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| **Economic and Financial Module of the Integrated Urban Water Management Toolkit** |
| Background Report |

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| Date | Status | Client |
| 31.10.16 | Final | World Bank |

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# Introduction to the Background Report

In 2014, the World Bank’s Water Partnership Program (WPP) entered into a collaboration with the Global Water Partnership (GWP), the University of South Florida (USF) and the International Water Management Institute (IWMI) on the development of a course and toolkit on Integrated Urban Water Management (IUWM). GWP, USF and IWMI where the initial proponents of this initiative and they coordinated the development of the first set of modules. They invited the Bank’s WPP to participate in the process, and to develop the modules on financing and economic aspects of IUWM.

The toolkit is aimed at all parties that are involved in the planning of urban water systems or that want to learn more about IUWM. Potential users of the tool box include among other: urban planners, municipal engineers, water utility operators, water system and technology consultants, water system policy makers, development agencies investing in urban water systems and educational institutions.

The IUWM toolkit contains the following modules:

* IUWM Diagnostics
* Water Balance Model
* Technology Selection
* Building effective institutions
* Stakeholder Engagement
* Economic and Financial Analysis

This document provides guidance to the Economic and Financial Analysis Module.

The Economic and Financial Analysis Module is configured as a slide deck. The slides present the steps and methodologies for conducting an economic and financial analysis of a IUWM strategy. The present document is a complement to the slide deck. It provides an overall introduction to the topics presented in the slide deck, highlighting the underlying economic and financial principles. In this way the user of the Module gets a better insight in the logic and ultimate purpose of the economic and financial analysis in the development of IUWM strategies. Where relevant, the present document also points the user to sources with more detailed expositions and discussions.

## Reading guide

The present document follows the structure of the Economic and Financial Analysis Module.

* Chapter 2 presents an overall introduction to the economic and financial module.

The remaining chapters address various specific economic and financial issues of IUWM.

* Chapter 3 is consecrated to the economic assessment of IUWM strategies.
* Decisions about the development of IUMW strategies are taken in a context of risk and uncertainty. How to deal with this in the economic and financial assessment of IUWM strategies is addressed in Chapter 4.
* The financial assessment is taken up in Chapter 5.
* Chapter 6 focuses on the important distinction between funding and financing when assessing the financial viability of an IUWM project or strategy.
* In Chapter 7 the attention is shifted to the implementation of IUWM strategies, in particular the contracting and procurement of the projects and services that are needed to realize the selected IUWM project or strategy. Financial aspects play a crucial role in this regard. Sub-chapter 7.2 highlights opportunities for Public-Private Partnerships (PPPs) in the realization of IUWM. PPPs have played an important role in the financing and development of public infrastructure in many areas including water, and can do the same in IUWM.

# Introduction to Economic and Financial Analysis Module

⮊ **Slides of Module Section “Introduction to Financial and Economic Modules”**

This section of the Economic and Financial Analysis Module describes the economic and financial issues that are specific to IUWM, and introduces the user to the purpose and scope of the economic and financial analysis .

The key points are:

* The implementation of IUWM involves the development and operation of public infrastructure. As with public infrastructure in other sectors (transport, energy,…) it is good practice to conduct an economic and financial assessment of IUWM projects in their planning stage prior to implementation.
* In essence there are no methodological differences between the economic and financial analysis of IUWM projects and that of other public investment projects or programs. However, due to the specific characteristics of IUWM projects they face different economic and financial opportunities and challenges, and this has an impact on the focus of the economic and financial analysis.
* The economic and financial assessment have a distinct purpose and scope. The economic assessment evaluates the socio-economic *value* of the IUWM strategy. The financial assessment examines the financial *feasibility* of the IUWM strategy.
* The economic and financial assessment are used as a development and optimization tool (determination of an optimized IUWM strategy in an ‘explorative planning’ process) and as a justification instrument (to demonstrate the economic benefit and financial feasibility of the selected, optimized IUWM strategy).

## What is Integrated Urban Water Management?

⮊ **Slides “The World Bank defines IUWM as…” and “Three main elements characterize IUWM”**

The concept of IUWM is explained in detail in the overview document of the IUWM training modules.[[1]](#footnote-1) However, a brief description of IUWM is also presented in this document and in the slide deck for convenience of the user of the Economic and Financial Module.

IUWM involves three types of integration that are lacking in conventional UWM.

* First integration across the water cycle. In conventional urban water management the different phases of the water cycle (water sources, water supply, water use and water discharge) are viewed as separate processes. The requirements and investment plans are established for each phase separately, taking evolutions in the other phases as a given. In addition, water is largely considered as an undifferentiated commodity, with little attention to differences in quality and other characteristics. As a result, most urban water users are provided with potable water for all their needs, although only a small fraction of water usage requires potable water quality. Similarly, rainwater and wastewater are collected and discharged in the same pipes although their characteristics and treatment requirements are very different. In contrast, IUWM views the urban water cycle as one system, which extends even beyond the city boundaries and ultimately encompasses the wider watershed in which the city is located. The system approach to urban water management allows exploiting synergies between the various parts of the water cycle and maximizing the value of water resources.
* The second type of integration is that between urban and water functions. In conventional urban water management the water system is viewed as following the urban system. Water management infrastructure is planned, designed and developed in function of the present and future needs of the urban system, which are taken as a given. In IUWM, on the other hand, the water system is viewed as an integral part of the urban system. Water management infrastructure is planned and designed jointly with the other urban functions so that synergies between the two can be exploited. The urban system is configured so that its demands on the water system and risks to water-related disasters/issues are reduced. Inversely, water management infrastructure is designed to fulfill urban functions, such as providing open space for recreation.
* In order to achieve integration across the water cycle and between the urban and water systems, a third type of integration is needed in planning and implementation. In conventional urban water management the responsibilities for the different phases of the water cycle are divided among several institutions. Also, the different types of urban infrastructure (land, transport, energy, water) are managed by separate departments and agencies. IUWM requires a close coordination between these institutions, as well as with other public and private stakeholders.

## What are the economic and financial issues of IUWM?

⮊ **Slides “Characteristics of investments in urban water projects” and following**

Urban water management is a public service and urban water management infrastructure is public infrastructure. It is true that in many cities some water services (especially drink water supply) are provided by private companies and fully paid by users without government subsidies. However, even in that case the water services constitute public services in the production of which the government is closely involved (by providing right-of-way on the public domain, granting concession rights, regulating tariffs and service quality standards,…).

Investments in public infrastructure in all sectors (transport, energy, water, public buildings,…) are usually subject to an economic and financial assessment in their planning stage prior to implementation. Since the implementation of an IUWM strategy or project involves the investment in and operation of public infrastructure, it is logical that an economic and financial assessment should be conducted in the planning stage.

In essence there are no methodological differences between the economic and financial analysis of an IUWM strategy or project and that of any other public investment project or program. The same methodologies and principles apply in all types of projects. Nevertheless, there are differences in the focus of these analytical instruments due to the specific characteristics of IUWM projects. In this regard a distinction can be made between economic and financial opportunities and challenges.

Opportunities:

* Integrated planning of the urban and water system (as opposed to traditional single sector approaches) creates chances for exploiting synergies between different urban and water functions resulting in cost savings and new sources of value.
* The emphasis on closing the water cycle creates opportunities for maximizing economic benefits and financial revenues from re-use of water and recovery of energy and nutrients.
* The integrated approach paves the way for enhanced funding schemes in which revenue-generating activities in one part of the urban water system contribute to defraying costs in other parts of the system.
* Financial incentives such as tariffs and subsidies are a powerful instrument for steering the actions of water suppliers and users in order to achieve an efficient and sustainable water management.
* The long time horizon of IUWM favors the design of adaptive water management solutions that are robust to risks and uncertain future climate evolutions.

Challenges:

* Some urban water management infrastructure facilities have a very long lifespan, which is longer than is usually the case for other types of public infrastructure (e.g. in transport and energy). Consequently, there is a long time period available to recover the initial investment costs.
* Because of the very long operational period of some urban water management assets and the high degree of irreversibility of choices with respect to the urban structure, uncertainties about future cost and benefit conditions are inherently large, and must be taken into account in the planning and development of IUWM strategies. Consequently risk analysis is very important in the economic and financial assessment.
* The long time horizon of IUWM strategies renders them in particular vulnerable to the effects of climate change. Changes in temperature, rainfall volumes and patters, storm frequencies, sea level rise have an impact on the requirements, costs and effectiveness of the urban water system. Hence, when designing an IUWM strategy or specific IUWM project its sustainability and its robustness to climate risks must be taken into account, including with respect to financial and economic indicators. Applying an adaptive planning and design approach can provide both necessary flexibility by sequencing investments.
* The implementation of an IUWM strategy or project has many non-financial effects (for instance improved reliability of water supply, reduced probability of flooding, preservation of natural habitats, enhanced quality of urban spaces,…). The presence of non-financial effects entails two challenges. First, the non-financial effects must be included in the economic assessment so that they are not ignored when deciding about investments in public urban water management facilities. Secondly, where possible non-financial benefits must be captured into financial revenues so that an IUWM strategy or project with large benefits to the economy is also financially feasible.
* Because of the integration across the urban and water system the implementation of IUWM involves many public and private stakeholders in various roles: producers, users and consumers, regulators. Consequently coordination costs are high and the costs and benefits of the implementation of IUMW are dispersed among many different parties. A key challenge is achieving a balance between costs and benefits (financially and non-financially) for all involved stakeholders. The finding of such a balance is essential for the creation of community support for the implementation of IUWM.

## Differences between economic and financial analysis

⮊ **Slides “Financial versus economic assessment”**

As mentioned in the preceding chapter an IUWM strategy or project should be subjected to an economic and financial analysis, just as any other public investment program or project. While they may look at first instance similar, the purpose and contents of an economic analysis and a financial analysis are very different.

Purpose:

* The economic assessment evaluates the socio-economic *benefit* of the IUWM strategy or project on the economy. It addresses the question: is the realization of the IUWM strategy or project beneficial to society? Is the economic impact to the economy higher than the resources used to produce/ achieve the impacts?
* The financial assessment examines the financial *feasibility* of the IUWM strategy or project. It addresses the question: can the realization of the IUWM strategy or project be financed and funded?[[2]](#footnote-2) A financial assessment is also called a ‘(financial) business case’.

Scope of effects:

* The scope of an economic assessment includes all effects of the IUWM strategy or project on the economy, both the financial effects (expenditures and revenues/income) and the non-financial effects (reliability of water supply, flood protection, preservation of natural habitats,…). This also means that effects that any transfer *within* the economy have to be excluded from the analysis (e.g. taxes, subsidies, etc.) and that financial costs have to be adjusted to economic prices.
* The scope of the financial analysis is more narrow and only includes the financial effects, i.e. monetary expenditures and revenues.

Valuation of effects:

* Since a financial analysis is concerned with monetary expenditures and revenues, its principle for the valuation of effect is based on market prices.
* In an economic assessment the valuation of the financial effects is also based on market prices but then adjusted to economic prices. An economic assessment also includes non-financial effects for which no market prices are available. In that case the valuation is based on the willingness to pay for obtaining the benefits or avoiding the disadvantages caused by the implementation of IUWM.

Output:

* The output of an economic assessment is the Economic Net Present Value (ENPV) and the Economic Rate of Internal Return (EIRR).
* The output of an economic assessment is the Financial Net Present Value (FNPV) and the Financial Rate of Internal Return (FIRR), as well as other financial indicators.

## The place of economic and financial analysis in the IUWM strategy or project development process

⮊ **Slides “Financial and economic assessment in development of IUWM strategy” and following**

The project development process that is inherently tied to IUWM can best be described as ‘exploratory planning’. In this exploratory planning process, a multidisciplinary team works through several iterations on cross-sectoral solutions for urban water challenges. For example, a team of urban planners, water infrastructure engineers and financial analysts works on solutions that integrate urban development, waste water treatment and sewage systems. Important is not only the team, but also the process itself: it is an iterative process in which different diagnostics and analyses are carried out through different levels of detail, starting at preliminary design and analysis level to detailed studies. The conclusions of the analysis are feeding into the solution planning in each stage, thus allowing for optimal project design and minimizing risks.

In the explorative planning process successive IUWM strategies are evaluated and optimized. *Economic and financial assessment* are an essential part of this iterated evaluation process, in addition to the assessment with respect to other disciplines such as: water system, urban planning, technical feasibility, environmental impact...

The result of the exploratory planning process is an optimized IUWM strategy. This strategy is then subjected to a final economic and financial analysis. The purpose of the final economic analysis is to provide the economic justification for the public investment in the realization of the projects under the IUWM strategy. The objective of the final financial analysis is to demonstrate the financial feasibility of the selected IUWM projects under the IUWM strategy and to prepare project-level financing and procurement plans.

# Economic Assessment – Cost Benefit Analysis

⮊ **Slides Module Section “Economic Module”**

This section of the Economic and Financial Analysis Module describes in detail the approach of the economic assessment of an IUWM strategy or specific project.

The key points are:

* The economic assessment of an IUWM strategy or project usually takes the form of a Cost Benefit Analysis (CBA), also referred to as Economic Cost Benefit Analysis . In the CBA all effects caused by the implementation of a IUWM strategy or project on the economy are quantified and expressed in monetary terms. This yields an estimate of the economic value of the project.
* The preparation of a sound CBA of a project requires eight steps, which are explained in the Module.
* There are no methodological differences between the CBA of an IUWM strategy or project and the CBA of any other public investment project. However, due to the specific characteristics of IUWM projects, there are differences in topics and emphasis, in particular regarding the definition of strategy or project alternatives, the valuation of non-market effects, the analysis of risks and uncertainties and the analysis of the distributional of benefits among different stakeholders.

## What is a Cost-Benefit Analysis?

An economic assessment of public investment projects (such as projects to implement an IUWM strategy) usually takes the form of a Cost Benefit Analysis (CBA). A general definition of the purpose and scope of a CBA is presented in the slide deck. ⮊ **Slide “Economic assessment = Cost Benefit Analysis (CBA)**

*“A CBA sums all present and future, positive and negative effects on the economy as a consequence of a project selection of effects…”*

A first important fact to notice is that a CBA has a very broad scope. It includes all project effects with an impact on the resources of the economy, whatever the type of the effects and whenever and wherever they occur within the defined life of the project. So, while CBA is often qualified as an ‘economic’ assessment, its scope is much wider than the effects that are commonly regarded as ‘economic’, including also environmental and social effects.

Consider, for instance, a water supply improvement project that reduces the amount of bacterial contaminants in drinking water. The resulting reduction of the incidence water-borne diseases would not be regarded by most people as a financial effect. However, the effect must be included in the CBA because it affects the welfare and wellbeing members of society, in case the households being connected to the improved water supply.

Two criteria must be applied when identifying the project effects for inclusion in the CBA:

* *causality*: is the effect caused by the project (i.e. without the project the effect would not have occurred)?
* *human or welfare and wellbeing*: has the effect an impact on the welfare or wellbeing of a member of society or the resources of the economy?

If these criteria are satisfied, then the effect must be included in the CBA. In practice, however, it may not be possible to analyze all effects due to lack of resources, data and appropriate analytical models. In that case a practical approach must be developed to achieve a sound economic assessment within the given constraints. Less important effects may be safely omitted from the assessment, while important effects with insufficient quantitative data can be assessed instead in a qualitative manner. The Module presents a filtering tool for the selection of project. ⮊ **Slide “Filtering of effects”**

*“…by expressing them in monetary terms. The valuation in monetary terms is based on the willingness to pay: how much are the members of society prepared to pay to obtain a positive effect (benefit) or to avoid a negative effect (cost). The project has a positive economic return to society if the value of the benefits exceeds the value of the costs”*

Public investment projects usually have several types of effects. The effects of the implementation of a IUWM project may include effects as varied as cost savings from efficiency gains, revenues from nutrient recovery, improved reliability of water supply, reduced contamination of water supply, increased efficiency of water use, reduced depletion of non-renewable water resources and flood protection. In a CBA all these effects must be expressed in a common denominator and summed to a single score reflecting the value of the project to society.

The common denominator is the willingness to pay. The willingness to pay equals the monetary amount that members of society prepared to pay to obtain a positive effect (benefit) or to avoid a negative effect (cost).

If the project produces goods or services traded on markets (for instance nutrients) then the market price reflects the willingness-to-pay. In the case of non-market effects, an estimate of the willingness-to-pay can be derived using appropriate techniques. ⮊ **Slides “Consumer surplus” and following/**

## Steps of a CBA

⮊ **Slide “Steps of a Cost Benefit Analysis”** shows the step-by-step approach of the execution of a CBA. To prepare a sound CBA eight steps grouped in three stages are required

* In the DEFINITION stage, the scope of the CBA is determined, consisting of: three steps: problem analysis, definition of strategy or project alternatives, and identification of costs and benefits (in this step only qualitative).
* The second stage (MODELING) is devoted to the quantitative valuation of costs and benefits. For this purpose a CBA model in Excel is usually developed.
* The third stage (ANALYSIS) consists of the analysis and interpretation of the results of the CBA. This stage comprises three steps: calculation of the economic return, analysis of risks and uncertainties, and distributional analysis

Each of these steps is explained in detail in the Module. ⮊ **Slides “Steps of a Cost Benefit Analysis” and following**

## What is different for a CBA of a IUWM strategy or project?

The steps and methodology of a CBA are the same for IUWM projects as for other public investment projects. However, due to the specific characteristics of IUWM projects, there are differences in topics and emphasis.

*Definition of alternatives*

The specific characteristics of IUWM are most distinctly present in the problem analysis and the definition of alternatives (steps 1 and 2 of the CBA). In these steps the object of the CBA is defined. The object of the CBA obviously determines the nature of the CBA. If the object of the CBA is a conventional urban water management project, then the CBA will have no features that are typical of IUWM.

For purpose of this Module a strategy is defined as collection of coherent set of measures to achieve the envisioned objectives. A strategy aimed at the introduction of IUWM, these measures may include a variety of measures such as:

* + investments in infrastructure and equipment;
  + changes in the organization of water supply and sanitation activities;
  + changes in regulation of use/disposal of water;
  + change in water tariff policies.

The term project will be used to refer to a single measure of a strategy.

The definition of strategy alternatives is a creative process, for which there is no straightforward approach. The project team defining the alternatives must possess an openness to integrated thinking, in which the linkages between different parts of the water and urban system are explored. Such integrated thinking is promoted by a multi-stakeholder and multi-disciplinary approach with inputs from the Diagnostic Tool, the Water Balance Tool and the Technology Selection Tool.

Economic analysis provides an essential support to the strategy development by providing insights in the costs and benefits of various alternatives, pointing the way to options for optimizing the IUWM strategy. ⮊ **Slides “Definition of strategy alternatives” and “Practical steps of CBA in IUWM strategy design”**

*Valuation of costs and benefits*

The financial costs of a projects are the cash expenditures required to realize a project. In contrast, in a cost benefit analysis, the *economic* costs of the project have to be considered. These are the real cost of the resources used for the project to the economy, or, in other words, the opportunity cost or highest-valued alternative for the use of the resource required to realize the IUWM project or strategy. The economic cost is obtained by correcting the financial prices for inflation, any transfers such as taxes and subsidies, and by adjusting for imported goods and different skill levels of labor. The techniques for this conversion are presented in ⮊ **Slides “Conversion of financial to economic costs”, “Removal of general inflation”, and following.**

The implementation of IUWM typically causes many types of effects that are not traded on markets and for which special valuation techniques must be used. While the presence of non-traded goods and services is not unique to IUWM, it is likely to be more important for IUWM than for most other public investment projects.

The techniques for the valuation of non-market effects are presented in ⮊ **Slides “How to measure Willingness to Pay?” and “Shadow cost and prices” and following.** More detailed discussions can be found in **⮊ References #1-5**, as well as in any CBA textbook.

*Economic Value and Return*

In order to determine the economic value or return of a project, all costs and benefits need to be made comparable, regardless of their timing. This is done by discounting the future costs and benefits with an economic discount rate, to their present value. ⮊ **Slides “Calculation of economic return” and following.** There are several ways to determine the economic discount rate, see ⮊ **Slides “Determination of economic discount rate” and following.**

*Risks and uncertainties*

IUWM projects often have a very long lifespan. This makes their costs and benefits very sensitive to uncertain future evolutions of economic, social and environmental trends. The urban water system is in particular vulnerable to the effects of climate change.

As a result, while an analysis of risks and uncertainties is imperative in the planning of all public investment projects, it is especially important in IUWM projects. The discussion of risks and uncertainties is taken up in chapter4.

*Distributional analysis*

The number of actors and stakeholders in the implementation of IUWM is large and diverse. A key issue in the introduction of IUWM is finding a balance of costs and benefits for all stakeholders. In the absence of such a balance, the support for IUWM will also be lacking.

The primary input for the development of a balanced equilibrium between stakeholders is the analysis of the costs and benefits among all concerned and affected parties. The outcome of a CBA should not only be the total net value of a project to the economy, but also how this value is distributed among stakeholders. ⮊ **Slides “Distributional analysis” and following**

The distributional analysis receives input from and delivers input to the Stakeholder Module. It also provides useful input to the financial analysis, in particular the determination of a funding plan for IUWM. Stakeholders found to receive net benefits from the introduction of IUWM are potential contributors towards the coverage of the costs of realizing and operating urban water management facilities.

## Selected Literature References

|  |  |  |
| --- | --- | --- |
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# Risks, Uncertainties, and Robust Decision Making

⮊ **Slides “Risks and uncertainties” and following**

This section of the Economic and Financial Analysis Module discusses the risks and uncertainties associated with the implementation of IUWM and how to deal with these risks.

The key points are:

* Due to the long term horizon of the effects of an IUWM strategy or project (20-50 years and more) and the large complexity of the urban and water system, risks and uncertainties are inevitable in the implementation of an IUWM strategy. In particular climate change risks may have an large impact on the outcomes of IUWM.
* There are various methods to analyze and quantify the impact of risks and uncertainties on a project: sensitivity analysis, scenario analysis, Monte Carlo analysis and probability trees.
* There are also various options to deal with risks and uncertainties: additional research of uncertain factors, prevention and mitigation, selection of prudent, robust and/or flexible strategies.
* Due to nature of risks and uncertainties in IUWM (in particular climate risks) the most suitable risk analysis and management approach is centered on scenario and sensitivity analysis and the design/selection of robust/prudent/flexible strategies.

## Risks and Uncertainties

Risks and uncertainties are variables:

* with an influence on the strategy (or project) outcomes (in particular the eNPV)
* of which the value is not certainly known but can take one of several values.

Consequently, the strategy (or project) outcomes are also uncertain. They cannot be determined or forecasted with certainty since some of the influencing variables are not known with certainty.

*Note: sometimes a distinction is made between risks and uncertainties. However, in this Module both terms are used interchangeably.*

There are two basic types of risk:

* Pure risks: exceptional events with a small probability and a large impact on benefits or costs (for instance the occurrence of a natural disaster).
* Bandwidth risks: distribution of variables around a mean or modal value (for instance uncertainty about construction and maintenance costs, the price sensitivity of water demand, the capacity of an aquifer, effects of climate change,…).

## Analysing Risks and Uncertainties

Risk analysis proceeds in four steps (see diagram in ⮊ **Slide “Risk analysis”** )

* identification of risks;
* prioritization of risks;
* quantification of risk;
* impact assessment.

There is no fixed method for **risk identification**. The general approach is a careful, multi-disciplinary examination of the project to identify all uncertainties and risks. Workshops are a useful instrument to join the various disciplines (technical, environmental, social, financial, economic,...).

The **prioritization of risk** is based on expert judgment of the likely probability and consequence. At this stage no quantification is carried out. The objective of the prioritization is to eliminate low-impact risks from further analysis.

**Quantification of a risk** involves the determination of possible outcomes of the uncertain variable and the probabilities of the outcomes. There are three levels of quantification:

* If outcomes nor probabilities can be determined for lack of information, then the risk is not amenable to quantitative analysis.
* In most cases, however, at least a bandwidth of possible outcomes can be determined.
* When there is enough information, then a complete probability distribution of the uncertain variable can be specified. ⮊ **Slides “Quantification of risks”** show a number of simple, often used probability distributions.

The determination of the **impact of the risk** on the project outcomes depends on the type of risk.

In the case of pure risks the expected value of the risk is simply added to the project outcome (for instance the estimated damages caused by a natural disaster multiplied by the probability of occurrence).

In the case of bandwidth risks, there are four methods for calculating the impact on the project outcomes (see details in ⮊ **Slides “Sensitivity analysis”, “Scenario analysis”, and following**).

* Two methods (sensitivity analysis and scenario analysis) only require information about the bandwidth of the uncertain variables.
* The two other methods (Monte Carlo analysis and probability trees) require information about the complete probability distribution.

Once the risk analysis has been completed, options are explored to **reduce the vulnerability of the project** to the risks. Possible actions to deal with risks are:

* reduce uncertainties by undertaking additional research;
* reduction of the impact of uncertainties by taking preventive or mitigating measures;
* selection of robust strategy/ project, that may not have the highest expected eNPV, but performs reasonably well in most circumstances;
* selection of prudent strategy/ project, which performs reasonably well even if circumstances are very unfavorable.
* selection of flexible strategy/project, which can be adapted in function of future, as yet unknown, developments.

## Risks and Uncertainties in IUWM

Risks are inevitable in the implementation of an IUWM strategy for at least two reasons:

* The effects of an IUWM strategy run into the far future (50-100 years). The requirements and performance of an urban water system are determined by many factors of which the future evolution is not known with certainty (climate change, demographic change, economic growth, technological change,...).
* The water system is very complex. Many physical and behavioral processes and linkages are not known with certainty. Examples of uncertain relations are: response of water users to introduction of water charges, reduction of water table level in function of groundwater extraction, location and height of floods caused by heavy rainfall,…

## How to Deal with Climate Risks?

Climate risks and uncertainties have the following distinguishing characteristics.

* From the perspective of urban decision-makers, the risks are exogenous. No mitigation measures taken at the level of a single city is able to have a significant mitigating impact on climate change. *Consequently, the risk management measures are limited to adaptation measures, i.e. the design of robust strategies that perform fairy well even in adverse scenarios.*
* The degree of uncertainty about the future climate evolution and its consequences on the physical environment is very large. Often, no reliable probability distribution can be defined. *Hence the risk analysis must resort to non-probabilistic methods (sensitivity analysis, scenario analysis). Probabilistic methods (Monte Carlo analysis, calculation of expected value) are less suitable.*
* The consequences of climate risks for society and the economy can be very large. For certain extreme climate scenarios, the outcomes may be so catastrophic that the losses are difficult to calculate (for instance sudden and rapid climate changes caused by changes in the global ocean conveyor belt having worldwide impacts on agricultural productivity). In the financial analysis extremely bad outcomes can be ignored. At some point the entire investment is lost. Any worse risk outcomes do not further increase losses and are of no consequence to the investors and financiers*. However, in a socio-economic evaluation even the worst possible outcomes must be taken into account. Again, this can be best done though sensitivity and scenario analysis.*

The conclusion is that, given the non-probabilistic and exogenous nature of climate risks, the risk analysis and management approach is centered on scenario and sensitivity analysis and the design of robust strategies.

# Financial Analysis

⮊ **Slides Module Section “Financial Module”**

This section of the Economic and Financial Analysis Module describes in detail the approach of the financial assessment of an IUWM strategy or project.

The key points are:

* The objective of the financial analysis is to verify the financial feasibility of the IUWM strategy and its constituent projects.
* There are two levels of financial analysis: preliminary and detailed.
* The preliminary analysis allows a relatively quick assessment of the financial feasibility of the IUWM strategy and is suitable for the strategy planning and optimization phase.
* The detailed financial analysis is more accurate, but involves more modelling work. It should be applied to the large projects in the IUWM strategy that require substantial external financing.

## What is Financial Analysis?

The purpose of the financial analysis is to verify the financial feasibility of the IUMW strategy. Financial feasibility means that sufficient revenues are available to cover the expenditures over the lifespan of the projects. The financial assessment is carried out at two levels: the IUWM strategy and each of its constituent projects.

The scope of the financial analysis is much more narrow than the scope of the economic analysis. While the economic assessment considers all project effects on the economy, the financial assessment is only concerned with the financial effects on the investors and operators of urban water management facilities and services. Financial effects are effects that involve monetary expenditures and revenues.

There are two degrees of depth financial assessment:

* preliminary financial assessment
* detailed financial assessment

## What is a Preliminary Financial Analysis?

A preliminary financial assessment only covers the pre-financing cash flows. The pre-financing cash flow only contains the cash flow of the project/strategy itself, i.e. investments, maintenance, operation, revenues, taxes. ⮊ **Slide “Pre-financing cash flow”**

The financing cash flows (loans, interests, equity injection and redemption, dividends,...) are not included. They are implicitly included in the weighted average cost of capital (see below).

The financial assessment involves the following steps:

* Estimation of the pre-financing cash-flow over the lifetime of the projects.
* Estimation of the weighted average cost of capital (WACC).
* Calculation of the financial Net Present Value (fNPV) and the financial Internal Rate of Return (fIRR), using the formulas in ⮊ **Slide “Preliminary financial assessment results”**

The IUWM strategy is financially feasible if the fNPV is positive or, equivalently, the fIRR is larger than the WACC. If this condition is satisfied, the revenues are sufficient to cover the operating and maintenance costs and to repay loans and equity, including the return required by lenders and equity investors (interests and dividends). ⮊ **Slide “Preliminary assessment of financial feasibility”**

The preliminary financial analysis allows a quick assessment of the financial feasibility of the IUWM strategy. It is in particular useful in the strategy planning and optimization phase. When the strategy is found to be financially not feasible, then it can be modified in order to improve the financial results (for instance by adding or removing projects, exploring additional sources of revenues,…).

An very important output of the preliminary financial analysis is an overview of the financial cash flows by stakeholder or stakeholder group. Such an overview can be used in the consultation with stakeholders in order to achieve a balanced equilibrium between costs and benefits for all parties involved. ⮊ **Slide “Distribution of expenditures and revenues among stakeholders”**

## What is Detailed Financial Analysis?

The financial assessment involves the following steps:

* Estimation of the pre-financing cash-flow over the lifetime of the projects (as in the preliminary financial assessment, but possibly in more detail).
* Estimation of the financing cash flows: various types of loans, interests, equity injection and redemption, dividend payments,...).
* Calculation of financial ratios: Return on Equity, Average Debt Service Coverage Ratio, Loan Life Coverage Ratio (see formulas in ⮊ **Slides “Calculation of financial ratios”**).
* Projection of profit and loss (P&L) account and balance sheet.

The project is financially feasible if the conditions in ⮊ **Slide “Conditions for (detailed) financial feasibility”** are met. These conditions are the ones considered by equity investors and lenders when considering to finance a project.

A detailed financial assessment is needed, at least for the large projects in the IUWM strategy. The reason is that the preliminary feasibility assessment is approximate. If a project is financially feasible according to a preliminary analysis, a detailed financial analysis may nevertheless uncover weaknesses that need to be addressed. Otherwise the project may not be bankable, i.e. unable to attract financiers.

## Selected Literature References

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| **#** | **Reference** | **Of particular interest** |
|  | African Development Bank Group. *Guidelines for Financial Management and Financial Analysis of Projects*. African Development Bank Group: Tunis, 2006 | Chapter 3: Financial Analysis and Appraisal of Projects |
|  | European Commission, Directorate-General for Regional and Urban policy. *Guide to Cost-Benefit Analysis of Investment Projects - Economic appraisal tool for Cohesion Policy 2014-2020.* Publications Office of the European Union: Luxembourg, 2015 | Comprehensive guidance for both economic and financial assessment. The financial assessment is covered in section 2.7. |
|  | Otoo, Miriam; Drechsel, Pay; Danso, G.; Gebrezgabher, Solomie; Rao, Krishna; Madurangi, Ganesha. *Testing the implementation potential of resource recovery and reuse business models: from baseline surveys to feasibility studies and business plans.* Colombo, Sri Lanka: International Water Management Institute (IWMI). CGIAR Research Program on Water, Land and Ecosystems (WLE). 59p. (Resource Recovery and Reuse Series 10), 2016 |  |

# Special Topic: Financing

⮊ **Slides Module Section “Financial Module Special Topic: Financing”**

This section of the Economic and Financial Analysis Module presents an introduction to financing.

The key points are:

* There are two types of cash inflows to cover the cash outflows: financing and funding.
* There are basically two types of financing: equity provided by investors and debt provided by financiers. Investors and financiers have a different risk appetite, which determines the way they evaluate project financing decisions.

## What is Financing? And Funding?

In each project there are two types of cash inflows: financing and funding.

* Financing is a sum of money provided to an enterprise or project with the expectation to be repaid with a return (interest or dividends). Financing comes in two basic forms: debt and equity (as well as many variants and hybrid forms).
* Funding is a sum of money provided to an enterprise or project without repayment requirement. Types of funding are user fees and government subsidies.

A financing plan specifies how:

* the initial investment expenditures will be covered by sources of financing (and upfront funding payments, if available);
* the recurring operational and maintenance expenditures and financial costs (repayment of loans and equity, interests, dividends) will be covered by sources of funding.

## Debt and Equity

There are two basic types of financing: equity provided by investors and debt provided by financiers.

Investors and financiers look at a project with a different perspective.

* Financiers focus primarily on downside risks. They require a lower return than equity investors, but in return do not accept risks that endanger the repayment of the debt and the payment of the interests. If bad developments happen, financiers are at the top of the cash waterfall (i.e. they are reimbursed before equity investors). When evaluating a project, financiers mainly look at the Debt Service Coverage Ratio (DSCR), i.e. the ratio of net revenues (after payments of operating costs) to debt service (repayment of principal and interest). Financiers require a sufficiently high DSCR to provide a buffer before the debt service is affected in the case that revenues fall short of expectations. If risks are too high financiers may seek additional securities (for instance a government guarantee or collateral).
* Investors focus on upside risks. They are willing to accept a higher degree of risks, but require in return a higher expected return. This includes the prospect of a very high return in case the project performs well to compensate for the low return in case bad developments occur and the investors are at the bottom of the cash waterfall (i.e. they are only repaid after all other claimants have been reimbursed). Investors therefore require a sufficiently high return in equity (ROE) in order to provide equity to a project.

## Risk, Debt and Equity

In case of projects with higher risks, financiers will require a higher DSCR. This implies that the ratio of debt to equity must be lower. There is therefore an inverse relation between the risk profile of a project and the debt/equity ratio.

## Selected Literature References

|  |  |  |
| --- | --- | --- |
| **#** | **Reference** | **Of particular interest** |
|  | Yescome, E.R. Principles of Project Finance. Academic Press: San Diego, 2002. | Comprehensive guidance to financing of projects on non-recourse basis (financing structure, contractual structure, risk management, financial analysis,…) |

# Contracting and Procurement Options

⮊ **Slides Module Section “Contracting and procurement options” and “Special Topic: PPP”**

This section of the Economic and Financial Analysis Module presents and discusses options for the procurement and contracting of IUWM projects.

The key points are:

* Procurement and contracting constitute the first step towards the effective implementation of the IUWM strategy.
* Governance, procurement and financial feasibility are strongly interlinked, and must be considered together.
* Private participation in the provision of water management facilities and services is quite common, and can, when appropriately structured, achieve various efficiency benefits.

## From Making to Implementing Plans

Once the decision has been taken to adopt an IUWM strategy, the next step is to prepare an implementation plan. The implementation plan must specify:

* Governance: who decides?
* Procurement: who procures the required water management facilities and other investment projects?
* Funding and financing: who funds or finances the costs of implementing the IUWM strategy and its sub-projects?

Governance, procurement and financing/funding are strongly interlinked and must be considered together.

IUWM involves many stakeholders and requires the cooperation of many different public and private agencies. An efficient governance model must strike a balance between central coordination and decentralized implementation. The stylized governance structure in ⮊ **Slide “IUWM strategies require innovative governance structures”** illustrates this principle.

Urban water management faculties and services are provided through a range of procurement and delivery models with a varying degree of private participation. The full range of models is shown in ⮊ **Slide “The private sector can take various roles when participating in public works”** .

## Special Topic: Public-Private Partnerships

Private participation in the provision of water management facilities and services is quite common, as shown by the examples on ⮊ **Slides “Example Pevensey Bay flood defense project” and following, and “PPP or not? Example 1” and following**.

While the desirability of private participation must be assessed on a case-by-case basis through a Value-for-Money analysis, well-designed public private partnerships yield the following advantages:

* mobilization of the private sector's creativity to deliver the agreed public service at lower costs, or to provide better quality at the same cost (see also the example on ⮊ **Slide “Example: Rebuild by Design Competition”** how the early involvement of the private sector in the design of projects that are innovative and better tailored to local demands);
* transfer of project risks to the private party, making the private proponent responsible for controlling project costs and ensuring the quality of services;
* opportunity for optimization of life cycle costs.
* private financing constitutes an addition to scarce public financing
* the financiers monitor the performance of the private operator, so that cost and quality targets are more likely to be achieved.

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| **#** | **Reference** | **Of particular interest** |
|  | PPFIAF Knowledge Center <http://www.ppiaf.org/page/knowledge-center>   * PPP Resources * PPP Training Resources | The Public-Private Infrastructure Advisory Facility of the World Bank provides extensive knowledge, guidance, best practices on various aspects of PPP, including a database. |

1. Kebreab Ghebremichael, Seneshaw Tsegaye and Kalanithy Vairavamoorthy (2014), *Integrated Urban Water Management (IUWM) Training Material and Case Studies*, Patel College of Global Sustainability University of South Florida, December 2014. [↑](#footnote-ref-1)
2. The difference between financing and funding will be explained later. At this stage, the difference is not yet relevant. [↑](#footnote-ref-2)