METHODOLOGIES FOR PREPARATION AND INTEGRATED APPRAISAL OF INVESTMENT PROJECTS IN GHANA

NOVEMBER 2024

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ABBREVIATIONS

CAPEX	Capital Expenditure
CBA	Cost-Benefit Analysis
CEA	Cost Effectiveness Analysis
DLI	Disbursement Linked Indicator
DLR	Disbursement Linked Results
GDP	Gross Domestic Product
GoG	Government of Ghana
IBP	Integrated Bank of Projects
MDA	Ministries, Departments and Agencies
MCA	Multi-Criteria Analysis
NMTDP	National Medium-Term Development Plan
NPV	Net Present Value
PCN	Project Concept Note
PFM	Public Financial Management
PFS	Pre-Feasibility Studies
PIM	Public Investment Management
PIP	Public Investment Plan
PMF	Project Management Framework
PPP	Public Private Partnership
SoE	State Owned Enterprises

DEFINITION OF TERMINOLOGIES

Guidelines	Guidelines for Preparation and Appraisal of Projects and Development of the Public Investment Plan
Project Proposal	Project Concept Note, Pre – feasibility Study and Feasibility Study Report
Selection Criteria	Project Selection/ Prioritization Criteria for Inclusion In The Public Investment Plan

ACKNOWLEDGEMENT

The preparation of this document was a challenging and rewarding endeavour that demanded significant effort and dedication. We extend our gratitude to the management of the Ministry of Finance, including the former Minister for Finance, Hon. Ken Ofori Atta, for his instrumental role in establishing the Public Investment Management Framework.

We also acknowledge the incumbent Minister for Finance, Hon. Mohammed Amin Adam, for his support in facilitating the preparation of various PIM guidelines. Special thanks are extended to Ms. Eva Esselba Mends, the Chief Director of the Ministry of Finance, for her invaluable contribution to the review and approval of the document.

Additionally, we express our deep appreciation to Mr. David Klotey Collison, Ag. Coordinating Director (Technical) of the Ministry of Finance and former Director of the Public Investment and Assets Division (PIAD) for his unwavering support and guidance in the development of this document.

We acknowledge Mrs. Cynthia Arthur, Ag. Director of the Public Investment and Assets Division and the former Head of the Public Investment Programs Unit (PIPU) for her exceptional guidance, leadership, and active involvement in ensuring the successful preparation of this document.

Furthermore, we appreciate the significant contributions of the Institutional Development and Reforms Team from PIPU, particularly Mr. Yaw Agyarko Obeng-Yeboah, who played a pivotal role in drafting the document. Their tireless efforts and professionalism were instrumental in ensuring the document's quality.

Lastly, our appreciation extends to the Sector Investment Project Development Team (SIPDT) from PIPU, whose valuable contributions during review sessions enhanced the accuracy of this document.

We trust that this document will serve as a valuable resource for all stakeholders involved in the preparation, appraisal, and implementation of investment projects in Ghana.

FOREWORD

It is with immense pride and anticipation that I present to you this comprehensive guide, **"Methodologies for Preparation and Integrated Appraisal of Public Investment Projects in Ghana".** This publication represents a pivotal achievement in our ongoing efforts to enhance Public Investment Management (PIM) in Ghana.

Since 2015, significant progress has been made with the passage of key legislative reforms, including the Public Financial Management Act, 2016 (Act 921), the Public Private Partnership Act, 2020 (Act 1039), and the Public Financial Management (Public Investment Management) Regulations, 2020 (L.I. 2411). These reforms have laid a strong foundation for the principles and practices detailed in this guide.

Foremost, I would like to express my sincere gratitude to the management and dedicated team of officers at the Public Investment and Assets Division of the Ministry of Finance, who have worked tirelessly to bring this manual to fruition. I would also like to thank Prof. Edgardo Mimica, an international PIM expert, for his invaluable contributions at the beginning of our public investment management reform journey. Their expertise and commitment have been instrumental in shaping the insights presented here.

This manual provides comprehensive coverage from the initial stages of project conception to the details of integrated appraisal, giving a step-by-step guide to the preparation and appraisal of investment projects, from the identification of the project to the evaluation of its impacts. This work bridges the gap between academic knowledge and real-world application by incorporating both theoretical frameworks and practical insights. It is a valuable resource for project managers, government officials, and stakeholders involved in the implementation of public investment projects.

As someone deeply invested in ensuring efficient and prudent financial management, I am particularly excited about the potential impact of this manual. This guide encapsulates the wealth of knowledge and best practices that have emerged from our PIM reforms over the years. It offers practical insights and systematic approaches to project preparation and appraisal, aligning with international standards while being tailored to the unique context of Ghana.

I urge all readers to engage with the guidelines presented in this manual with an open mind to advance the preparation and appraisal of public investment projects in Ghana. Let us not only learn from the insights presented here but also use them as catalysts for meaningful action.

May this manual serve as a cornerstone for your professional development and a driving force for the successful realisation of investment projects that will propel Ghana towards a prosperous and sustainable future.

Thank you for joining us on this PIM journey. Together, let us strive to create a world where knowledge is not just a possession but also a force for engendering broad-based development.

God bless our homeland, Ghana, and make our nation great and strong.

Thank you.

Hon. Dr. Mohammed Amin Adam, (MP)

Minister of Finance

PROLOGUE

In public policy, governments face the problem of allocating scarce resources (natural, human, and capital) to infinite uses to satisfy needs and obtain the maximum social and economic benefits. Developing countries have found success by standardising and systematising their public investment processes. Notably, a positive correlation exists between the efficiency of public investment project selection and the ultimate social impact achieved through capital expenditure. This consideration is essential in countries such as Ghana, which is faced with fiscal constraints and, therefore, must allocate scarce resources to the most productive investments.

Economic Appraisal is essential for making decisions to ensure the highest socio-economic return. Comparing total project costs and benefits allows the measuring of projects' contribution to the country's wealth. Evaluation tools, including the Cost-Benefit Analysis (CBA) and Cost-Effectiveness Analysis (CEA), are essential elements for project comparison, providing a valuable basis for decision-making and assisting in the systematic appraisal and management of investment projects.

The primary objective of this methodological framework is to support consultants, technical advisors, and technocrats in delivering financially and economically feasible projects in various sectors including irrigation, health, public buildings, roads, energy, and education. The framework aims to aid the Government of Ghana (GoG) in preparing and evaluating investment projects that advance economic and social well-being.

1.0 SCOPE AND OVERVIEW

To assess projects' economic contribution, it is imperative to meticulously identify, measure, and evaluate their costs and benefits. This comprehensive analysis aids in both qualitatively and quantitatively determining each project's positive and negative impacts. While it may not be feasible to quantify and value all costs and benefits, evaluators are tasked with rigorously identifying and assessing as many effects and impacts as possible.

This framework serves as a valuable resource for covered entities involved in conducting socio-economic appraisals of investment projects. Advocating for a standardised approach facilitates enhanced decision-making, enabling the selection of higher-quality initiatives that yield greater economic well-being. Rooted in the theoretical foundations of applied economics, this document offers pragmatic guidance for practitioners, drawing upon experience and best practices from both developed and developing countries where economic appraisal is utilised to inform public investment decisions.

Designed for diverse users, including project analysts, this methodology provides a suite of practical, user-friendly analytical tools grounded in economic theory. For project analysts, it offers a step-by-step guide to implementing socio-economic analyses for projects. Furthermore, it serves as a valuable resource for public sector managers and authorities, particularly within the Ministry of Finance, who are responsible for making informed decisions regarding public sector investments. Additional beneficiaries include Ministries, Departments, and Agencies (MDAs), State-Owned Enterprises (SOEs), and Metropolitan, Municipal, and District Assemblies (MMDAs) involved in project preparation, appraisal, and implementation.

The development of this document has been informed by International Best Practices and a comprehensive review of textbooks and methodological guides from various countries and international organisations.
The document is divided into eight main chapters.

Chapter 1 provides the scope and overview of public investment management practices.

Chapter 2 explains the guiding principles of Public Investment Management and the Integrated Project Analysis.

Chapter 3 outlines the project life cycle stages, from planning to operation, and links to the Integrated Bank of Projects (IBP) system.

Chapter 4 details a step-by-step methodology for project appraisal, covering objectives, alternatives, demand analysis, and financial and economic assessments.

Chapter 5 presents project evaluation criteria, including discount rates, net present value, and cost-effectiveness analysis.

Chapter 6 focuses on economic appraisal, exploring methods for assessing project economic viability.

Chapter 7 provides sector-specific methodologies for economic appraisal across irrigation, health, roads, public buildings, energy, and education sectors.

Chapter 8 offers recommendations and final comments on the application of these methodologies

2.0 PUBLIC INVESTMENT MANAGEMENT

Public policy presents a fundamental challenge for governments in allocating finite resources (natural, human, and capital) across a vast array of potential uses. This process aims to satisfy specific societal needs and achieve maximum social and economic benefits.

Aligning with International Best Practices in resource allocation and utilisation is crucial to achieving efficient public investment management. Developing framework documents serves this purpose, ensuring the effective implementation of the Public Financial Management Act, 2016 (Act 921) and its accompanying Public Investment Management (Public Financial Management) Regulations, 2020 (L.I. 2411).

> *Regulation 5(1) of L.I. 2411 mandates that "the Minister shall issue guidelines to facilitate efficient and effective public investment management."*

Adopting a well-defined set of criteria for project selection is essential to guaranteeing the efficient utilisation of scarce resources in capital investments. Project appraisal emerges as a critical technical tool in this process, aiding decision-makers in ensuring the optimal allocation of public funds.

This aspect is particularly significant in public investment due to its inherent long-term effects, which exceed those of current expenditure. Decisions made today can have irreversible impacts on the welfare of future generations.

> *Economic evaluation tools are crucial for informed decision-making regarding project selection and maximising returns. Through Cost-Benefit Analysis (CBA), a project's total costs are meticulously compared with its anticipated benefits. This rigorous approach allows for a clear determination of a project's true contribution to the nation's overall wealth. The primary objective of CBA is to enhance decision-making by enabling the selection of projects with demonstrably higher net benefits, ultimately maximising the effectiveness of public investments.*

The pre-selection process

Traditionally, there have been some recurring problems with CBA carried out across the public service. These challenges include:

1. *Covered entities not carrying out CBA for investment projects;*
2. *Underestimation of costs – some projects have significantly higher costs than expected;*
3. *Lack of sufficient options analysis, including no definition of the 'counterfactual[1]';*
4. *Lack of clarity over specific objectives for the project;*
5. *Double counting of benefits; and*
6. *Insufficient sensitivity analysis.*

[1] *"Counterfactual" refers to the "do-nothing scenario" The "do-nothing" scenario is a term used in options analysis to describe the current environment and what would happen if nothing changed. It is also called the "do-nothing" scenario because it assumes that no action is taken to address the problem at hand.*
In options analysis, the "do-nothing" scenario is used as a baseline to compare other scenarios against. For example, if you are considering implementing a new project, the "do-nothing" scenario would be the current situation without any changes.

Pre-selection is the decision point that concludes the development of an initial project idea. It involves a formal decision on whether to proceed to more in-depth project planning and appraisal.

1. *Pre-selection prevents public financial resources from being wasted on redundant feasibility studies and assists in restraining expansionary pressures on the budget by containing the project pipeline.*
2. *Pre-selection also provides an important opportunity for MDAs to test the robustness of a project concept in terms of logic, risk, and sustainability; reject unsuitable project alternatives, and identify those alternatives that are worthy of further appraisal alongside the reference project.*
3. *The pre-selection stage also offers an opportunity to feed lessons from the ex-post evaluation of similar completed projects, where available, into the initial design of new projects.*

A comprehensive project appraisal methodology involves the identification, quantification, and monetisation of costs and benefits attributed to a project. By discounting, it determines the net benefits or costs in terms of present value. It also considers the difference between alternative options, such as Do-Something versus Do-Minimum, and the cost and benefits of a project or policy intervention from the perspective of society. The primary goal of this methodology is to improve the quality of investment and generate economic welfare.

All projects, whether financially or non-financially significant, are expected to follow the formal appraisal process. However, for small-sized, non-financially significant projects with limited recurrent cost implications, the intensity of research and analysis that is acceptable may be lower. The decision-making process requires that the project's strategic policy relevance, rationale, and practicality are demonstrated to the satisfaction of the relevant decision-makers. Additionally, a convincing case must be made to justify further expenditure on planning and analysis.

> *In a 2015 study, the International Monetary Fund (IMF) found that in countries with efficient investment systems, a 1 per cent increase in public investment could increase output by 0.6 percentage points of GDP, reaching better-quality infrastructure, whereas in countries with less efficient investment systems, the increase is only half (0.3 percent).*

2.1 Guiding Principles

Economic analysis is considered an important step in the preparation and structuring stage of a project. It is a mandatory condition to follow both the efficacy and efficiency approaches for public investments. In this regard, all projects that are to be included in the Portfolio of Projects (PoP) need to fulfil two prerequisites:

1. The strategic fit of each eligible project (i.e., the efficacy approach) must be checked.
2. Each project must have gone through an integrated economic evaluation that assures economic attractiveness (i.e., the efficiency approach).

Strategic and economic planning are both necessary and complementary and should not be disconnected. These two prerequisites should be mandatory to provide the Seal of Quality to allow for budgetary or Public-Private Partnership (PPP) funding.

The Efficiency Approach, derived from Economic/Financial Planning, is responsible for allocating one scarce national resource: capital. This is a highly technical process that must guarantee the economic profitability (or attractiveness) of each public investment project. The Efficiency Approach commonest approach around the world, and it is the base of project cost-benefit analysis. Harberger (1971) formalises the underlying model assumptions, establishing three basic postulates for applied analysis of welfare economics:

1. *The competitive undistorted demand price for an incremental unit of a good or service measures its economic value to the consumer and, hence, its economic benefit.*
2. *The competitive undistorted supply price for an incremental unit of a good or service measures its economic resource cost.*
3. *Costs and benefits are added up without regard to who the gainers or losers are.*

When a project produces a good or service (output), the economic benefit or the economic price of each incremental unit is measured by the demand price or the consumer's willingness to pay for that unit. On the other hand, the economic cost of a resource (input) that goes into the production of the project's output is measured by the supply price of each incremental unit of that resource. Finally, the net economic benefit of the project is measured by simply subtracting the total resource costs from the total benefits.

The Efficacy Approach, on the other hand, is used in Strategic Planning, where the emphasis is on "investment efficacy," that is, spending on the right public assets. Strategic planning at different levels ensures the alignment of investment projects with national and sector strategies.

2.2 The Integrated Project Analysis

Project evaluation helps determine the suitability of various initiatives for investment when resources are scarce. This tool considers financial and economic aspects, measuring the costs and benefits of competing projects to prioritise those with the highest expected benefits. However, other areas of analysis provide a broader view of a project's effect on society's welfare.

A good project has the potential to augment a country's economic output, potentially yielding benefits for all involved. Nevertheless, this ideal scenario may not always materialise, as certain stakeholder groups may encounter losses. Identifying beneficiaries, contributors, and adversely affected parties provides analysts with insights into stakeholders' motivations for either supporting or opposing the project.

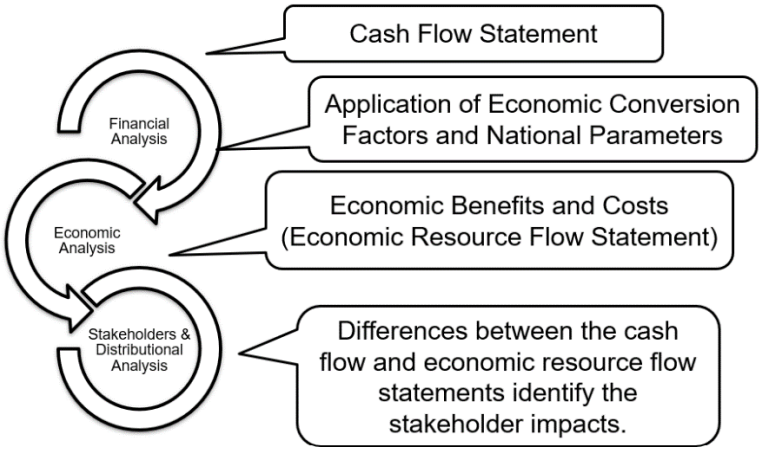
Analysts must consider not only a project's net contribution to a country's welfare but also the distribution of its costs and benefits for equity and sustainability. In this regard, employing an integrated approach enables the assessment of projects' social impact, facilitating a thorough understanding of stakeholders and their perspectives.

Integrated appraisal enables the identification of potential future problems associated with a project that might have otherwise been overlooked. The extent and specificity of the integrated assessment depend on the project's characteristics and the contextual factors influencing its development.

By comparing the overall costs (Capital Expenditure and Operational Expenditure) of a project with its benefits, covered entities can assess its potential contribution to the country's wealth. This evaluation involves converting financial cash flows into economic resource flows, utilising economic prices (efficiency or shadow prices) of goods, services, and resources. While some costs and benefits may be challenging to quantify and value, it is the analyst's responsibility to rigorously identify and assess all project effects and impacts, striving to quantify and value as many as feasible.

Figure 1 illustrates the three fundamental types of analysis that form the basis of integrated appraisal for assessing the sustainability of a project.

Figure 1: Steps of Integrated Appraisal



Source: *Jenkins G, Harberger A, Kuo Ch. (2013).*

The general relationship is the following:

$$E\,\mathrm{NPV}_{SDR} = F\,\mathrm{NPV}_{SDR} + \sum \mathrm{PV}\,EXT_{SDR}$$

Where:

$ENPV_{SDR}$ is the Economic Net Present Value, discounted at the Social Discount Rate (SDR);

$FNPV_{SDR}$ is the Financial Net Present Value, discounted at the SDR;

$\Sigma PVEXT_{SDR}$ is the Sum of the Economic Externalities, discounted at the SDR.

The integrated approach is expected to develop the tools to answer questions that arise when determining the contribution of public investment to society. These questions include:

1. *How should public investment proposals be analysed?*
2. *What is the aim of the project?*
3. *What are the expected outputs?*
4. *What are the expected impacts?*
5. *What happens if the project is not implemented?*
6. *What are the available funding sources?*
7. *Does the project have separable components?*
8. *Are there economically suitable alternatives in terms of growth and distribution?*
9. *Who benefits, and who pays the costs of the project?*
10. *Who are the stakeholders that may affect the investment decision or the performance of the project?*
11. *Is it appropriate to continue or discontinue projects? (if it is an ongoing project)*
12. *What is the set of alternatives that optimise the use of the projected budgetary constraints?*
13. *Is the project financially sustainable (feasible)?*
14. *What are the environmental and social impacts of the project?*
15. *What are the sources and magnitudes of the risks?*
16. *Is the project the most desirable compared to others competing for the same budget?*

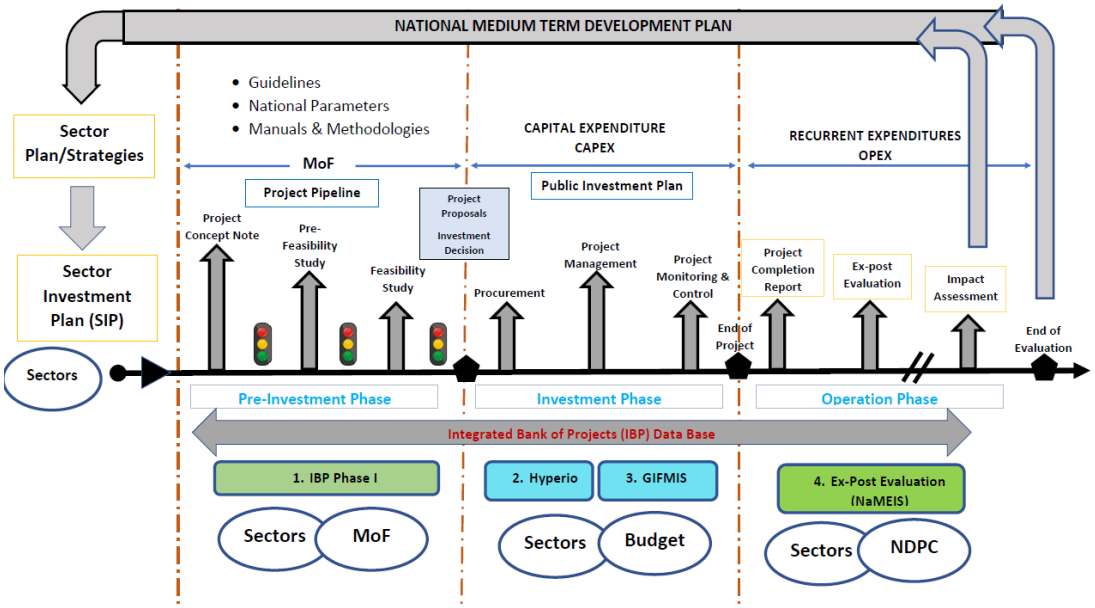
3.0 THE PROJECT LIFE CYCLE

The project life cycle is the process by which an idea is transformed into a concrete solution, and the most profitable alternative is chosen through the analysis of alternatives. Every project has certain phases in its development and implementation. These phases are very useful in planning a project as they provide a framework for budgeting, resource allocation, scheduling project milestones in implementation, and establishing a monitoring system. The purpose is to provide a basis for organising the project, developing resource requirements, and setting up the management system that will finally guide the project activities.

For optimal allocation of public resources, the process of financial and economic evaluation of projects should ensure the correct selection. In the context of public sector investment, a project may be viewed as an instrument for achieving the country's planning objectives and development goals, available to planners and policymakers. Often, a project may be considered as a series of activities and tasks with a specific objective to be completed within certain specifications and within a given timeframe. Usually, it will also have funding limitations, consume resources, and may be evaluated as an independent unit.

Although the exact separation of a project's life into its different phases is somewhat sector-specific, the project lifecycle phases may be broadly placed in different steps. Figure 2 shows the project lifecycle. As the project moves through its lifecycle, the focus of managerial activities shifts from planning to operating and controlling activities. It should be emphasised that these phases represent a natural order in which projects are planned and carried out. Also, none of these phases becomes final until the project approaches its termination stage.

Figure 2: Project Life Cycle



The project's economic viability is one of the dimensions that is analysed at the different stages of the gateway process whenever the project is identified, structured, tendered and delivered. Nevertheless, economic analysis is even more useful when used early in the project cycle to identify poor projects and their components. If used at the end of

the project cycle, economic analysis can help determine whether to proceed with a project or not; however, at the pre-feasibility stage, it allows the analyst to:

1. Compare options and find the best solution to the problem faced by the country;
2. Analyse what could be the best version of the project in terms of location, scale, technology and timing; and
3. Compare projects to select the most profitable ones for subsequent detailed appraisal.

At the structure finalisation and tender design stage, as well as the tender management and transaction execution stage, it is recommended that the CBA performed at the feasibility stage be reviewed to check if the project remains profitable, given the new information acquired through the tender process. Also, during the project's construction and operation stages, it is essential to monitor and evaluate ex-post to ensure that it is delivering the anticipated outputs and outcomes and that the benefits are realised as expected.

3.1 Planning Phase

The planning phase entails the identification of potential public sector projects. The purpose is to establish the basic desirability of a project and to identify high-priority projects that fall within the responsibility of the public sector.

In the planning phase, the emphasis is on “investment efficacy” or spending on the right public assets. Spending should promote achieving strategic priorities, and resources should be allocated only to those areas that best align with the government’s objectives. The strategic fit of projects, therefore, ensures the strategic alignment of investment projects with national and sector strategies. The specific objectives of investment projects should consequently be designed to support the overall national development agenda.

The project proposal is a tool for planning economic growth and development. The main advantage of casting investment decisions into a project format is that it enables the planner to establish a framework for analysing information in a systematic procedure. Based on the project proposal assessment results, covered entities may include projects as new proposals in their draft strategic plans.

This analysis introduces the project to the pre-investment phase. At this stage, the analyst should:

- Discard all unfeasible alternatives.
- Select the feasible alternatives that could advance to the next stage.
- Postpone the solution to the problem (wait) while the covered entity makes a decision.

3.2 Pre-investment Phase

The pre-investment phase is a gradual process of elaborating project ideas, following the project lifecycle until an appraisal conclusion is reached. This corresponds to the process of preparing the necessary studies and analysis for the identification, preparation and evaluation of the project that can solve the problem or meet the needs that triggered it, reducing the degree of uncertainty in investment decisions.

The objective of this phase is to ensure that the selected alternative is superior to the other alternative solutions and that the project presents higher technical standards and sounder indicators of effective performance compared to similar projects. Once the pre-investment phase is completed, the decision-maker may determine, with greater certainty, whether to accept, defer, or reject a project.

The economic analysis in the pre-investment phase must follow certain principles:

- **Proportionality:** a viability analysis must be conducted to estimate the net benefit of the appraisal itself;
- **Incremental basis analysis:** benefits and costs should be estimated by reference to the "do-nothing" alternative;
- **Use of market prices:** market prices are the best starting point for valuing benefits and costs. However, in the presence of clear market distortions, these prices must be adjusted to reflect real opportunity costs;
- **Adjustment for taxes, subsidies and transfers:** indirect taxes (VAT), subsidies and social transfers (social security benefits) are not considered economic resources (they are transfers); market prices must be amended to exclude taxes, subsidies and social transfers; and
- **Use of real prices:** benefits and costs must be expressed in real terms, excluding inflation effects. The base year is usually the current year. Values must be estimated using the Consumer Price Index (CPI).

The project proposal (Project Concept Note) stage should be followed by **Pre-Feasibility Studies (PFS)**. The PFS is one of the two components of what has been traditionally known as the appraisal phase of a project. This is the first attempt to examine the overall potential or viability of the project. The data and information gathered at the project proposal stage are used in this phase. It is a critical stage of the project cycle because it is the culmination of all the preparatory work and provides a comprehensive review of all aspects of the project before a decision about its viability is made.

At this stage, if a project does not prove to be promising, it may be rejected without the investment of any additional time and resources into its further examination. The principal objective of a PFS is to reject alternatives and to examine the project's potential through sensitivity analysis to determine its critical variables. The result of a PFS is usually a recommendation to abandon the project or to advance to a deeper feasibility study.

Project appraisal activities may be outsourced, depending on the capacity of the covered entity. These institutions must provide for project planning and studies within their current budget baselines, including funding for outsourced project appraisals.

After all the modules of the PFS have been completed, the project must be examined through a **Feasibility Study (FS)**. This is the final part of the appraisal of a project to improve the accuracy of the measures of key variables if the project shows potential for success. To improve the accuracy of the appraisal, more primary research will have to be undertaken and perhaps a second opinion sought on other variables. Since the estimates of costs and benefits may be subject to substantial margins of error, an analysis should always be made about the sensitivity of the project's outcome to variations in the values of key variables.

Having identified and thoroughly evaluated the alternatives that may provide a solution to the identified need, it is important to quantify the cost of the shortlisted alternatives

that are more likely to provide a complete or partial solution to the problem. Based on the result of the analysis, the alternative with the most economic viability potential should be selected as the preferred alternative for funding.

At this point, the cost estimates should be known with a high level of accuracy and the sources and nature of financing identified. Conditional approval of the project must be given before the detailed design work is completed. The detailed design of the project will involve substantial financial outlays. A **preliminary design criterion** must be established when the project is identified and appraised, but usually, expenditure on detailed technical specifications is not warranted at that time.

At the end of this stage, the most important decision must be made – whether to approve the project or not. The **final approval of the project** should come after the FS has been completed. It is much more challenging to stop a bad project after the detailed and often expensive design work has been carried out at the next stage of project design. Once resources have been committed to preparing the detailed technical and financial design of a project, it takes courage for public servants and politicians to admit that it was a bad idea.

The decision at the pre-investment phase may be to provide funding, either through the traditional fiscal budget, Public-Private Partnership (PPP) or International Cooperation (Grants and/or Loans), and to proceed to the execution of the project. The drafting and negotiation of the legal documents are essential to ensure that the borrower and the bankers agree not only on the terms of financing but also on the broad objectives of the project, the detailed schedule and the specific activities necessary for implementation. Also, the formal approval will require the acceptance of funding proposals and agreement on contract documents, including tenders and other contracts requiring the commitment of resources.

The following results are expected at the end of the pre-investment phase:

i) preparation of detailed plans required to support the project;
ii) indication of possible technical packages to be considered;
iii) realistic assessment of costs, schedule, and operational requirements;
iv) identification of areas where high risk and uncertainty exist and further exploration of those areas;
v) identification of human and other resources required for the project;
vi) determination of necessary support systems; and
vii) identification and initial preparation of documents required to support the project, such as procedures, job descriptions, budget, and funding terms.

It is important to mention that not all projects must go through all stages of the pre-investment phase; it will depend on the degree of certainty that is reached in each of these stages. Therefore, in certain cases [i.e. mid-size (second-tier) investment projects] it is possible to skip the pre-feasibility study and proceed directly to the feasibility study. In the case of big projects (requiring detailed engineering studies), it is necessary to go through all the phases and stages of the project lifecycle.

The efficient implementation or execution of a project is critical to ensure that investment flows become productive assets for the country. The final investment decision concludes the pre-investment phase.

3.3 Investment Phase

The next stage of the project's development cycle is project execution, starting with the investment phase which is the responsibility of the project implementing agency. The purpose of project execution is to deliver the project's expected results (deliverables and other direct outputs). Typically, this is the phase where most of the budgetary resources are applied. The execution involves the implementation of all the construction works.

Once the project has been approved for implementation, the design task should be completed in more detail. **Project final design** involves:

- detailing the basic programs;
- allocating tasks;
- determining resources and setting down the functions to be carried out along with their priorities in operational form;
- preparing detailed architectural design;
- selecting engineering and/or specialities deemed appropriate; and
- completing project execution plan.

Technical requirements, such as manpower needs by skill class, should be finalised at this stage. Upon completion of the blueprints and specifications for the construction of facilities and equipment, operating plans, schedules, and contingency plans must be prepared and brought together before the implementation phase.

Project implementation involves planning, procurement, fabrication, civil work construction, installation, and contract terms and conditions. During project execution, the construction team utilises all the schedules, procedures, and templates that were prepared and anticipated during earlier phases. Unanticipated events will inevitably occur, and the project manager will have to deal with them as they arise.

In addition, there is also another monitoring and control process in place that has to do with budget execution. The Ministry of Finance (MoF) ensures that cash releases during the budget year are consistent with the efficient implementation of the capital expenditure budget. MoF also monitors the disbursement of project-allocated funds and provides incentives and penalties to avoid finishing the fiscal year with unused resources. At the end of this phase, it is necessary to apply performance tests, hand inbuilt drawings, proceed to close, decommissioning and disposal, etc.

3.4 Operation and Ex-post Evaluation Phase

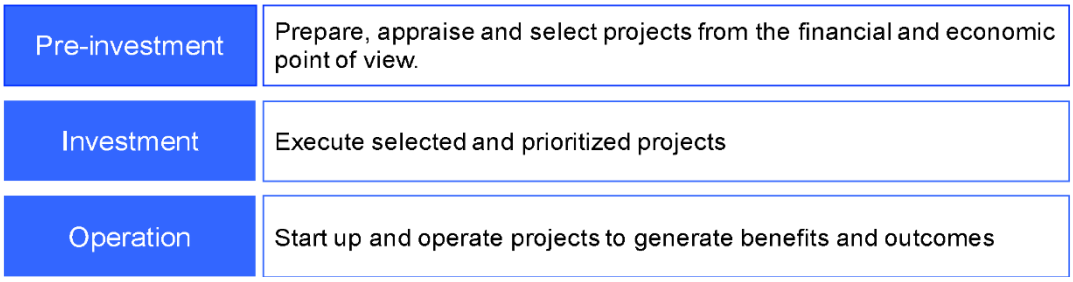
The final phase is when the project is fully operational. Here, the project evolves into its operation stage when it can produce its final fully operational deliverables. The management processes in this stage are now shifted towards the effective and efficient delivery of the project products and outputs from the new services, plant, or mine. A permanent organisational structure is put in place, and a new team must earn revenues and/or produce financial and economic benefits. For this, operational expenses (such as production, maintenance costs, etc.) will also be incurred. This phase is the responsibility of the project implementing agency.

Once a project has been implemented (i.e. its construction phase is finished), the results are revised, and cost deviations are analysed, assuming that the benefits are achieved (the focus is on project management indicators like schedule, time of construction, overall construction costs, quality and technical specifications). Changes in the

expected financial and economic criteria are explained according to higher investment costs, timing, size, etc. This process is known as a **Short-term Ex Post Evaluation,** and it is focused on project costs and schedules, as well as checking the assumptions made during the pre-investment stage.

However, after a reasonable period of project operation, it is important to verify whether the intervention has solved the problem. This process, known as **Mid-Term Ex-Post Evaluation,** involves assessing a project's actual operational results and comparing them to the planned forecasts. The focus is on establishing learning lessons for the design and implementation of similar projects in the future. The objective of Ex-Post Evaluation is to determine the efficiency and efficacy of the investment initiatives through a feedback structure with management controls and measurements of short/medium/long-term results of projects. Figure 3 summarises the main steps in the project life cycle.

Figure 3: Pre-investment, Investment and Operation Phases



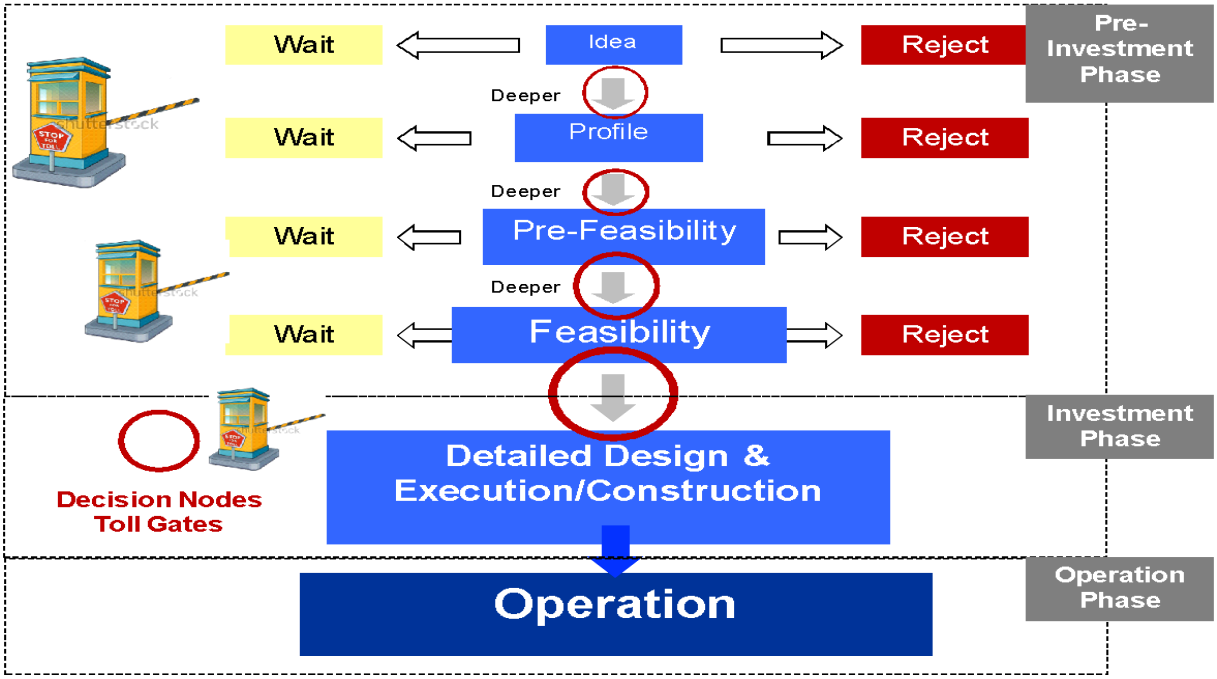
Source: *International Best Practices.*

3.5 Project Life Cycle and the Integrated Bank of Projects (IBP) System

The **IBP System** is designed to ensure investment projects go through the Project Life Cycle, from identifying a project idea/concept to the final operation and ex-post evaluation stage. In this context, the project cycle can be seen as an assembly-line production process, but there are interactions and feedback between project designers and project evaluators. There is considerable interaction between the implementation phase and the evaluation phase as the lessons of ex-post evaluation are constantly used to modify the project's operations suitably.

Figure 4 shows the interaction between project phases, stressing that the deeper a project is allowed to go down the project cycle, the more difficult it becomes to stop, even if it is a bad project.

Figure 4: Interaction between Pre-investment, Investment and Operation phases



Source: *International Best Practices.*

The tollgates in the diagram become smaller on purpose. The more a project advances in the cycle, the less capacity there is to stop it. It is important to impose these tollgates as effective decision nodes. This means there must be a decision to reject the project at that stage, invest more money to eliminate uncertainty, or postpone/wait.

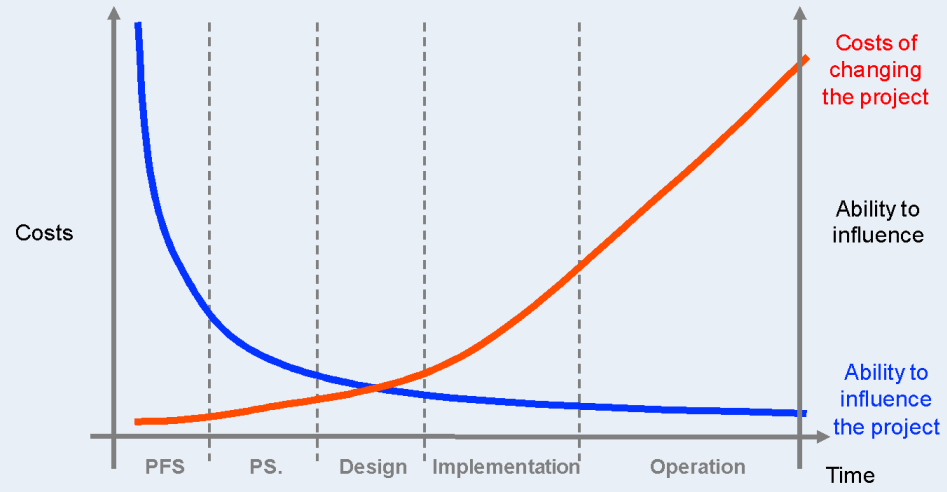
The Front-End Loading

The Front-End Loading (FEL) concept is widely applied in investment projects worldwide and is also used in engineering design. FEL states that the early stages (or front end) in a project cycle are the ones where the potential to add value to the project design is at its maximum, whereas the corresponding cost is at its minimum (Figure 5).

From the diagram, the early stages in a project life cycle are the ones where the potential to add value to the project is at its maximum, and the related cost is at its minimum. This is because in the first phases of an industrial project, the capacity to influence its design is maximum, and the costs to make any changes are minimal. In the context of a PIM System, the FEL introduces decision nodes as milestones within the project cycle; a formal decision must be made before the project can move on to the next phase.

Therefore, it is very efficient to intervene in the project design as early as possible before project execution and operation.

Figure 5: Illustration of the effect of Front-end-loading



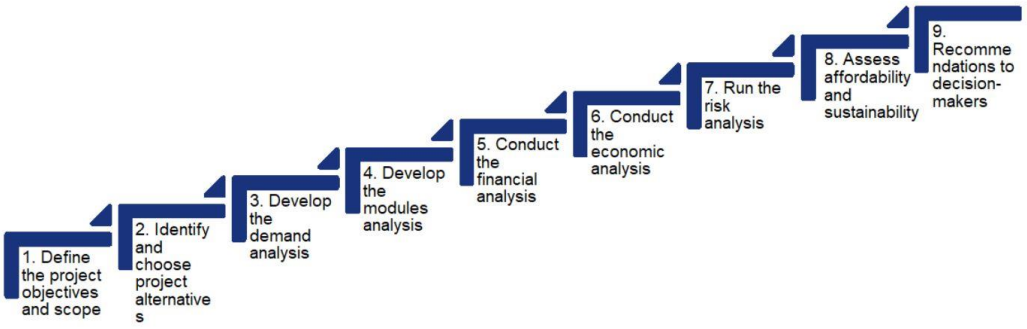
Source: *International Best Practices.*

4.0 THE PROJECT APPRAISAL: A STEP-BY-STEP METHODOLOGY

This manual was prepared based on the experience of several countries that use economic analysis as a decision-making instrument for public investment. The document first describes the steps to run an economic analysis. Subsequently, each step is described in more detail, describing important features that must be considered when performing a project appraisal from the economic point of view.

Generally, an economic analysis can be performed using the following steps (see Figure 6). These steps cover the sequenced analytical work leading to an informed decision on a capital investment project's financial and economic worth and its long-run sustainability. Balanced and consistent decision-making depends on their systematic application in the project appraisal process. The main technical outputs underpinning the appraisal process are the PFS and FS, and although the detailed content and any supporting studies may be project or sector-specific, the overall analytical framework should reflect the outlined steps. The following sections further explain each of these steps in more detail.

Figure 6: Steps in the economic appraisal of projects



Source: *International Best Practices.*

The project appraisal process can be divided into 9 steps as follows:

Step 1: Define the project objectives and scope

Step 2: Identify and choose project alternatives

Step 3: Develop the demand analysis

Step 4: Develop the module analysis

Step 5: Conduct the financial analysis

Step 6: Conduct the economic analysis

Step 7: Run the risk analysis

Step 8: Assess the affordability and sustainability

Step 9: Make recommendations to decision-makers

While the aim of defining these steps is to ensure a systematic and sequential process, some iteration between certain steps may be required. For example, some weaknesses uncovered at different steps could lead to a review of project alternatives with a view to reducing costs or increasing benefits. Some flexibility is therefore required in applying the steps.

4.1 The Project Appraisal Method

The Cost-Benefit Analysis (CBA) is the default tool at the heart of the project appraisal methodology set out in this manual. CBA consists of quantifying as far as possible all the costs and benefits of a project in monetary terms and, by discounting, determining the net benefits (or costs) in terms of a present value. Net benefits/costs so expressed can be used to choose between a given Project Proposal and alternatives, including the "without project" alternative or even the "do-nothing" alternative.

While every reasonable effort should be made to apply CBA, depending on the nature of project benefits and costs, it may have to be supplemented or replaced by other tools. If it is not feasible or too expensive to value project benefits, then Cost-Effectiveness Analysis (CEA), possibly supplemented by a Multi-Criteria Analysis (MCA) scoring system, should be used.

Although economic CBA is performed using monetary values, it is not the same as a financial CBA. Even when financial and economic appraisal share the basic method (the comparison between benefits and costs), they use different relative prices and different flows and discount rates. While financial analysis focuses on the financial attractiveness of the project from the private investor's point of view, economic analysis measures the project´s impact on the entire society. The economic analysis helps to determine whether the project increases the society´s net wealth as a whole or not. Table 1 summarises the differences.

Table 1: Major differences between financial and economic CBA

Perspective	**Agency/organisation/firm (Financial CBA)**	**Economy/society (Economic CBA)**
Objective	Analysis of the net financial impact of the proposal on the agency	Maximising the social returns to the economy's resources
Pricing	Market prices	Opportunity costs/shadow prices
Transfer payments (taxes & subsidies)	Included	Excluded
Equity/distributional effects	Excluded	Can be included, usually treated qualitatively
Externalities	Excluded	Included
Depreciation	Excluded	Excluded

Source: *International Best Practices.*

Differences between financial and economic analysis

The following example illustrates the differences between financial and economic analysis. The project sells certain goods and receives Government subsidies. In addition, the project pays taxes and produces negative environmental externalities. The table represents the CBA from different points of view: the project´s owner, the Government and the entire Society.

Analysis ➔	Financial				Economic	
Viewpoints ➔	Owner's (B)		Government Budget (D)		Country (C)	
Year	0	1	0	1	0	1
Receipts		400				400
Operating cost		-140				-140
Equipment	-1,000	950			-1,000	950
Operating Subsidy		50		-50		
Taxes		-100		100		
Environmental Externality						-190
Opportunity cost of land	-30	-30			-30	-30
Net Resource Flow	**-1030**	**1,130**	**0**	**50**	**-1,130**	**990**

Source: *Jenkins G, Harberger A, Kuo Ch. (2013).*

As can be seen from the example, assuming all the values are expressed in real and current terms, the project is recommendable from the financial point of view but not from the economic point of view. In addition, the net effect for the Government is a positive increase in net tax revenues.

Where the project has potential for PPP structuring, an integrated appraisal approach must be adopted in line with good practice. This means there is no parallel track for PPP projects, and they must follow the appraisal methodology, just like any other financially significant project. As with any public investment project, a potential PPP project's financial and economic worth must be demonstrated using economic CBA and/or other appropriate tools, as explained in this document. The value-for-money analysis to justify (or not) the PPP procurement can commence only after the project has been appraised and its strategic importance, feasibility and sustainability have been confirmed.

Step 1: Define the project objectives and scope

P**roblem identification** is the first phase of the project life cycle. It is concerned with determining a project's basic desirability and identifying the high-priority projects that fall within the public sector's responsibility.

> *Covered entities have a responsibility to clearly identify the problem that gives rise to the idea of a given project. Problem identification should conclude with a literal definition of the problem under scrutiny. The*

identification process implies identifying gaps in the economy and defining investment priorities for the public sector.

The gaps could lie in one or more sectors, such as basic infrastructure, food and agriculture, heavy or basic industry, or social sectors, such as health and education. For example, bad service coverage, bad service delivery, lack of assets, and lost opportunities for improvement are among other factors. The definition and evaluation of a range of alternatives that may provide solutions to the problem must follow, ending with the selection of the alternative that maximises social welfare.

A project may be identified from a variety of sources:

- Ministries, Departments and Agencies, Metropolitan, Municipal and District Assemblies, and State-Owned Enterprises (covered entities).
- The National and Sector Development Plans and local government authority plans.
- Regional integration policy
- Political Manifestos
- The people's representatives.
- Demand from interest groups or beneficiaries.
- Private sponsors and enterprises.
- Dialogue between the country on the one hand and bilateral donors and international agencies on the other.

The problem to be addressed and the rationale behind the proposed project will already have been presented in the project proposal. This review of the project proposal will involve:

- Verifying the description of the specific problem the project intends to address and ensuring that it is accurate and relevant enough to warrant an intervention.
- Confirming the broad explanation (cause and effect logic) of how the project is expected to alleviate the identified problem or respond to the opportunity and further deepening this explanation where necessary.

The project's strategic relevance is a central component of the proposal and a core criterion for the pre-selection decision. It will be important to verify the project's continued strategic relevance to account for any changes in policy direction that may have occurred at Government, Ministerial, or other relevant governance levels.

In any case, it is necessary to focus on the root problem, establishing the causes that originate it and the effects that it produces.

- **The sources of information that shed light on the problem should be identified;** through examples, through reviewing existing studies, questionnaires and/or interviews with the relevant authorities or stakeholders, consulting experts, etc.
- **Problem identification should conclude with a literal definition of the problem**. Along with this, it is necessary to identify the variables contained in this definition, specifying what each means and what the related dimensions and magnitudes are. This will allow the problem to be understood consistently by all stakeholders.
- **The analysis of causes and effects should be focused on a single problem**; this allows the analysis to be refined and to be more effective in shedding light on solutions.

- **Do not confuse the problem with the "lack of solution".** Framing a problem in terms such as "a new hospital building is lacking" is not the same as stating that "there is a group in the population with high rates of morbidity, and it is not being served" (there is a problem). To reduce the problem as "the absence of a given solution" seriously limits the analysis of alternative solutions to the problem, which may lead to the implementation of actions that do not necessarily solve the root problem.

To facilitate the problem identification, the use of the **Logical Framework Approach (LFA)** is proposed, including the Problem Trees (Causes and Effects Trees) and Solution Trees (Means and Objectives Tree). The LFA is based on a systematic analysis of the problem, and particularly key is the analysis of the options for addressing those problems. It can be applied in a range of circumstances and to a range of types of activities. The LFA is an analytical, presentational and management tool which can help planners and managers to:

- Analyse the existing situation during activity preparation;
- Establish a logical hierarchy of means by which objectives will be reached;
- Identify the potential risks to achieving the objectives and to sustainable outcomes;
- Establish how outputs and outcomes might best be monitored and evaluated;
- Present a summary of the activity in a standard format, the Logical Framework Matrix (LFM); and
- Monitor and review activities during implementation.

The methodology to perform the LFA can be found in Annex 1.

Diagnosis

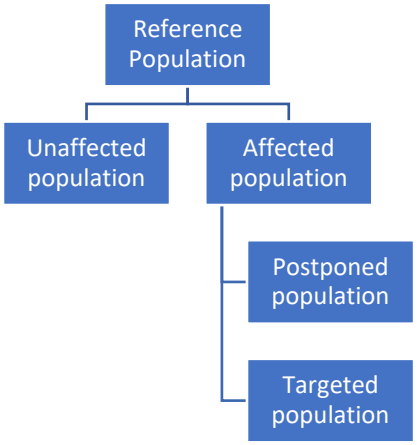
The objective of the current situation diagnosis is to analyse the main variables that identify, describe, explain, and size the main problem detected and to consider the processes that generated the situation and possible future trends. The diagnosis also serves to corroborate the existence of the problem identified previously. Within the relevant background set of diagnosis is essential in analysing the following areas.

The **Influence Area** corresponds to that area where the problem directly affects the population and where the alternative solutions should be considered. Typically, the influence area is a subset of the study area, but there are also situations for which the study area and area of influence are equivalent. When defining it, it is recommended that the following variables be considered:

- The geographical location of the population is directly and indirectly affected by the problem;
- Administrative characteristics;
- Physical aspects: geographic location, climate (temperature, precipitation, humidity), geomorphology and topography;
- Main economic activities taking place in the areas;
- Analysis of socio-economic characterisation; number and structure of the population (quantification and classification of the population according to age and gender characteristics); and
- Institutional sector and local government (e.g., municipality location, neighbourhood, police stations, etc.).

Inside the area of analysis, the recognition and description of the **affected and target population** are critical to understanding the current situation and finding solutions to the problem. Figure 7 shows the different segments that can be recognised in the analysis.

Figure 7: Segmentation of the Population



Source: *International Best Practices.*

The definition and sources of information for each group are as follows:

- **Reference Population** refers to the relevant population inside the area of influence, which might or might not be affected by the problem. Information from the last census, municipal database, or other statistics can be used to identify it.
- **Unaffected Population** refers to the current population that will not be affected by the problem.
- **Affected Population** refers to the population that will be affected by the problem and requires goods or services resulting from the project's implementation. It can be determined from surveys, related studies, field data collection, and other sources.
- **Target Population** refers to the population directly benefiting from the project.
- **Postponed Population** refers to the part of the affected population whose problem will not be resolved with the selected project, at least in the assessment period.

For purposes of identification, it is recommended that efforts be concentrated on the identification of the affected population.

Scope of the project

The scope described in the project proposal must be reviewed and given more detail. This involves setting out all the project outputs, i.e. what will be delivered by the project upon completion, and the main activities required to accomplish these outputs. The intention should be to demonstrate that all the necessary activities have been captured and that the planned outputs are sufficient to achieve the purpose of the project, i.e. sustainable benefits for the target group.

For analytical purposes, the project boundary should extend to all activities and outputs necessary to deliver the intended benefits, even if these are the responsibility of another covered entity. Access roads, utility connections, or staff training provided by another covered entity would be examples of project components that should be included, even if the costs do not fall upon the covered entity promoting or sponsoring the project.

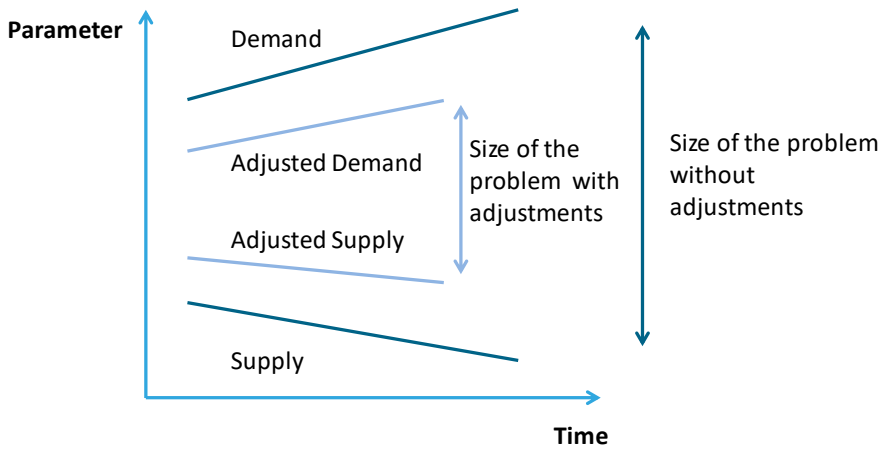
Ultimately, the definition of the project scope should be sufficient to determine whether the project represents a sufficiently comprehensive solution to the identified issue/problem.

Baseline alternative

Once the problem has been identified and before proceeding to the identification of solution alternatives, it is important to acknowledge the extent to which the prevailing problem (or business opportunity) is due to administrative inefficiencies, carelessness in infrastructure maintenance or the lack of law enforcement. For instance, when it is identified that current long waiting times on public transport services are caused by poor scheduling of departures rather than the lack of vehicles or that high incidence of crashes is caused by the lack of signalling rather than the design of the road, the current situation must be "adjusted", to incorporate these minor corrections to avoid granting illegitimate benefits to any project.

Incorporating these corrections is commonly known as the "do minimum" option, which will modify either the demand and/or the supply and produce a new interaction equilibrium known as the baseline or reference point, based on which the project's benefits and costs will be calculated. If these "small" inefficiencies are not removed, there is a risk of assigning more benefits (or even costs) to the project, which could lead to an incorrect decision. This is mainly because if no adjustments are considered, then the size of the problem would be more significant. Figure 8 depicts graphically the expected effect of the "do minimum" option in terms of the size of the problem.

Figure 8: Supply and demand with and without adjustments



Source: *International Best Practices.*

The key element that must be analysed is the impact of the "adjustments" over the supply and the demand to reassess its interaction and to re-evaluate how the problem looks forecasted. Thus, it will be necessary to recalculate the following:

- Re-evaluate the difference between the demand and the maximum capacity of the baseline's system when the problem is defined as a deficit.
- Re-evaluate costs in the baseline situation if the problem is high, for both with and without congestion in the baseline.
- Re-evaluate the socio-economic surplus in the baseline when the problem is defined as an opportunity to take on for the government.
- Re-evaluate costs and the potential deficit in the baseline if the problem is a combination of the three above.

Another important step in the adjustment of the current situation is to define the baseline scenario, which forecasts how this situation will evolve over time. There are several methods that analysts can use to forecast the demand and supply of the "without-project" situation, from a simple historical growth rate to probabilistic distribution models. However, the use of one method or another will depend on the complexity of the situation to be described and the availability of information. Commonly, in cases with limited information, average growth rates or population growth rates are suitable parameters to perform the forecast needed, because sectors such as transport, consumption of public services (water, waste collection, electricity, public health, etc.) respond to similar paths of growth than those that compound macroeconomic variables.

When there are no adjustments, the baseline is assumed to be equal to the current situation, potentially adjusted.

Step 2: Identify and choose project alternatives

The project appraisal involves comparing the life-cycle costs and benefits of the reference project and feasible project alternatives. Covered entities should refine the alternatives, including technical variants of the reference project, that have been shortlisted in the pre-selection stage and consider introducing any realistic new alternatives that may have been overlooked at Pre-Selection. This step should maintain flexibility in terms of introducing alternative comparators against which to test the preferred project.

Many important choices are made at an early stage when alternatives are rejected or retained for more detailed analysis. The need to compare mutually exclusive options is one of the main reasons for applying economic analysis from the early stages of the project cycle.

The problem a project is designed to solve may have many alternative solutions, some of which may be optimal from a technical point of view but not necessarily optimal economically. Furthermore, different alternatives may involve differences in important aspects such as the scope of the components, types of outputs and services, production technology, location, start date, and the sequencing of the component's implementation.

When the alternatives are identified, it is important to remember that projects normally originate as a public interest in the form of problems to solve, needs to satisfy and opportunities to take on. For project evaluation and appraisal purposes, the alternative solutions are the different courses of action that could be undertaken to solve or mitigate a particular problem. It is paramount to include every alternative that solves the identified problem. By defining alternative interventions, a "Business-As-Usual (BAU)" or "without-project" alternative must always be defined, against which the

reference project and the short-listed alternatives will be compared. The BAU alternative should generally be equated to doing nothing (the "do-nothing" alternative) unless this is extremely unrealistic, in which case a "do-minimum" alternative may be defined.

Project alternatives may include measures other than expenditure on new public sector capital assets and direct public provision of services, such as improved regulatory control or subsidies to private sector service providers. Some examples of alternatives that may be considered are:

- Using different technological approaches or different technologies;
- Varying the timing, phasing and scale of capital investment;
- Renting, building or purchasing facilities;
- Refurbishing existing public facilities instead of building new ones;
- Changing the balance between capital and recurrent expenditure, such as by choosing between more or less capital-intensive service provision;
- Sharing facilities with other agencies;
- Changing locations or sites; and
- Improved implementation of existing measures or initiatives instead of investing.

The LFA can also be used to define the project alternatives. Once formulated, the alternatives ought to be compared. For example, when dealing with solving the problem of congestion on an existing highway, the alternative solutions are:

1. expansion of the current lanes of the highway,
2. creation of a new highway with a different stroke line, or
3. identification of bottlenecks and building of a tunnel or bridge that decongests the relevant crossings.

The comparison of alternatives gets even more complex, considering that for each of the alternative solutions, other options must be considered. For instance, the geographic location of the project, its size, the optimal timing for implementing the project, and which technology would be used could be options to be considered. Thus, the first step in comparing alternatives is to identify a list of alternatives by studying the current situation.

For identifying alternatives, these three additional fundamental questions must be asked:

1. What market failure leads the private sector to produce more or less than the socially optimal quantity of this good or service?
2. What sort of government intervention is appropriate to ensure that the optimal quantity is produced?
3. Is the recommended government intervention likely to have the desired impact?

Once the alternatives have been listed, they can be preliminarily assessed to eliminate those that are either not feasible or clearly dominated by others. For instance, legal, technical, environmental, economic, financial, strategic/political, commercial, and social viability aspects may be assessed based on MCA. The objective of applying this simple methodology would be to narrow down the list of alternatives, considering each alternative's restrictions for its execution.

Once alternatives have been short-listed, they must be fully evaluated through a detailed analysis of their costs and benefits. At this stage it is important that the description and design of each alternative include at least the following elements:

- Set of investment components and their relative size;
- Geographic location;
- Technology;
- Execution duration and program of activities;
- Estimated investment, operation and maintenance costs;
- Sources of financing;
- Useful life;
- Estimated capacity and expected production;
- A summary of legal, technical, environmental, administrative, and social feasibility considerations.

The best comparison method (CBA, CEA and MCA) to use would depend on the type of the alternatives. In most cases, CBA would be the preferred methodology, but in some cases, the benefits would be identical between the two alternatives, or it would be impossible to monetise the project's benefits, and thus, CEA would be the preferred method. A quantitative MCA could also be a good option when many important impacts of the alternatives cannot be directly monetized, and the economic profitability of the project must be balanced with other criteria.

In the case of comparing alternatives by CBA, for each of the shortlisted alternatives, the following steps of the CBA process would be necessary to calculate the CBA indicators of each alternative and then proceed to their comparison.

Optimisation of the base case for Greenfield and Brownfield projects

A **greenfield project** is an investment where the construction and operation of the new production facilities start from scratch, including all the necessary offices, living quarters and distribution hubs. On the contrary, a **brownfield project** is an investment where the structure would need to be demolished or renovated. Brownfield projects are built over brownfield land or brownfield sites. A brownfield land or brownfield site means land, buildings, or infrastructure that is operational or no longer in use. It is called a brownfield project when a parent company invests in such land or infrastructure for their project. The term brownfield project is used in many industries, including software development, to mean to start a project based on prior work or to rebuild (engineer) a product from an existing one.

One important concept when defining a brownfield project is to ensure that the project's benefits and costs are measured incrementally. One alternative solution for all types of problems to be considered in project evaluation is what is known as the "optimisation of the base-case situation." The analyst must take this into account when comparing the alternatives.

In addition, one of the alternative solutions for all types of problems to be considered in project evaluation is the "optimisation of the base-case situation" to define the "without-project" scenario. The "without-project" scenario is a projection of how the relevant items would naturally evolve if the project did not go ahead, but with the correct actions being taken on matters such as the maintenance of the existing facilities. A simple before-and-after comparison is not appropriate because circumstances can be expected to change, even if the project is not executed.

> *The optimisation of the base case (the without-project scenario) should always be considered as an alternative solution. Optimisation investments apply to all low-cost measures that can improve the current situation, partially or completely eliminating the problem. In this case, it allows for improvements without needing a full-fledged project, which involves many*

financial resources. Different actions can be performed to optimise the base situation, including:

1. *Low-cost investments*
2. *Management measures*
3. *Redeployment of staff*
4. *Recruitment of additional staff*
5. *Increased service hours*
6. *Changes in the use of infrastructure*
7. *Redistribution of equipment*
8. *Minor repairs to infrastructure*
9. *Repair of equipment*
10. *Education programs for users*
11. *Training of personnel*

Analysis of the optimised base case prevents the overestimation of benefits and oversizing of a project. Through such an analysis, it is possible to discover a decrease in the estimated deficit, and therefore, the size and cost of the project may be less than originally thought.

If, after the evaluation of the optimised base-case situation, the conclusion is that there is no solution to the given problem, it will be necessary to evaluate other alternative solutions, considering the "without-project" scenario as a base-case situation. From this starting point, the analyst should measure the incremental benefits and costs of each alternative and then choose the most profitable option. It should be noted that the evaluation of projects is always a comparison between different alternatives.

Step 3: Develop the demand analysis

This step examines whether there is a demand for a project's goods/services both in the domestic market and abroad. Demand corresponds to how much of a good or service a population needs. The demand must be measured in appropriate quantities, e.g., the number of medical visits per year, the litres of drinking water per day, etc.

Demand analysis

Demand is the amount of goods and services required to satisfy the needs of the target population. From an economic point of view, it is represented by the consumer´s willingness to pay for a specific good or service. For example, demand can refer to the amount of water consumed by households, the number of vehicles travelling on a highway, or the number of health services consumed by a population.

The project proposal identifies the target beneficiaries and gives indicative estimates of the demand for the project services. When describing demand, it is important to explain the features that limit the amount consumed and its historical behaviour. Moreover, to fully characterise demand, the analyst must obtain the following information:

1. **Target population**: This is established by delimiting the project's geographic area. Once this area is known, the reference population and the affected population will be derived, and the target population can be determined. The concept refers to the people who are going to be direct consumers of the good or service and the people who will be beneficiaries of the infrastructure.
2. **Current consumption**: This is the amount of goods or services that the target population is currently consuming per unit of time. It could be disaggregated by segments of the population, allowing the analyst to understand the magnitude of the demand and subsequently compare it with the supply.

3. **Consumption conditions**: This describes the different ways in which an individual consumes a good or service. It must include the amounts consumed on each consumption channel and the prices for each one.
4. **Prices and consumption levels**: This describes the quantity of goods and services that consumers are willing to consume, given the price they must pay for them. This is also known as the price curve.

In the demand and marketing analysis, a distinction must first be made between the output of the project to be used to meet local demand and the output to be sold internationally. For products that are sold on the international market, significant information is available on market trends, new technologies, and the approximate cost of production of potential competitors.

The key question is: *What are the proposed facility's advantages and disadvantages relative to other competitors, both domestically and internationally?*

For some products, research on costs relative to those of other producers may suffice; for others, research on likely price trends may be needed; and in some cases, research into the likely demand for the output of the specific project under study may also be required. The function of this module is not only to assess the current demand but also to undertake the more difficult task of forecasting future demand.

Rigorous demand analysis is at the heart of good project appraisal and is essential for:

- Designing appropriately sized capital assets with the necessary capacity for current and future users;
- Making reliable cost estimates;
- Estimating the benefits of the project accurately; and
- Arriving at a robust conclusion on the economic viability of the project.

As part of the project appraisal, covered entities must develop a quantified forecast of the expected demand for the defined services of the project, including the expected growth in this demand over the lifetime of the project. Depending on the nature of the project, these forecasts may cover things such as school enrollment, hospital caseloads, road traffic, water consumption and solid waste generation. Demand is influenced by various factors, which, depending on their relevance, may need to be taken into account when making forecasts. These include:

- Background economic growth;
- Income changes among potential target users;
- Demographic change (natural growth or decline in the population and of different cohorts within it, migration into or out of the project area);
- New industrial, business or agricultural developments coming on stream in the project area;
- The cost of the services provided (even if free, there may be costs involved in accessing services); and
- Long-term technological change and changes in public preferences.

The most widely used method for estimating demand is through individual consumption, i.e. per capita or household. To determine individual consumption (or per capita), available historical records of the consumption of a population with similar characteristics or specific information sources can be used. The rates used to estimate the demand growth during the project life must be justified by specific studies, noting all the cases under consideration.

The total demand for each period is estimated by multiplying the individual consumption (per capita) by the affected population, as follows:

Total Demand = Individual consumption × Affected population

The level of detail in demand forecasts may vary depending on the scale of the project and the extent to which it is innovative. For major or highly innovative projects, demand analysis is expected to be very detailed, involving the collection of primary data through surveys and the use of econometric analysis and, where applicable, modelling techniques. For straightforward and lower-value projects, the approach can be simpler, based on intelligent trend analysis. Simply extrapolating current trends without question is not acceptable. Trends must be examined critically to ensure that there will be no significant shifts in the underlying factors over the life of the project. Whatever approach is used for projecting demand, it is important to present historical evidence of previous trends, where this exists, to put the forecast in context.

Supply Analysis

The supply is the actual production capacity or the amount of goods and services currently available in the market. The supply is represented by how much goods or services producers are willing to put forward for sale to a set of consumers. The supply analysis must consider the amount and quality of the good or service being supplied, the innate characteristics of the production process (including the necessary inputs), and the legal and environmental aspects of the production process. The following characteristics of supply must be thoroughly assessed:

- **Geographic location**: This delimits the physical area where the goods or services will be provided. This information will allow the analyst to know the scope of the project and identify the potential beneficiaries.
- **Physical characteristics of the existing infrastructure**: This exhaustively summarises the dimensions, the present conditions of the good or service, and the current useful life.
- **Operational capacity of the existing infrastructure**: This defines the maximum capacity of a good or service under current conditions.
- **Production costs for the provision of the good or service:** This determines the current supply curve which gives the amount of goods or services the producer is willing to supply at different price levels.
- **Operational and administrative processes**: This gives feedback on how the good or service is currently provided, to identify areas of opportunity.
- **Compliance**: The product or service being produced by the project must be compliant with quality standards.

It is necessary to consider the expected evolution of the provision of goods or services by existing providers and the entry of new suppliers. Along with this, the medium and long term must be analysed, in which there might be an increase or decrease in the supply of goods or services.

Current and Projected Deficit

Based on the interaction between the supply and the demand, the analyst will usually identify the existence of one (or more) of the following problems:

- The interaction may show that the market has a deficit equilibrium. In this case, the installed capacity is not enough to meet the needs of the target population.

For instance, deficits can lead to economic inefficiencies like longer waiting times, longer travelling times, or higher morbidity. It is common to find a deficit equilibrium when assessing social infrastructure (i.e. hospitals, water provision services, educational infrastructure, etc.).

- In some cases, the problem to be fixed could be a business opportunity that could translate into lower prices for consumers, thus enabling higher consumption. This is the case where a resource could be potentially demanded by consumers but is not possible due to the present conditions of supply. It is important to highlight that, business opportunities normally come from productive projects (e.g. tourism projects, irrigation projects, etc.).

The interaction between supply and demand shows a problem. The current and projected deficit is estimated based on the comparison of the current and projected demand and supply in the area of influence. The deficit calculation allows the determination of the magnitude of the current and projected gap. This can be expressed in qualitative terms (i.e. deficiencies in quality, regulatory compliance) or quantitative terms. However, current and projected demand and supply **must** be expressed in the same unit of measurement and time horizon.

Due to differences in the underlying drivers of demand, more accurate forecasts will be obtained by projecting demand for different groups of users separately (and then combining them), rather than developing aggregate forecasts. Over-optimistic forecasts of demand are a worldwide cause of poor public investment decisions. This systematic phenomenon, referred to as **optimism bias**, should be guarded against wherever possible. It is, therefore, advisable to subject demand forecasts to independent external scrutiny, especially for major projects.

Step 4: Develop the modules analysis[2]

Technical Analysis

This step is concerned with the input parameters of the project, the quantities, and prices of inputs by type required for the construction of the project, the inputs required for the operation of the project by year, and the appropriateness of the technology adopted. It is also concerned with issues such as the size of the project, its design, location, and the technology to be adopted, including the equipment to be used and the processes to be employed. Assessment of the environmental impact caused by inputs, outputs or technology should be a central component of this module.

For investment and implementation, it is essential to identify the inputs required by each of the alternatives under study (machinery, equipment, materials, and labour), their quantity, cost, and ease of access either at the domestic or international markets, as well as technological advances and the possibility of their incorporation into the project.

Incorporating the analysis of the various technological alternatives also allows decisions about the optimal size and time to carry out the project. The information obtained in this module also allows for the estimation of the entire costs of construction and operation during the project's lifecycle.

Legal and Regulatory Analysis

This step deals with the adequacy of the local institution responsible for managing the different stages or phases of the project. Experience shows that insufficient attention to

[2] Based on Jenkins G, Harberger A, Kuo Ch. (2013).

the institutional aspects creates serious problems during the implementation and operation phases of the project.

The analysis must include the entire management that goes into the project, along with its policies and procedures. In a broad sense, the institutional setup also incorporates the whole range of government policies and procedures. The institutional module should address the following issues:

- Which institutions are related to the project? Which institution should lead the project? Does this institution have enough resources to run and monitor the project properly?
- Is the relevant local entity properly organised and equipped to handle the project?
- Are the local capabilities and facilities being properly utilised?
- Would there be a need for change in policy and the institutional set-up outside of these local entities? Would these changes be warranted in the policies of the local or regional governments? Would it be necessary to take legal or regulatory action to carry out the project?
- What are the current regulations? Would changes to existing agreements or commitments or the creation of new ones be necessary?

Human Resource Analysis

This step goes into the manpower requirements both for the construction and operation phases of the project. It reconciles the technical and administrative requirements of the project with the supply constraint on manpower. The project should not be undertaken if those two cannot be reconciled. A careful study of the labour markets should be made to ensure that the estimates of wage rates to be paid are accurate and that the planned source of manpower is reasonable in light of labour market conditions. In general, manpower requirements should be broken down into occupational and skill categories and these needs should be evaluated in terms of the possible sources from which they would be met.

It would be a mistake to confine project appraisal to the analysis of financial and economic costs and benefits under the assumption that the project can be built and ready for operation on time. This assumes a degree of administrative support and project management capacity for the implementation of projects that may not exist in many countries. Many projects have failed because they were undertaken without the administrative and project management expertise necessary to complete them as specified. The prospect of future financial and economic benefits materialising is only as good as the administrative/project management capability of the agency in charge of putting the project in place.

Environmental Resources Analysis

Project appraisal is not limited only to a quantified financial and economic CBA. There may be benefits and costs that cannot be readily valued, which often relate to environmental impacts. Decision-makers are also interested in where the benefits and costs fall in society and whether this is fair. Environmental and social impact assessments may be required alongside economic studies, and these are also considered below.

Some projects may negatively impact the environment and adversely affect a group of people in society. This is an externality generated by the project and should be reflected in the project's social costs. Failure to consider these actions in the ex-ante evaluation

may lead to the selection of an alternative that is not necessarily the most profitable economically.

> *The importance of the environmental analysis lies in environmental sustainability and the rules regarding it, which may prevent or hinder the implementation of the project. Therefore, it is essential to identify how project alternatives behave in relation to environmental conditions and the effects they may generate. In addition, this analysis must be taken into account throughout the project lifecycle, including the choice of size, technology, materiality, and location.*
>
> *Whenever the project impacts the environment, all the costs of pollution control equipment and facilities used for mitigation should be included in the project cost. Whatever residual pollution and environmental impacts remain after the pollution control equipment is in place should be estimated and their economic value assessed. Finally, these values should be included as a cost in the project's cash flow.*

Other Considerations for Modules Analysis

In conclusion, the PFS should utilise secondary research data whenever possible. Most technical and marketing problems have been faced and solved by others. Therefore, a great deal of information can be obtained quickly and cheaply if the existing sources are utilised efficiently. Secondary research is probably most useful in the technical and engineering modules and less valuable in the marketing, manpower, and administrative support modules. Marketing and administrative support modules generally require information that is specific to the project and may require some primary data.

Even when the environmental module, manpower and administrative support module and institutional module are not related to project evaluation, they should be considered in the project design and preparation because they are related to the sustainability and viability of the project in the medium and long term. Furthermore, the conclusions derived from the analysis of these modules should be incorporated into the project evaluation when they affect the benefits and costs of the project. For example, environmental mitigation measures may generate higher investment costs (CAPEX) or attract more and better human resources to ensure the proper functioning of the project, which can generate higher operating costs (OPEX). Finally, all aspects of the project should be subject to compliance with the law, even when it is not related to economic efficiency.

The necessary studies for project preparation reduce uncertainty about investment decisions, thus allocating fiscal resources efficiently. Given the importance of these studies, a series of recommendations and obligations to ensure that the project is formulated correctly is listed below:

- The definition of the problem is essential in determining possible alternative solutions. Framing the problem as a lack of a given solution, good, or service leads invariably to a unique and single solution. It prevents the analysis of more than one alternative to the root problem.
- It is necessary to understand that a problem, in itself, is not a project. A project comprises courses of action that arise from a given problem and provides a rational response to the problem. To facilitate the definition and understanding of a problem, it is recommended to construct a Problem Tree.
- When conducting a diagnosis of the current situation, it is helpful to set a baseline for comparisons and benchmarking. This is essential for the ex-post evaluation of

the project, which aims to verify whether the project has been a real solution to the problem.

- In brownfield projects, the optimization of the base case ("without project" situation) should always be considered as one of the alternative solutions to the problem.
- To properly identify alternative solutions to the problem, it is recommended that the Objectives Tree be constructed, which shows the means and ends. The means (i.e., the roots of the Solution Tree) identify the probable actions that will solve the problem, and the ends (i.e., the top of the Solution Tree) allow a clear idea of the scenario that will be achieved once the selected project enters operation.
- More than one alternative should always be analysed as a solution to the problem.
- For calculating the benefits and costs of each alternative, the "without project" situation or "optimised base case" should be considered the baseline for comparisons, thus avoiding overestimation or underestimation of benefits or costs.
- It is recommended that the analysis of project alternatives be performed at the PFS stage, as this involves looking at each alternative in greater detail and, therefore, increases the probability of choosing the best alternative to solve the problem. A modular analysis for each alternative is recommended.

Step 5: Conduct the financial analysis[3]

When conducting a project appraisal, one should conceptualise two scenarios: one that includes the project (*the "with-project" scenario*) and one that does not include the project (*the "without-project" scenario*). The costs and benefits of the "without-project" scenario should then be subtracted from the costs and benefits of the "with" project scenario to derive the incremental resource flow statement.

Financial analysis assesses a project's impact on the financial costs and funding of the organisation that makes the decision to carry it out. This type of analysis requires the construction of cash flows based on different points of view. For example, if the project does not yield an attractive return to private investors, a related function of financial analysis is to calculate the minimum amount of income to induce these investors to undertake the investment (for example, to define subsidies or transfers from the government to the private sector).

The financial analysis of a project helps to determine the financial sustainability of the project and its overall success. But an important question arises immediately: "Why a financial appraisal for a public sector project?". It may appear that the financial appraisal of a project is only of interest to a private investor who wishes to determine the net financial gain (or loss) resulting from an investment project. From a country's point of view, a project will increase the country's net wealth if it has net positive economic returns. Conversely, a project that yields negative economic returns should not be undertaken as it would lower society's net wealth.

On paper, a project may contribute substantially to the economic welfare of a country (socio-economically profitable), but if the implementing agency lacks the funds to finance it, project implementation will suffer. It will also suffer if the funds that governments are supposed to provide (counterpart funds) are not provided on time or at all. Therefore, in addition to assessing a project's financial viability, it is necessary to look at its fiscal impact. In particular, it is necessary to look at the annual cash flows to ensure that, even during its leanest years, the project will have the requisite funds to ensure its success. Furthermore, it is necessary to look at the project's recurrent costs

[3] Based on Jenkins G, Harberger A, Kuo Ch. (2013).

and factor them into the financing agency's annual budget. It is often the case that brand new hospitals stand empty for lack of funds to pay for doctors, nurses, medicines, and utilities.

> *According to the previous reasoning, a financial appraisal for a government-funded project is needed to ensure the availability of funds to finance the project through its investment and operating stages (financial sustainability). In other words, a project that has high economic returns may very often fail if there are not enough funds to finance the operations (working capital) of the project. Therefore, one of the main objectives of a financial appraisal for a government project is to determine if a project has sufficient liquidity "to pay its bills" throughout its entire life and, if not, how the shortfalls can be met.*
>
> *The second reason for conducting a financial appraisal of public-sector projects is directly related to the understanding of the distributional impacts of the project. For example, the difference between the financial price an individual pays for a litre of water (found in the financial cash flow statement) and the gross economic benefit he derives from consuming that litre of water (found in the economic resource flow statement) reflects a net gain to the consumer. Similarly, the difference between the financial price (inclusive of tax) that a project faces and the economic cost of an input required by the project measures the tax gain to the government. Gains and losses of this nature will be more difficult to establish on the basis of economic analysis only.*
>
> *Thirdly, in certain cases, the government approaches a project like a private sector investor to determine the financial profitability of the project. This is necessary if the privatisation of the project is being considered (also for the PPP financial model). Determining the profitability of a project is essential to estimate the value that a private investor would be willing to pay for it. Ascertaining financial profitability is also necessary when government policies are designed to encourage small investors and certain groups in society to undertake projects by providing them with grants or loans.*

The financial appraisal also helps in determining the level and structure of prices or user fees to be charged to the beneficiaries to ensure the project's financial viability. Sometimes, governments decide to subsidise specific services to consumers as a matter of policy or pure expediency. The recovery of user charges must take into account the income position of the beneficiaries and the practical problems of administering a particular system. The degree of fiscal impact of such government policies on the budget has a strong bearing on the viability and sustainability of the project. In such cases, not only should the level and structure of prices be defined but also, the procedure for making future adjustments in prices and government subsidy should be clearly laid down.

The result of the financial analysis is to build a flow of benefits and costs. To do this, the following steps are proposed:

1. Identify the relevant effects of revenues, expenses, or investments;
2. Measure in specific measurement units;
3. Value them in monetary terms;
4. Create a time schedule, i.e., establish at what point in the future each will happen; and

5. Compare them in order to determine the net expense or income.

The construction and result of the cash flow depends on the type of financing that the project under study develops and whether it is appraised from the financial (private) or economic (social) perspective.

The Investment Plan

The investment plan combines information from the market and technical analyses to establish a detailed plan for annual incremental expected capital expenditures during a project's investment phase[4]. It should also provide estimates of the liquidation or scrap value of all major fixed assets and the value of net working capital at the end of a project's life. In addition, it should disaggregate expenditures on machinery, equipment, and building materials into tradable and non-tradable commodities and indicate the breakdown of workers by skill and likely source of availability.

The investment plan deals with the expenditure on new acquisitions and the opportunity cost of existing assets. If there are different scales and/or locations under consideration, corresponding investment plans for each scale and/or location should be formulated. Once time schedules and deadlines are formulated, expenditures should be broken down by year of expected expenditure. Each expenditure item should be broken down into its components whenever possible and appropriate. Civil works and building construction should be broken down into raw materials and different types of labour. These breakdowns are necessary to conduct the economic analysis of the project and are also important in providing a clear understanding of its cost structure. Investment credits or other forms of subsidies should be explicitly presented.

Table 2 illustrates sections of a project's investment plan. The cash flow statement includes all data in the investment plan regarding expenditures on new acquisitions and the opportunity cost of existing assets, if applicable. Financing data is included in some statements but not others, depending on the point of view, as explained below.

Table 2: List of cost items on the expenditure statement

INVESTMENT EXPENDITURE		
Preliminary Expenditure ● Initial investigations ● Research and technical studies (nature of the ground, raw materials analysis, water availability and quality, working out the manufacturing processes, etc.) ● Economic, Marketing, Profitability,	**Equipment and Materials** ● Machines ● Foundations for machines ● Machine installation costs ● Testing and start-up ● Electricity and telephone ● Equipment ● Vehicles ● Office equipment and supplies	**Incorporated Fixed Assets** ● Patents ● Licenses ● Reproduction rights **Costs of Establishment** ● Costs of forming the company ● Costs of issuing shares ● Setting up a sales network ● Recruitment personnel ● Personnel training (wages and salaries,

[4] *Capital expenditures include land, buildings, machinery, equipment, building materials, and construction and management labour.*

Design, Financial and Legal studies		teaching, travelling expenses)
Working Capital ● Stocks of raw materials and requisites, intermediate products, and finished products ● The average period for payment allowed to customers. ● Cash requirements	**The Site and its preparation** ● Cost of land ● Registration duties and fees ● Drainage ● Access roads	**Construction** ● Foundations ● Buildings ● Water pipes and connection to electricity mains, telephone system and, gas supply ● Reservoirs and tanks ● Waste-water disposal. ● Roads and paths

TECHNICAL OPERATING EXPENDITURE		
Taxes and duties ● Direct duties and taxes: Land tax; Municipal and regional taxes and duties ● Indirect duties and taxes: Value-added tax; Tax on services rendered ● Registration taxes, duties and fees: Registration fees for deeds and contracts; Stamp duties ● Customs duties ● Trade taxes ● Duties levied by international bodies	**Works, supplies, and external services** ● Rents ● Maintenance and repairs ● Works by outside firms on a contract basis ● Water, gas and electricity supplies ● Fees for patents, licenses, brand marks, etc. **Purchases** ● Initial investigations ● Materials ● Fuels ● Maintenance materials ● Office supplies ● Packaging materials	**Miscellaneous management expenses** ● Office supplies ● Telephone ● Legal documents and litigation ● Grants and contributions **Personnel expenses** ● Wages and salaries ● Allowances ● Commissions ● Social security commitments **Transport and travelling** ● Personnel transport ● Travel and removal expenses ● Freight and transport for purchases ● Freight and transport for sales

Source: *Jenkins G, Harberger A, Kuo Ch. (2013).*

Table 3 shows an example of an investment plan for a dam project.

Table 3: Example of investment plan for a dam project (investment expenditure)

	Year 1			Year 2			Year …			Year t		
	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total
a. Water reservoirs/pumping stations												
Civil works												
Equipment and materials												
b. Transmission mains												
Civil works												
Equipment and materials												
c. Secondary/tertiary networks												
Civil works												
Equipment and materials												
d. Service connections												
Civil works												
Equipment and materials												
e. Office buildings												
g. Consulting services												
h. Land cost												
i. In-house Eng. services												
j. Taxes and duties												
Total												
Summary of investments												
Civil works												
Equipment and materials												
Office buildings												
Consulting services												
Land cost												
In-house Eng. Services												
Taxes and duties												
Total												

Source: *Jenkins G, Harberger A, Kuo Ch. (2013).*

The Financing Plan

The Financing Plan deals with the means and schedules of financing the investment expenditures. The sources of finance used, whether budgetary allocations, equity or grants, domestic short-term and long-term loans, foreign loans, suppliers' credit, concessional loans and other forms of foreign aid should be identified, and the disbursement schedules should be formulated. The financing plan should provide details about how any anticipated negative net cash flows will be financed during a project's investment and operating phases. Also, equity investors should be identified, and the anticipated timing of their contributions, specified. In addition, debt holders should be identified, and the anticipated timing of their contributions, specified (interest and amortisation schedules should also be stated). Financing data is included in some statements but not others, depending on the point of view as explained below[5].

Table 4 shows an example of the financing plan.

Table 4: Example of the financing plan (financing sources)

	Year 1	**Year 2**	**Year …**	**Year n**
Loans/ grants				
Equity				

Source: *Jenkins G, Harberger A, Kuo Ch. (2013).*

For most projects that are directly undertaken by the government or involve some government intervention in the form of grants, loans or subsidies, there are several stakeholders that would like to determine the impact of the project on them. Stakeholders are defined broadly to include all those affected by the project. For example, the stakeholders of a project may include the owners, participating banks, any (other) government department providing loans or grants or collecting taxes, competitors, workers, etc. It is therefore necessary to conduct the analyses from the points of view of the different important stakeholders to ensure the project's sustainability and success. Even one influential stakeholder adversely affected by the project may be able to derail the entire project.

Whether or not the data in the financing section of the investment plan is included in the cash flow statement depends on the viewpoint considered. When appraising the project from an owner's point of view, the loan disbursement is an inflow, and the repayment is an outflow as the owner is looking to the net receipts after paying any debtors or other shareholders. However, the analysis of the financial performance of the total invested capital is not concerned with the financing but seeks to determine the financial viability of the project to all investors irrespective of the sources and terms of financing. The most commonly undertaken financial analyses for government and government-related projects are from the following viewpoints:

i) point of view of the owner;
ii) point of view of all investors combined (banker's point of view or total investment point of view); and
iii) point of view of the fiscal budget.

The Owner's Point of View

The owner of a project considers all receipts and expenditures related to the project in the cash flow statement to determine whether they are better off. The owner may be a private investor who is receiving some form of support from the government or a government department undertaking a project. Consequently, the sponsors of the project receive the net cash flow after

[5] *The sales revenues and cash expenditures in a project will occur almost on a continuous basis. However, these inflows and outflows have to be lumped together for each time period that may be a year, a quarter or a month. In this manual, as a matter of convention, all inflows and out flows are supposed to occur at the end of the corresponding time period. One could very well assume that they all occur at the beginning of the time period. The important thing is to adopt any one of these conventions and then be consistent.*

paying off all other involved parties. The cash flow statement from an owner's point of view will include the loan disbursement as an inflow and all subsequent loan repayments and interest payments as expenditures or cash outflows. If the project receives any grants or subsidies, these should be included as receipts in the cash flow statement, and if the project pays taxes, these should be included as a cash outflow. If the project sponsor gives up an existing source of income to undertake a project, these forgone earnings (i.e., opportunity cost) should be included as an expenditure in the cash flow statement.

The Total Investment (Banker's) Point of View

This point of view examines the returns to the total invested capital. In other words, this analysis disregards any distinctions in the sources of finance. It asks the question of whether the financial receipts generated from the operations of this project are sufficient to cover the investment and operations expenditures and provide a sufficient return or not. This is also known as the "total investment or banker's point of view" because a bank will be interested in examining the expected receipts and expenditures to determine if the net cash flow is sufficient to cover the loan and interest repayments. The banker typically has first claim to the project's assets and net cash flow, so the banker's net cash flow is the project's gross receipts net of operating and investment expenditures.

The only difference between the analysis from the owner's point of view and that from the banker's point of view is financing. Specifically, the cash flow statement from the total investment point of view will include all items from the owner's perspective except loan and loan repayments. The Bank will ensure to retain the first payment priority to other financial players through mortgages, warranties, guarantees, pledges, co-debtors, etc. The Bank will subsequently estimate the profitability of total capital (i.e., the Return on Investment, ROI) prior to funding to determine whether it is feasible to offer the project developers and sponsors financial leverage or not.

The Debt Service Coverage Ratio of a Project

The Annual Debt Service Coverage Ratio (ADSCR) is a criterion for evaluating the financial viability of a project, from the banker´s point of view, on a year-to-year basis. A viable project must repay the principal and interest on the loan, as well as to bring a positive return on equity to the owners. Another criterion, a summary ratio, is called Loan Life Coverage Ratio (LLCR) and it is calculated as the present value of net cash flows divided by the present value of loan repayments from the current period to the end period of the loan repayment. The LLCR tells the banker if there is enough cash from the project's cash flow to offer a bridge-financing, even when some years have inadequate cash flows to service the debt. The criteria are estimated as follows:

$$ADSCR_t = \frac{Annual\_Net\_Cash\_Flow_t}{Annual\_Debt\_\mathrm{Re}payment_t}$$

$$LLCR_t = \frac{\sum_{i=t}^{n} PV\_Net\_Cash\_Flow_i}{\sum_{i=t}^{n} PV\_Debt\_\mathrm{Re}payment_i}$$

The Annual Net Cash Flow of the project is calculated before financing. The Annual Debt Repayment includes the interest expenses and principal repayment due in the specific year (t) of the loan repayment period. The last year of debt repayment is denoted as (n).

Budgetary Point of View

Given the importance of fiscal policy for overall macroeconomic stability, the fiscal impact of the project should always be analysed with the following questions:

- How and to what extent will the project's costs be recovered from its beneficiaries?
- What changes in public expenditures and revenues will be attributable to the project?
- What will the net effect be for the central government and local governments?
- Will the cost recovery arrangements (for instance, a toll for a toll road) affect the quantities demanded of the services provided by the project?
- Are these effects being properly considered in designing the project?
- What will be the effect of cost recovery on the distribution of benefits?
- Will the cost recovery arrangements contribute to the efficient use of the project output and resources generally?
- Is the non-recovered portion factored into the analysis of fiscal impact?

The purpose of the analysis from the budgetary point of view is to ensure that the covered entity has enough resources to finance its obligations to the project. If the government is the project owner, then the only distinction between the cash flow statement from the owner's point of view and the budget point of view is that opportunity costs are not taken into account in the latter. If, on the other hand, the government's involvement is in the form of providing concessional funding, subsidies, or grants, then the cash flow statement will only reflect these transactions. The fiscal assessment gives complementary information to the results of the CBA and is a crucial aspect to ensure the project's feasibility.

Integrated Point of View

It is essential to realise that an analysis that includes the costs and benefits to all involved parties constitutes the first step in the economic analysis of the project. This point is used as a starting point for discussions on economic analysis. Table 5 summarizes how different financial items should be included in the cash flow statement from different points of view.

Table 5: Summary of cash flow statement from different points of view

Items	Point of View of Owners	Point of View of All Investors (Banker's or Total Investment Point of View)	Point of View of Budget	Other Perspective
	(A)	(B)	(C)	(D)
Cashflows	Include all receipts in Inflows and all expenditures related to the project in Outflows	= (A) – Loan and interest repayments	Include all subsidies/grants to the project in Outflows and taxes from the project in Inflows	Include the financial impacts of the projects on any affected group
Grant/Subsidy	Positive	Positive	Negative	Not included
Loan	Positive	Not included	Not included	Not included
Investment costs	Negative	Negative	Not included	Not included
Operating costs	Negative	Negative	Not included	Not included
Loan repayment	Negative	Not included	Not included	Not included
Interest payment	Negative	Not Included	Not included	Not included
Foregone earnings	Negative	Negative	Not included	Not included
Taxes	Negative	Negative	Positive	Not included
Positive Externalities	Not included	Not included	Not included	Positive
Negative Externalities	Not included	Not included	Not included	Negative

Source: *Jenkins G, Harberger A, Kuo Ch. (2013).*

The Operating Plan

The operating plan combines information from the market and technical analyses to establish a detailed plan for the operating phase of a project. Also, it should provide projections of expected sales revenues and expected operating costs for each year during the operating phase[6] and should forecast annual net working capital requirements. In addition, it should specify the management and operating manpower requirements by skill and source of availability for each year of the operating phase and disaggregate material inputs into tradable and non-tradable commodities.

The operating plan is developed using the data formulated and organised in the technical, demand (market), and manpower modules. It includes all cash receipts generated from the business's operations and all operating expenditures. Expenditure and corresponding receipts should be projected by year of operation.

Similar to investment expenditure, data breakdowns are necessary. Operating expenditure should be broken down into internationally traded and non-traded items and each expenditure item should be broken down into its components whenever possible. Expenditure on different types of labour (skilled, unskilled, etc.) should be identified and recorded separately. Any taxes or subsidies associated with operating expenditures should also be identified and recorded separately whenever possible. These breakdowns are necessary for conducting the economic analysis of the project and for providing a better understanding of the cost structure of the operating expenditures[7]. Table 6 shows an example of an operating plan for a potable water project.

[6] *Operating costs include operating material inputs and operating labour.*

[7] *Direct data requirements for a cash flow statement are slightly different from, and may not be as readily available as, data requirements for income statements and balance sheets. For example, an income statement includes sales and purchases, while a cash flow statement includes receipts and expenditures. Sales and purchases include credit as well as cash transactions, while receipts and expenditures are cash only.*

Table 6: Example of operating plan for a domestic energy distribution project

Operations and maintenance	Year 2	Year 3	Year...	Year...	Year...	Year...	Year...	Year t
Personnel								
Connections/employee								
Total employees								
Unit salary/mo. (JD)								
Total personnel cost								
Power/fuel (JD /cum.)								
Chemicals								
Maintenance								
Total								
Production schedule								
Connections								
Beginning								
New								
Ending								
Cumulative new connections								
No. of houses/connection								
Average consumption/house (kmw/month)								
Total consumption (kmw/month)								
Incremental consumption (kmw/month)								
Working capital								
Number of months accounts receivable								
Accounts receivables								
Change in accounts receivable								
Cash balance								
Change in cash balance								
Accounts payable								
Change in accounts payable								

Source: based on *Jenkins G, Harberger A, Kuo Ch. (2013).*

Opportunity cost of existing assets

The concept of opportunity cost is widely applicable in both the financial and economic appraisal of projects. For example, it is common for a covered entity to assess rehabilitation projects where some of the project's existing assets may be kept and utilised together with some newly acquired assets. The opportunity cost of the existing assets should be included in the cash flow statement together with the expenditure on the newly acquired assets. In other instances, a government may wish to assess a going concern to determine whether operations should be continued or ceased or to determine how much the project (and its assets) could be commercially sold for. Here again, the opportunity cost of the existing assets should be included in the cash flow statement. A covered entity considering undertaking a project on land that it already owns should include the opportunity cost of land in the cash flow statement even though there will be no cash outlay for the land when the project is undertaken.

Another example of a different type of asset would be a worker's time. If a farmer or a small investor is going to undertake a project and manage it, it is essential to include the opportunity cost of their time (i.e. foregone earnings) on the expenditure side of the cash flow statement. This is equivalent to paying the sponsor a wage for their work on the project. However, if the project sponsor is paid a wage from the project and that wage is included in the cash flow statement, then no opportunity cost should be recorded.

Also, it is necessary to distinguish the "opportunity cost" of an asset from the "sunk cost" of an asset. The opportunity cost of using an asset in a specific project is the benefit foregone by not putting the asset to its best alternative use. To measure the opportunity cost of an asset, a monetary value must be assigned to it that should be equal to what has been sacrificed by using it in the project rather than in its next best use. On the other hand, the value of an asset is treated as a sunk cost if the asset has no alternative use. The opportunity cost of such an asset is zero. For illustration purposes, take an asset that has been purchased by a firm and can be used to make only one product and nothing else. Also, it cannot be leased to any other firm and its scrap value is negligible. In other words, the asset has no alternative value except in its current operations. Clearly, its opportunity cost is zero.

> ***Sunk costs*** *are defined as the net book values of an existing asset minus the greater of the liquidation or in-use values. If sunk costs are negative, it implies that there has been a financial capital gain. Sunk costs, in general, should not enter into the decision of whether to improve or discontinue the existing facility. Even if the existing assets may now be sunk costs, there may be financial obligations such as bank loans or debt that cannot be ignored if the existing assets serve as its collateral. If the same legal entity continues to be the owner or sponsor of the incremental project, such debt may affect the cash flow of an "improved" project and thus indirectly alter the economic returns from incremental investments.*
>
> *Sunk cost involves neither current nor future opportunity cost and, therefore, should have no influence in deciding the most profitable thing to do. It should, however, be noted that while the sunk cost of an asset should not be counted as a cost to a new project in examining its feasibility, any outstanding liabilities due to that asset may become the liability of the new project if the ownership is the same. In other words, expenditures already incurred are sunk costs and should not be considered in the analysis. Only future benefits and costs should be taken into account.*

The opportunity cost of the existing assets is generally included in the first year of the project's cash flow profile because the assets could be sold at that time if the project is not feasible. The financial opportunity cost of an existing asset is the highest financial price for which it could be sold. The highest financial price is typically the higher of the in-use value of the asset and its liquidation value. The in-use value of the asset is what it would sell for if it were to be used as a going concern. The liquidation value is what the asset would be sold for.

If an asset is broken into its different components and sold in parts, the costs of installing machines and equipment, as well as their liquidation cost, are further deducted to derive the net liquidation value of the assets. When considering the opportunity cost of any production plant, one should consider the in-use value of the plant if it continues to be operated as it is.

Finally, the opportunity cost of an asset should be included in the cash flow statement if the financial profitability of the project is being assessed (i.e. if financial returns to the project are going to be estimated). The opportunity cost will also be a cash flow item in the economic analysis since it is a real resource cost.

Why a non-cash item should be included in the cash flow statement

Suppose a neighbour gave us a gift in the form of an old machine that produces nails. The machine has an operating life of one year, after which it has a scrap value of zero. The market value of the nails that can be produced by the machine during this year is GHS500,000. Expenditures on raw materials, labour and other operating expenditures during the year are GHS300,000. Should we produce nails or not? The situation is summarised below:

Receipts from nail sales: + 500,000

Operating expenditures: - 300,000

A superficial analysis may lead us to undertake this project because we generate net receipts of GHS 200,000. To understand why this decision may be wrong, suppose that the market value of this machine is GHS 250,000. In this case, if we produce the nails, we earn GHS200,000 but we forgo GHS250,000 resulting in a net loss of GHS 50,000. In other words, we should not make a decision whether to produce the nails or not until we find out what the opportunity cost of the machine is. With this additional piece of information, the situation can be summarised as follows:

Receipts from nail sales: + 500,000

Opportunity cost of machine: - 250,000

Operating expenditures: - 300,000

Net Cashflow: - 50,000

It becomes clear in this case that we should not produce nails. Instead, we would be better off selling the machine. To arrive at this correct decision, we should include the opportunity cost of the asset in the cashflow statement even though no cash outlay is incurred in acquiring the machine.

Treatment of assets depreciation

Depreciation expense or capital cost allowances are an accounting device to spread the cost of capital assets over the length of the life of the investment so that net income in any given year will reflect all the costs required to produce the output. However, depreciation expense is not a cash outflow and thus should not be included in the project's financial cash flow profile. The total capital costs of an investment are accounted for in the financial cash flow profile since the amount of the investment expenditures are deducted in the year they occur.

Depreciation rates could be obtained from plant manufacturers, technical journals (which may contain information on depreciation patterns), and insurance companies (which insure a plant's assets and have some estimates for the plant's rate of financial depreciation). If any further capital charge, such as depreciation expense, were deducted from the cash flow profile, it would result in a double counting of the investment opportunity cost of existing assets.

The residual value

When a new project acquires an asset, the entire expenditure on the asset is accounted for in the cash flow statement at the time that the expenditure occurs. It is quite possible that the life of the project will not coincide with the life of all its assets or that the span of the analysis will not extend as far into the future as the project may be expected to operate (for example, railway

projects). If either of the two conditions exist, then the residual value of the asset (i.e. the value of the part of the asset that has not been used) should be included in the cash flow statement.

As a matter of convention, residual values are recorded in the cash flow statement in the year following the cessation of operations. The underlying assumption is that liquidating assets may require a few months. When determining the residual value of the assets at the end of the project, it is preferable to break down all the assets into different categories: building, equipment, vehicles, etc. The residual value is taken as the higher of the in-use or liquidation value. The in-use value of the plant is the value of the plant under the assumption that it will continue to operate as a going concern. The liquidation value is the value of the assets if all components of the project are sold separately, and perhaps even the plant is taken apart and liquidated.

This approach is similar to when estimating the opportunity cost of existing assets. It is, however, more difficult in this case to estimate the in-use and liquidation values since we are dealing with a situation in the future. General guidelines could be utilised to determine the residual values for these assets based on published economic depreciation rates that specify how much of the value of assets is lost as a function of time and/or use.

The in-use liquidation value

The most appropriate way to determine in-use and liquidation values is through reliable market valuators. When estimating in-use values using valuators, the valuators' and sales agency's fees should be subtracted from the quoted value to obtain the net in-use value. When valuators give a liquidation value for a project's assets, the valuators' and sales agency's fees, as well as the expenditure incurred in dismantling the assets, should also be netted from the quoted price to obtain a net liquidation value.

Another approach to estimating the in-use value of a set of assets is to consider their net replacement costs. The net replacement cost is the expenditure that would have been incurred today to build a facility that would provide the same amount of services in the future as the existing assets. To estimate the net replacement value of an asset, two adjustments must be made to the historical purchase cost of the assets. The first adjustment is for the change in the nominal prices of new assets or the same type of asset that can perform the same function as the evaluated asset. This price change is measured as the ratio of the current price or price index for this asset to the price or Price index of the evaluated asset in the year when purchased.

The financial opportunity cost of an existing asset is the highest financial price that it could be sold for. The highest financial price is typically the higher of the asset's in-use value and liquidation value. The in-use value is what the asset would sell for if it were to be used as a going concern.

Land is a unique asset in that it generally does not depreciate. The residual value of land recorded in the cash flow statement should be equal to the market value of the land recorded at the beginning of the project unless the project results in some improvement or deterioration of the land. Situations where the project may enhance land value should be treaded cautiously and treated as the exception rather than the rule. In many cases, expectations may indicate that land values are likely to rise faster than the general rate of inflation, but the increase is unrelated to the project[8]. It is important that project analysts do not include any increase beyond the general inflation rate in the land's residual value.

Increase in land values

Land has an opportunity cost like every other asset when it is used by a project. Even if the land is donated to the project by the government, it should be included as part of the investment cost at a value that reflects the market value of land in the project area.

However, land is a very special asset because it does not depreciate in most situations. Due to improvements in infrastructure, the value of land being used by a project may increase much faster than

[8] *For example, real increases in land value usually come about because of investment being made in public sector infrastructure or land value may be expected to increase due to a change in zoning laws or due to the anticipated construction of some large infrastructure project or simply because of increasing demand and fixed supply of land.*

inflation during the life of the project. In most cases, the increase in the liquidation value of land (particularly in urban areas) has nothing to do with the project under evaluation.

It is important not to attribute the increase in the real value of land to any particular project to avoid introducing a bias toward land-intensive projects. The only exception to this rule occurs when the project either improves or causes damage to the land. In such cases, the amount of the land improvement or deterioration should be added to or subtracted from the real value of the land measured at the beginning of the project to determine the liquidation value of the land at the end of the project.

The increase in land values will occur whether the project under consideration is undertaken, and the project sponsors will benefit from this increase irrespective of undertaking the project.

There are two ways in which the cost of land may be included in a project's cash flow. The first one is straightforward: any appreciation or depreciation that cannot be attributed to the project is simply ignored. The capital cost is included as investment cost at the beginning of the project, and the same value is included as liquidation value at the end of the project life. In case of inflation, the final value should take the inflation into account so that the real value remains unchanged.

An alternative approach is to levy an implicit rental charge as a cost in each period of time, even when no actual rental is paid. The opportunity cost of land can be reflected in the cash flow profile of the project by an annual rental charge. This rental charge can be estimated by using the rental rate value of the land [×] the real value of the land for each period of the project's life. If the annual rental charge approach is used, then neither the initial cost of the land nor its final market value should enter the cash flow profile of the project. If there is an annual appreciation or depreciation in rent, the appreciated or depreciated rental value is the annual cost but, in this approach, the value of land improvement or damage should be included in the final year of the cash flow.

Adjustment of Sales, Purchases, and Cash Balance

A project's viability is determined by the sales it generates and the timing of the cash receipts from the sales. A cash flow statement records sales transactions only when the cash from the transaction is received. Typically, projects forecast their sales as a single line item comprising credit and cash transactions. Only cash sales are included in a cash flow statement. Many government projects and firms provide their clients with goods and services without immediate cash payments.

A distinction must be made between sales and cash receipts. When a project makes a sale, the good or service may be delivered to the customer, but no money is transferred from the customer to the project. At this point, the project's accountants will record that the project has an asset called **Accounts Receivable** equal to the amount of the sale or the proportion that was not in cash. The transaction will not impact the cash flow statement until the buyer has paid for what he has received. When the buyer pays for the items, he previously bought from the project, the project's accountants will record a decrease in accounts receivable and an increase in cash receipts by the amount the buyer paid. Only then are these cash receipts included in the cash flow statement as inflows.

Cash receipts for any period will be determined as the sales during the period plus the accounts receivable at the beginning of the period less the accounts receivable at the end of the period. The maximum amount of cash a project can receive during a period would be equal to the new sales and the outstanding receivables, if any.

Accounts Receivable are typically measured as a percentage of sales. To determine the appropriate percentage of accounts receivable that a project will maintain, one can examine the current performance of the covered entity if the project is similar. If such information is unavailable, one should examine the industry standards or ranges. It is crucial to ensure that the accounts receivable selected for the project are consistent with the department's current performance or industry standards. If not, a plausible explanation should be given for why the proposed accounts receivable differ.

When dealing with accounts receivable, it is essential to assess the likelihood of bad debts and make allowances for them. Bad debts occur when a project's customers default on their payments, which lowers the project's cash inflows. Bad debts must be accounted for so that the cash flow statement is as realistic as possible. If accounts receivable at the end of the project operations are generally challenging to collect, this should also be reflected in the cash flow statement.

Adjustment of Purchases

Similar to the distinction between sales and receipts, a distinction between purchases and cash expenditures is necessary. The transaction will be recorded in the cash flow statement only when the cash from the transaction is paid. When the project makes a purchase, the good or service may be delivered to the project, but no money is transferred from the project to its vendor. At this point, the project's accountants will record that the project has a liability called **Accounts Payable**, equal to the amount of the purchase or the proportion that was not in cash. In other words, the project owes the seller the goods or services it purchased. Until the project has paid for what it has received, the transaction will not impact the cash flow statement. When the project pays the vendors for the items it bought from them, the project's accountants will record a decrease in accounts payable by the amount the project has paid and an increase in cash expenditure. These cash expenditures will be included in the cash flow statement as an outflow.

The cash expenditure for any period will be determined as the purchases during the period plus the accounts payable at the beginning of the period, less the accounts payable at the end of the period. The maximum cash expenditure that the project could make during a period is for new purchases during the period plus the settlement of any outstanding accounts payable. However, if the project still maintains a balance of accounts payable at the end of that period, then the expenditures for the period will be determined by subtracting the ending balance of the accounts payable from the maximum the project could have paid.

Accounts payable are typically measured as a percentage of total purchases or that of a significant input. The appropriate number of accounts payable that a project will maintain can be determined based on the current performance of the covered entity if the project is similar. Similar to accounts receivable, if such information is unavailable, one should examine the industry standards or ranges. It is vital to ensure that the accounts payable on which the cash flows will be based are consistent with the industry standards.

Adjustment for Changes in Cash Balance

Increases and decreases in project cash balances can occur even when no change occurs in sales, accounts receivable, purchases, or accounts payable. For example, when cash is set aside for the project's transactions, it is a cash use, which is represented as an outflow in the cash flow statement. Similarly, a decrease in cash held by the project is a cash source for the project and its sponsors and is a cash inflow.

The amount of cash to be held for facilitating the project's transactions is typically a percentage of the project's expenditures, sales, or major purchases, and it can be determined by examining the performance of similar projects in the same sector or industry.

Working Capital

A project's working capital is generally defined as the net of its current assets and current liabilities. Current assets typically include cash and marketable securities, accounts receivable, inventories, and prepaid expenses. Current liabilities include accounts payable and any other form of debt that is due within a year.

Accounting for Working Capital in the Cash Flow Statement.

The impacts of changes in Accounts Receivable and in Accounts Payable on the cash flow statement, as well as changes in cash balances, which are directly recorded in the cash flow statement, are explained above. Changes in prepaid expenses should not be included in the cash flow statement. An expenditure is recorded as a cash outflow once an actual outlay occurs. Whether the expenditure is to pay for past rent or future rent is irrelevant when preparing a cash flow statement.

Changes in inventories should not be included in the cash flow statement. When a project purchases a certain amount of raw material, inventories will increase. These inventories are financed through a cash outflow and/or increased accounts payable. If the inventories have been paid for in cash, a cash outlay has been recorded in the cash flow statement. If they have been acquired on credit terms, they will be recorded in the cash flow statement only when paid for. The situation is similar when dealing with changes in the inventories of the final product. For example, a decrease in final good inventories implies increased sales. This in turn implies an increase in cash receipts or accounts receivable.

Since the components of working capital are developed independently in different plans[9], it is necessary to check for the overall consistency of working capital. This can be done by comparing the working capital implicitly estimated for the project to industry averages or to similar projects operated by the same department if available. Certain liquidity ratios such as the current ratio and quick ratio can be estimated and compared to industry averages or similar projects.

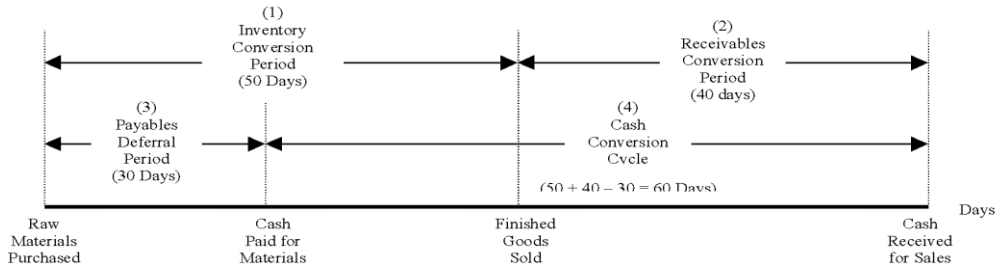
Estimation of working capital requirements

Ensuring a project's access to sufficient working capital is crucial for success. When a project starts operations, it will typically incur expenditure without generating receipts. During this period and until the project starts generating sufficient receipts, it is crucial to estimate the working capital requirements for the project carefully and to determine how they will be met.

Initial working capital requirements for any project depend on the inventory conversion cycle, the receivables conversion cycle, the payables conversion cycle and ultimately, the cash conversion cycle. The inventory cycle is the time for converting raw materials into finished goods; the receivables cycle is the period for converting accounts receivable into cash; the payables cycle is the period for converting accounts payable into cash. The cash cycle is the net outcome of the inventory, receivable and payable cycles.

Figure 9 illustrates how the working capital financing needs are determined. Suppose a project buys raw materials on credit, pays after 30 days, and takes about 50 days to convert them into final products to sell them. Furthermore, suppose it takes 40 days to collect the outstanding accounts receivable. In this case, the cash conversion cycle is estimated to be the inventory conversion cycle plus the receivable's conversion cycle less the payables conversion cycle (i.e.

Figure 9: The cash conversion cycle



[9] *For example, accounts receivable is identified as a percentage of sales in the demand or market plan; accounts payable is estimated as a percentage of purchases in the technical plan; sources of finance are identified in the project's financing plan, etc.*

50 days + 40 days - 30 days = 60 days). Consequently, the project analyst should determine the project's expenditure during the 60 days, and suitable means of financing should be sought.

Source: *Jenkins G, Harberger A, Kuo Ch. (2013).*

The cash conversion cycle on which the working capital requirements are based is typically much shorter than the unit of time used in the cash flow statement (generally one year). In other words, a net cash flow for the first year of operations will reflect the total receipts generated during the year net of total expenditures without shedding any light on whether there is enough working capital to get the project started and progressing. It is quite probable that the net cash flow for the first year of operations is indeed positive, but not enough working capital has been secured to ensure that the project continues to function smoothly. Consequently, it is necessary that working capital requirements for a project are explicitly estimated and the appropriate means of financing identified.

Treatment of taxes

Income taxes paid by the project should be included as an outflow in the cash flow statement. The income tax liability is estimated based on the project's income statement following the accounting and tax rules of the country concerned. Year-by-year estimates of the cost of goods sold, interest expense, tax depreciation expenses, and overheads are all subtracted from the project's revenues to estimate the project's earnings before taxes. While estimating the income tax liability, provisions for loss carry backward and forward, if applicable, should be taken into account.

Value Added Tax Liabilities

Most countries levy value-added taxes (VAT) on the goods and services sold domestically, but zero-rate sales are made to customers outside the country. For a taxable firm, the value of sales will include the VAT collected by the project on behalf of the government.

The cost of taxed inputs will include VAT paid on these purchases. If the firm is taxable, the payment made to the government is the difference between the value-added taxes collected on the sales and the value-added taxes paid on the purchase of inputs. These VAT payments to the government are reported in the cash flow statement as an outflow. The net effect of this tax treatment is to largely eliminate the VAT from being a financial burden on the project.

When a project produces an output that is exempt from VAT, it will not charge VAT when it sells that output. In most circumstances, it will continue to pay VAT on its purchases of inputs. In this case, there will not be an additional line item reporting the VAT payment to the government. The net effect of VAT is to increase the cost of inputs and, hence, the project's financial cash outflow.

The third possible situation occurs when the project's output is expected with a rate of zero imposed on the export sales. In this case, no tax is included in the sales revenues or cash inflows. The VAT will be levied and included in the inputs purchased by the project. The difference between the taxes collected on sales of zero and the taxes paid as part of the input purchases now becomes a negative tax payment or a refund of taxes paid. This should be reported as a negative cost or a cash inflow to the project.

Inflation in Financial Analysis

Experience with projects suffering from financial liquidity and solvency problems has demonstrated that inflation can be a critical factor in project success or failure. Correctly designing a project to accommodate changes in relative prices and changes in the rate of inflation may be crucial for its ultimate survival.

Improper accounting for the impacts of inflation when conducting the financial analysis could have detrimental effects not only on the financial sustainability of the project but also on its economic viability. Assumptions regarding inflation will have a direct impact on the financial analysis of the project and may require adjustments in operating or investment decisions. Since

an inadequate treatment of inflation may adversely affect the financial sustainability of the project, the economic viability of the project may be compromised if inflation is not properly accounted for and the necessary adjustments made.

It is important to realize that the ultimate analysis of financial cash flows should always be carried out on a statement prepared in real terms (i.e., net of inflation). The correct treatment of inflation requires that the analysis be done using nominal prices, and at the very end, cash flow statements prepared in nominal prices should be deflated to obtain the cash flow statements in real prices.

When the implementing agency prepares the cash flow statement, certain variables such as tax liabilities, cash requirements, interests, and debt repayments must be estimated at the prices of the years they are to be incurred. Other variables making up the cash flow statement are also presented in current prices, and consequently, cash flows in current prices are developed. These cash flows are later deflated and presented in real prices. By constructing the financial analysis in this manner, we ensure that first, all the effects of inflation are consistently reflected in the projected variables, and second, all variables are deflated by the projected increase in the general level of prices.

The steps required to carry out the inflation analysis are as follows:

1. Estimate the future changes in the relative prices for each input and output variable. This will involve the examination of the present and future demand and supply forces that are expected to prevail in the market for the item. For example, real wages tend to increase over time as the economy grows.
2. Estimate or develop a set of assumptions concerning the expected annual changes in inflation over the project's lifetime.
3. Determine what the nominal rate of interest will likely be over the lifetime of the project, given the expected changes in the price level estimated above.
4. Combine the expected change in relative prices with the expected change in the rate of inflation to give the expected change in the nominal price of an item.
5. Multiply the nominal prices for each item by the projections of quantities of inputs and outputs through time to express these variables in the current year's prices of the period in which they are expected to occur.
6. Begin the construction of a cash flow statement using the current (nominal) values for the inputs and outputs.
7. Construct a profit and loss statement for each year of the project's life to determine income tax liabilities with all variables expressed in their nominal values. Depreciation expenses, cost of goods sold, interest expenses, and income tax liabilities are estimated according to the taxation laws of the country. The estimated income tax liabilities are included in the cash flow statement.
8. Estimate cash requirements and any changes in the stock of cash that are reflected in the cash flow statement.
9. Determine financing requirements, along with interest payments and principal repayments, and include these items in the cash flow statement. This completes the construction of the projected variables in terms of their current (inclusive of inflation) values. Now, we have a cash flow statement in current prices from the owner’s point of view.
10. Deflate all items in the owner’s cash flow statement by the inflation price index to arrive at real values for the cash flow statement. Note that loans, interest payments, and loan payments are included at their deflated values in the determination of cash flow in real prices.
11. Calculate the net financial cash flow from different points of view.

When the financial analysis is carried out in terms of real prices, it is essential that the private opportunity costs of capital or the target financial rates of return used as discount rates be

expressed net of any compensation for the expected inflation rate. In other words, these discount rates must be real, not nominal, variables.

It should be noted that the real financial prices for the input and output variables developed above are used as the basis for estimating the economic values for the project's benefits and costs. Once these economic costs and benefits are estimated, an economic resource flow statement is prepared. The structure of the statement should be similar to that of the financial cash flow statement.

Financial Cash Flows

The financial cash flow statement of a project is a profile of its receipts (inflows) and expenditures (outflows) over time. Direct data requirements for a cash flow statement are slightly different from data requirements for income statements and balance sheets[10], and may not be readily available. For example, an income statement includes sales and purchases, while a cash flow statement includes receipts and expenditures. Sales and purchases include credit and cash transactions, while receipts and expenditures are cash only. Even though direct data requirements for cash flow statements may not exist, a cash flow statement can be constructed from the information in a set of balance sheets and income statements. A few important distinctions between variables included in a cash flow statement and variables in other financial statements are discussed below. The distinction generally stems from the fact that non-cash impacts (except for opportunity costs) are not included in the cash flow statement.

The cash flow statement is organised into two main sections; the first section typically contains the expected financial receipts generated by the project, while the second one contains the expected financial expenditure incurred to generate the receipts of the project. The project's total expenditure, also known as total outflows, is subtracted from its receipts (inflows) to provide its net cash flow. Table 7 is an illustration of some of the line items that may appear in the financial cash flow statement of a project.

Figure 12 illustrates four of the different profiles that a net cash flow can take. Each profile plots a project's receipts net of expenditure (net cash flows) against the sequence of years that make up the project's life. Typically, a project's net cash flow is negative in the early part of its life (the investment stage) when the initial investment (CAPEX) is being undertaken, and the project is not generating any receipts. Once the investment is completed and the project starts operating (when OPEX is incurred), the net cash flow is likely to be positive (Case A). Case B presents an alternative situation where a period of reinvestment or plant retooling is planned during the project's life. This may result in negative net cash flows during the operating life of the project. Case C presents a profile for a class of projects that require a large expenditure at the end of the project. The expenditure could be, for example, attributed to clean-up and landscaping costs associated with a mining project or the decommissioning of a power plant. The profile of the net cash flow in Case D represents projects that do not generate any financial receipts (road projects that charge no tolls) or projects that generate low receipts that are insufficient to cover operating expenditures (possibly water and wastewater projects). In such cases, the project will have a large initial outlay during the investment stage and will continue to show negative net cash flows during the operating stage.

The construction of the cash flow statement in Table 8 is generally preceded by the chronological organization of variables and data into three stages: investment, operation, and end-of-operations. Each of these stages corresponds to a plan. Most of the data required for these three plans should be already organised in the technical, demand, manpower, and financing analysis discussed previously. Rules for including variables and data in the cash flow statement are presented and discussed for each of the three plans. There is, however, one simple guideline that can be mentioned here; "Only cash impacts are included in the cash flow

[10] *One of the main reasons for more readily available information for balance sheets and income statements is that these statements are often required by law for disclosure and tax purposes.*

statement, with two exceptions. These exceptions are the opportunity cost of existing assets and the residual values of the assets remaining at the end of the project".

This document is applicable to the preparation of the cash flow statement as a whole and can help the analyst when in doubt whether a variable should be included in the cash flow statement or not. Most of the data required should already be organized in the modules discussed before.

Table 7: Variables in a financial cashflow statement

Financial Receipts: 1. Sales 2. Changes in Accounts Receivable 3. Residual Values (a) Land (b) Equipment (c) Buildings 4. Total Inflows	
Financial Expenditure: *(i) Investment Expenditure/Opportunity Costs* 5. New Investment (a) Land (b) Type 1 Equipment (c) Type 2 Equipment 6. Buildings 7. Existing Assets (if any) (a) Land (b) Equipment *(ii) Operating Expenditure* 8. Raw Material (1, 2, n) 9. Management 10. Skilled Labour 11. Unskilled Labour 12. Maintenance 13. Changes in Accounts Payable 14. Changes in Cash Balance	
15. Total Outflows	
16. Net Cash Flow	

Source: *Jenkins G, Harberger A, Kuo Ch. (2013).*

The most important items related to financial receipts to consider within cash flow depend on the nature of each project. However, the most important items are related to fees charged to users and state grants. In the case of State Grants, the government can provide a subsidy (per capita or global), which is a cash inflow to the institution responsible for the operation. Table 8 shows an example of the financial cash flow, including the debt service coverage ratios.

Table 8: Financial cashflow example

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
INFLOWS													
Gold Sales	0,0	0,0	81,8	95,4	109,0	109,0	109,0	109,0	109,0	109,0	109,0	109,0	0,0
Silver Sales	0,0	0,0	9,7	11,3	13,0	13,0	13,0	13,0	13,0	13,0	13,0	13,0	0,0
Change in A/R	0,0	0,0	-13,7	-2,3	-2,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	18,3
Salvage Value	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	13,6
Land Grant	25,0												
TOTAL INFLOWS	**25,0**	**0,0**	**77,8**	**104,5**	**119,7**	**122,0**	**122,0**	**122,0**	**122,0**	**122,0**	**122,0**	**122,0**	**31,9**
OUTFLOWS													
Investment Costs													
Land	25,0												
Infrastructure	4,0	4,0	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,0
Machinery & Equipment	0,0	136,0	6,8	6,8	6,8	6,8	6,8	6,8	6,8	6,8	6,8	6,8	0,0
Installation Cost	0,0	16,0	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,0
Mine Reserve Development	10,0												
Site Restoration	0	0	0	0	0	0	0	0	0	0	0	0	6,0
Operating Costs													
Labour	0,0	0,0	8,0	9,3	10,6	10,6	10,6	10,6	10,6	10,6	10,6	10,6	0,0
Imported Materials	0,0	0,0	6,3	7,4	8,4	8,4	8,4	8,4	8,4	8,4	8,4	8,4	0,0
Timber	0,0	0,0	5,4	6,3	7,2	7,2	7,2	7,2	7,2	7,2	7,2	7,2	0,0
Fuel	0,0	0,0	10,5	12,3	14,0	14,0	14,0	14,0	14,0	14,0	14,0	14,0	0,0
Domestic Transport & Handling	0,0	0,0	0,9	1,1	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	0,0
Miscellaneous	0,0	0,0	2,7	3,2	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6	0,0
Cash Balance													
Change in A/P	0,0	0,0	-2,6	-0,4	-0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	3,4
Change in C/B	0,0	0,0	1,7	0,3	0,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-2,3
Taxes statement													
Income Tax	0,0	0,0	10,7	13,8	17,4	17,8	18,3	18,8	19,2	19,2	19,2	19,2	0,0

Royalty	0,0	0,0	4,6	5,3	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	0,0
TOTAL OUTFLOWS	**39,0**	**156,0**	**56,2**	**66,4**	**76,3**	**76,9**	**77,4**	**77,9**	**78,3**	**78,3**	**78,3**	**78,3**	**7,2**
NET CASH FLOW BEFORE FINANCING	**-14,0**	**-156,0**	**21,6**	**38,1**	**43,4**	**45,1**	**44,6**	**44,1**	**43,7**	**43,7**	**43,7**	**43,7**	**24,7**

Table 9: Financial cashflow example (cont'd)

		2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
PV Net Cash Flow				197,4	188,1	160,5	125,3	85,9	44,1					
PV Debt Repayment				100,2	100,2	80,1	60,1	40,1	20,0					
ADSCR				**3,30**	**1,51**	**1,81**	**1,99**	**2,09**	**2,20**					
DSCR				**1,97**	**1,88**	**2,00**	**2,09**	**2,14**	**2,20**					

Step 6: Conduct the economic analysis

Economic analysis examines the project from the entire economy's point of view to determine whether its implementation will improve the country's economic welfare. An economic appraisal is similar to financial analysis, except that now the benefits and costs are measured to choose projects that maximise the welfare of the entire society. Therefore, another main difference should be considered: the effects in a private (financial) evaluation do not take into account all the relevant costs and benefits, such as externalities and intangible effects.

When the markets for the outputs and inputs are perfectly competitive, and there are no other reasons for economic externalities, market prices will measure economic prices. Under these conditions, and where a project introduces only small changes in the demand for its inputs and in the supply of its outputs, the financial analysis of a project will serve as a good proxy for the economic analysis. Instead of relying on market prices to measure expenditure and costs, as in the case of a financial appraisal, economic analysis requires techniques to determine the economic prices of goods and services, foreign exchange, cost of capital, and labour. The true economic values of costs and benefits are not reflected in market prices in the presence of various distortions such as trade restrictions, price control, taxes, subsidies, and minimum wages.

Economic analysis requires that a series of adjustments be made to convert estimates of incremental cash receipts into incremental economic benefits and estimates of incremental cash disbursements into incremental economic costs. These adjustments are based on the following three basic postulates of applied welfare economics, used to measure economic benefits and costs:

1. *The competitive undistorted demand price for an incremental unit of a good or service measures its economic value to the consumer and its economic benefit.*
2. *The competitive undistorted supply price for an incremental unit of a good or service measures its economic resource cost.*
3. *Costs and benefits are added up without regard to who the gainers or losers are.*

To conduct the economic analysis, the opportunity cost of the resources must be known. If a project does not have an economic return equal to the opportunity cost of public funds, it usually should not be undertaken. In some circumstances, however, the project may also lead to net social benefits which can be quantified (but not necessarily measured in monetary terms) and which may be viewed by the decision-makers as being worth the sacrifice of economic resource cost that the project entails. For example, the project might distribute income to a group of people the government is very anxious to help. It is in this context that an important factor must be noted. A project may distribute income to the desired group and at the same time, it may increase the incomes of those that are not favoured. Therefore, both outcomes must be considered by the decision-makers in determining the overall attractiveness of the project.

As in the case of financial analysis, economic analysis strongly depends on the proper construction of an economic resources statement. The steps to conducting an economic analysis are the following:

Step 1: Describe the "with project" situation

For each selected alternative, the baseline scenario must be estimated. The objective at this point is to determine how the new situation would look like assuming that the project gets implemented; thus, the description must include its location, the technical specification, what the supply will be, how the demand should look like and what is likely to be the interaction between the two. At this stage, the analyst should be able to answer the following questions:

- How much does the project reduce the deficit identified in the baseline situation? Does the project generate new customers (i.e., will more products and services be consumed)?

- Does the project reduce costs, and if so, how much?
- How much does the project increase socio-economic surpluses?

In short, the description must answer the question of how and to what extent the implementation of the project will solve the problem throughout its lifespan. This forecast will be compared to the baseline scenario, and the relative socio-economic profitability of the project will be derived from its marginal effects over such baseline.

Step 2: Identification of Economic Costs and Benefits

All the benefits generated by the project to society are recognised. The sponsoring agency should consider not only those benefits that are generated in the same market services or products (direct benefits) but also the benefits generated in a related market (secondary and indirect benefits and positive externalities). Similarly, all the costs should be recognised, considering the direct costs plus the costs imposed on the rest of society (secondary and indirect costs and negative externalities).

Step 3: Quantification and Valuation of Economic Costs and Benefits

This step requires the appropriate allocation of benefits and costs in measurement units. Quantification of direct costs is generally the easiest task at this stage, as it only requires adequately estimating the physical requirements of each type of input used in the implementation of the project (investment), as well as the operational and maintenance costs. The valuation of these costs does not present major difficulties since, for most of the resources used in the project, there are clearly defined markets with prices that can be used.

Quantification of economic benefits, particularly positive externalities, is a complex task that requires different studies to establish numerical relationships between resource availability and consumption of goods. This also applies to the quantification and valuation of indirect, incidental costs and externalities, which must be analysed case by case, depending on the available information.

Step 4: Economic (Shadow Prices) and Conversion Factors

For the purposes of economic analysis, costs and benefits are estimated using the three postulates of the efficiency approach. The economic prices of goods and services used for economic analysis are derived by adjusting the market or financial prices for distortions. Financial prices are used to construct financial cash flows and are essentially the starting point for conducting the appraisal of any project. Thus, it is imperative to develop a strong financial analysis before proceeding to undertake the economic appraisal. From the third postulate, the net economic benefit of the project is measured simply by subtracting the total resource costs from the total benefits of the project's output.

In order to get these true economic values, the project formulator needs to know:

1. Whether the goods are tradable or non-tradable.
2. How distortions such as tariffs, taxes, and subsidies create a wedge between the market and the economic exchange rates and how these distortions also create a divergence between the economic and financial values of both the tradable and non-tradable inputs and outputs of the project.
3. How the transportation and handling costs of inputs and outputs affect the true economic values of goods and services used and produced by a project.

Tradable and Non-Tradable Goods

A good or service is considered tradable when an increase in demand (supply) by a project does not affect the amount demanded (supplied) by domestic consumers (producers). The increase in demand (supply) by a project is eventually reflected as an increase/decrease in imports or a decrease/increase in exports, depending on whether the project is demanding or supplying the importable or exportable commodity. Importable goods include imported goods and all goods produced and sold domestically that are close substitutes for either the

imported goods or potentially imported goods. Exportable goods refer to goods that are exported as well as goods that are domestically consumed and are of the same type or are close substitutes for the exported goods. If a project leads to an increase in demand for an importable product, it will result in increased imports. Conversely, if a project leads to an increase in demand for an exportable product, it will lead to a reduction in exports.

A commodity or service is non-tradable from a country's point of view if its domestic price lies above its FOB export price or below its CIF import price[11]The international transportation cost may be very high compared to the product's value, so no profitable trade is feasible. Alternatively, an importable good will become non-tradable if it receives such a high level of protection in the form of trade quotas or prohibitive tariffs that no import transactions will take place.

As such, the concept of a conversion factor, defined as the ratio of the economic price to the financial price, plays an important role in looking at the financial and economic costs or benefits of a project. If the conversion factor is specific to the project's inputs and outputs, the economic costs of capital and foreign exchange are known, it is easy to translate the financial appraisal of a project into its economic valuation. For a given good or service, the term Commodity Specific Conversion Factor (CSCF) is used. While CSCF values may be different when calculated at project sites, economic parameters such as economic cost of capital and foreign exchange are national parameters that remain constant at a given time across projects in the overall economy.

If there are no distortions in the supply and demand market of a commodity, the CSCF will simply be one (1) because the economic and financial prices are the same. If the market for foreign exchange is distorted, the Market Exchange Rate (Em) or the Official Exchange Rate (OER) will not accurately reflect the economic value of a unit of foreign exchange in relation to the domestic currency. Thus, it is essential to make an adjustment for the divergence between the market or official price of foreign exchange and its economic price, also referred to as the Economic Exchange Rate (Ee) or sometimes the Shadow Exchange Rate (SER).

In summary, the steps required to carry out an economic analysis are as follows:

1. *Estimate the CSCF for all the prices of inputs and outputs involved in the evaluation.*
2. *Estimate the future changes in the relative prices for each input and output variable. This will involve the examination of the present and future demand and supply forces that are expected to prevail in the market for the item.*
3. *Multiply the economic prices for each item by the projections of quantities of inputs and outputs through time to express these variables in the current year's prices for the period in which they are expected to occur.*
4. *Begin the construction of a resource flow statement using the current values for the inputs and outputs.*
5. *Discount the net economic resource by the Economic Opportunity Cost of Capital (EOCK).*
6. Conduct the risk analysis.

Step 7: Run the risk analysis

Generally, when evaluating investment projects, it is assumed that the variables used have a deterministic character. However, there are variables whose value cannot be accurately predicted because there is some uncertainty in their estimation. Systematic errors may also have been introduced as a result of planners' natural responses to the incentive environment that they are facing.

[11] *FOB price implies a "free-on-board" export price, and it is the price of a good at the country's border before it is shipped abroad. Thus, it includes transportation and handling when moving the goods to the port. CIF price implies "costs of insurance and freight" import price, and it is the price at the border before any transportation and handling are incurred to move the goods inland to the project site.*

The benefits and costs of the projects are not immediate but distributed over time. This causes each variable related to calculating a project's profitability to be estimated by models, which leads to uncertainty in its estimation. In addition, obtaining information to make reliable estimates is expensive.

A traditional cash flow analysis assumes single (deterministic) values for all the variables. The outcome of that analysis is a point estimate of a project's indicators, such as NPV or its IRR, and a decision on whether to accept a project is made on that basis. More realistically, we know that values for most project variables are subject to change and are difficult to predict. While the past values of a particular variable are known with certainty, predicting future values is a different matter. It is more likely to forecast the correct range of future values for a variable rather than its exact value. Given that there are probabilities attached to the possible values of a variable in a given range, there is a good chance that the value that occurs will be other than the one we have chosen.

The uncertainty may come from different sources. The first source of uncertainty is the fact that there are contingencies whose occurrence will affect the project, both internally and externally. The second source of uncertainty is in the process of evaluating the project itself (the uncertainty arises either because the available information about variables, such as prices, demand elasticity and other factors, or the methodologies to estimate them are not able to reflect the preferences of people perfectly). Another source of uncertainty arises from human factors in the project design or economic project modelling.

Each of these sources of uncertainty has a different impact on the possible final values of the evaluation criteria. Risks for administrative public building projects can be categorised as follows:

- Construction Risk: Buildings are not completed on time, to budget or to specification.
- Demand Risk: Demand for services does not meet forecasts.
- Design Risk: Design cannot deliver services at the required performance or quality standards.
- Economic Risk: Project costs or benefits affected by economic influences, e.g., inflation or exchange rate movements.
- Funding Risk: Availability of funding delays the project or changes scope.
- Legal and Regulatory Risk: Difficulties in solving legal requirements related to land use in time and within budget.
- Operation & Maintenance Risk: Costs of operating and maintaining the new facility differ from the planned budget.
- Procurement Risk: Shortfall in capacities of contractors or contractual disputes.
- Technological Risk: Services provided using non-optimal technology because of rapid technological change.

Risk analysis is important for several reasons, including reducing the likelihood of undertaking a "bad" project while failing to accept a "good" project. It would be easy to avoid "bad" projects simply by making very conservative assumptions about the values of the key variables and then accepting only those projects that still have a positive NPV. One of the ways to reduce uncertainty is to gather more data and information about the key project variables to the extent feasible in order to narrow their likely range and to determine the appropriate probability distribution more precisely.

To face the problem of the uncertainty inherent in the relevant variables in the calculation of the profitability of a project, the implementing agency can use three main methods:

1. Sensitivity Analysis.
2. Scenario Analysis.
3. Monte Carlo Analysis.

Sensitivity Analysis

The Sensitivity Analysis tests how sensitive a project's outcome is to changes in one parameter at a time. Sensitivity analysis is often referred to as "what if" analysis, such as, "What would happen to evaluation criteria if some variable changes by a certain amount or percentage?". Sensitivity analysis is conducted as follows:

Step 1: Estimate the resource flows and evaluation criteria of a project based on expectations of future values or the deterministic analysis. This is called the base-case analysis.

Step 2: Set assumptions on the values of the variables that underpin the values estimated under Step 1. The variables could be specific to the project or broader macroeconomic variables.

Step 3: While holding other values constant, let the base-case value of each variable change by (for example) 10 per cent, and calculate the percentage change in the evaluation criteria. The resulting number measures the degree of sensitivity of the evaluation criteria to changes in each variable while holding other variables constant.

Step 4: The results can be recorded in a table or graph where it is relatively easy to spot the key risk variables.

The variables that are an important source of risk are generally those that satisfy two criteria:

a. They represent a large share of cash receipts (benefits) or cash disbursements (costs).

b. The range of their possible values is quite wide.

However, sensitivity analysis has a number of limitations:

a. Although Step 3 above took some account of the likely range of values for a variable, there are no probabilities attached to the values in a range. As a result, sensitivity analysis does not recognise that some values are more likely to occur than others.

b. Sensitivity analysis alters the variables one at a time without considering any relationship (correlation) between variables. This shortcoming can be rectified by conducting the scenario analysis on revenues rather than selling prices, directly taking any correlation with units sold into account, or using Monte Carlo analysis properly adjusted to make allowances for the correlation.

c. How the results of sensitivity analysis are viewed depends on the risk preferences of investors or analysts. For these reasons, it is difficult to derive a general decision rule about whether to accept or reject a project based on sensitivity analysis.

The quantitative economic analysis will initially be performed using the best estimates of costs and benefits and the underlying parameters (demand forecasts, for example).

Scenario Analysis

In practice, values for input parameters for economic analysis may be interdependent or subject to systemic estimation biases. For this reason, it is sensible to conduct scenario analyses whereby the quantified economic analysis is subjected to simultaneous changes in key input parameters to test the sensitivity of the results.

The scenario analysis deals with a major limitation of the sensitivity analysis, that is, the variation of the variables individually. This tool recognises that one-at-a-time testing of variables is not realistic because of the interrelation between variables, so it provides consistent scenarios in variations of a group of variables together. Scenario analysis then solves this interrelation by allowing several variables to be altered in a consistent manner at the same time.

The main limitation of this method is that it does not allow the representation of the probability of occurrence of each of the proposed scenarios. While the scenario analysis delivers as much

information as the sensitivity analysis (considering the correlation between different variables), it is not enough since the number of variables and values for each variable that can be tested is limited. Given this limitation of the scenario analysis, this proposed user guideline will explicitly model the sensitivity analysis and the Monte Carlo simulation.

Monte Carlo Simulation Analysis

The Monte Carlo Simulation recognises the impossibility of predicting the behaviour of relevant variables of the project, especially in the medium and long term. The Monte Carlo method is a natural extension of sensitivity and scenario analysis, estimating probability distributions for those relevant variables and considering their correlation. Subsequently, a series of simulations are performed, and each one of these variables takes a value following the chosen distribution. When there is a significant number of simulations, an evaluation criteria probability distribution is estimated. Monte Carlo Simulation analysis is conducted as follows:

Step 1: Define the probability distribution for the critical variables identified in the sensitivity analysis. The selection of the probability distribution for each variable is not trivial. In many cases, simplification can be used, especially when insufficient information is available to estimate a complex probability function. Uniform or triangular distributions are recommended to perform simplified Monte Carlo Simulations; other distributions, such as normal or binomial, require more parameters and information for their specification.

Step 2: Once the random variables have been defined and the distribution for each one has been estimated, the simulation program (running in MS Excel) estimates the project's evaluation criteria. By doing this many times, a probability distribution for the evaluation criteria will be obtained.

Three cases can be identified as a result of the simulations:

a. If the evaluation criteria are acceptable (for example, the NPV is greater than 0) and the probability is 1, the project must be chosen;
b. If the evaluation criteria are not acceptable (for example, the NPV is lower than 0) and the probability is 1, the project must be rejected;
c. When intermediate cases are faced, the criterion is not unique, and the decision must be carefully taken by the project sponsor.

Risk analysis provides additional information that facilitates the decision-making process. It also allows for identifying the areas or variables most relevant to the project's final outcome, indicating where the research should be deepened and the information gathered.

The previous methods are presented in an orderly manner according to their complexity. The choice of method will depend on the size of the project and the uncertainty in its variables. The Monte Carlo method is recommended for large projects.

Finally, a risk management plan outlines the most important risks and their likelihood of occurrence, assigns responsibility for managing them, and describes how they will be monitored. The plan also outlines the planned responses should the risks materialise.

Step 8: Assess affordability and sustainability[12]

Project promoters should verify that projects are financially sustainable and affordable during implementation and operation. In addition, the managerial sustainability of the project needs to be assessed in relation to social and environmental sustainability. This analysis should be applied to the reference project and to project alternatives; however, analysts are required to use discretion and

[12] Based on Republic of Cyprus (2016).

flexibly apply the affordability and sustainability assessment to highlight the differences between alternatives rather than to confirm similarities.

Determination of Financial Sustainability and Profitability

Financial sustainability means that a project's revenues cover its costs and will not run out of cash. Financial sustainability is not the same as financial profitability, which is a more demanding standard.

Financial analysis of a public investment project is carried out for several reasons:

- To verify that a revenue-earning project is financially sustainable and will have sufficient funds to meet commitments at each stage of its life.
- To identify any changes to tariff regimes or provision of budget subsidies that may be necessary if a project is not financially sustainable.
- For commercially oriented public operating entities, to ascertain whether an investment is profitable and thus contributes to improving overall profitability (or reducing losses in the case of entities subsidised from the national budget).
- Where a project is potentially profitable, financial analysis may also point towards possible financing modalities, including PPP.

Financial analysis is applicable to revenue-earning projects, such as investments by public sector energy and water utilities or public transport operators. Further, some important financial issues should be investigated for non-revenue projects, such as the adequacy of recurrent financing during operation and financial management capacities, as well as the affordability of capital costs. These are generally the focus of separate budgetary analyses.

Financial analysis, which examines the project's financial performance independently, determines whether the project will contribute to the operating entity's financial objectives and whether it is sustainable over the longer term. Estimating the financial profitability of an individual project involves examining its net cash flows and using discounted cash flow analysis.

If the project's Financial Internal Rate of Return (FIRR) exceeds the operating entity's Weighted Average Cost of Capital (WACC), the project is financially viable. The weighted average cost of capital represents the cost (in real terms) to the entity of raising capital for the investment and, since this may come from several sources with different costs (for example, a blend of loans from different international financial institutions). If the entity receives all its investment capital via the national budget, then the cost of capital is equivalent to the central government's cost of borrowing (expressed in real terms). Where the FIRR falls below the WACC (and the project is economically viable), some form of government subsidy is needed. This may come in the form of national budget funding of a portion of investment costs or equity participation of the State in a commercial entity. Raising user charges may also be considered.

Assessment of Financial Sustainability

Financial analysis of the operating entity looks at its financial strength as a whole, its capacity to meet the project's negative cash flow requirements, if any, and, by inference, the extent and timing of any requirements for subsidies from the national budget.

Usually, a capital investment project will be carried out by an existing entity, which might be performing other ongoing operations. In these cases, the entity's financial analysis will be relevant to assessing financial sustainability. For instance, a profitable project undertaken by a financially weak or failing entity is unlikely to be sustainable. Sometimes, a project is carried out in isolation, and a new entity is created to operate it: in these cases, the two dimensions of financial analysis effectively merge into one.

Financial statements are usually produced in current prices rather than constant prices. Assumptions about inflation should be clearly stated so the statements can be reconciled against the discounted

cash flow analysis of the project, which is in constant prices. The statements should also be forward-looking, capturing forecasts of the future financial position of the operating entity, including the impact of the proposed project on revenues and costs[13].

Budgetary Analysis for Assessing Affordability

Budgetary analysis must be performed for all projects to determine the net impact on the national budget during implementation and operation and to establish whether an investment is affordable from the fiscal perspective. It enables affordability to be assessed in relation to projections of expenditure ceilings and available fiscal space during budget preparation.

The minimum requirements for demonstrating the budgetary impact are shown in Table 10, which identifies total budgetary costs, projected revenues (if any) and the net impact. Costs for budgetary impact analysis must be in current prices (i.e., adjusted for inflation). Economic entities promoting projects must consult with the relevant statistical authority to obtain forward inflation estimates. If annual operating and maintenance costs are expected to be very similar, the post-implementation analysis period can be truncated, and estimated annual averages can be presented post-year. For projects expected to be financed from diverse sources outside of national budgetary funding, Table 11 should be completed to supplement Table 10.

Table 10: Summary of budget analysis

	Year 1	Year 2	Year 3	Year…	Year n
Budgetary Costs					
Capital Costs					
Net Recurrent Costs					
Operation					
Maintenance					
TOTAL COSTS					
Project Budgetary Revenues (if any)					
NET BUDGETARY IMPACT					

Source: Based on *International Best Practices*

Table 11: Expected sources of funding for project implementation

	Year 1	Year 2	Year 3	Year…	Year n
Donor 1 financing					
Donor 2 financing					
Donor 3 financing					
Budgetary funding					
National private capital					
Other Loans					
TOTAL SOURCES EXPECTED FUNDING FROM ALL SOURCES OF FINANCE					

Source: based on *International Best Practices*

A full budgetary analysis can be employed to estimate the total budgetary impact in present value terms and establish whether it is positive overall. This is wider in its perspective than the financial analysis (but not as wide as economic analysis) because it takes account of all direct and indirect financial flows that impact public finances and not just those that affect the project's operating entity.

[13] F*urther explanations can be obtained from UK HM Treasury, 2013.*

A full budgetary impact analysis should only be prepared for major projects with significant direct revenue-earning potential or substantial tax effects.

Table 12 is an example of the information that should be included in the full budgetary analysis of a major project. The analysis period should extend throughout the useful life of the project. Based on the analysis of the information in Tables 10 and 11, it can be established whether or not the project has a positive or negative net impact on the public sector finances in present value terms. The net fiscal impacts in each year are expressed in present value terms using a discount factor and are summed to arrive at the net present value of the project for the budget. Table 12 shows a format of the Net Cash Flow Analysis, which includes estimates of the taxes that will be generated by the project. These can be direct or indirect tax effects, but it can be difficult to estimate the latter, so a cautious approach is recommended, and only incremental tax revenues that would not have occurred without the project should be considered.

Table 12: Format for public sector budgetary analysis - Net cash flow analysis

	Year 1	Year 2	Year 3	Year…	Year n
Revenues from charges					
Residual values					
TOTAL INFLOWS					
Budget subsidies/grants					
Operating costs					
Investment costs					
Decommissioning costs					
TOTAL OUTFLOWS					
Indirect taxes (e.g. vehicle registration, custom & excise)					
Direct taxes (e.g. personal income tax, corporation tax)					
TOTAL TAX IMPACT					
OTHER FLOWS					
NET CASH FLOW FOR FINANCING					
DISCOUNTED NET CASH FLOW					

Source: based on *International Best Practices*

Assessment of Institutional/Managerial Sustainability of Projects

Efficient project implementation requires a capable organisation with adequate internal arrangements for:

- Managing the different phases of the proposed project, identifying issues that need to be resolved and ensuring their resolution;
- Ensuring that the required approvals and direction are obtained at each stage;
- Ensuring a proper flow of information between stakeholders; and
- Making sure necessary policies and procedures are followed.

The project appraisal should include an assessment of the adequacy and sustainability of implementation and operational arrangements for the proposed project. This should include an assessment of the capacities of the organisation(s) responsible for implementing and operating the project, indicating any strengthening measures required before construction or operation commences. The project appraisal, therefore, needs to include the following elements:

- An assessment of the capabilities of the organisation(s) responsible for implementing and/or operating the project, especially the adequacy of human resources to meet the estimated needs

during implementation and operation, identifying any constraints and proposing capacity building measures, where required.

- Development of an outline plan and timetable for implementing the project, indicating key milestones in detailed planning, approval and construction. This should include the steps from approval of the FS to commencement of construction, i.e., detailed design, preparation of tender documents, procurement arrangements, environmental and spatial planning approvals, and land acquisition.
- Planning for the project management arrangements, including the organisational arrangements and allocation of responsibilities between the different parties involved. If any part of project management is to be handled external to the organisation promoting the project, this should be indicated.
- Assessment of the organisational arrangements and the allocation of responsibilities for operating and maintaining the project once completed, including assessing the organisation's capabilities.

Assessment of the Economic Profitability Projects

Economic analysis requires that project viability is demonstrated/estimated from the point of view of the entire economy. The steps required to carry out an economic analysis are as follows:

- Estimate the CSCF for all the prices of inputs and outputs involved in the evaluation
- Estimate the future changes in the relative prices for each input and output variable. This will involve the examination of the present and future demand and supply forces that are expected to prevail in the market for the item.
- Multiply the economic prices for each item by the projections of quantities of inputs and outputs through time to express these variables in the current year's prices for the period in which they are expected to occur.
- Prepare a resource flow statement using the current values for the inputs and outputs.
- Discount the net economic resource by the Economic Opportunity Cost of Capital.

Assessment of the Environmental and Social Sustainability of Projects

Infrastructure projects frequently have environmental and social impacts arising from construction and operation that, if significant enough, could threaten long-run sustainability. Beyond financial, budgetary, and managerial sustainability, decision-makers need to be provided with adequate evidence on the environmental and social sustainability of projects and made aware of any significant risks that could threaten sustainability.

Environmental and social costs and benefits should, to the extent possible, be accounted for in monetary terms in the economic analysis and be included in the aggregate measure of economic viability. Where this is not the case, non-monetised costs and benefits should nevertheless be identified, and their relative importance should be assessed at project appraisal. Environmental and social impacts of the projects are usually negative and may have significance beyond what can be captured in aggregate measures of economic viability. The effects of political, social, and legal constraints and long-term environmental concerns will question long-run sustainability if they exceed or risk exceeding explicitly defined limits or implicit tolerances, even if a project is shown to be economically viable. Decision-makers must then balance these broader sustainability issues against economic viability considerations.

Where valuation in monetary terms is not possible, costs and benefits should be identified in quantitative or qualitative terms and their relative importance compared to monetised benefits and costs assessed. In this case, 'quantitative' means a numerical indication of the scale of environmental and social benefits and costs, such as quantified

levels of CO2, pollution in terms of Parts Per Million (PPM), the number of households affected by increased noise and by how much (decibels), etc.

Depending on the scale and nature of the project, and the likely importance of these effects, a formal environmental impact assessment and/or social impact assessment may be necessary. Environmental and social impacts should be explored in depth in the FS and summarised for decision-makers, adjusted based on the sector in question.

Any licenses and permits required by the project in relation to environmental issues should be identified, along with the procedures and timetable for obtaining them. This process must be factored into the project implementation plan. If environmental monitoring is a requirement for project completion, the arrangements for doing this must also be described.

Bearing in mind the limitations of economic analysis, project appraisal also requires a wider perspective that examines the implications of unbalanced impacts on the sustainability of the project. If, for example, a certain group(s) of stakeholders (e.g., a region or an income group) is negatively affected disproportionately and cannot be commensurably compensated, this could damage the acceptability of the project from a social perspective, which would not be picked up in the economic CBA. Social impact assessment, therefore, involves identifying stakeholder groups likely to experience major welfare losses (or gains) due to the project. Similarly, localised environmental impacts may exceed statutory limits or acceptable tolerances for specific ecosystems or stakeholders. Environmental impact assessment involves identifying these cases.

Step 9: Recommendations to Decision-Makers[14]

Once the economic analysis is performed and the analysis steps are followed, it will be possible to determine whether the project is viable based on its socioeconomic profitability. In either case, the analysis will provide enough information to recommend making the project smaller, waiting a certain amount of time to undertake it, or providing the necessary elements to go with the investments and carry on with the project.

The final step involves identifying the preferred alternative on the basis of a comprehensive appraisal of all factors and arriving at a decision on whether to proceed with a project proposal. All relevant project impacts and quantitative and/or qualitative findings must be recorded. The recommendation should be made based on the findings with respect to economic viability combined with the findings on sustainability and non-monetised effects. The social impact of the project, i.e., where the costs and benefits fall, also needs to be considered. The sustainability of the project from a number of different perspectives, both during implementation and operation, also needs to be confirmed.

Based on the quantitative economic analysis, project promoters should decide whether the project as conceived is preferred over the alternatives considered, including doing nothing. In making this decision, the robustness of the quantitative economic analysis should be considered. The decision on financial and economic viability should be made based on the expected NPV determined through a probabilistic analysis. Where this cannot be done, either because of the absence of data (or valid approximations) on the probabilities of key outcomes or because the research effort is not justified, the findings of sensitivity analysis should be considered when confirming that the economic case remains robust.

Other things being equal, this would indicate that the project is not economically viable; however, if non-monetary benefits are significant, this finding may be overturned, provided there is strong and well-argued justification. A qualitative assessment of the importance of these benefits is therefore required as a basis for reaching a decision. Equally, a positive economic case for a project based on

[14] *Based on Republic of Cyprus (2016).*

quantitative economic analysis may still be overturned if non-monetised costs (negative externalities) are demonstrated to be unacceptable or if there are unacceptable concerns about a project's environmental or social sustainability.

The comprehensive appraisal involves considering the affordability and sustainability factors and assessing the importance of any significant intangible benefits and costs that were not feasible to monetise. If the affordability and sustainability analyses and economic analysis point in different directions, then the final recommendation must be carefully presented, giving a full explanation of the reasoning and the relative weights given to the different factors in arriving at the conclusion. If the quantitative economic analysis indicates that one of the project alternatives is more attractive than the reference project, then project promoters should consider investigating this alternative in more depth. This may require further studies and a new project appraisal. A PFS or FS is the core analytical document for project appraisal. This must be supported by technical studies. An FS is too detailed a document for decision-makers. The Project Appraisal Report must, therefore, contain a clear recommendation on whether to proceed, justified based on the FS findings.

If the project is appraised to be financially unsustainable or unaffordable within current budgetary allocations, it may not proceed in the current form. Either further development of the project should be halted, or ways of reducing costs, such as phasing or reducing the specification, must be considered. Project promoters should be ready to perform a number of iterations of the project appraisal process, including introducing new project alternatives, to find an affordable solution if necessary.

5.0 PROJECT EVALUATION CRITERIA

The financial and economic attractiveness of a project is determined by the net present value of its incremental net cash or resource flows. Accountants, financial analysts, and economists widely accept the net present value criterion as the evaluation criteria that yields correct project choices in almost all circumstances. However, some investors have frequently relied upon other criteria, such as a project's internal rate of return and the cost-benefit ratio.

5.1 Time Dimension of a Project

Investment decisions are fundamentally different from consumption decisions because the former have a time dimension. For example, land and capital equipment are purchased at one point, and they are expected to generate net cash flows, or net economic benefits, over several subsequent years. To determine whether the investment is worthwhile, it is necessary to compare the benefits and costs, which occur in different time periods.

The time dimension of a project's net cash flows and net economic benefits can be captured by expressing them in terms of either future or present values. To compute future values (FV), analysts must compound the present value (PV) with the interest rates (r). On the other hand, when bringing future values back to the present for comparison purposes, it is necessary to discount them. Discounting is just the inverse of compounding.

The discount factor allows us to compute the present value of an amount received or paid in the future. Since we are moving backwards rather than forward in time, the discount factor is the inverse of the compound interest factor. At a 10% annual discount rate, the discount factors are as follows in Table 13.

$$[FV = PV(1+r)^{t}]$$

$$t = time/\ period/\ number\ of\ years$$

Table 13: Discount factor estimation

Year	**0**	**1**	**2**	**….**	**50**
Formula	$1/(1.1)^0$	$1/(1.1)^1$	$1/(1.1)^2$		$1/(1.1)^{50}$
Value	1.0	0.9	.826		0.0085

Source: *Jenkins G, Harberger A, Kuo Ch. (2013).*

The later a cash flow is received or paid, the lower its present value. Thus, GHS100 received 50 years from now has a value of only GHS0.85 today at a 10% discount rate.

5.2 The Discount Rate

To determine whether the investment is worthwhile, it is necessary to compare the benefits and costs, which occur in different time periods. Therefore, it is not possible to just add up the benefits and costs of a project to see which is larger without first considering that Ghana cedis spent on investment today are worth more today than Ghana cedis received as benefits in the future.

The discount rate is a key variable in applying any major investment criteria to project selection. The correct choice of discount rate is critical, given that a small variation in its value may completely alter the analysis's results and affect the final choice of a project.

The discount rate, stated in simple terms, is the cost of funds invested in the project. In financial analysis, the discount rate depends on the point of view of the analysis. For instance, when a project is being appraised from the point of view of the equity holders or owners, the relevant cost of funds is the return on equity being earned in its alternative use. Thus, if the equity holders are earning a return of 15% on their current investments and they decide to invest in a new project, the cost of funds or the discount rate from their perspective for the new project is 15%. When appraising the project from the total investment or the bankers' perspective, the relevant discount rate is the Weighted Average Cost of Capital (WACC). For instance, if one-third of the funds are coming as equity and the rest as loans at an interest rate of 12%, the discount rate is the weighted sum of 15% and 12%, the weights being equal to 1/3 and 2/3, respectively. Thus, the discount rate is 13%. If the loan comes from more than one lender, including foreign lenders, at different interest rates, then the discount rate is the weighted average of the return on equity and the different interest rates. If, in the above example, half the loan is at 12% and the remaining half at 6%, the discount rate is a weighted average of 15%, 12%, and 6% with equal weights. Thus, the rate is 11%.

In the financial analysis, besides the timing of the cash flow, the other factor that determines the discount rate is the level of market interest rates. This is why it is critical to pay attention to the estimation of the private and economic discount rates in the financial and economic analyses.

The SDR is most relevant in a project's economic analysis. The SDR is society's rate of time preference and the rate used to convert future values into present value equivalents. The discount rate is the cost of funds, but in economic analysis, it is the cost imposed on the economy. The SDR specified for calculating present values is also a real rate.

5.3 The Net Present Value Criterion

The Net Present Value (NPV) is the algebraic sum of the present values of the incremental expected positive and negative net cash flows over a project's anticipated lifetime. If this sum is equal to zero, investors can expect to recover their incremental investment and earn a rate of return on their capital equal to the private discount rate used to compute the present values[15].

An NPV greater than zero means that investors can expect not only to recover their capital investment and earn a rate of return equal to the discount rate but also to receive an addition to their real net worth equal to the positive amount of the NPV. Only projects with positive NPVs will be beneficial and, hence, attractive to private investors. They are unlikely to pursue a project with a negative NPV unless there are strategic reasons.

The formula for computing the NPV of expected incremental net cash flows over n time periods with annual discounting is:

[15] *The recovery of the invested capital is anticipated when because the incremental capital expenditures are included in the initial negative net cash flows.*

$$\text{NPV} = \sum_{t=0}^{n} \frac{CF_t}{(1+\text{r})^t}$$

Where:

The incremental net cash flows (CF_t) could be negative, zero, or positive.

r is the discount rate equal to the cost of capital

The Sigma sign ($\sum$) is the symbol for summation.

The NPV formula can be written out in its component present values of the annual net cash flows as follows:

$$\text{NPV} = C_0 + \frac{CF1}{1+\text{r}} + \frac{CF2}{(1+\text{r})^2} + \ldots + \frac{CF_n}{(1+r)^n}$$

The net present value criterion can be stated as a set of decision rules.

Decision Rule 1: Do not accept any project unless it generates a positive NPV when discounted by a discount rate equal to the opportunity cost of the funds.

Decision Rule 2: To maximise net wealth, choose among the various projects, or scenarios of projects, the one with the highest NPV. If the investment is subject to a budget constraint, choose the package of projects that maximises the NPV of the fixed budget.

Decision Rule 3: When there is no budget constraint, and a choice must be made between two or more mutually exclusive projects, e.g., projects being considered for the same building site, investors seeking to maximise net worth should select the project with the highest NPV.

These rules follow from the definition of the NPV, namely the algebraic sum of the present values of the incremental expected positive and negative net cash flows over a project's anticipated lifetime.

5.4 The Internal Rate of Return Criterion

The Internal Rate of Return (IRR) is the discount rate (ρ) that sets the NPV = 0, as illustrated in the following equation:

$$\sum_{j=1}^{n} \frac{CF_j}{(1+\rho)^j} - I_0 = 0$$

Where:

CFj is the incremental net cash flow in year j to total, or equity, capital,

I is the initial investment,

ρ is the IRR.

This definition is consistent with the meaning of a zero NPV, as explained in the previous section, namely that investors recover their invested capital and earn a rate of return equal to the discount rate, which is the IRR. The IRR criterion can be stated as a set of decision rules.

Decision Rule 1: Do not accept any project unless its IRR is greater than the opportunity cost of the funds (accept the project if ρ > r, the opportunity cost of capital; otherwise, reject).

The opportunity cost of capital is measured by the cost of funds, or the expected rate of return offered by other assets equivalent in risk to the project being evaluated.

Decision Rule 2: When a choice must be made between two or more mutually exclusive projects, investors should select the project with the higher or highest IRR.

Weaknesses of the IRR

Though both NPV and IRR criteria use the same formula, there are profound differences between them. Some of the problems of the IRR are the following:

The IRR may not be unique, there could be multiple IRRs, or the IRR may not even exist*. The IRR is, strictly speaking, the root of a mathematical equation. The equation is based on the time profile of the incremental net cash flows. If the time profile crosses the horizontal axis from negative to positive only once, the root, or IRR, will exist, but it may not be positive. However, if the time profile crosses the axis more than once, there may be more than one root, or there may be no real roots, only imaginary roots. Although this may sound more of a theoretical concern, it is certainly disconcerting to know that an investment decision criterion may not have a solution.*

Wrong ordering of mutually exclusive projects, e.g. projects of different scales*. The problem of choosing between two or more mutually exclusive projects arises quite frequently. Examples would include two alternative buildings being considered for the same building site or a new highway that could run down two alternative rights of way. Whereas the NPV takes explicit account of the scale of the project using the required investment and the initially negative net cash flows accompanying it, the IRR ignores the differences in scale. The IRR is expressed as a rate per Ghana cedis of investment but does not indicate how many Ghana cedis that rate can earn.*

IRRs are not additive*. Larger projects frequently have several separable components. Each should be analysed on its own merits and then assessed in conjunction with the others. Since some of the possible components may be mutually exclusive, those separate combinations must also be examined.*

The problem is that whereas NPVs are additive, IRRs are not. When the separate projects were analysed, they all had the same scale of investment, but the combinations increased the scale of investment and, therefore, should not be ordered according to the IRR criterion. In this case, the larger scale of investment lowers the IRRs of the combinations and makes them appear less attractive.

5.5 The Benefit Cost Ratio Criterion

As the name indicates, the Benefit–Cost Ratio (BCR), sometimes referred to as the profitability index, is the ratio of the NPV of the net cash inflows (or economic benefits) to the NPV of the net cash outflows (or economic costs):

$$BCR = \frac{NPV\_\text{inf}lows / economic\_benefits}{NPV\_outflows / economic\_\text{cos}ts}$$

The following set of decision rules should guide the use of the benefit-cost ratio criterion to determine project viability:

Decision Rule 1: Do not accept any project unless its BCR is greater than one (Accept the project if BCR > 1; otherwise, reject). The NPVs in both the numerator and the denominator of the ratio should be discounted by the opportunity cost of the funds. The opportunity cost of capital is measured by the cost of funds or the expected rate of return offered by other assets equivalent in risk to the project being evaluated.

Decision Rule 2: When a choice must be made between two or more mutually exclusive projects, investors should select the project with the higher or highest BCR.

Due to its limitations, using the BCR alone to measure economic desirability risks screening out possibly viable projects. In some instances, good projects could be eliminated from consideration early on based on their BCRs, lowering the overall NPV unnecessarily. Subsequent sections will demonstrate that the NPV criterion and the BCR criterion can often draw the opposite conclusion; using the two criteria together then becomes a source of confusion or mistakes.

Also, the IRR and BCR criteria have weaknesses compared to the NPV criterion, which is generally recommended in corporate finance theory for project decision-making.

5.6 The Annual Net Present Value Criterion

According to the third decision rule of the NPV criterion, when there is no budget constraint and a choice must be made between two or more mutually exclusive projects, investors seeking to maximise net worth should select the project with the highest NPV.

Note that to be compared, alternative and mutually exclusive projects should have the same length of life. This section addresses this caveat. The reason for wanting to ensure mutually exclusive projects have the same length of life when their NPVs are being compared is to give them the same opportunity to accumulate value.

Consider two mutually exclusive projects with the same scale of investment, a three-year Project A and a four-year Project B, that have the following net cash flows. All the net cash flows are expressed in thousands of GHS, and the cost of capital is 10%. See Table 14.

Table 14: Example of NPV calculation

Time Period	**t_0**	**t_1**	**t_2**	**t_3**	**NPV @ 10%**
Net Cash Flow A	10,000	6,000	6,000		410
Net Cash Flow B	10,000	4,000	4,000	4,750	500

Source: Jenkins, Harberger & Kuo (2013).

If we were to overlook the differences in the lengths of life, we would select Project B because it has the higher NPV. In doing so, however, would run the risk of rejecting the potentially better Project A with the shorter life.

One approach to this problem is to determine whether we might be able to repeat the projects a number of times (not necessarily the same number of times for each project) to equalise their lives. To qualify for this approach, both projects must be supra-marginal (i.e., have positive NPVs) and should, in fact, be repeatable at least a finite number of times, e.g., the rebuilding of a dock.

Assume that the two projects, A and B, above meet these requirements. If we were to repeat Project A three times and Project B twice, then both projects would have a total operating life of 6 years, as shown in Table 15.

Table 15: Example of NPV calculation

Time Period	t_0	t_1	t_2	t_3	t_4	t_5	t_6
Project A's NPV for each repeat	410		410		410		410
Project B's NPV for each repeat	500			500			500

Source: Jenkins, Harberger & Kuo (2013).

In year t_6, both projects can start up again, but there is no need to repeat this procedure. Given the equal lengths of life for the repeated projects, they can now be compared based on Decision Rule 3.

$$NPV\ of\ A's\ repeats = 410 + \frac{410}{(1.1)^2} + \frac{410}{(1.1)^4} = 1{,}029$$

$$NPV\ of\ B's\ repeats = 500 + \frac{500}{(1.1)^3} = 876$$

Given an equal opportunity to earn economic rents, Project A has a higher overall NPV and should be considered the more attractive project.

The approach to rank mutually exclusive projects with different lives can be generalised. The Annual Net Present Value Criterion (ANPV) is the indicator to be used when the analysed alternatives produce the same benefits but have a different useful life, according to the following equation:

$$ANPV = NPV * \left[\frac{(1+\mathrm{r})^t * r}{(1+\mathrm{r})^t - 1} \right]$$

Where:

NPV is the Net Present Value.

r is the discount rate.

t is the evaluation horizon.

The decision rule is to select the alternative that has the highest ANPV.

Using this formula for a reasonable number of repetitions is acceptable.

5.7 The Evaluation Period

The evaluation horizon corresponds to the period of time for which the project evaluation will be done. An analysis period must be decided upon, over which the benefits and costs of the reference project and those of its alternatives will be assessed. The analysis period should normally correspond to the useful life of the fixed asset created and should be the same for all alternatives. In reality, some major infrastructure assets have almost indefinite lives, provided a programme of planned routine and periodic maintenance is pursued. It has been common practice internationally to curtail the analysis period and include a residual value as a benefit in the final year of the chosen analysis; however, this can potentially be a crude approach, depending on the extent to which future values are discounted.

It is assumed that during this period, there will be no major changes that affect the assumptions made when evaluating the project. It should be noted that if the evaluation horizon is less than the project's economic useful life, then its residual value must be estimated. Table 16 presents the reference analysis periods by sector as recommended by the European Commission.

Table 16: Reference periods for project appraisal by sector

Sector	Years
Railways	30
Roads	25-30
Ports and Airports	25
Urban transport	25-30
Water supply and sanitation	30
Waste management	25-30
Energy	5-25
Broadband	5-20
Business Infrastructure	10-15
Other sectors	10-15

Source: European Commission (2014).

In keeping with the approach adopted in a number of countries with best practices, the recommended approach in this manual is to place less weight on residual values and use an analysis period more closely reflecting the useful life of a long-lived asset. The analysis period for major infrastructure projects involving a large share of civil works (roads and airports, for example) may, therefore, be extended beyond 30 years to as much as 60 years. Projects with significant environmental benefits and costs which extend across generations may have even longer analysis periods.

5.8 Cost-Effectiveness Analysis

Cost-Effectiveness Analysis (CEA) is similar to cost-benefit analysis, but it does not involve placing monetary values on the major benefits of a project. In this regard, benefits are expressed in physical units rather than in monetary terms.

CEA provides a measure of the relative effectiveness of alternative projects in achieving a given objective. It is applied in situations where it is easier to identify benefits than to value them; thus, it is more widely used in the areas of health, education, and defence, where there are some difficulties in putting monetary values on benefits like improvements in life expectancy, reductions in illness and improved quality of education. CEA compares the cost of alternative ways of producing the same or very similar outputs or outcomes. The results can be expressed either as a cost (GHS) per unit output/outcome or as outputs/outcomes per GHS. Like cost-benefit analysis, costs over the life cycle of a project are discounted to arrive at present values and present costs for the project.

The limitation of CEA is that it does not provide a criterion for accepting or rejecting a project because costs and benefits are not directly comparable. If a political decision has been made to undertake certain expenditures, for instance, on pure public goods, cost-effectiveness analysis can be applied to ensure that services are provided in the most efficient way possible. In this example, the value of benefits no longer matters because a political decision has been made to provide them anyway.

> *CEA is often used to find the project alternative that meets a predefined objective at minimum cost from a range of alternatives. It can also be useful as part of an initial analysis of alternatives prior to a cost-benefit analysis to identify a shortlist of project alternatives to pursue for a more in-depth cost-benefit analysis.*

In applying the CEA, the Net Present Costs (NPC) or the Annual Net Present Cost (ANPC) must be computed. While using the CEA, it is important to estimate the salvage values correctly at the end of the projects and choose the discount rate carefully. The preferred outcome may clearly change with a change in the discount rate. The rate at which the two alternatives are the same is referred to as the "cross-over discount rate".

The Net Present Costs Criterion (NPC)

In some cases, the CBA cannot be applied; for example, for projects where the benefits are difficult to estimate in monetary terms or in cases where different alternatives provide the same (or equal) level of services. In such cases, the NPC is the indicator to be used when comparing project alternatives that have the same benefits and useful life, according to the following equation:

$$NPC = \sum_{t=0}^{n} \frac{C_t}{(1+r)^t}$$

Where:

C_t is the economic cost of the project for each period;

r is the discount rate equal to the SDR.

t is the evaluation horizon.

The decision rule is to select the alternative with the lowest NPC (assuming that the benefits from different alternatives are the same).

The Annual Net Present Cost Criterion (ANPC)

The ANPC is the indicator to be used when the analysed alternatives produce the same benefits, but have a different useful life, according to the following equation:

$$ANPC = NPC * \left[\frac{(1+r)^t * r}{(1+r)^t - 1} \right]$$

Where:

NPC is the present value of costs.

r is the discount rate equal to the SDR.

t is the evaluation horizon.

The decision rule is to select the alternative that has the lowest ANPC.

6.0 ECONOMIC APPRAISAL

In the realm of investment project evaluation, financial analysis plays a crucial role in assessing the financial viability and impact of a proposed project from the perspective of the covered entity. This analysis involves constructing cash flows that reflect the project's financial inflows and outflows, taking into account factors such as revenue generation, operational expenses, and capital investments. Financial analysis provides valuable insights into the project's profitability, financial sustainability, and overall financial viability, enabling informed decision-making regarding project implementation and resource allocation.

Economic evaluation is similar to financial evaluation regarding the changes in the wealth generated by projects. However, economic evaluation is concerned with society's welfare as a whole and not just about the resources of a covered entity. Thus, it considers the real costs and benefits based on the use of the country's resources.

Another difference between financial and economic analysis relates to prices to estimate benefits and costs. Where outputs and inputs markets are perfectly competitive and there are no other economic externalities, market prices will be a good measure of economic prices. Under these conditions, and where a project introduces only small changes in the demand for its inputs and in the supply of its outputs, the financial analysis of a project will serve as a good proxy for the economic analysis.

Table 17: Differences between financial and economic analysis

	Financial Analysis	Economic Analysis
Perspective	Agency/organisation/firm	Economy/Society
Objective	Analysis of the net financial impact of the proposal on the agency	Maximising the social returns to the economy's resources
Pricing	Market prices	Opportunity costs/shadow prices
Transfer payments (taxes & subsidies)	Included	Excluded
Equity/distributional effects	Excluded	Can be included, usually treated qualitatively
Externalities	Excluded	Included
Financial Depreciation	Excluded (from discounted cash flow analysis but included in financial statements).	Excluded
Economic Depreciation	Excluded	Included

Source: *International Best Practices.*

The incremental net economic resource flow is the difference between total benefits and total costs on a year-by-year basis. The values of the resulting annual net economic flow are then discounted to the initial year of analysis at the Social Discount Rate (SDR) to compute the project's economic NPV.

The economic NPV criterion allows for the best combination of projects when selecting among several alternatives. Alternative projects with the highest NPVs should be selected first to maximise net economic benefits over time.

In practical terms, the incremental economic resource flow statement consists of two parts: economic benefits and economic costs. On the benefit side, four types of benefits should be considered:

i) Release of resources
ii) increase in consumer surplus
iii) sales revenues
iv) externalities.

Real versus Nominal Prices

"Nominal" prices are easily observed in the marketplace, while underlying "real" prices are not. The nominal price of an item is its real price plus the cumulative effect of inflation. To simplify the financial analysis, the analyst might use only "real" costs and benefits. If the real input or outcome for a commodity or service changes for any reason other than inflation, the projected future nominal cost will also be adjusted.

Conversion of Financial Expenditures into Economic Costs.

Economic prices reflect the actual resources used or produced by a project and do not include tariffs, taxes, and subsidies, as these are financial transfers within the same economy. An Economic Conversion Factor (CF) is the ratio of the economic price of a commodity to its financial price. Market distortions drive a wedge between the financial and economic prices of goods and services[16]. The concept of the CF is a way to express the relationship between the economic and financial values of the same commodity or service. Hence, the economic price of any commodity can be determined by multiplying the CF for that commodity by its financial price:

$$CF = \frac{\text{Economic Cost}}{\text{Financial Cost}}$$

Once all conversion factors have been estimated, transforming financial expenditures into their economic equivalents is very straightforward.

Costs in financial prices are adjusted to reflect the economic resource cost of project inputs in terms of the domestic price. Costs are allocated to tradable goods, non-tradable goods, foreign skilled labour, local skilled labour, local unskilled labour, fuel, and transfer payments and are adjusted by the appropriate conversion factors. Non-tradable goods and skilled labour are assumed to reflect their economic prices; hence no conversion factor is applied. Tradable costs (including fuel) are multiplied by the shadow exchange rate factor, and unskilled labour costs are multiplied by the shadow wage rate factor. Transfer payments and price contingencies are excluded from the economic analysis.

Economic Parameters

Investment and operating cost components consist of individual items such as freight, insurance, non-tradable and tradable materials and equipment, and tradable fuel costs. Before calculating the conversion factors for the investment and operating items, it is necessary to determine the following cash flow items.

- Import tariff.
- Local freight and handling.
- Non-tradable materials.

For each component of investment-cost items, the investment cost must be broken down into tradable and non-tradable materials and skilled and unskilled labour. Operating costs consist of wages, maintenance, and repair materials but exclude generating costs such as fuel costs. The CF for operations and maintenance is the weighted average of the conversion factors for labour and material as estimated for maintenance. Generation cost items consist mainly of fuel and capacity costs. The CF for generation is calculated based on shares and available conversion factors.

Economic CFs are required to estimate the economic cost components of projects. A database of economic conversion factors for all commodities is suggested to be developed and organised into a

[16] Jenkins, G.P., Kuo, C.Y. & Harberger, A.C. (2013). "Cost–Benefit Analysis for Investment Decisions". Chapter 7: Principles Underlying the Economic Analysis of Projects.

single database under a harmonised tax system[17]. To arrive at economic costs, the analyst should examine the outlays on domestically produced inputs, imported inputs, cost of services (i.e., design, supervision, etc.), and labour by skill[18].

The economic cost of foreign exchange (Foreign Exchange Premium, or FEP) is extensively used in the calculation of economic conversion factors. FEP represents the difference between the market value and the economic value of foreign exchange[19].

The labour markets of many developing countries are characterised by high rates of unskilled labour unemployment and close-to-full employment of skilled labour and are generally highly regulated, unionised, and distorted. In such situations, the wage rate paid by a project for a particular skill or occupation will usually be significantly different from its economic opportunity cost.

The SDR is the appropriate discount rate to use when estimating the economic Net Present Value (NPV). From the point of view of the economy, funds are generally drawn from three sources. Firstly, some funds would have been invested in other investment activities and have now been displaced by the project (the cost of these funds is the return that would have been earned on the alternative investments that are now foregone).

Secondly, funds come from different categories of savers in the economy, who postpone consumption in the expectation of getting a return on their savings (the cost of this part of the funds is the cost of postponing consumption, and this is reflected in the interest rate that the savers earn).

Finally, some funds may be coming from abroad, that is, from foreign savers (the cost of these funds would be the marginal cost of foreign borrowing). The SDR will simply be a weighted average of the costs of funds from the three sources outlined above: the rate of return on postponed investments, the rate of interest on domestic savings, and the marginal cost of additional foreign capital inflows. ***For developing countries, a 12-percent SDR is generally adopted if a more accurate estimate is not available.***

[17] A user-friendly online database software called National Parameters has been developed for Ghana. This open-source software is available to analysts, including private companies, international bilateral agencies and development institutions. It can be found at http://national-parameters.mofep.gov.gh. The conceptual framework and estimation procedures are presented in "Cost–Benefit Analysis for Investment Decisions", *Chapter 10 and Chapter 11*.

[18] Please refer to Jenkins, G.P., Kuo, C.Y. & Harberger, A.C. (2013, *Chapter 12)*.

[19] Please refer to Jenkins, G.P., Kuo, C.Y. & Harberger, A.C. (2013, *Chapter 9)*.

7.0 SECTOR-SPECIFIC METHODOLOGIES FOR ECONOMIC APPRAISAL

In Ghana, the decision to undertake an investment project is not taken lightly. Significant resources are often committed to these projects, and it is crucial to ensure that they are economically viable and aligned with national development goals. Economic appraisal, therefore, plays a vital role in evaluating proposed projects' potential benefits and costs, providing a basis for informed decision-making.

This section delves into the economic appraisal of investment projects in six key sectors that contribute significantly to Ghana's socio-economic development: health, education, energy, roads, irrigation, and public buildings. Each sector faces unique challenges and opportunities, and the economic appraisal process must be tailored to capture the specific benefits and costs associated with each type of project.

Cost estimation considerations

In performing this task, it is essential to bear in mind the following:

- **All Inputs and Assets Should Be Assessed**: Even though some project inputs or assets may be owned by the entity that will implement the project or have been donated or provided at no cost, they should be valued anyway. From society's point of view, all inputs used by the project could eventually have an alternative use in another economic activity; this alternative use must be forgone because the project will use the input or asset. Thus, when the project uses the inputs or assets, society stops receiving the benefits it would bring if another project or alternative activity had used those inputs or assets. This concept is the "opportunity cost" of inputs or assets.
- **Taxes Must Be Identified and Treated Separately**: For society, the taxes associated with project inputs or assets are not a cost. Indeed, even though they must be paid to carry out the project or paid during its operation, those resources are used in other works. Therefore, from society's point of view, a tax is just a transfer, not a resource cost. It is assumed that the state uses cash subtracted from the project via taxes (at a national, regional, or municipal level) in other projects with similar economic profitability. Thus, taxes on a project's inputs are just transfers to society, the equivalent of taking money from one pocket and putting it in another.
- In the case of taxed inputs, the analyst needs to provide its price with and without tax. The price without tax must be used in the economic evaluation of the alternative project. The price with tax shall be used to develop the project's budget, used to determine financing needs.
- **All prices must be expressed in the currency of the same date:** Because of inflation, the purchasing value of money has diminished over time. Therefore, it is

required that prices be in real terms, reflecting the value they had on a particular date. To bring the prices of inputs to the same date, the procedure is as follows:

  - Choose an indicator to correct the general price level; usually, it is the Consumer Price Index (CPI).
  - Seek the CPI values corresponding to the dates of the prices we know for each input.
  - Choose a date on which all costs are to be expressed and the corresponding value of the index sought.
  - Calculate the corrected prices or costs, i.e. expressed in the currency of the desired date.
  - Correct market prices and use economic (social) prices, where applicable.

- **Calculation of the total cost of each input**: The last step in estimating project costs is the calculation of the total cost required for each input. To do this, simply multiply the amount of input by the price and get your total cost for that input.
- **Summary table of the costs of the alternative**: Finally, it is worthwhile summarising all the information gathered in the previous steps in a supplementary table showing the required volume of each input, its price, and the total estimated cost for each item. Two versions of this auxiliary table should be prepared. The first supplementary table should be called "project budget calculation" which usually includes all prices with their corresponding taxes (i.e., sales, VAT, etc.). However, it should exclude input donated or provided for free to the project.

Furthermore, since this budget will be used to negotiate the funding of the project's implementation, it is appropriate to add an item to cover incidentals. The second auxiliary table should be called "project economic evaluation", which presents all prices excluding their corresponding taxes (i.e., sales, VAT, etc.). It should also include any inputs or assets donated or provided for free to the project, valued at their market price. It should consist of all appropriate inputs, corrected at economic prices, such as labour, equipment if they are imported, etc. This table will be used to make an economic evaluation of the project alternative.

7.1 IRRIGATION SECTOR

In general terms, as stated by the Asian Development Bank (2017, pp. 40), agriculture projects "usually involve one or more of the following activities: constructing or rehabilitating irrigation systems; introducing new farming technologies, including crop varieties; providing agriculture extension services such as building storage facilities and market information and training; supporting research and development in agriculture; and increasing livestock and fishery production. Natural resource projects include interventions to improve the management of land or water resources such as forests, wetlands, watersheds, and aquatic environments, including fisheries". This methodology for irrigation and dam projects is focused only on those activities related to the construction or rehabilitation of irrigation and dam systems.

The principal benefits of agriculture sector projects consist of increased output resulting from improved productivity or enhanced yields and reduced unit production costs or losses. Specifically, expected direct benefits are related to:

1. Increase in productivity and production;
2. Reduction of production losses; and
3. Reduction of inputs and labour costs.

Irrigation projects are relevant because they directly impact the production levels of target groups, which, in turn, will lead to net income increases. For example, this kind of project can impact the incomes of poor rural communities by increasing their access to inputs and services that will subsequently increase their productivity. However, in most cases, these projects must consider the inclusion of complementary supporting programmes from the authorities' perspective. Some examples are technical assistance, rural finance services, access to working capital through credit/loan or grant facilities, provision of storage, drying and cooling facilities to enhance post-harvest preservation, and technical advisory and financial resources to support entrepreneurs in starting small and microenterprises.

Economic Benefits of Irrigation Projects

To assess if the irrigation project is making good use of public funds, the costs of implementing it (including the institutional setting and capacity-building of both implementers and producers) must be compared with the benefits produced. In other words, the value added by the project is compared with the incremental costs of implementing it. Then, in brownfield projects, the project analyst shall model the "without-project scenario" and compare it with the "with-project" scenario".

For irrigation projects in general, benefits come from the following sources:

1. **Benefits due to an increase in agricultural production**: With the project's construction, water availability will increase, and water needed by crops will be met. As a result, current crops are going to obtain higher yields and improved quality. On the other hand, agricultural hectares that were not being irrigated could be incorporated. In both cases, the current production will increase. This category includes the benefits of changing the cropping pattern.
2. **Cost savings**: this refers to the resources that are no longer used in the current operations, such as saving time in the manual distribution of water, decreasing water losses, saving energy, saving operating costs and maintenance, etc.
3. **Energy sales**: Where the irrigation scheme has energy generation as part of the project scope, the energy generated may be sold. Energy sales refer to energy from hydro generation projects, where the project owner can sell power to the electricity distributor.

The methodology for estimating the benefits generated by irrigation projects is presented below:

1. **Benefits due to an increase in agricultural production.**

In order to define the benefits obtained by the project, the Marginal Productivity Method needs to be applied. This method estimates the Net Present Value of the highest agricultural production given the higher availability of water for agricultural production systems due to the project.

$$y_j = f(W, X)$$

Where:

y_j= yield per hectare of crop j

W= Water availability per hectare

X= Matrix of other productive factors per hectare (labour, capital, etc.)

Yields

The greater water availability in *a "with-project"* situation allows farmers to increase their agricultural production compared to the "*without-project"* case. This benefit is, therefore, the difference in the net income between the scenario *"with-project"* and the *"without-project"* scenario:

$$BA = \sum_{j}^{n} (p_j * q_j^{wp} - C^{wp}) * ha_j - \sum_{j}^{n} (p_j * q_j^{np} - C^{np}) * ha_j$$

Where:

BA= Benefit in agriculture

P_j= output price of crop j

q_j^{wp} = yield per hectare of crop j in a *"with project"* situation

C^{wp}= cost per hectare in *"with project"* situation

ha_j = hectares of crop j

q_j^{np} = yield per hectare of crop j in a *"without project"* situation

C^{np} = cost per hectare in *"without project"* situation

This method assumes *ceteris paribus* (all things being equal), the differential of financial benefits is directly related to the productive increase generated by the greater availability of water. Although, in practice, there is a dynamic behaviour of farmers in the management of productive systems in terms of techniques, use of inputs, the destination of production, and technological advances, it is considered that these variables remain fixed in the *"with project"* situation.

For the "with project" scenario, a cropping pattern must be presented, considering several factors, including:

- Farmers' wishes and aspirations.
- Marketing aspects (consumer and industrial)
- Government Regulations
- Agronomic considerations
- Soils
- Climatic Conditions
- Crop water requirements.
- Rotation considerations
- Access to inputs
- Financial considerations
- Labour requirements

The production structure must fit the market and potential markets, and their supply and demand must be determined. The larger the scheme, the more crucial it is to have a clear view of exactly how the marketing will take place. One general rule applies typically: the safer the market, the lower the price. Having considered all these factors, a proposed cropping pattern is presented.

Yield estimates should be based on experience from various irrigation schemes. In some countries, government agricultural departments produce farm viability models detailing potential yields under multiple conditions. Where available, these data can be used to estimate potential yields for a planned scheme.

NB: Production costs must be determined in both situations, with and "without project" scenarios.

An essential item is labour cost. The labour requirements are calculated on a crop-by-crop basis and added up to estimate the total needs in any given situation. An exhaustive survey on labour requirements on smallholder irrigation schemes has been carried out. This provides the data associated with various operations in the proposed scheme. For example, labour requirements for each crop can be presented in the following tables.

Table 18: Example of household labour requirements for the "without project" scenario

Crops	Area (ha)	Labour requirements (labour days)												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Grain maize	1.10	9.3	15.1	6.1	24.2	12.2	13.4	14.6				18.2	18.4	131.5
Sorghum	0.15	0.9	0.0	0.0	0.0	5.2	8.9					0.4	0.9	16.4
Cotton	1.00	10.1	5.3	27.6	96.7	7.7						12.4	22.1	181.9
Total requirement		21.4	29.0	57.8	129.4	29.6	25.3	14.6	0.0	0.0	0.0	31.4	52.0	390.6
Available labour		90.0	60.0	60.0	90.0	90.0	60.0	60.0	90.0	90.0	60.0	60.0	90.0	900.0
Hired labour		0.0	0.0	0.0	39.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39.4

Table 19: Example of household labour requirements for the "with project" scenario

Crops	Area (ha)	Labour requirements (labour days)												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Grain maize, irrigated	0.20	2.1	3.2	0.7	6.8	0.9	0.9	0.9				5.8	5.9	27.3
Wheat, irrigated	0.20					4.5	6.1	2.8	3.7	2.8	20.2			40.0
Green maize, irrigated	0.20								5.8	5.9	2.1	2.8	5.3	21.9
Cotton, rainfed	1.00	10.1	5.3	27.6	96.7	7.7						12.4	22.1	181.9
Total requirement		30.5	40.0	59.1	141.7	33.6	23.1	19.0	13.9	8.6	25.9	40.8	58.9	495.2
Available labour		90.0	60.0	60.0	90.0	90.0	60.0	60.0	90.0	90.0	60.0	60.0	90.0	900.0
Hired labour		0.0	0.0	0.0	51.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.7

Source: *FAO, 2012*

Variable costs

The variable costs included in our crop budget are:

- Land preparation (hired labour or equipment)
- Planting material (for example, seed)
- Fertilizers (both organic and inorganic)
- Chemicals (pesticides, insecticides, herbicides)
- Transport of inputs
- Interest on seasonal loan if money for inputs is borrowed.
- Casual labour for weeding, harvesting, etc.
- Packing material
- Transport of outputs
- Marketing costs

Expenses for *land preparation* should be indicated if help is brought in from outside, such as contract ploughing on a cost-per-hectare basis. If the farmers cultivate the land themselves, it should not be included as a cash expenditure, as the purpose of this analysis is to establish the return to the resources of labour and capital invested by the farmer.

The rates recommended by research and extension for planting material, fertilisers, and chemicals are applied and valued at the most recently available prices. The expenses for transporting inputs will vary according to the input quantities and the price that would be charged to the project site. The amounts are given and can easily be summarised, but the transport costs from prospective transporters need to be established.

Hired *labour cost* is included in the crop budget if there is a disparity between available household labour and required labour during the crop's production period. Packing material should be included in the crop budget to the extent that it is deemed realistic.

As far as the *transport of outputs* is concerned, some output will be sold locally at the farm gate, with little or no transport costs involved, and some will be sold in markets further away as local markets normally cannot absorb the total output from the scheme.

Gross income

Gross income is the total value of an enterprise's production. It includes sales plus the value of retained produce for consumption at home (farm) and any by-products with value, such as retentions for livestock feed:

- Gross income of marketed output = marketed output (quantity) x market blend price (US$/unit quantity)
- Gross income of retained output = output retained (quantity) x farm gate price (US$/unit quantity), where the farm gate price is the value the produce would have fetched if sold.
- Total gross income = gross income of marketed output + gross income of retained output

Gross margin

The gross margin is the difference between the total gross income earnings and the total variable costs. It is estimated as the gross return to labour and capital that a farmer has invested in the particular crop's unit land area. The gross margin is usually expressed on a per-hectare basis to compare different crops. The gross margin of various enterprises on the farm can be added up to come up with a whole farm margin.

Standard crop budgets or viability models for various crops are usually produced by government research and extension departments and can be used to make rough estimates of enterprise performance.

For each crop proposed in the "with-project" situation, it is necessary to estimate the gross margin. The gross margin of the irrigated plot, multiplied by the number of plots in the scheme, is used in the scheme investment analysis to approximate the irrigation scheme's "with-project" benefits. The same procedure must be used for the "without project" situation.

2. Cost savings

For projects that release resources, either inputs or productive factors, it will be necessary to value them in monetary terms. The magnitude of the resource savings must be quantified and then applied to a price that reflects its value.

2.1 Input saving

$$IS = \sum_{i} \left(Q^{i}_{WOP} - Q^{i}_{WP}\right) * P^{i}$$

Where:

IS: input savings

Q_{WOP}^{i}: quantity of input i used in the "without project" situation.

Q_{WP}^{i}: quantity of input i used in the "with-project" situation.

P^{i}: price of input i

2.2 Labour saving

$$LS = \sum_{i} \left(L^{i}_{WOP} - L^{i}_{WP}\right) * P^{i}$$

Where:

LS: labour savings

L_{WOP}^{i}: quantity of labour i used in the "without project" situation (i=unqualified, semi-qualified or qualified labour)

L_{WP}^{i}: quantity of labour i used in the "without project" situation (i=unqualified, semi-qualified or qualified labour)

P^{i}: wage per labour (i=unqualified, semi-qualified or qualified labour)

2.3 Energy saving

$$ES = \left(Kwh^{i}_{WOP} - Kwh^{i}_{WP}\right) * T$$

Where:
ES: Energy savings
Kwh_{WOP}: energy consumption in the "without project" situation
Kwh_{WP}: energy consumption in the "with-project" situation
T: Price of energy
i: Unit of energy consumed

3. Energy production

In some cases, irrigation infrastructure can generate energy (at the dam or irrigation canals). In these cases, the benefits generated by the production of electric power are:

$$EI = P * Kwh$$

Where:

EI: Energy production income

Kwh: energy produced

P: Unit price of energy

Economic Costs of Irrigation Projects

The cost items can be classified into investment (CAPEX), operating (OPEX), and maintenance costs. The selected method to estimate the investment costs will vary depending on the alternatives identified (projects that increase or projects that keep the capacity level constant).

For irrigation projects in general, costs are incurred through:

- Investment costs (CAPEX): These correspond to the amount of money dedicated to constructing civil works such as collection systems (reservoir), conduction systems, pumping equipment, drilling, irrigation, etc. They also consider the acquisition of land on which the project will be located, equipment and technology, transfer of knowledge/skill, and training of farmers and operators. They also include the investment in improving the irrigation system to make it more efficient.
- Operation and maintenance costs: These correspond to the expenses incurred during the lifespan of the project and are those that allow for the proper functioning of the system for the provision of the service, such as salaries of operating personnel, expenses in energy, fuel, and maintenance costs of infrastructure, among others.
- Agricultural production costs: These correspond to the expenses incurred in the acquisition of productive factors and inputs such as labour, seeds, machinery, fertilisers, and others. These costs are already described as a part of the benefits due to increased agricultural production.

The cost estimation is initially done using financial prices. After that, specific conversion factors must be used to transform market prices into economic prices to reflect the real use of national resources in the project. To perform this task, it is convenient to visit the database for commodity-specific conversion factors [20] on the Ministry of Finance Website.

Capital Expenses (CAPEX)

Investment costs are associated with civil works, including structures, equipment, and any other facilities.

- **Site (land):** This item corresponds to the cost of the physical space required to execute the civil works. The valuation of the site land must always be done. Therefore, since there is always an economic opportunity cost for the land, the use of this land by the project involves an economic

[20] national-parameters.mofep.gov.gh

cost to society. In determining the cost of the land (and any costs in an economic evaluation of project alternatives), the analyst should consider the concept of opportunity cost.

Any cost resulting from a tax (e.g., tax on property transfer) shall be included only for the project's budget preparation but shall not be included for economic evaluation. Similarly, where land for irrigation must be rented, the rental appears as a cost in the investment analysis.

- **Construction costs:** The construction cost corresponds to the value of facilities and other necessary physical works needed to materialise the project alternative. It includes the costs of materials, transportation of those materials, labour, supervision, project management, advisory/consultancy services, and all other necessary expenses for constructing the civil works. For the economic evaluation of the project, it may be required to correct some of the market prices of inputs to convert them into economic prices. This correction will include the elimination of taxes and possibly an additional correction due to other market distortions.

  Also, at the end of the project life, the project analyst should consider the residual value of the facilities. This corresponds to the value at which the facilities could be sold when the project stops its operation.

- **Equipment costs:** This item corresponds to the value of all movable elements and other components necessary for the project to remain operational. The equipment shall be valued at its market price, inclusive of taxes, for the project budget, but taxes shall be eliminated for the project's economic evaluation. If the equipment is donated, it must not be considered for budgeting purposes. However, for economic evaluation purposes, the equipment must be valued at market prices, excluding taxes.

Operating Costs (OPEX)

Operating costs are expenses that are incurred in order for the irrigation project to provide regular water. The quantification of operational costs is usually done on an annual basis.

- **Replacement costs:** These are the costs incurred to replace specific items. For example, the following assumptions about the replacements are:
  - All hoses and valves are suggested to be replaced every five years
  - All sprinklers and tripods are recommended to be replaced every ten years
  - The pumping unit is proposed to be replaced every fifteen years
- **Energy costs:** These costs depend on the elevation of the water source relative to the elevation of the scheme, which determines whether water should be pumped to reach the scheme, and on the irrigation´s system used (surface or pressurized). Engineers designing the irrigation scheme could provide the figure for the energy requirements of the system. Fixed charges levied by The Electricity Company can also be included in the energy cost. The fuel source is diesel or petrol, and the energy cost is the estimated cost of diesel or petrol that the farmers will be expected to pay.
- **Repair and maintenance costs:** These costs are usually assumed to depend on the cost of the equipment utilized. Thus, a percentage of the cost of Real equipment costs can be used if known from other similar schemes.
- **Technical support:** Usually, in irrigation projects, it is included in the activity of agricultural extension services to improve capacity of farmers at technical and organizational levels. The cost of this activity should be included in the project appraisal.

- **Water charges:** These are the charges payable to whoever supplies water, for example, the national water authority. Where water is purchased, the water charges should be indicated as a cost.
- **Remunerations:** This is the cost of the salaries and wages of all the necessary human resources during the operations. To identify the economic costs associated with this item, the analyst must consider all incremental personnel involved, that is, all those that produce an additional expenditure for the entity that shall operate the project.

  In the economic evaluation of the project, it will be necessary to correct market wages to calculate the economic price of labour. To obtain this, multiply the estimated remuneration cost, separated by skill levels, by the corresponding conversion factor.
- **Operational supplies:** This corresponds to the value of the essential elements that allow the proper functioning of the irrigation. The price of inputs required for the project can be estimated based on the experience of other projects developed by the sector.
- **Maintenance costs:** This is the expenditure required to maintain the capacity to generate the benefits of movable or immovable property, preventing deterioration or premature failure. Generally, this value is estimated as a percentage of the value of the facilities subject to maintenance. The values of equipment maintenance may be obtained from project information or similar establishments.
- **Other operating costs:** This item should detail all additional operating expenses necessary for the irrigation facilities' functioning. Some of these are communication, insurance, etc. When making the economic evaluation, only consider incremental costs from project implementation.

Sunk costs: Sunk costs are the costs incurred in the past that cannot be retrieved as a residual value from an earlier project. A sunk cost has no opportunity cost, as the assets represented by the sunk cost have no alternative use. A sunk cost is, therefore, not included in the outflow when projects are analysed. This can be the case if the project is a rehabilitation of a previously operated irrigation scheme, and a dam was constructed to provide water for the previous irrigation scheme. Then the dam is considered a sunk cost.

7.2 HEALTH SECTOR

Investment in the health sector yields substantial economic benefits by promoting a healthy and productive workforce. Improved health outcomes contribute to increased labour productivity, reduced absenteeism, and lower healthcare costs, ultimately leading to economic growth and prosperity. Economic appraisal of health projects should consider factors such as the impact on life expectancy, disease prevalence, and healthcare utilisation.

Economic Benefits of Health Projects

The analysis of health sector projects requires that health outcomes be valued in monetary units to calculate the net economic benefit of a project or program. As stated by Adhikari et al. (1999, p. 15),

"… Monetary valuation of health benefit through a reduction in mortality and morbidity as a result of a health project is known to be very difficult. Although there are various possible approaches, the most popularly known are the human capital approach and the willingness-to-pay approach. These may work well in a developed country context but have practical limitations in developing countries. As a result, cost-effectiveness analysis is more popularly used than conventional cost-benefit analysis in the economic analysis of health sector projects".

Economic Costs of Health Sector Projects

To receive the benefits of the project, some costs must be incurred. The cost items associated with each alternative will depend on their characteristics and the type of project. For each of these projects, the cost items receive a similar treatment, regardless of the project alternative.

The costs for each alternative of a project can be classified under the following categories:

- Investment costs
- Operating costs
- Users´ costs

The cost estimation is initially done using financial prices. After that, specific conversion factors must be used to transform market prices into economic prices to reflect the real use of national resources in the project. See National Parameters and Conversion Factors Database for more details on conversion factors and economic costing estimations.

Investment costs

It corresponds to expenses incurred to execute the project from its inception to the operating stage. The costs of land, construction, and equipment can be distinguished from the investment costs. The investment costs are also known as Capital Expenditures (CAPEX).

- **Site (land):** This item corresponds to the cost of the physical space required to execute the civil works. The valuation of the site land must always be done. This is obvious in cases when the land must be purchased by the project, but the land also has to be valued when the project sponsor owns it and when the land has been donated or if it can be occupied at no cost. Therefore, since there is always an economic opportunity cost for the land, the use of this land by the project involves an economic cost to society. In determining the cost of the land (and any costs in an economic evaluation of project alternatives), the analyst should consider the concept of opportunity cost.

When the project acquires the land, the total acquisition cost should be considered, including all costs involved in the transaction (transfer, legal fees, etc.) and site preparation (clearance, drainage, levelling, and fencing; connections to primary services networks, such as electricity, water, sewerage, etc.). If the land belongs to the project sponsor or is a donation, the value to be attributed must correspond to the market value. Any cost resulting from a tax (e.g., tax on property transfer) should be included only for the project's budget preparation but shall not be included for economic evaluation.

The project must also consider the residual value of the land, which corresponds to the estimated sale value of this land at the end of the project life. Usually, land does not depreciate (i.e., it does not lose its value); on the contrary, its value increases over time. Thus, a conservative assumption is that the land will be sold at the end of the project life at the same amount at which it was acquired.

- **Construction costs:** The construction cost corresponds to the value of buildings and other necessary physical works needed to develop the project alternative. It includes the costs of materials, transportation of those materials, labour, supervision, project management, consultancy, and all other necessary expenses for constructing the civil work. The critical issue is that the assessment should be made considering the cost per square meter (m^2) of "construction" and differentiated between construction, remodelling, repair, and others.

  In addition, the analyst should consider the residual value of the buildings at the end of the project life. This corresponds to the value at which the buildings could be sold when the project stops its operation. The analyst must not consider the value of the land in calculating the residual value of the buildings because that would be double counting, given that the land has already been considered a separate asset.

- **Equipment costs:** This item corresponds to the value of all movable elements and other components necessary for the project to remain operational. For example, computer, clinical desk, ergonomic chair, exam stretcher, adult analogy scale with height rod, calliper, non-invasive blood pressure monitors with oximetry, oto-ophthalmoscope mural set, examination lamp, heartbeat detector, gynaecological exam set, dental unit, etc., where applicable.

  In cases where the equipment is more complex (i.e., specialised medical equipment), it is recommended that a detailed list of the required equipment be made, with their respective technical specifications, and that two or three quotes be obtained from different companies.

  The life of the furniture and equipment is usually less than the life of the healthcare facility's infrastructure. Consequently, during the assessment horizon, the equipment will need to be replaced from time to time. This refers to periodic re-investments during the life of the project. Since the usefulness of these assets is different depending on their type, there should be an estimation of when they should be replaced for each category. This cost must be recorded in the project's cash flow in the year in which it is estimated to occur.

  Finally, some equipment may have a residual or scrap value at the end of its life, which must be considered cash inflow in the year in which the replacement is made. For example, in the case of land and construction, the revenue from selling the equipment should be regarded as opportunity costs.

Operating and Maintenance (O&M) cost

It corresponds to expenses incurred for the project to operate and deliver the services. Operating costs include personnel remuneration and costs of basic services (drinking water, electricity, communications, administrative services, surveillance, etc.).

- **Remuneration:** This is the cost of the salaries and wages of all the necessary human resources of the healthcare facility, including the staff that delivers all administrative, auxiliary, and health services. This cost item is recorded in the accounting books as health professionals, administrative and auxiliary staff salaries. It includes social security costs, gratuities, bonuses, and others.

  In the economic evaluation of the project, it is necessary to correct market wages to calculate the economic price of labour, i.e., multiply the estimated remuneration cost, separated by skill levels, by the corresponding conversion factor. In the health sector, professionals are all considered skilled workers, while secretaries, inspectors, clerks, etc., are classified as semi-skilled workers. Janitors, cleaning staff, etc., are also considered as unskilled workers. In the case of projects aimed at providing a specific health service, usually, the wage bill is the most significant cost item.

- **Input costs:** This refers to the value of the essential elements that allow the proper functioning of the healthcare facility. These include pharmacy, materials and supplies, cleaning materials, clothing, fuel, office supplies, support materials, etc. As in the previous categories, the analyst should only consider the incremental costs attributable to implementing the project alternative.

- **Basic services costs:** This is the cost of all services required to operate the healthcare facility. These services include water, electricity, and, in some cases, fuel. It is important to note that only incremental costs involving the project should be considered. In the case of basic services and maintenance, the relevant costs are only those incremental costs that are absent from the without-project situation.

- **Maintenance costs:** This is the expenditure required to maintain the capacity to generate the benefits of movable or immovable property, preventing deterioration or premature failure. This refers to expenses such as painting and minor repairs of buildings, periodic maintenance of vehicles and equipment, repairs and painting of furniture, etc. Generally, this value is estimated as a percentage of the value of the facilities subject to maintenance. As a rule, infrastructure maintenance costs and equipment costs are calculated based on the square footage and projected construction costs observed in similar characteristics and locations[21]. The values of equipment maintenance must be obtained from other similar project information.

- **Rental costs:** This item corresponds to the payment of rentals for buildings, land, vehicles, and equipment required for the project's operation. The economic evaluation should consider the total cost of the lease, including commissions but excluding any tax-shield effect. If the issuance of a guarantee is necessary, it must be reflected in the cash-flow statement as an output when money is set aside for guarantee payment and as a cash inflow when the money is recovered at the end of the leasing period.

- **Other operating costs:** This category should detail all additional operating expenses necessary for the health establishment's functioning. Some examples are communications, printing and publishing, insurance, etc. When making the economic evaluation, only incremental costs from project implementation should be considered.

User costs

In many cases, an alternative project might require people to travel to the health facility or change current travel habits. Therefore, the assessment methodology incorporates the so-called User Cost projects. The user costs are incurred by patients and their companions when they go to health centres. It consists of:

[21] Maintenance requirements vary according to latitude, altitude and geographic conditions found in establishments.

- **Changes in commuting cost (time and cost of transportation):** If the alternative project significantly modifies distance, travel time, or the travel costs of users, it is advisable to estimate these costs. This may be the case when the project alternative is the construction of a new healthcare facility, the transfer or closure of an existing healthcare facility, or the merger of two healthcare facilities, etc.

  To estimate these transportation costs, the analyst must study the map of the influence area. In this map, one or more geographic points may be considered as the centre of gravity or as representative of the location of the target population. The time required and the cost of travel are then estimated, considering the means of transport utilised from each point to the healthcare facility. This must be done both for the "without-project" situation and the "with-project" situation. These costs and times are then multiplied by the annual number of trips the target population needs to make. In situations where users need to be accompanied to the healthcare facility, the cost incurred by their companions should also be addressed.

- **Waiting time at healthcare facilities:** Although waiting time at healthcare facilities represents a real cost to users, it is not relevant for assessing alternative solutions because it can be resolved with management measures that optimise the current situation.

  The following criterion should be applied to estimate the increase or decrease in time and cost of movement from the users' location to the healthcare facility:

  1. Based on the users' means of transportation, estimate the average length of round trips for the "with and without project" scenario. Values are expressed in hours.
  2. The number of users is indicated according to the means of transportation.
  3. The total hours of travel are calculated by multiplying the values of the duration of the trip and the number of people in columns A and B in Table 20 and obtaining the total hours used in moving users from their locations to the healthcare facility (Column C).

Table 20: Transfer time cost in the "without-project" scenario

Human Resource	Travel Duration (round-trip), in hours **(A)**	Number of Users **(B)**	Number of Hours in the "Without-Project" situation **(C)**
On foot/bicycle			
By bus (public transport)			
By taxi			
By car			
Other			
TOTAL			

Source: an *example based on International Best Practices.*

An estimation must be conducted to determine the transfer time cost in the "with-project" situation. Next, the change in total travel time must be calculated by computing the difference between the "without-project" and "with-project" scenarios.

The net transfer time cost is the travel time multiplied by its social value, which helps to determine the cost or savings of travel time.

Net Transfer Time Cost = Travel Time * Social Value of Time

7.3 ROADS SECTOR

Efficient transportation infrastructure is crucial for facilitating the movement of goods and people, enabling trade and economic growth. Investment in road projects enhances connectivity, reduces travel time, and lowers transportation costs, contributing to economic productivity and regional development. Economic appraisal of road projects should consider factors such as impact on traffic, accessibility to markets, and economic activity along transportation corridors.

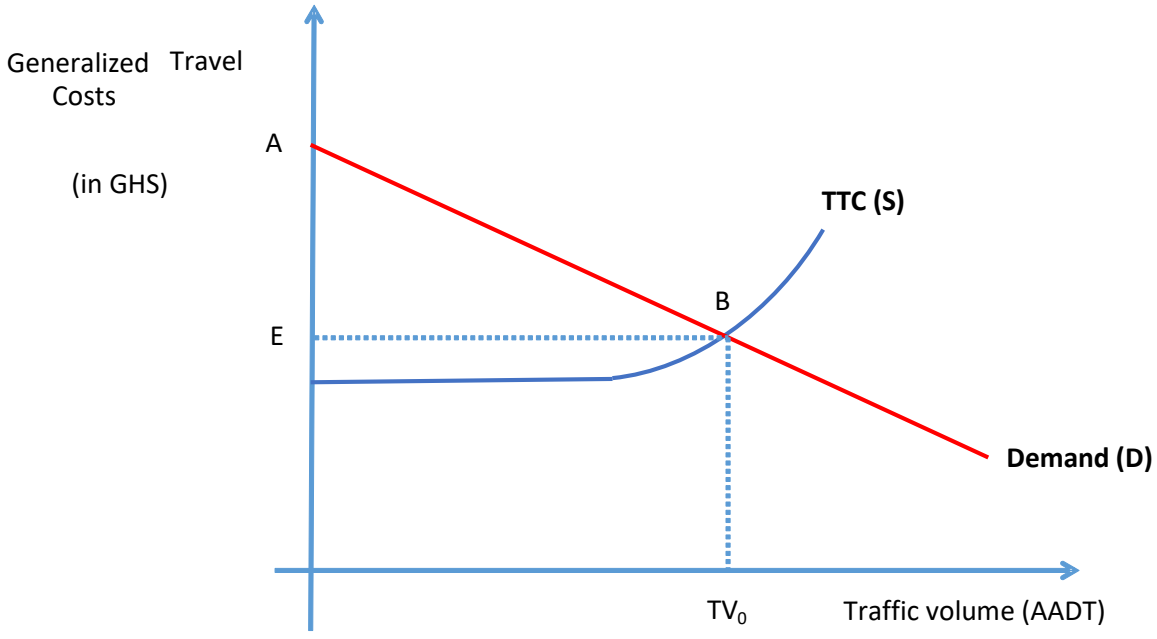
Economic Benefits of Road Projects

The assessment of the benefits of road projects can be challenging when the project in question has no anticipated cash flows. To remedy this, the various direct and indirect benefits are used for the analysis since they can be justifiably quantified. With road projects, "user-benefits" constitute the most direct benefits; they include the savings in time, vehicle operating costs and other benefits associated with better roads. The savings are calculated as the net of new journeys created by the project and possible problems (such as congestion) created elsewhere in the network.

From the economic point of view, a road project is "good" according to market laws when there is demand, which reflects the willingness to pay for travel, and there is supply, which represents the cost incurred for making such trips. This is shown in Figure 10. The traffic volume (demand curve) is measured by the Annual Average Daily Traffic (AADT, the number of trips), and it is estimated per unit of time; it is measured between a source-destination pair. The costs incurred by users (supply curve) are called Generalized Travel Cost (GTC), which mainly depends on the amount of time spent on the trip and on the operating costs of vehicles (fuel, tyres, etc.).

Both demand and supply curves are expressed in private terms, i.e. at market prices. The area $0ABTV_0$, under the demand curve D, represents the willingness to pay (the total benefit received by road users).

Figure 10: Supply and demand in intercity road projects



Source: *International Best Practices.*

Once relevant costs and benefits of a project are identified, the next step is valuation. At this stage, it is important to clarify whether local, national, or global approaches are taken to evaluate the costs

and benefits of a project. In a situation where a project's benefits and costs are realised locally, a local perspective could be taken. If a project is considered to have a national significance, regional costs and benefits should be evaluated. A global approach could also be warranted if a project has a wider reach beyond national borders. Projects that have a significant environmental impact (C02 emissions), tourism projects with significant foreign patronage, and international transport corridor projects are typical examples of where the global perspective is necessary.

When assessing road projects, analysts must anticipate fluctuations in user costs and benefits. This involves examining generalised transport costs, which encompass both monetary and non-monetary elements. Monetary or "out-of-pocket" costs include a fare on a public transport journey or the costs of fuel, wear and tear and any parking charge, toll, or congestion charge on a car journey. Non-monetary costs refer to the time spent undertaking the journey, lives lost because of accidents, emissions harmful to the environment etc. These costs are converted to a monetary value using established techniques with appropriate input parameters relevant to the project area.

The CBA of road projects involves the measurement of user benefits. This is usually done by looking at a reduction in the total (generalised) transport costs and the change in route capacity (i.e., the anticipated change in the traffic pattern after the new project). The calculation of user benefits and assessment of wider road transport-induced changes in the economy requires accurate forecasts of traffic flows and the measurement and valuation of costs. This is done by means of a transport demand model, which predicts traffic flows.

A critical component of the valuation of user benefits in road projects is quantifying travel time savings. Due attention should be paid to different types of time savings depending on whether they are related to working time or non-working time (i.e., commuting time or leisure time).

Since the TTC is the perceived cost by road users, it is also equal to the Economic Average Travel Cost (EATC). The TTC is the sum of Vehicle Operation Costs (VOC) and the Value of Time Cost (VTC), which is considered a cost on transportation projects.

Reduction in Vehicle Operating Costs

The VOC represents the costs incurred by road users in terms of input consumption: petrol and diesel, lubricants, wear-and-tear on tyres, repair, and maintenance expenses. All these inputs are combined into the definition of VOC. The new road improvements are expected to cause the decline of the VOC, which should be assessed based on the following:

- Road Geometry
- Type and texture/surface status
- Type of vehicles; volume, composition, and distribution of vehicles
- Economic price of inputs

For each type of vehicle, the project analyst must estimate the following cost items:

- Fuel consumption
- Lubricants consumption
- Tyre usage
- Auto Part Usage
- Maintenance hours consumption
- Vehicle depreciation

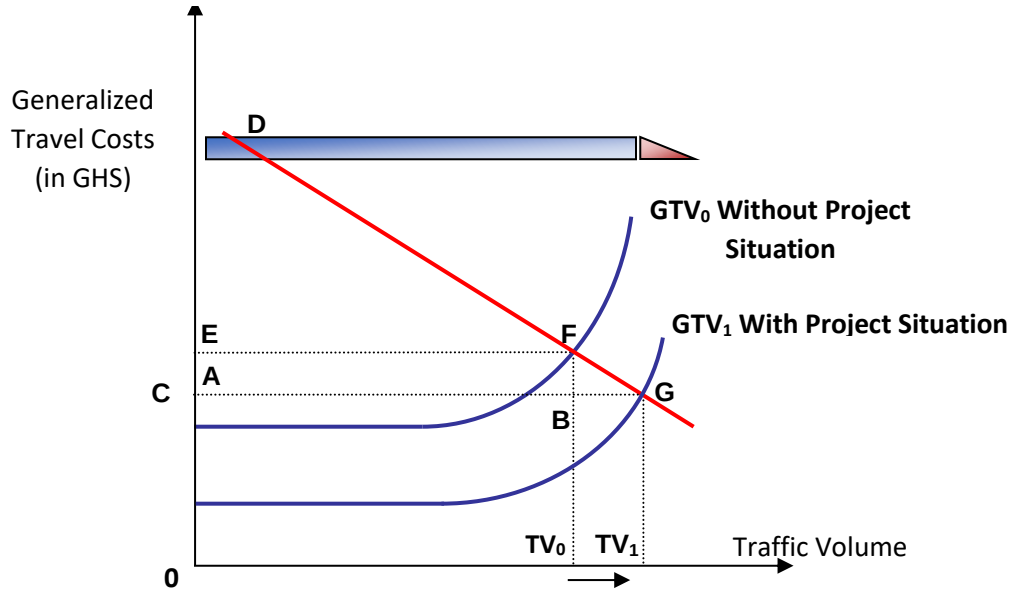
These costs will depend on the type of users: Normal Traffic, Diverted Traffic and Newly/Generated Traffic.

The **"Normal Traffic"** corresponds to the road users who will travel on the road even without road improvement. The incremental VOC savings can be estimated by comparing the total VOC "without project" with the proposed road improvement (with project) VOC. This annual VOC savings in financial prices must be converted into economic prices (values) to reflect the value of the resources saved for the economy.

The total amount of such savings depends on the traffic volume and the vehicle composition on the route. It will also depend on the degree of surface improvement. In the case of a dirt or gravel road upgrading to a tarred surface, the value of VOC savings is likely to be substantial, as graphically presented in Figure 11. Note that Figure 11 represents not only VOC reduction but also a combination of VOC and time costs incurred by road users.

The **"Diverted" Traffic** corresponds to the users that change their route, keeping their origin and destination. For diverted traffic, the benefits are measured by the difference between the total VOC on the alternative route and the total VOC on the upgraded road. To estimate these benefits, it is necessary to consider the alternative routes in terms of distance and road surface condition. In the absence of an improved road, "diverted users" are not willing to incur the current GTC but they are willing to incur on the new GTC measured as the sum of the value of time, VOC, and toll rate (if any). Figure 11 illustrates this.

Figure 11: Reduction of total user costs for existing and new traffic



Source: *International Best Practices.*

Line D in Figure 11 is the demand function (holding all other factors constant). The vertical axis denotes the price (cost) per vehicle-km for travelling over the road (this price is the maximum total cost per vehicle-km). With the unimproved road, the cost per vehicle-mile is E, and the traffic level is TV_0, including all those traffic units willing to bear costs of C_0 or more. Under the improved road, costs will fall to A and traffic volume will now expand to TV_1. The net benefit to the "normal" traffic is described by rectangle $AEFTV_0$, which is

simply the difference between the total VOC plus the time costs "with" and "without" the project.

The gross benefits received by the incremental traffic are measured by TV_0FGTV_1, but the costs they perceive are TV_0BGTV_1. Therefore, the triangle BFG measures their net benefit for a particular period. They do not receive as much net benefit as the existing traffic because some of the reductions in costs will be necessary to induce them to travel on the improved road[22].

The reduction in the cost of using the improved road resulting from the lower vehicle operating costs and faster travel (time savings) will induce more travel on the road. The additional (newly/generated) users of the road are not willing to incur the current (without project) generalised cost, but they are willing to incur the new GTC measured as the sum of the value of time, VOC, and toll rate (if any). The benefit to the generated traffic is measured based on half of the per-unit GTC reduction since this type of traffic would not be materialised without this reduction. Referring to Figure 11, if the additional traffic is entirely of "newly generated" type with a volume TV_1TV_0, then its per-unit value of benefits is equal to ½(E-A).

The increase in traffic as a result of lower transportation costs depends on the elasticity of demand for roads, which in turn depends on the elasticity of demand for the individual commodities involved[23]. The traffic model that provides traffic forecasts should incorporate these factors in order to generate a series of "diverted" and "newly generated" traffic.

Travel Time Savings

The magnitude of time savings depends on the traffic volumes, average effective speeds, economic value of time for users of vehicles and economic opportunity cost of commercial vehicles. The valuation of time savings requires measuring the average speeds travelled on the road before and after road improvement. At some point, the speed of the road will negatively affect traffic volume due to congestion.

Normal Traffic: For passengers and tourists that constitute "normal traffic", the improved road allows their vehicles to travel at a higher speed as compared to the existing road, which saves them time. A good proxy for working time savings, to some degree commuting time, is the average wage. The economic value of time is typically linked to the wage rates of unskilled, semi-skilled and skilled labour in the region/country. Once the average occupancy is established for each vehicle type, the analyst can estimate the value of time savings, depending on the vehicle rate of use (the number of passengers by type of vehicle). Leisure time valuation is generally valued at a cheaper rate than work time. Because the time savings for an individual user is small, the calculation of the value of time benefits often involves the aggregation of time savings across many users. While the methods for the valuation of time are becoming more advanced, there remain questions regarding the valuation of business time savings. Freight time savings calculations are often done crudely and fail to reflect the type of load that is being carried, ignoring small time savings.

Diverted and Generated Passenger Traffic: Typically, the value of time savings per additional vehicle-km travelled for "diverted" and "newly generated" passenger traffic is taken as only one-half of the value of time savings for "normal" traffic.

Diverted and Generated Freight Traffic: There are a few approaches to estimate the value of time savings for cargo transportation. Ideally, the analyst should know what commodities are being

[22] Harberger, A.C. (1976) Cost-Benefit Analysis of Transportation Projects", Project Evaluation: Collected Papers, Chapter 10. University of Chicago Press.

[23] Adler, H.A., "Economic Appraisal of Transport Projects: A Manual with Case Studies", Indiana University Press, London, UK (1971), pp. 28-29.

transported on the road, as well as their volumes and destinations. This would facilitate an estimation of a delay cost as measured through the willingness to pay for a faster delivery.

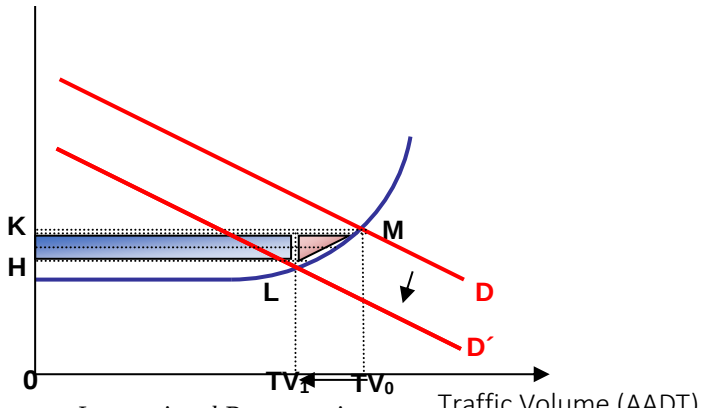
Valuation of time savings by different types of vehicles requires a substantial volume of survey information, often specific to the road segment in question. Time savings should be projected for the future period.

Savings of maintenance costs: The construction costs of a tarred surface are typically justified by its lower annual maintenance costs as compared to gravel-type surfaces. Savings of maintenance expenditure are estimated as the difference between the projected expenditure over the periods covered by the analysis of the existing road ("without-project" situation) and the projected expenditure on an improved road ("with-project" situation). The resulting annual financial savings must then be converted into economic values to measure the real economic value of resources being conserved.

Most road improvement projects, or new roads, will affect the pattern of traffic on other roads that are complementary or substitute to the road being improved. The traffic volume will increase on complimentary roads because people will use these roads either to access or exit the improved road. It would be normal for road maintenance requirements to rise to a certain extent on these roads as their traffic increases. This rise in the annual road maintenance costs should be included in the costs associated with the road improvement project. The opposite situation arises in the case of substitute roads. The net change in the maintenance cost on substitute roads should be included as a benefit or cost in the appraisal of the road improvement project.

Figure 12 shows the GTC curve for a section of the road network; it is assumed that this curve does not change the effect of the project, as the road remains standard. The project produces a shift in the demand curve from D to D' because of the diverted (or transferred) users to the improved road. If there is a distortion in this section (for example, congestion), reduced traffic will lead to an indirect benefit of the project.

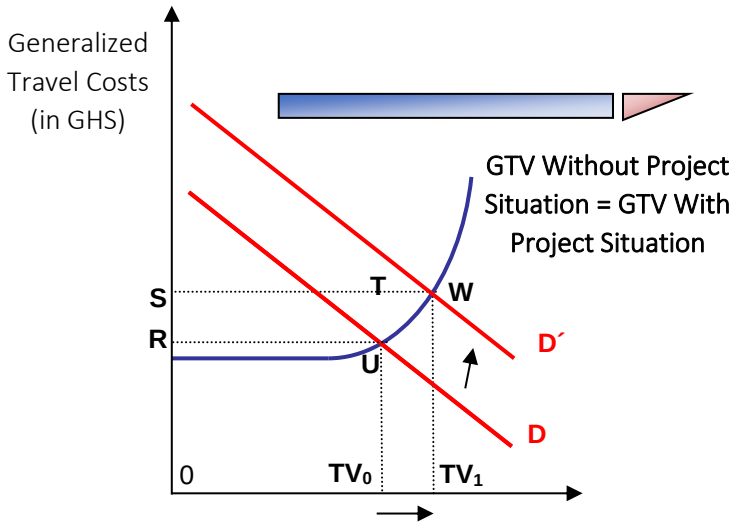
Figure 12: Positive indirect benefits on a substitute road



Source: *International Best Practices.*

On the other hand, sections of a complementary road will increase their traffic, as shown in Figure 13. In this case, the existence of a distortion, such as congestion, will cause a negative indirect benefit of the project (equivalent to a cost, but is considered part of the benefits because the benefit of the project is the sum of these partial).

Figure 13: Negative indirect benefit on a complementary road



Source: *International Best Practices.*

Summary of direct benefits: The economic benefit of the project is the sum of direct and indirect benefits, i.e., the following shaded areas:

- The AEFB area in Figure 2 corresponds to the release of resources or increase in consumer surplus associated with the normal traffic of the improved road.
- FBG Area in Figure 2 corresponds to the increase in consumer surplus associated with diverted (transferred) and newly/generated traffic in the improved section of the road.
- The HKLJ area in Figure 3 corresponds to the increase in consumer surplus associated with the normal traffic on substitute or alternate paths due to reduced congestion.
- LMJ area in Figure 3 corresponds to the increase in consumer surplus associated with the traffic that deviates and is transferred to the road that the project improves; this increase is determined by the excess reducing congestion to the point where the user decides to change the route.
- Areas RSTU and TWU in Figure 4 should be considered negative as they correspond to costs.

Accident Reduction

Transport Infrastructure projects typically aim to improve traffic safety by reducing traffic accidents. An improved road is an important factor in the reduction of the number and degree of accidents, but there are a number of other influential aspects determining the accident rate: width and geometric alignment of the road, congestion, volume of slow traffic, effectiveness of law enforcement, vehicles mechanical condition, and driver behaviour. As a result, road improvement per se may not automatically imply a substantial reduction in the rate and severity of accidents. A detailed assessment is needed for each road in question before final conclusions are derived.

Two main steps must be taken to assess the magnitude of accident reduction. Firstly, the rate of traffic accidents "with" and "without" the proposed improvement must be established. The rate is typically expressed as the number of accidents per million vehicle kilometres. Secondly, the reduction in the value of accidents must be estimated. Typically, three types of damages are considered: property damage, cargo damage and injuries and fatality.

The value for property and cargo damage is easily appraised, but the assessment of injury and fatalities will require putting a value on human life or forgone earnings over the remaining years of life. It is, therefore, necessary in CBA to put a monetary value on the benefit of saving a human life. Valuing the present value of foregone earnings is a common technique to place a monetary value on a life saved from traffic accidents. A more rigorous approach involves estimating the willingness to pay for additional safety features or willingness to accept payment for bearing additional risk for life.

Externalities and Wider Benefits

In many transport investment projects, user benefits capture all the benefits (welfare effects). Generally, two conditions must be met for this to happen. First, the induced changes from the project in the rest of the economy must be minimal. Second, the rest of the economy is operating perfectly efficiently. However, there are circumstances where these conditions fail, which in turn require a deeper analysis to capture the "wider benefits" of transport improvement changes. Typical reasons for these include tax distortions in the labour market or imperfect competition in the goods market.

It is appropriate, in the analysis of any project from the point of view of society, to take into account external or indirect benefits and costs. For example, owing to the existence of a road project, unskilled labourers were to be employed in the area. Indirect benefits are measured by the excess of the amount these workers were paid over the minimum amount they would be willing to work for. The value of these indirect benefits is attributed as an additional benefit to the project[24].

Economic Costs of Road Transport Projects

In order to receive the benefits of the project, some costs must be incurred. Obviously, the most important costs are related to road improvement: construction, maintenance, conservation, and future replenishments. However, the project can have effects on other roads or areas where no construction work is carried out (for example, alternative roads that will require less investment in maintenance or roads that will postpone future replacements on the surface).

In practice, what is commonly done is to determine the total resources that would be needed each year to maintain the technical standard of the sections belonging to the project (including alternative and complementary ways). Then, the cost of the project is given by the additional amount of resources required in the "*with-project" scenario (situation)* regarding the *without-project scenario (situation)*.

In addition, the project costs should include interference causing traffic congestion (diversions, arrests, complaints, etc.). To assume that during the project execution, the road continues its normal operation (and therefore, no additional operating costs and travel time are produced) may not reflect the real world. It should be noted that in most cases, the additional costs incurred by users during the project execution will be insignificant (it is common that users must wait in line). If these costs are considered, they should be clearly defined, indicating the type of interference and the additional travel costs that users will incur compared to the situation without interference.

Economic inter-urban road benefits

Historically, road vehicle operating costs tend to dominate roads economic appraisals in developing countries due to poor road surfaces.

Key Issues of Operating Costs: Costs accrued during the functioning of the transport infrastructure are borne by:

[24] Harberger, A.C. (1976) Cost-Benefit Analysis of Transportation Projects, Project Evaluation: Collected Papers. University of Chicago Press. Chapter 10.

- Users (e.g., vehicle drivers/passengers where they are the owners of the vehicle and ships whilst in port)
- Service providers (e.g., the operators of public transport services (e.g., rail service) or the owners of vehicles driven by others (e.g., road haulage firm)).
- Infrastructure owner

Operating costs can be influenced by the regulatory and institutional characteristics of the environment in which the transport industry in a particular country sits. Local country-specific data and relationships on operating costs for these sectors should, therefore, be utilised wherever possible, though in many cases, the availability of such data will depend upon the accounting practices within that sector (country-specific). Off-the-shelf models and computer software exist to calculate road vehicle operating costs; however, these models require some local data.

Operating costs are also influenced by the transport infrastructure maintenance strategy, particularly in areas subject to periodic environmental shocks (e.g., a wet season). If transport infrastructure is not maintained, operating costs can increase significantly. Operating cost calculations should, therefore, reflect the infrastructure maintenance strategy.

In some cases, particularly regulated sectors, the infrastructure owner and the service provider are the same body (e.g., a nationalised road network). In other situations, the infrastructure owner and the service provider may be separate bodies, but the service provider may pay the owner for access to the infrastructure on a variable basis (e.g., for haulage trucks on a per km of road travelled). This payment by the service provider would include a component for the maintenance of the infrastructure, but from the point of view of the service provider, it would be considered an operating cost of the service. In such situations, it may be difficult to distinguish between operating and maintenance costs, and it may be easier to consider the two simultaneously, ensuring that there is no double counting.

Operating costs accrue throughout a project's life and, as such, should reflect the manner in which resource costs vary during the lifetime of a project. Consideration should be given to the derivation of future year resource costs. Comparability should be maintained with the assumptions regarding other future year costs (e.g., value of time and accident costs).

Road Vehicle Operating Costs

Operating costs for road vehicles comprise costs incurred by road users and road service providers (e.g., road haulage firms). The nature of these costs is that they are distance-dependent. However, some vary linearly with distance travelled (e.g., fuel costs), whilst others vary in a step-like or lumpy manner (e.g., vehicle purchases and maintenance schedules). The principal components of road vehicle operating costs are detailed in Table 22.

Table 21: Components of vehicle operating costs and their relative contributions

Component	Percentage Contribution	
	Private Cars	Trucks
Fuel	10-35	10-30
Lubricating Oil	<2	<2
Spare parts	10-40	10-30
Maintenance (labour)	<6	<8
Tires	5-10	5-15
Depreciation	15-40	10-40
Crew costs	0	5-50
Other costs and overheads	10-15	5-20

Source: *"A guide to Road Project Appraisal," Overseas Road Note 5, Overseas Development Administration, 1988, p51.*

These costs vary by vehicle type, the condition of the road surface and vehicle speed. Road vehicle operating costs are therefore correlated with the proposed road design standard (e.g., bitumen, concrete or gravel surface), the road maintenance strategy, environmental impacts, the composition of the traffic flow and road congestion (through speed).

The Highway Design Model Vehicle Operating Cost (HDM VOC) model contains predictive relationships for the above factors and is recommended for World Bank funded road projects. It should be noted that such a model is incremental in nature. Thus, should the scale of the project under consideration record a steep change (e.g. a doubling or trebling of the fleet size of bus public transport or road haulage), the model will not fully reflect the costs of the structural change that will occur within the sector. Additionally, this model will not be able to reflect the nature of regulatory or structural reform in either the bus sector or the road haulage sector.

The following local data will be required to populate the HDM4 vehicle operating cost model (source TRL (1988):

ROAD CHARACTERISTICS

- *Rise (m/km)*
- *Fall (m/km)*
- *Curvature (degrees/km)*
- *Roughness (m/km)*
- *Road width (meters)*
- *Surface moisture content for gravel and earth roads (per cent)*
- *Rut depth*

VEHICLE CHARACTERISTICS

- *Free flow speed in the environment under consideration (km/h)*
- *Vehicle weight (tons)*
- *Power to weight ratio (bhp/ton)*
- *Vehicle age (km, yr)*
- *Vehicle price*
- *Tyre price.*
- *Price of fuel and lubricants (per litre)*
- *Price of maintenance labour (per hr.)*
- *Vehicle crew costs (per hr.)*
- *Overheads*

CLIMATE

- *Rainfall (mm/year)*

Overseas Road Note 5 (TRL (1988) defines the data that are required for each of the above local variables. Wherever possible these should be surveyed or obtained from reliable sources (e.g., maps or the regional or central government). In some cases, a pragmatic approach may have to be utilised, drawing on data from other countries to provide an estimate for the study area under consideration.

Valuation of Time Savings

Travel time savings are a major benefit arising from investments in transport infrastructure. However, the lack of data regarding the economic value of time savings within a developing country means that they can often be omitted from appraisals. In such instances, benefit estimates may be based only on vehicle operating cost savings. Such omissions will give bias appraisals to favour schemes that reduce vehicle operating costs rather than those which may induce a mode shift from slow modes, such as walking and head loading, to faster, motorised forms of transport.

The conceptual model underlying the valuation of travel time savings is one of consumer welfare maximisation. It postulates that everyone maximises the satisfaction or utility he gets by consuming and engaging in leisure activities. Consumption of goods and leisure activities is constrained in two important ways.

- *First, expenditure is limited by income which must be earned by devoting time to working; and*
- *Second, work, leisure activities, and travel compete for an amount of time available that is strictly limited by the number of hours in the day.*

In allocating time between activities, the individual must trade off the extra consumption that work earns against the foregone leisure which it requires. But he also has the possibility of extending the amount of working or leisure time available by spending the extra money to save travel time.

This conceptual framework yields important insights into the nature of the value of travel time savings.

- *Working time has value because output is lost to the employer whilst the employee is travelling.*
- *Non-working time has value because travellers are willing to pay to save time. Additionally, the value of non-working time savings is influenced by individual preferences, the value of the activity with which travel is associated and the tightness of the money budget constraint (and hence incomes) and the time budget constraint (and hence person type).*

The theoretical basis for the inclusion of travel time costs within transport appraisal has been developed over a substantial period. Travellers experience utility or disutility from the time they spend travelling. Thus, a change in travel time will either give rise to benefits or costs through a change in consumer surplus or, in the case of travel during work, can give rise to a change in business productivity. In valuing travel time, the challenge arises in understanding the way travel time valuations may vary according to:

- Work trip or non-work trip.
- For non-work trips.
    - Journey purpose (e.g., commuting, market day, leisure, etc.).
    - Income of traveller.
    - Socio-economic characteristics (e.g., retired status).

  - Length of journey (e.g., long distance or short distance).
  - The conditions under which the travel is made (e.g., congestion).
- Mode of transport (e.g., bus, rail car driver or passenger).
- Passenger travel to freight travel; and
- Size of the change in travel time (e.g., can travellers perceive small time savings?).

The most important distinction is between travel in the course of work and travel for non-work purposes. A practical consequence of this is that travel demand data ought, at the very minimum, to distinguish between these categories of journey.

A fundamental distinction is drawn between travel in the course of work (on employer's business) and non-work travel. Classically, a ***work trip*** is defined as a trip undertaken on an employer's business. Travel during the course of work has productive value for employers and society.

The wage rate or cost savings approach is based on the classical economic theory of marginal productivity. Any savings in production costs will be met through an increase in production until the point that the marginal cost of production equals marginal revenue. Reductions in labour costs (due to shorter journeys) will, therefore, result in more units of labour being hired to increase production. This will occur up to the point that the value of an extra unit of labour is equal to the cost of that labour. Thus, the cost savings approach suggests that the value of in-work time savings is the wage rate plus overhead costs.

Under the recommended cost savings approach, the economic value of work travel time savings is the marginal productivity of the person making the saving (i.e., their wage rate). Thus, different workers will have different time valuations. One would expect that within a developing country, agricultural workers will have a lower valuation of time than blue-collar workers (skilled tradesmen) or white-collar workers (e.g., doctors and lawyers).

Ideally, time values should be developed for each worker classification. However, for the economic appraisal to operate at this level of disaggregation, demand forecasting must occur at the same level. Travel time savings for professional drivers, such as bus, train, taxi, and freight transport drivers, plus attendants, should be included in the economic appraisal. Care, however, should be taken to ensure that the wage costs of such drivers and attendants are not double counted with the operating costs of the vehicle. This is because some operating cost models already include the time-related costs of drivers and attendants.

The economic value of time savings for ***non-work trips*** (i.e., non-wage-earning trips) is the difference between the marginal valuation of time associated with travelling and that associated with leisure. The implication is that there is no theoretical basis for deriving the economic value of non-work trips from the wage rate. Instead, the values must be inferred from behaviour. Cultural attitudes will, therefore, influence the value of non-working time and make the transfer of values between countries and cultures difficult. For example, Chilean studies indicate that the value of time for non-work journeys, particularly for inter-urban trips, is considerably higher as a proportion of household income than studies in the Organisation for Economic Co-operation and Development (OECD) nations.

Local and inter-urban bus time savings comprise the sum of the time savings made by the passengers and that of the driver and attendant. Operating cost savings associated with reduced journey times should be captured within the operating cost model.

Time trends in the value of time

The value of work trips is directly related to the wage rate (as discussed above). The value of such trips will, therefore, grow with the projected wage rate, which is typically assumed to equal the growth in GDP per capita (in the absence of other data). The value of non-work trips is not related to the wage rate, and as such, there is no theoretical justification for linking it to wage rate growth.

However, its value is related to income, and any changes in income will affect that value. As discussed earlier, the values attributed to non-working time are cultural and need to be derived explicitly.

In the absence of other data, the following growth rates should be used for the real changes in the value of time over time:

- Working Time, growth in GDP per capita.
- Non-Working Time, growth in GDP per capita.

Regional disparities and "standard values of time"

A standard approach, therefore, is to use national standard values of time. Such standard values may include a single value for work trips and a single value for non-work trips. The exceptions to this general approach are projects that allow people to pay to save time (e.g., new metro schemes or toll roads). For such projects, it is recommended that a minimum value of time be used by the income group (non-working time) and industrial sector (working time). This is for two reasons: firstly, such variations will be paramount to ensure the demand forecasts are robust, and secondly, it is preferable to have consistency between the parameters used in the demand forecasts and those used in the evaluation. Ideally, the values of time should also be representative of local conditions, particularly in areas where local conditions differ significantly from national averages.
As with other aspects of the economic appraisal, the relationship between willingness to pay values and income levels implies that the appraisal could favour high-income areas. This is also the case if standard values of time are used. It is, therefore, critical that the evaluation is augmented with poverty impact analysis and, at the project screening and sifting stage, cost-effectiveness analysis.

7.4 PUBLIC BUILDINGS SECTOR

Public buildings, such as schools, hospitals, and government offices, provide essential services and infrastructure that support economic activity and social well-being. Investment in public building projects improves access to education, healthcare, and essential government services, contributing to human capital development and overall quality of life. Economic appraisal of public building projects should consider factors such as the impact on access to services, utilisation rates, and long-term maintenance costs.

Economic Benefits of Public Building Projects

Like any other investment project, public building projects generate benefits and involve costs (both CAPEX and OPEX). In general, a project becomes desirable from the point of view of society when its benefits are greater than the costs that must be incurred to implement and operate it. However, it is often difficult to identify all the benefits that a project will generate and even more difficult to quantify and value them.

Each project alternative will have its costs and benefits; therefore, to select the best alternative, it is necessary to study the costs and benefits. The evaluation of administrative public building projects helps with the estimation of savings and how much economic resources have been invested. These benefits must then be compared against the costs involved in its execution. The typical benefits attributable to administrative public building projects are the following:

Operating and maintenance cost-saving

To estimate these savings, it is necessary to determine the relevant resource flow, both for "with project scenario" and "without project scenario". Cost-saving flows should be estimated in annual terms and presented in a table based on each type of benefit. The information collected in the costing process must be used to estimate these benefits.

Conservation (repairing and remodelling) cost savings.

The preservation of buildings includes the minor works needed to maintain the functioning of the buildings within the usual standards of comfort and habitability, preserving them from deterioration caused by use and time. This type of expense is occasional and, therefore, not appropriate to be expressed in annual terms but as investment costs in the year in which it is carried out.

Repairing and remodelling costs include cleaning and replacement of glass, taps, and fittings; arrangement and replacement of hardware; maintenance and replacement of machinery; maintenance of air-conditioning equipment; maintenance of pedestrian and vehicular access; maintenance of gardens and green areas; paints; replacement of floors and coverings; varnishes; etc.

To estimate these savings, it is necessary to determine the relevant resource flow, both for "with project scenario" and "without project scenario". Cost-saving flows should be estimated in annual terms and presented in a table based on each type of benefit. The estimation of these costs can be based on the experience of previous years and similar projects. The information collected in the costing process must be used to estimate these benefits.

Employees' time savings on commuting

This benefit is related to the increase in productivity resulting from time savings in the displacement of individual staff. An example is when a project concentrates the operation of one or several public entities or sub-units that previously operated in separate locations in a single building, leading to shorter staff travel time.

Increase of employees' productivity due to the better working environment

The increase in employees' productivity may be due to improvements in the condition of the workplace. This benefit is different from the one mentioned above for improving staff efficiency (i.e., benefits due to shorter staff travel time). This benefit refers specifically to the improvement in productivity of individual staff, which is measured by the additional product generated per worker and per hour worked when there is an improvement in the conditions of comfort and standards for civil/public servants because of the project.

Release of real estate assets and rental savings

If the project sponsor institution owns one or more properties and they are released because of the project (in the "with project scenario"), the value of their sale or rent must be considered as a benefit. This implies that the properties and real estate goods often have alternative uses. Nonetheless, if the properties and real estate goods released have no alternative uses, it must be noted that all things being equal, the land on which the properties are allocated would always have a positive value and, therefore, would have an economic profit deriving from their release.

On the other hand, if the released property was leased, the benefit is given by rental savings costs of these properties and real estate goods, expressed in annual terms during the period considered as the project evaluation horizon.

Intangible benefits

The concept of "intangibles" refers to the identification of benefits that cannot be quantified or valued but can influence the decision when choosing between several project alternatives. The following are some intangible benefits related to administrative/public building projects:

- Agglomeration economies[25].
- Reduction of emission of pollutants and noise.
- Non-monetary benefits (aesthetics, historic preservation, information security and safety, resiliency[26], and sustainability).
- Increase in the public service corporate image (or "country pride").
- Increase in the quality of public services.
- Impact on the urban environment.

Some of these benefits can be estimated using evaluation techniques such as stated preference[27] or revealed preference methods. However, the effort to estimate the benefits must be carefully analysed due to the cost and complexity involved in the application of these methods.

Economic Costs of Public Building Projects

The cost items can be classified into three main headings: **investment costs, operating costs, and maintenance costs**. The selected method to estimate the investment costs will vary depending on the alternatives identified (project size). Once the size of the project is defined, the cost must be estimated

- [25]*Agglomeration economies are the benefits that come when firms and people locate near one another together in cities and industrial clusters. Source: National Bureau of Economic Research*
- [26]*Resilient infrastructure is infrastructure that is planned, designed, and constructed considering ex-ante climate change.*
- [27]*Stated preference (sometimes referred to as contingent valuation) is a survey-based technique for establishing valuations. The subject is asked how much they value something. The answer might be based on a lot of things, and it may be very different from their actual behaviour.*

for different inputs: land acquisition, construction (civil works), equipment acquisition, or lease of real estate, remodelling, and repair works.

The cost estimation is initially done using financial prices. After that, it must use specific conversion factors to transform market prices into economic prices to reflect the real use of national resources in the project.

Investment Costs

It corresponds to those expenses incurred to execute the project from its inception until it enters the operating stage. Within the investment costs, the costs of land, construction, and equipment can be distinguished. In the case of building acquisition projects, the cost will correspond to the total purchase value of the property and the respective transformation costs (if necessary) to meet the needs of the sponsoring agency. The investment costs are also known as Capital Expenditures (CAPEX).

Operating and Maintenance (O&M) Cost

It corresponds to those expenses incurred for the project to operate and deliver the services. The following can be distinguished among operating costs: personnel remuneration and costs of basic services (drinking water, electricity, communications, administrative services, surveillance, etc.).

These costs must be estimated for both "with project scenario" and "without project scenario ". Usually, the costs for the "with project scenario" are smaller than the costs for the "without project scenario" because of the efficiency gains derived from the project. However, if the result is negative, it becomes a cost to the project. The operating and maintenance costs are also known as the Operational Expenditure (OPEX).

Conservation (remodelling and repairing) costs

It corresponds to those expenses that the institution must incur to maintain both the service level and the quality of operation of its physical infrastructure. Usually, the costs for the "with-project scenario" are smaller than the costs for the "without-project" scenario because of the efficiency gains derived from the project.

OPEX and Conservation cost projections

The relevant items must be identified to forecast the operating, maintenance, conservation, and repair costs within the project period/life cycle. In forecasting, the items must be related to some variables that may have historically influenced them, such as the number of staff service employees, built square meters or the number of delivered services. The projections for explanatory variables must be justified by some criterion (for example, the number of delivered services may be related to the population growth rate).

7.5 ENERGY SECTOR

A reliable and affordable energy supply is essential for economic growth and development. Investment in energy projects, such as power generation, transmission, and distribution, can stimulate economic activity, improve living standards, and create new employment opportunities. Economic appraisal of energy projects should consider factors such as the impact on energy security, electricity costs, and environmental sustainability.

Economic Benefits of Energy Projects

The main economic benefits of electricity projects include:

- A higher consumption of energy and/or lower acquisition costs for users.
- Reduced consumption of resources such as candles, paraffin, gas, and batteries, while reducing the time associated with their purchase because of the implementation of rural electricity projects.

In both cases, the benefits affecting all sectors where the project has influence should be considered, i.e. residential, public, commercial sector, etc.

The methodology for estimating benefits measuring the Willingness-to-Pay (WTP) for incremental energy consumption is the simplest approximation. Schematically, the potential benefits of the project for the electricity supplier and for each type of stakeholder are as follows:

Table 22: Benefits by type of stakeholder

Stakeholder	Benefit
Supply company or organisation	Revenues on electricity sales
Residential	Reduced resource dependence
	Higher consumption
Public light users	Reduced resource dependence
	Higher level of safety
	Increase in social activities
Productive sector	Reduced resource dependence
	Increase in productivity
Public service	Reduced resource dependence
Others	Reduced resource dependence
	Increase in productivity

Source: International Best Practices.

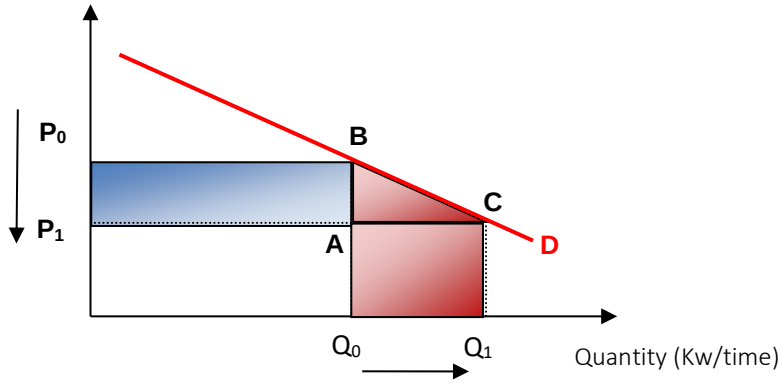
Sales revenue is the major financial benefit of electricity projects, and it can be broken down into fixed and variable revenues, both regulated and incorporated into the tariff system (load factor charges and Kwh charges). If there is no concession or project in the area, the value applied in the nearest concession area with similar characteristics should be used.

Benefits of projects that serve new residential markets

In the estimation of the benefits of a project that serves a new market, it is assumed that the current energy supply (without-project) is from other energy sources (for example, kerosene, gas or fuel). Line D in Figure 14 represents the demand function for electricity. The vertical axis denotes the price (cost) of each successive unit of electricity per period. Without the project, the price/cost per unit is P_o, and the equilibrium consumption level is Q_0. Under the project, costs will fall to P_1, and electricity volume will now expand to Q_1. For simplicity, it is assumed that electricity is used only for lighting and that kerosene oil is currently used for this purpose. The project displaces the current use of kerosene and induces additional use of electricity due to its lower cost. Initially, kerosene consumption is Q_0 (electricity equivalent) and its cost is P_0.

Supplying electricity to a new market involves incremental and non-incremental benefits. The project displaces this use of resources and increases electricity consumption by Q_1–Q_0. The non-incremental benefit is represented by area P_0BAP_1, which is the resource cost savings on kerosene. The area Q_0BCQ_1 represents incremental benefits, and it is composed of sales revenue from incremental output (area Q_0ACQ_1) and the consumer surplus (area ABC). Figure 14 illustrates this.

Figure 14: Benefits of supplying electricity in a new market



Source: International Best Practices.

The information required to undertake benefit estimation, such as kerosene price and quantity purchased (equivalent to the electricity quantity Q_0), can be collected through a survey in the project area. The price of electricity (P_1) corresponds to the long-run marginal cost of electricity supply. In the new market, the incremental output is unknown and should be estimated by the implementing agency. It is usual to have undertaken a survey in similar, recently electrified areas to identify incremental consumption in order to be able to assume that a similar increase will take place in the project area. The above figure assumes that the demand function is linear; however, the analysis can be extended to relax the linearity assumption.

In addition, the project could produce another effect: improving lighting quality by replacing kerosene lamps with electricity lamps. However, it is difficult for homeowners, for example, to value the improvement in light quality. Also, using electric lighting to substitute for kerosene lamps could produce other benefits such as cleaner indoor air and improved safety through reduced fire risks. Therefore, cost savings estimated by using the expenditure on kerosene provide only a lower band for the non-incremental benefits of electricity. Finally, the costs saved on car batteries and similar alternatives should be included in the estimation of non-incremental benefits.

Benefits of projects that serve new productive markets.

In certain kinds of projects, electricity is used for agricultural, industrial, and commercial purposes as an intermediate input. Therefore, benefits are equal to the marginal revenue product of electricity (the physical marginal product × the price of produced output).

To estimate these benefits, it is necessary to know the marginal product of electricity in various agricultural, industrial, and commercial production activities. Because of difficulties in obtaining this information, the benefits of electricity production can be measured in terms of the costs of potential substitutes.

As Asian Development Bank (2013, pp. 284) indicates,

"… carefully designed surveys can generate data on actual use of alternative sources of energy which will be replaced when electricity is available, and the resource cost savings can be considered as the benefits of electricity supply".

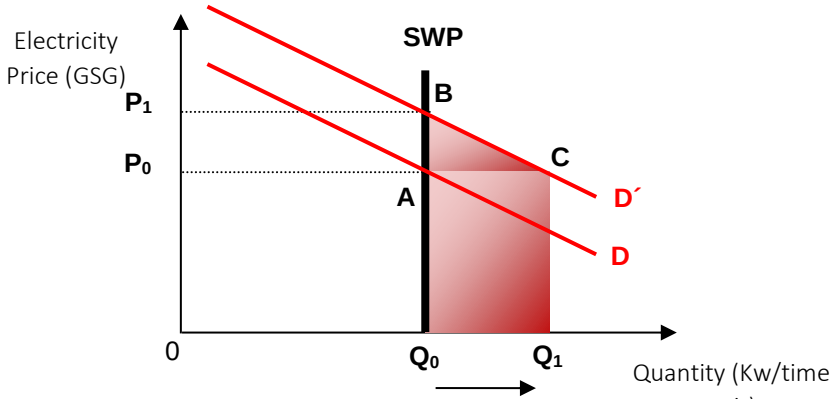
Benefits of projects that reduce energy shortages

The above examples assume that the demand function does not shift due to income effects during the project period. However, it is unrealistic to assume that demand remains the same in a growing economy. Therefore, the basic model needs to be extended to accommodate the impact of a shift in the demand curve.

Consider a project that adds energy generation capacity to the system where an energy shortage is present. In Figure 15, the Supply Without the Project (SWP) is fixed. The electricity price is set at P_0, which is equal to the long-run marginal cost. Supply is constrained at the current level of output, Q_0. As the demand for electricity shifts to the right in the absence of a price control, the without-project price will increase from P_0 to P_1.

Now, assuming a new project that removes the supply constraint by adding an energy plant that produces $Q_1 - Q_0$ units of electricity, the gross incremental benefits are Q_0BCQ_1. In this case, there is no resource cost saving because the electricity supply was not displaced by the project. Figure 15 illustrates this example.

Figure 15: Benefits of Supplying Electricity in a Market with a Shortage



Source: International Best Practices.

To estimate these benefits, the project sponsor should know the electricity price (P_0), the without-project output (Q_0), and the with-project output ($Q_1 - Q_0$).

Total benefits can be divided into two:

I. Project revenue (area Q_0ACQ_1).
II. Consumer surplus (area ABC).

The estimation of project revenue is straightforward, but the area ABC cannot be estimated without knowing the demand function. In some practical applications, project revenue can be assumed as a proxy for benefits, but this is an underestimation.

To simplify the analysis, consumer surplus (area ABC) can be computed as half of the difference in the price multiplied by the project output [$\frac{1}{2}(P_1 - P_0)(Q_1 - Q_0)$]. P_1 can be estimated as the cost or price of alternative energy sources or the cost of current alternative energy sources in areas where electricity is unavailable without the project. However, the theoretically correct approach for estimating the total WTP (area Q_0BCQ_1) is to integrate the demand function over Q_0Q_1.

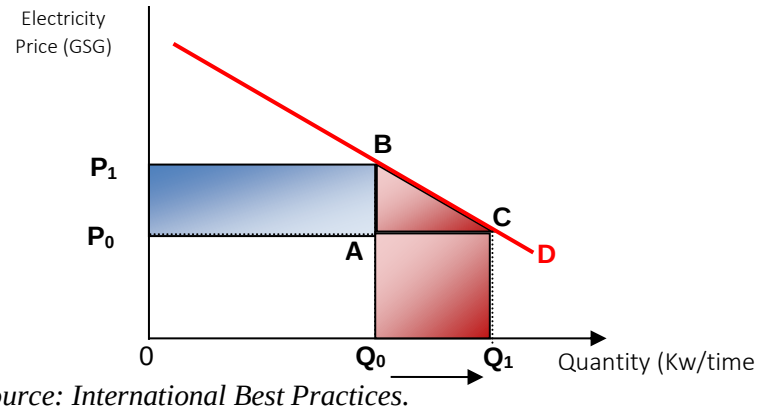
Benefits of projects that reduce generation costs

Energy projects are also built to reduce generation costs by displacing or rehabilitating old facilities that possess low-generation efficiency, higher generation loss, or higher Operating and Maintenance (O&M) costs.

If the tariff remains fixed and the output remains constant, project benefits are solely non-incremental (resource cost savings), as illustrated by the shaded area (P_1BAP_0) in Figure 16. In this case, the benefits accrue to the electricity company, not users.

If the tariff is reduced to P_1 after replacing the old or higher-cost plants, there will be incremental output ($Q_1 - Q_0$). The incremental benefit will be equal to area Q_0BCQ_1, which has a revenue component [$P_0 \times (Q_1 - Q_0)$] and a consumer surplus component (area ABC). In such a case, total benefits are equal to the sum of non-incremental and incremental benefits.
Here, non-incremental benefits (area P_1BAP_0) accrue to consumers.

Figure 16: Benefits of Supplying Electricity on Cost-Reducing Projects



Source: International Best Practices.

Data issues in the application of these methods are similar to those described earlier. The cost-savings or benefits of the saved resources, such as fuel, equipment, and labour, should be measured in economic prices. Non-traded goods (and labour services) are valued at market prices, adjusted by the appropriate conversion factors to take into account market distortions and government interventions.

Summary of the benefits of electricity projects

The economic benefits of electricity projects are incremental and non-incremental. They are explained as follows:

- Non-incremental benefits of projects that serve new residential areas; area P_1BAP_0 in Figure 14 corresponds to the release of resources or increase in consumer surplus associated with cost savings.
- Incremental benefits of projects that serve new residential areas; area Q_0BCQ_1 in Figure 14 represents sales revenues from the incremental output (area Q_0ACQ_1) plus the consumer surplus (area ABC).
- Incremental benefits of projects that reduce energy shortage; area Q_0BCQ_1 in Figure 15 represents sales revenues from incremental output (area Q_0ACQ_1) plus the consumer surplus (area ABC).
- Incremental benefits of projects that reduce generation costs; area Q_0BCQ_1 in Figure 16 is the revenue component $[P_0*(Q_1-Q_0)]$ plus the consumer surplus (area ABC).
- Non-incremental benefits of projects that reduce generation costs; area P_1BAP_0 in Figure 16, which is the consumer surplus.

Externalities

It is appropriate, in the analysis of any project from the point of view of society as a whole, to take into account external or indirect benefits and costs. For example, a particular concern is that if the cost of carbon and other environmental pollution effects of energy generation are incorporated into the economic analysis, economically viable projects may fail cost−benefit tests with this type of proxy, which underestimates the benefits of the project.

Economic Costs of Energy Projects

In order to receive the benefits of the project, some costs must be incurred. Obviously, the most important costs are related to the expenditures to be made by companies that supply energy. In general, these costs can be separated into investment, operation, maintenance, and administration costs.

Investment Costs

Investments are associated with the acquisition and installation of generation systems: transmission lines, distribution transformers, switches, fuses, lines, civil works, joints, and other indoor facilities. For non-conventional energy projects, investment costs are considered to be civil works, supporting structures, equipment uptake of renewable energy, protection, distribution lines, transformers, joints and outdoor facilities. In general, all inputs are involved in enabling the energy supply system.

Operating and Maintenance (O&M) costs

O&M costs occur when the system is ongoing or when the project in question is operational. Among other things, these costs include fuel costs, energy purchases and power purchases. Unitary values are determined by node prices, while the amount to purchase includes residential demand plus electricity losses. Other operating and maintenance costs should also be considered. Maintenance costs correspond to the resources used to repair or replace the network.

When looking at non-conventional energy-project operating and maintenance costs, consider:

- Personnel costs and materials designed to operate, maintain, and manage the system.
- Losses of energy and power (distribution losses).
- Training costs and/or dissemination of unconventional technology to ensure smooth operation.

In general, these costs can be represented by the following expression:

Operation Costs = Energy Costs + Maximum Power Costs

The total amount of maximum power and energy demanded by the supplier is obtained from the amount of maximum power and energy demanded by all users, plus their corresponding transmission losses between the place of purchase and the selling place.

Administrative costs: These costs are related to consumption readings, billing, ticketing and payment collection.

Indirect costs: These costs will be considered only if the markets are distorted. The intangible costs generated by the project should be indicated in a list.

In practice, it is usual to determine the total resources that would be needed each year to maintain the technical standard of the project. The cost of the project is given by the additional amount of resources required in the with-project situation to the without-project situation.

7.6 EDUCATION SECTOR

Education is a cornerstone of economic development, equipping individuals with the knowledge and skills necessary to contribute to a skilled and productive workforce. Investment in education projects generates economic benefits through enhanced job prospects, higher earnings, and increased tax revenues. Economic appraisal of education projects should consider factors such as the impact on literacy rates, numeracy skills, and employment opportunities.

Economic Benefits of Education Projects

Like any other investment project, education projects generate benefits and involve costs (both CAPEX and OPEX). In general, a project becomes desirable from the point of view of society when its benefits are greater than the costs incurred to implement and operate it. However, it is often difficult to identify all the benefits that a project will generate and to quantify/value such benefits.

Due to the complexity of the valuation of project benefits in the education sector, a more pragmatic approach is adopted. This approach revolves around the acknowledgement that investing in education yields economic returns, an established truth requiring no further demonstration. Education is deemed a fundamental necessity that governments are obligated to provide its citizens. The only question for project appraisal then becomes:

What project alternative is the cheapest in satisfying the demand for education?

Each project alternative will have its own costs and benefits. Therefore, to select the best alternative, it is necessary to study the costs and benefits of each. However, in the cost-benefit analysis, it is assumed that all project alternatives generate the same or very similar benefits, and to select the best alternative, the one with the lowest cost must be chosen.

Benefits Quantification

The benefits generated by education projects are many and varied. However, they are usually difficult to quantify, and only in very special cases is it possible to value them in monetary terms. The usual result is that the cost and effort required to obtain a good estimate of the education benefits becomes higher than the cost and effort required for implementing the project. Given this situation, the basic needs approach has been adopted for the evaluation of education projects. This approach assumes that society assigns a greater value to the benefits of education projects than the costs of providing such services.

Even though the benefits of education projects cannot be easily assessed, it is important to identify and quantify who receives the benefits. In this sense, the benefits of an education project generally are:

- To increase the level of productivity of the beneficiaries, their own income and the income of the employers who hire them.
- To increase personal satisfaction and self-esteem for the knowledge acquired.
- To improve the integration of the beneficiaries into society by allowing them to access new services and reducing some anti-social behaviour.

Unfortunately, it is not easy to quantify these benefits, although they are real. Therefore, it is necessary to use some parameters, which are not benefits per se but have a direct relationship with a benefit. In other words, because it is difficult to measure the benefit by itself, we measure one or more variables ("proxy" variables) and anticipate them to have a direct relationship with the real benefits of the project.

It is assumed (although it does not always happen) that if these variables occur in the project, then the expected benefits shall materialise. This will only be known if good project monitoring and an ex-post evaluation are carried out. For example, consider the following use of a proxy variable. A project aims to improve the management of educational institutions in a region through the provision of training for school principals or directors in modern management techniques. This is expected to generate a better use of available resources and allow the delivery of better-quality education to students. In this case, it is not possible to estimate what positive impact this project will have on the future conditions of the lives of students, nor how much this project will increase the level of personal satisfaction of the trained principals and those working with them.

It is also very difficult to estimate how much the savings will be from better management of establishments. We cannot even estimate a priori how and by how much the management of each school will be improved. We can only know how many principals/directors we will train. Thus, the number of trained managers could be accepted as a "proxy variable" of actual project benefits, assuming that the project has been well-designed and that if we train more directors, there will be future benefits. Generally, it is assumed that the benefits of each project alternative could be adequately represented by all additional services it shall provide. However, only those services that each alternative is, in fact, going to provide to the beneficiaries should be rightly considered as its benefits.

The analyst must first estimate the actual services that the beneficiaries are going to receive and not consider the potential services that a given alternative could provide in theory as benefits. While this may seem obvious, in practice, it is common to see errors in quantifying the benefits of education projects when analysts confuse these two concepts.

A special case is those projects that do not affect the quantity or the quality of educational services but reduce the costs of delivering those very same services. In this case, the benefits of the project are clearly identifiable, measurable, and assessable. The benefits can be easily determined as the difference between the costs associated with the optimised base case and the corresponding costs of the alternative project.

Economic Costs of Education Projects

In order to receive the benefits of the project, some costs must be incurred. The most important costs are related to the expenditure to be made by companies that provide education services.

The cost items associated with each alternative will depend on their characteristics and on the type of project. Basically, we distinguish two types of projects: those that aim to increase or improve the infrastructure for the delivery of educational services and those that aim to improve the quality of the service being provided. For each of these types of projects, the cost items receive a similar treatment regardless of the project alternative.

The costs associated with each alternative education project can be classified under the following categories:

- Investment costs
- Operating costs
- Transportation costs

To quantify the costs associated with a project regardless of the type or alternative, the following steps should be followed:

1. *Identification of the required cost items for implementation (Capex) and operation (Opex).*
2. *Quantification of required costs.*
3. *Estimated price of each item.*

4. *Calculation of the total annual cost of each item.*
5. *Preparation of a summary table of the costs of the project alternative.*

Identification of Cost Items

The first step in estimating the cost of a project alternative is to identify all cost items that will be required for its realisation and operation. It is important to note that all items should be identified, regardless of whether the analyst may think a priori that some of those cost items will not produce a disbursement for the entity that executes and/or operates the project.

To perform this task, it is convenient to search and analyse similar projects that have been implemented in recent years. If there is no previous experience in the education sector, the analyst may look at similar projects in other sectors. If there is no experience whatsoever in the country, then it is advisable to consult or hire an expert in this subject.

At this stage, it is sufficient to prepare a comprehensive list of assumed cost items and classify them into the categories identified above (i.e. investments, operation, transport). Then, briefly describe the cost item and its estimated frequency of occurrence.

Investment costs (Capital Expenses): CAPEX are all those costs that initiate the execution of the project until it is ready to be handed over to operations. That is, investment costs are those incurred after the investment decision has been made and until the project is able to start providing the expected services and benefits. Investment costs incurred in an education project are:

- **Land**: This item corresponds to the cost of the physical space required to execute the civil works. For the sizing of the land, it is recommended that the surface requiring the civil works be considered, in addition to some open spaces for future expansion, etc. The valuation of the land must be done, including whether the land is purchased by the project, owned by the project sponsor, has been donated, or can be occupied at no cost. Since there is always an economic opportunity cost for the land, the use of this land by the project involves an economic cost to society. This opportunity cost should be considered only for economic evaluation purposes and must not be included in the budget when negotiating the financing of the project.

  In the case of land being acquired for the project, the total acquisition cost should be considered, including all costs involved in the transaction (notary fees, transfer, legal fees, etc.). If the land belongs to the project sponsor or is donated, the market value should be used for the analysis (a value that it could be sold for, assuming there was no impediment to it).

  Besides the initial cost of land acquisition, in the economic evaluation of the project, we must also consider the residual value of the land. This corresponds to the estimated sale value of this land at the end of the project life. Usually, urban land does not depreciate (i.e. it does not lose its value); on the contrary, in many cases, the value of land increases over time. Thus, a conservative assumption is that, at the end of the project life, the land will be sold at the same amount at which it was acquired.

  It is also necessary to include all the expenses required for land preparation, such as clearance, drainage, levelling and fencing. Additionally, if the land has no connections to the networks of basic services (i.e. electricity, water, sewerage), the analyst must incorporate all these connection costs, including its feasibility study, into the economic evaluation.

Any cost that is a result of a tax (e.g. tax on property transfer) should be included only for the purpose of the project's budget preparation but should not be included for the purpose of economic evaluation.

In determining the cost of the land and any costs in an economic evaluation of project alternatives, the analyst should consider the concept of opportunity cost.

For example, consider the case of a school construction project in which a deficit of 566 m^2 in buildings and 600 m^2 of free area was detected. Suppose that adjacent to this school there are two vacant lots, each of 600 m^2. One is a municipal property, and it is offered to the school for 100 years of occupation at no cost. The second is a private property that must be acquired at a market price of USD 125,000. In this case, for the purpose of economic project evaluation, the cost of land is USD 250,000. This is because the project initiators must pay USD 125,000 to the private owner and another USD 125,000 for the municipal land; even though this land is free, it must be valued at its market price, which is given by the value of other similar land sales.

However, in the project's budget to be prepared for project funding, the relevant cost is only USD 125,000, i.e. for the acquisition of the private land.

- **Construction Costs**

- The construction cost corresponds to the value of buildings and other necessary physical works needed to materialise the project alternative. It includes the costs of materials, transportation of those materials, labour, supervision, project management, and all other necessary expenses for the construction of the civil works.

  At this point, we are referring to construction costs in generic terms, understanding that they could also be repair, remodelling, expansion, etc. The important thing is that the assessment should be made taking into account the cost per square meter (m^2) of "construction", differentiated between whether it is construction, remodelling, repair or other. Moreover, within the generic construction costs, the architectural designs and the detailed engineering studies should be incorporated as costs, if appropriate.

  For the economic evaluation of the project, it may be necessary to correct some of the market prices of inputs in order to convert them into economic prices. This correction will include the elimination of taxes and possibly an additional correction due to other market distortions.

  Also, at the end of the project life, we should consider the residual value of the buildings. This corresponds to the value at which the buildings could be sold at the time the project stops its operation. The analyst must not consider the value of the land in the calculation of the residual value of the buildings because that would be double counting, given that the land has already been considered as a separate asset.

  Finally, as in the case of land, the residual value of the buildings should also be valued at their market price. Any additional donation of work and/or supplies for the project's construction should also be considered in the evaluation, valued at their economic opportunity cost, even though this may not actually be paid.

- **Equipment costs**: This item corresponds to the value of all movable elements and other components necessary for the project to remain operational. For example, chairs, school tables, desks, blackboards, etc. The cost of the equipment should include the cost of installation, where applicable.

  In the case of the construction of a new school or of the partial replacement of an existing school that involves the implementation of new construction works, the value that is to

be assigned to the equipment should generally vary between 3% and 5% of the total construction cost. It is important to remember that in the case of the expansion or partial replacement of a school, the analyst should only consider the equipment that is actually missing and not the full list of equipment that might be required for a school.

It is recommended in cases where the equipment is more complex (i.e. specialised equipment for technical education, libraries, laboratories, etc.) that a detailed list of the required equipment is made, with their respective technical specifications, and that two or three quotes are obtained from different companies.

The equipment shall be valued at its market price, inclusive of taxes, for the purposes of the project budget, but taxes shall be eliminated for the project's economic evaluation. If the equipment is donated, it must not be considered for budgeting purposes but for economic evaluation purposes, the equipment must be valued at market prices, excluding taxes. In some cases, it may also be necessary to correct the market prices of the equipment to obtain their economic price. For example, if some of the equipment is imported, it will be necessary to correct the market price, applying the conversion factor for foreign exchange. A cost that must not be forgotten is the replacement of equipment because the life of the furniture and equipment is usually less than the life of the school's infrastructure. Consequently, during the assessment horizon, the equipment will need to be replaced from time to time. This means periodic re-investments during the life of the project. Since the usefulness of these assets is different depending on their type, for each category, there should be an estimation of when they should be replaced. This cost must be recorded in the cash flow of the project in the year in which it is estimated to occur.

Finally, some equipment may end up having a residual or scrap value at the end of its life, which must be considered as cash inflow in the year in which the replacement is made. As in the case of land and construction, the revenue from selling the equipment should be considered opportunity costs.

- **Operating Costs**: Operating costs are all those expenses that must be incurred by the school in order to provide regular and sustainable educational service. However, it is important to note that in the case of a project that adds something to an already existing operation (i.e. a brownfield project), the relevant operating costs that should be considered for economic assessment are only the incremental costs. The quantification of operational costs is usually done on an annual basis.

  Remunerations: This corresponds to the cost of the salaries and wages of all the necessary human resources of the school, the staff that delivers all administrative, auxiliary and educational services. This cost item is recorded in the accounting books as teachers' salaries and the wages of administrative and auxiliary staff; it includes social security costs, gratuities, bonuses and others.

  This cost item should detail total staffing requirements, specifying whether they are for professionals, technicians, secretaries, assistants, or others. In addition, it must be specified if hiring qualified personnel is necessary for a given subject (e.g. an international expert).

  For the purpose of identifying the economic costs associated with this item, the analyst must consider all incremental personnel involved, that is, all those that produce an additional expenditure for the entity that will operate the project. In other words, the analyst should not consider the cost of the existing staff (i.e. the staff of the "without project" situation, those who remain working in the school regardless of whether the project is implemented or not).

When making an economic evaluation, the salaries of volunteer personnel working on the project should be calculated as if they were hired at the market wage rate in order to take into consideration their opportunity cost to society.

In the economic evaluation of the project, it will be necessary to correct market wages in order to calculate the economic price of labour by multiplying the estimated remuneration cost (classified by skill level) by the corresponding conversion factor. In the case of the education sector, teachers, principals or other professionals are all considered skilled workers, while secretaries, inspectors, clerks, etc., will be classified as semi-skilled workers, and all those who work as janitors, cleaning staff, etc., are considered unskilled workers. It should be noted that in the case of projects aimed at providing a specific educational service, the wage bill is usually the most important cost item.

Input costs: This refers to the value of the essential elements that allow the proper functioning of the school, including cleaning materials, clothing, fuel, office supplies, support materials, etc.

As in the previous categories, the analyst should only consider the incremental costs attributable to the implementation of the project alternative. In those cases where some current inputs might be replaced with new ones in the project alternative, the economic evaluation should only consider the net incremental cost, i.e. the cost of new inputs minus the cost of those old inputs that are going to be replaced.

The price of inputs required for the project can be estimated based on the experience of other schools or projects developed by the sector. However, more accurate and updated prices are usually obtained if a comprehensive list of the necessary inputs is quoted at the market price. These prices must include transportation costs to the project site. The relevant taxes to be paid must be indicated separately.

Basic services (Utility) costs: This is the cost of all services required to operate the school. These services include water, electricity and, in some cases, fuel. It is important to note that only incremental costs involving the project should be considered. In the case of basic services, the relevant costs are only those incremental costs that are absent from the "without project" situation.

To determine the price to pay for basic services, it is generally sufficient to contact suppliers and public utility providers for the cost. If this is not possible and some of the services must be supplied by the project itself (e.g. an electricity generator), it will be necessary to resort to entities that provide this service to find out the cost.

Maintenance costs: This is the expenditure required to maintain the capacity to generate the benefits of movable or immovable property, preventing deterioration or premature failure. This includes expenses such as painting and minor repairs of buildings, periodic maintenance of vehicles and equipment, repairs and painting of furniture, etc. Generally, this value is estimated as a percentage of the value of the goods subject to maintenance. As a rule of thumb, consider between 2% and 3% per year; this will depend on the type of asset used and whether it has received prior maintenance. In the case of maintenance costs, the relevant costs are only those incremental costs that are absent from the "without-project" situation.

Rental costs: This item corresponds to the payment of rentals for buildings, land, vehicles and/or equipment required for the operation of the project. The economic evaluation should consider the total cost of the lease, including commissions but excluding any tax-shield effect. If the issuance of a guarantee is necessary, this must be

reflected in the cash flow statement as an outflow when the money is put aside to guarantee payment and as a cash inflow when the money is recovered at the end of the leasing period.

To estimate these costs, the calculation should be based on the costs incurred in recent similar projects or on quotations requested from potential suppliers. The rental agreement can also be estimated as a percentage of the value of the leased object.

Other operating costs: All other operating costs necessary for the functioning of the educational establishment should be detailed within this item. Some of these are communications, printing and publishing, insurance, etc. Only incremental costs from project implementation should be considered when making the economic evaluation.

- **Transport Costs**: In many cases, the implementation of a project alternative implies that the school population should move daily or modify their current travel habits. In both cases, the project alternative should contemplate providing a bussing service, and incremental transportation costs should be estimated when travel times and distances are modified by the project.

  Time and cost of transfer: If the alternative project significantly modifies distances, travel time, or the travel costs of its students, it is advisable to estimate these costs. This may be the case when the project alternative is the construction of a new school, the transfer of an existing school, the closure of an existing school, or the merger of two schools, etc.

  To estimate these transportation costs, the analyst must study the map of the area of influence. In this map, one or more geographic points may be considered as the centres of gravity or as representative of the location of the target population. The time required and the cost of travel are then estimated, considering the most common means of transport by the students from each point to the school. This must be done for both the "without-project" situation and the "with-project" situation. These costs and times are then multiplied by the annual number of trips that the target population needs to make. This is how the total cost and total travel time is calculated. In the case of small children who need to be accompanied to the school, the cost incurred by their guardians should also be addressed.

  Transportation of students and/or teachers: If the alternative project includes providing a bussing service, then the total cost of that service should be incorporated, including fuel and lubricants, tyres, the remuneration of drivers, maintenance and servicing of buses, cost of the buses, etc.

  Also, the analyst should try to estimate the additional cost (or savings) involved in commuting for students and/or teachers. For this, it is necessary to calculate the average general cost of travel, i.e., including travel and time.

Quantification of the Cost Items

The next step is to determine how much will be required of each of the identified items. For the operating and transport costs, indicate requirements (i.e., whether the project will operate for several years or less than a year, monthly, weekly, or daily).

If the project is related to infrastructure, it is recommended when estimating construction costs to use the standards required by the authority of the sector as a base. Based on the standards, the analyst will know the total area required to meet the deficit that has been identified. It is convenient to use as reference, similar projects that have been recently developed, whether in the education sector. It is also advisable to resort to expert opinion, at least as a validation of the estimates that have been carried out.

8.0 RECOMMENDATIONS AND FINAL COMMENTS

The standardisation and systematisation of public investment processes have yielded substantial benefits in terms of enhancing the effectiveness and productivity of public investments across various sectors, including education, health, irrigation, public buildings, energy, and roads. Project appraisal serves as a vital tool for identifying policies that maximise social welfare, allowing for the rejection of unfavourable projects while promoting sound ones.

This document offers technical guidance for the formulation and evaluation of projects within the education, health, irrigation, public buildings, energy, and roads sectors. It is essential to note that the methodology's scope is technical and does not encompass the administrative roles and responsibilities within the Public Investment Management (PIM) System, which must be detailed in the system's rules and procedures.

Project evaluation plays a pivotal role in decision-making, facilitating the allocation of limited resources to projects that yield the highest expected economic benefits. This evaluation process serves several critical functions, such as:

- Identifying criteria for investment policies that maximise social welfare;
- Distinguishing between "bad" and "good" projects;
- Determining whether the public or private sector should implement a project;
- Estimating the fiscal impact of the project;
- Establishing agreements for cost recovery; and
- Assessing the project's impact on various factors, including the environment, regional development, and poverty.

Effective project choice and design in the education, health, irrigation, public buildings, energy, and roads sectors greatly benefit from a well-articulated and feasible policy framework. This framework should clearly outline policy objectives, directions, and priorities while offering implementable strategies to achieve sectoral objectives.

To ensure sustainability in these sectors, the policy framework should consider the socio-cultural context's receptiveness to proposed interventions, the country's economic and financial capacity, and the managerial capacity within the country's institutional context.

For projects to succeed, it is crucial to focus on the production of intermediate (e.g., trained professionals) and final outputs (e.g., graduates). The project analyst plays a pivotal role in demonstrating how changes in inputs and processes will increase the production of desired outputs.

The project lifecycle and its phases significantly impact project success. Gathering information and conducting necessary studies for project identification, formulation, and appraisal reduces uncertainty in investment decisions, enhancing fiscal resource allocation.

The proposed framework for project appraisal in these sectors must be closely integrated into sector policies. Quality within each sector plays a critical role in ensuring the system's ability to deliver expected benefits. The measurement of quality encompasses various indicators relevant to each sector, providing essential information for guiding policies.

Appendix 1

The Logical Framework Approach.

The logical framework approach is based on a systematic analysis of the problem and the options for addressing those problems. The tool categorises the problem into a Problem Tree (Causes and Effects Trees) and a Solution Tree (Means and Objectives Tree).

Building the Problem Tree

The construction of the problem tree should be performed guided by the following steps:

Construction of the Causes Tree	**Start from the definition of the central problem (trunk of the tree), then identify the causes downwards (roots of the tree) that give rise to that central problem. It is important to identify the primary, secondary, and independent causes that bring about the central problem. For the identification of causes, brainstorming sessions should always be carried out with the key stakeholders and institutional managers, among others, who have an interest in the problem.**

The identification of causes can be organised into two parts:

causes generated from the supply of the good or service and *causes generated from its demand.*

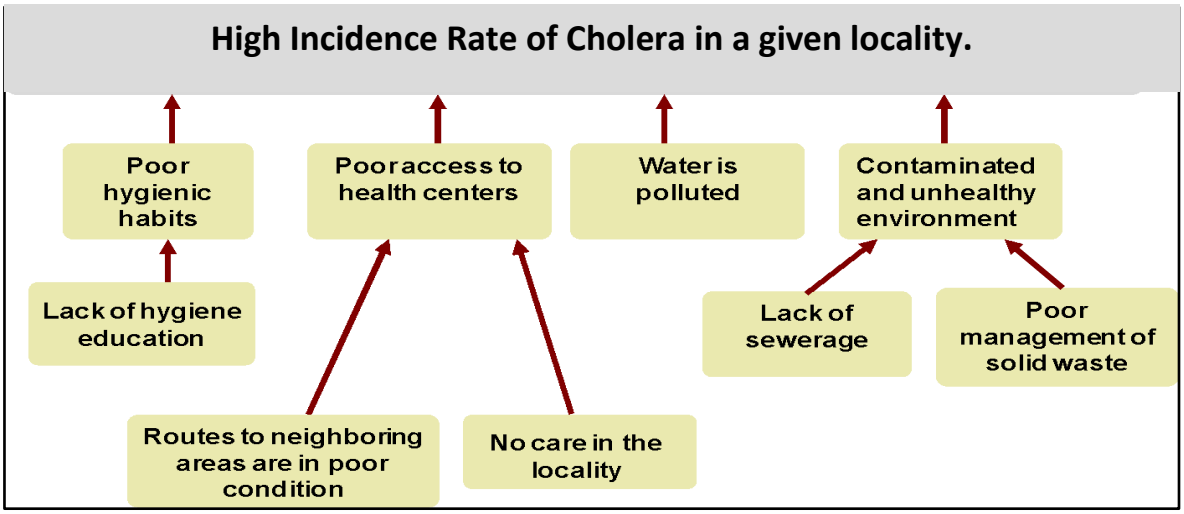
For example, *suppose that a certain Municipality had received complaints from a group of neighbours regarding a high incidence rate of Cholera in their locality. Based on this, the neighbours demand putting in place a health centre in the locality. The problem can then be defined as a "high incidence rate of Cholera in a given locality", for example, Abokobi.*

The problem should not be stated as the lack of a solution.

For example, there is a "lack of a health centre" because the analysis would then be restricted to a single solution, which is not always the optimal solution to the root problem ("the high incidence rate of Cholera").

From the study of the current situation through conversations with neighbours, visitations and brainstorming, the various causes of the problem can be identified as illustrated in Figure 17.

Figure 17: The Causes Tree



Source: based on *Ortegón E, Pacheco J, Roura H. (2005).*

As shown in the figure, there are different hierarchical levels of causes. At the first level, immediately under the root problem, are the direct causes of the problem. These causes are generated by various other causes (shown in the levels below). The number of hierarchical levels will depend on the size and scope of the problem.

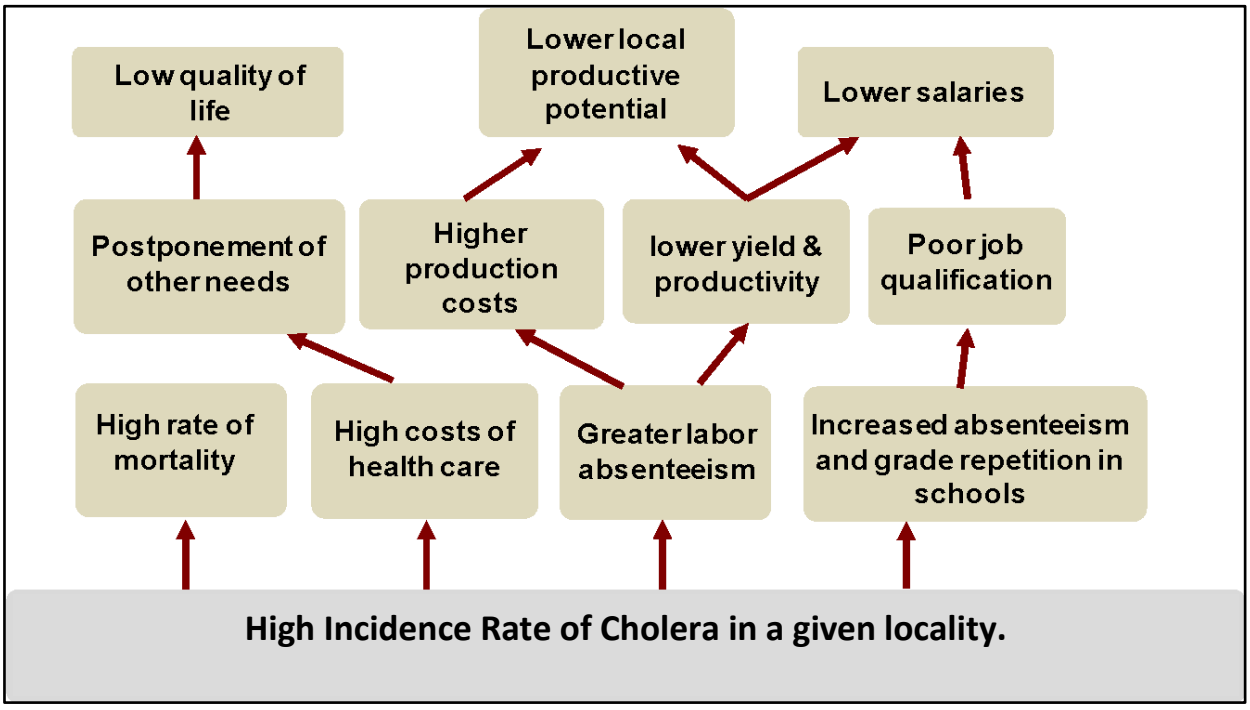
Building the Effects Tree

Following the analysis, the project formulator must identify the effects (i.e. tree top and branches) generated by the central problem (i.e. tree trunk) on the target group. Similar to the Causes Tree, these effects should be identified through brainstorming sessions with the main stakeholders affected by the problem as well as project sponsors.

Identifying effects can clarify the outputs and outcomes of the problem to be solved. A distinction should be made between the different effects since there are different hierarchical levels. The Effects Tree plots the "chain" effects of this problem. The effects generated directly by the project are those of the first level, which in turn generate the effects of the second level and so on. The number of levels to be considered in the design of the Effects Tree will depend on the expected scope of the project.

For example, *a direct effect of the identified problem is the high number of people with Cholera, which in turn has the effect of high healthcare costs and work absenteeism (see Figure 18).*

Figure 18: The Effects Tree



Source: based on *Ortegón E, Pacheco J, Roura H. (2005).*

Choosing the right solution will allow remedying the effects identified in the Effects Tree.

Integrating the Problem Tree	Integrating the analysis into the Problem Tree, by integrating the Causes Tree with the Effects Tree.

By integrating the Causes Tree with the Effects Tree, the complete Problem Tree is drawn (see Figure 19). After this, it is necessary to check the Problem Tree to ensure there is vertical logic to understand the problem (bottom-up check).

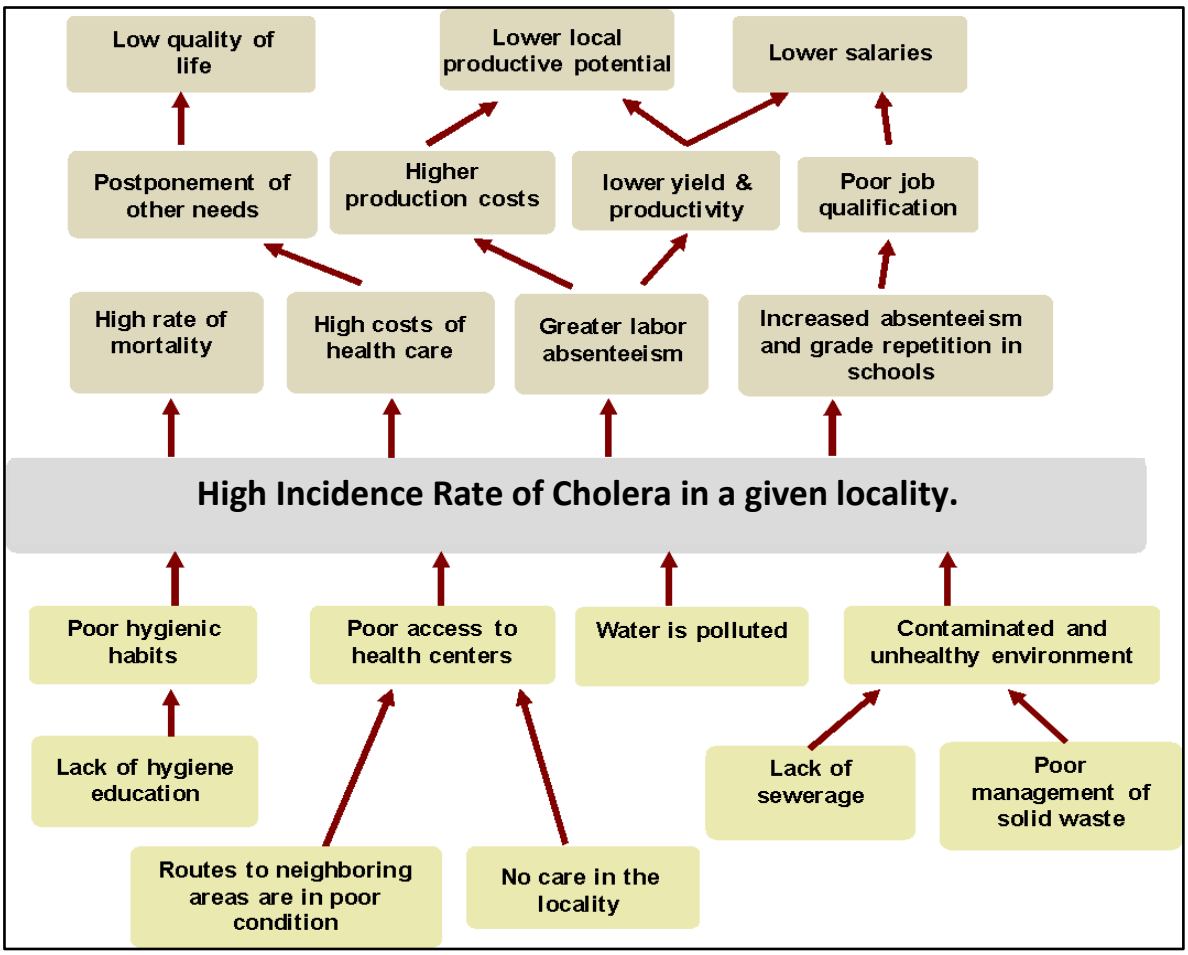
Once the problem and rationale for government intervention are justified, it is important **to have a clear statement of the objectives of the project** so that appropriate alternatives for achieving these can be considered further. In addition to assisting in defining project alternatives, a good specification of objectives is essential for monitoring the project during implementation and for evaluating its performance on completion.

A key aspect of project appraisal is testing the "reference" project against alternative ways of achieving the same objective. The hierarchy of objectives for the project should be defined as follows:

- **Overall Objective:** General objectives such as income increases, standard of living improvement, poverty reduction, natural resources protection, etc., to which the purpose is going to contribute.
- **Project Purpose:** The project's central objective is expressed in terms of the achievement of sustainable benefits for the target group.
- **Project Outcomes:** Achievements created by the project, which produce the services or facilities corresponding to the project purpose.
- **Project Outputs:** These are the deliverables, products or services created by the project.

Alternative approaches can be identified at the level of the **Project Purpose**. For example, the construction of a new road is not the only way of reducing travel costs and improving safety. There are other ways of achieving the project's purposes, such as improving traffic management procedures, increasing police controls, charging for congestion, and installing speed cameras. Some of these alternatives will not need capital investments.

Figure 19: The Problem Tree



Source: based on *Ortegón E, Pacheco J, Roura H. (2005).*

The **Project Outputs** are the things that will need to be delivered to achieve the purpose. For example, for the road construction project, it is expressed in terms of km of road constructed. Alternatives to road construction would have different outputs. These might be completely different outputs from the reference project. for radical alternatives to road construction or non-dissimilar alternative routes.

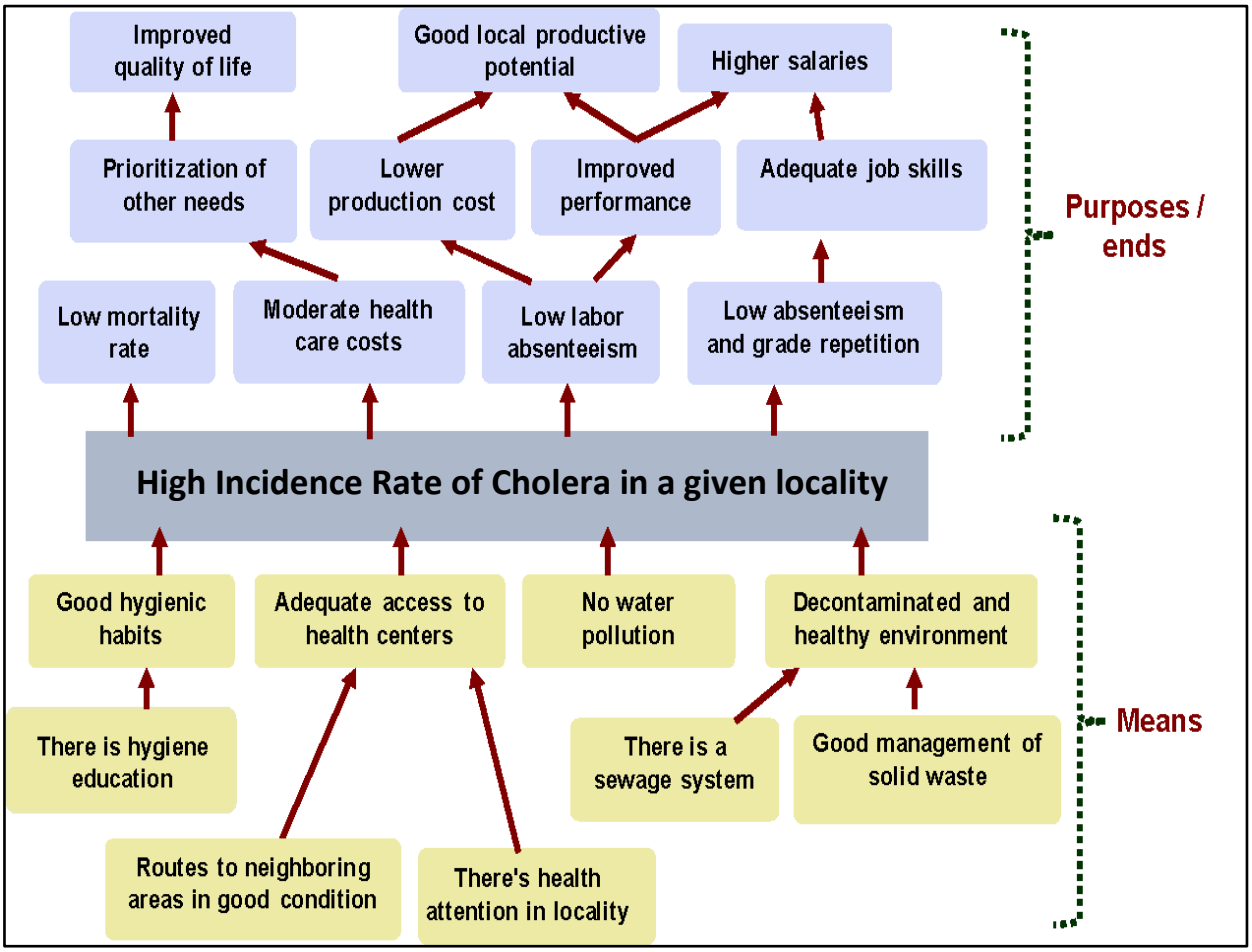
Building the Solution Tree

To identify possible solutions, the first thing is to visualise the expected situation once the central problem is solved; this provides strategies for action and, therefore, the set of alternatives to be analysed.

To construct the Solution Tree, it is necessary to change all the negative conditions of the Problem Tree into positive conditions; then, the Causes of the Problem Tree are transformed into the Means of the Objectives Tree, and the Effects are transformed into Purposes and Ends. What was defined as the root problem now becomes the central objective or purpose

that the project must accomplish. Figure 20 shows the Solution Tree associated with the Problem Tree.

Figure 20: The Solution Tree

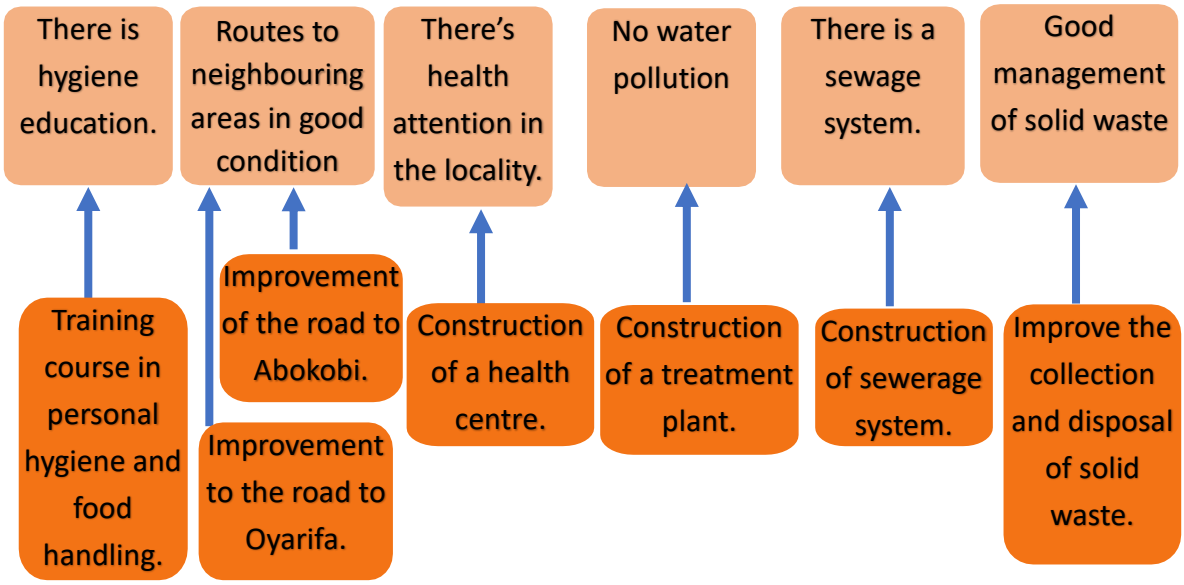


Source: based on *Ortegón E, Pacheco J, Roura H. (2005).*

Identification of Actions

For each root (means) of the Objectives Tree, creatively look for at least one action that could achieve this means.

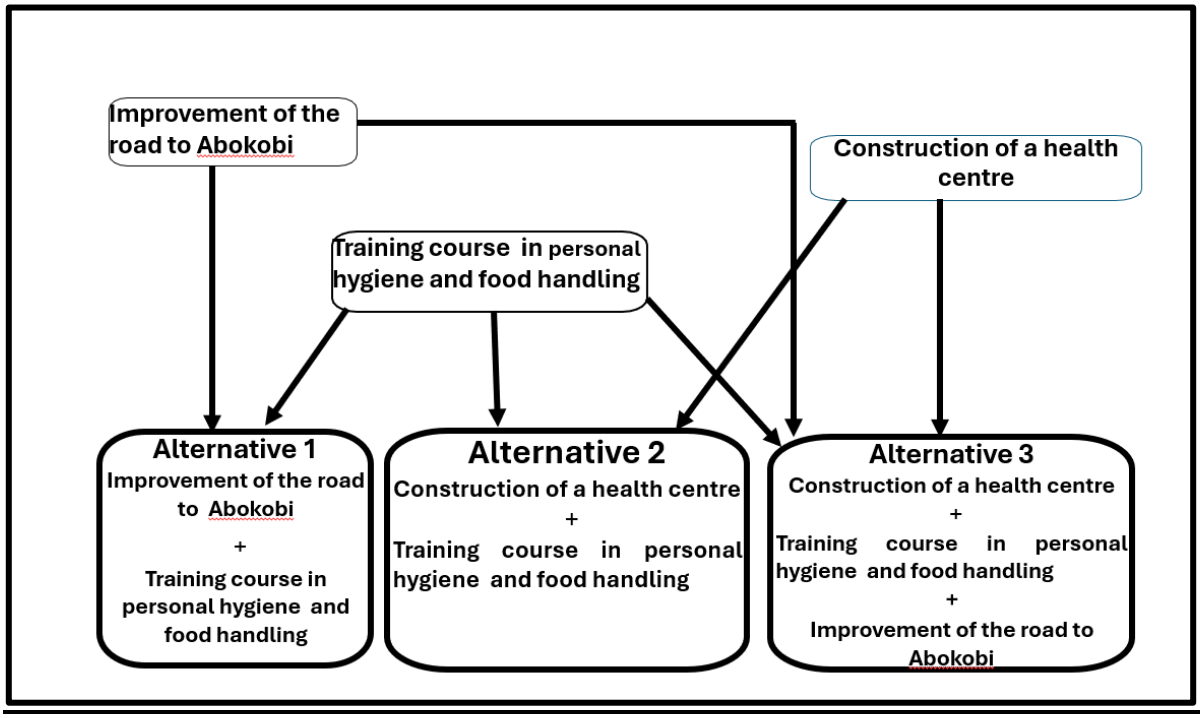
Figure 21: Identification of Options



In finding the alternatives to the project or program, the analyst must examine the proposed actions within the following areas:

- Analyse the level of impact of the proposed action on the solution of the problem.
- Prioritize the action with the highest incidence.
- Check interdependencies and group those actions that are mutually complementary. Bundle or group actions.
- Define alternatives based on the grouped actions.

Figure 22: Identification of Alternatives



It is recommended that the analysis of alternatives be carried out during the Pre-Feasibility Study. As the sponsoring agency gets involved in the details of the studies, the probability of choosing the best alternative for solving the problem increases.

The purpose of an **Options Analysis** is to undertake an analysis of all feasible options that can achieve the identified output specifications. This will assist in identifying the preferred solution to the problem. The following principles should guide the options analysis:

- All feasible options should be evaluated.
- The preferred option should be affordable.

A first high-level analysis of these options should include a qualitative listing of the advantages and disadvantages as well as a preliminary quantification of the costs and benefits of each option relative to the objectives of the project. This comparison should allow for the development of a shortlist of 2 to 3 preferred options, which will be assessed in detail. The processes described in the following stages will separately assess each of the shortlisted options. This information needs to be assembled to enable the project to undertake the financial and economic CBA.
The alternative identification is linked to the LFA.

Logical Framework Matrix

A useful tool to display and organize the project idea resulting from the ex-ante evaluation is the Logical Framework Matrix (LFM), which summarizes what the project intends to do and how it will achieve it; what the key assumptions are, and how the inputs and outputs of the project will be monitored and evaluated. It consists of a matrix with four rows and columns, which summarizes selected aspect of an activity design, namely:

- What the activity will do, and what it will produce (Activity Description)
- The activity's hierarchy of objectives and planned results (also Activity Description)
- The key assumptions that are being made (Assumptions), and
- How the activity's achievements will be measured, monitored and evaluated (Indicators and Means of Verification).

Table 23 shows the structure of the LFM. The vertical logic of the matrix represents the project objectives: The first column of the LFM shows the End, Purpose, Components/Outputs and Activities of the project. The first row is the target level corresponding to the End, the Goal or Impact of the project. It is a description of the solution to a long-term problem that the project is expected to contribute (consistent with the purposes of the Objectives/ Solution Tree).

The second row develops the Purpose level that corresponds to the central objective of the project or the direct results to be obtained by the beneficiaries once the implementation period is completed (linked to the focus of the objective tree).

The third row shows the Components/Output, which corresponds to the development of products or services to be offered as a result of the project (matching the objectives tree).

Finally, the fourth row is the Activities section, which specifies the main tasks to be performed to produce the components previously identified.

Table 23: Logical Framework Matrix – General structure and content of LFM

Project Description	Indicators	Source of Verification	Assumptions
Overall objective: The broad development impact to which the project contributes – at a national or sectoral level (provides the link to the policy and/or sector programme context)	Measures the extent to which a contribution to the overall objective has been made. Used during evaluation. However, it is often not appropriate for the project itself to try and collect this information.	Sources of information and methods used to collect and report it (including who and when/how frequently).	
Purpose: The development outcome at the end of the project – more specifically the expected benefits to the target group(s)	Helps answer the question 'How will we know if the purpose has been achieved'? Should include appropriate details of quantity, quality and time.	Sources of information and methods used to collect and report it (including who and when/how frequently)	Assumptions (factors outside project management's control) that may impact on the purpose-objective linkage
Results: The direct/tangible results (good and services) that the project delivers, and which are largely under project management's control	Helps answer the question 'How will we know if the results have been delivered'? Should include appropriate details of quantity, quality and time.	Sources of information and methods used to collect and report it (including who and when/how frequently)	Assumptions (factors outside project management's control) that may impact on the result-purpose linkage
Activities: The tasks (work programme) that need to be carried out to deliver the planned results *(optional within the matrix itself)*	*(sometimes a summary of resources/means is provided in this box)*	*(sometimes a summary of costs/budget is provided in this box)*	Assumptions (factors outside project management's control) that may impact on the activity-result linkage

Source: *Australian Government (2005, pp. 3).*

Assumptions refer to key factors outside the direct control of the project team, which must hold true if the project is to achieve its results, purpose, or goal. If the assumptions do not hold true (certain events do not occur), then this may have a negative impact on the project. Identifying assumptions (or risks) is critical as these may have a strong influence on the project's likelihood of success.

Means of Verification specify where to gather the information needed to calculate the indicators so that you can perform the measurement. The assumptions consider those risk factors in achieving different levels of objectives, which are outside the direct control of project management, and have a high probability of occurrence and impact on outcomes. Sources of verification refer to:

- How should the information for indicators be collected (survey, document analysis, measurements, etc.)
- Who should collect it?
- When should it be collected?

In determining sources of verification, the project team should consider whether appropriate sources already exist. Where new sources are required, it is important to consider the cost of data collection, as well as how valid and accurate the data collection process is.

Where indicators relate to a specific change in a condition, baseline data (the current state of things) may be required. This will mean that the source of verification requires both baseline and post-project data and data sources. The indicators and sources for the baseline and post-

project data may be the same. However, you will obviously collect the data at different times in the project.

Indicators include information necessary to track the project and assess the achievement of the objectives at the level of goal, purpose, components, and activities proposed in the ex-ante evaluation. Indicators provide a means to assess the project's success. This is especially important for the purpose and goal, as various stakeholders may interpret these differently. One way to think of indicators is to visualise what a successful project would look like, that is, what conditions should be met. Indicators need to be closely linked to what you are trying to measure so that you are confident that what you undertook was an important factor in the observed result.

In developing LFM, the following points need to be considered:

- The matrix should provide a summary of the project design; its length will be dictated by the project's complexity.
- The matrix should only describe the main or indicative activities. The detailed activities should be documented separately in an activity schedule.

"If you can still ask 'how' questions and not find the answer in the draft log frame (with the accompanying draft work plan showing activities), then it is not complete."

Once the LFM is considered sound, the structure can then be used as a framework for preparing implementation, resource, and cost schedules. These schedules should be clearly and logically linked to log frame components and outputs through the use of appropriate reference numbers. Activities leading to outputs can (as appropriate) be specified in more detail and scheduled on a Gantt chart format (implementation schedule). The inputs required for each set of activities and/or outputs can then be specified and scheduled over time. Finally, the cost of inputs can be determined, and an activity budget estimate and cash flow calculated.