluation periods are used for different levels of investment and scales of options.	5 to 60 years (depending on investment lifecycle/impacts)
Dollar value	All values should be discounted and, if necessary, escalated to a common year defined at the onset of the study, Typically this will be the year the evaluation takes place in.	Real, year of evaluation

Glossary Table 8.2: *Financial Case assumptions*

Parameter	Value
Discount rate	5.5%
Inflation Rate	2%
Capital and Operating and Maintenance Cost Escalation	1% until 30 years from the base year of project evaluation, 0% after
Amortization	Straight Line based on useful lifecycle
Financing Costs	FY 2016/17 and beyond = 5.78% for any capital costs paid for by the Province of Ontario.
Labour Benefits	25% of salaries
Avg. Fare Price	Calculated on an investment by investment basis
Capping all growth	In the absence of input specific guidance, growth in all inputs to the evaluation (example: user benefits) should be capped after 30 years to reflect uncertainty.
Evaluation period	5 to 60 years (depending on investment lifecycle/impacts)
Dollar value	Nominal, year of expenditure
Unit of Account	Market prices

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