
6. Identifying Costs of Different Options

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This next step in the RIA process aims to answer the question:

What are the costs of the options?

6.1 Role of Cost Identification in Regulatory Impact Assessment

As noted earlier, RIA helps policymakers make more informed decisions regarding the type of interventions they choose to make in various broader economic or more specific industry and market contexts. A key component of the information provided by an RIA to policymakers is to do with identification and to the extent possible, quantification, of the various costs of the proposed regulatory interventions on all the identified stakeholders.

The identification and quantification of costs of the options also helps ensure that regulatory interventions remain **proportionate to the problem or market failure they are intended to address**. For example, environmental regulations aimed at reducing pollution may impose compliance costs related to emissions monitoring systems or pollution control technologies. If these costs are not identified and quantified, policymakers risk introducing regulations whose overall costs outweigh their overall benefits to stakeholders.

Finally, by identifying costs that may be borne by various stakeholders, policymakers can gauge the winners and losers from each option and determine equitable ways to fund the implementation of the options so that beneficiaries bear a commensurate share of implementation costs.

To illustrate, consider a regulation requiring packaged food manufacturers to display detailed nutritional information.

One policy option may involve voluntary labelling guidelines issued by the regulator. Another option may involve mandatory disclosure requirements that require firms to redesign packaging and verify nutritional data. A third option may involve digital disclosure through QR codes that provide additional product information online.

Each of these approaches involves different compliance and administrative costs -as well as a different level of benefits to consumers. Identifying these costs for each option helps policymakers i) Evaluate whether overall benefits exceed overall costs for a given option ii) evaluate which option delivers the

highest net benefits (I.e. benefits minus costs) to society and iii) who bears the various costs and to what degree which can help in considering options along equity/fairness principles.

6.2 Types of costs

There are a few key properties of costs that are a useful starting point to use for the analysis of costs in an RIA. These are:

6.2.1. Timing and frequency of costs

One-time costs tend to usually occur during the initial implementation of a regulation. These costs may include purchasing equipment, upgrading technology systems, or conducting initial staff training. For example, implementing a new digital tax reporting system may require businesses to upgrade accounting software and train employees on new reporting procedures.

Recurring costs are those that are repeated multiple times over the lifetime of the regulatory intervention. These costs may include periodic reporting costs, compliance audit costs, periodic licence fees, and routine costs of maintaining compliance systems.

Transition costs arise when organisations adjust to new regulatory frameworks. These costs may include retraining workers, modifying supply chains, or replacing outdated infrastructure. Transition costs are often temporary but can be substantial during the early stages of regulatory implementation.

Long term structural costs emerge gradually as markets adjust to regulatory changes. These costs may include changes in industry structure, reduced entry of new firms, or shifts in investment patterns across sectors.

6.2.2. Whether the costs can be quantified or monetised or whether they can only be qualitatively described

Monetisable costs are costs that can be estimated using market prices or financial data. Examples include price paid to set up compliance equipment and systems, paying licence fees, hiring additional staff for compliance functions, or investing in information technology systems required to meet regulatory requirements.

However, some costs, such as impacts on competition in the market or the impact on the ease of entry into the market for new suppliers are hard to quantify and monetise. Highly prescriptive regulations may also limit firms' ability to experiment with new business models or innovative technologies.

These can have significant future impacts on end consumers via final prices and product quality.

Detailed evidence and examples

The table below presents some of the major types of costs imposed on various stakeholders when regulatory intervention is undertaken - and their key properties.

TABLE 6.1

Type of cost	Description	Timeframe over which costs are incurred	Estimation method (Monetise, Quantify or Describe)
Implementation and enforcement costs	Costs borne by public authorities responsible for administering the regulatory framework. These include costs of establishing regulatory systems, monitoring compliance, and enforcing rules.	These can be both one time upfront costs of setting up the systems and processes and staffing to implement the regulations, hear complaints and take enforcement action for any breaches	These can be quantified at the very least in terms of the staff numbers needed both within the organisation responsible for the regulation as well as the potential costs on the enforcement systems and institutions such as the courts.
Professional and external service costs	Costs of engaging legal advisors, auditors, consultants, or technical experts to interpret regulatory requirements or design compliance systems.	These can be one off costs when setting up the compliance and enforcement systems or can be ongoing/intermittent costs to hear appeals or cases and to take enforcement action against breaches.	These can be monetised based on the charge out rates or retainers paid to experts and consultants
Compliance costs	Costs imposed on stakeholders due to the requirement to comply with the regulations	These can either be one off or recurring costs. For instance, an upfront change in IT systems can be a one off cost. However, annual reporting of information involves recurring costs.	These can be quantified, in terms of time taken to maintain and report relevant information or the new IT infrastructure required. If information on salary levels or spending on systems and relevant compliance infrastructure exists, they can also be monetised.

Type of cost	Description	Timeframe over which costs are incurred	Estimation method (Monetise, Quantify or Describe)
Broader economic costs (can be thought of as costly impacts of regulations)	Costs imposed when production systems need to be changed or when regulatory decisions impact competition in the market or small businesses. Regulations can also introduce delays in the permitting and production process which imposes holding costs on suppliers	Can be one off - such as changes to production systems or can be recurring, such as additional holding costs borne by suppliers due to delayed timeframes for gaining permits, approvals etc.	These can be quantified in terms of the amount of delay introduced by regulatory intervention. Impacts on competition in the market or on small businesses may be hard to quantify and may need to be qualitatively described. For example, if regulations make it harder for new suppliers to enter the market or for small businesses to compete due to disproportionately high compliance costs, these can have real impacts on consumers via final prices. However, the size of these impacts may not be easy to estimate monetarily.

6.3. Distribution of Costs Across Stakeholders

Regulatory costs are rarely distributed evenly across society. Instead, they are borne by different stakeholders, including businesses, workers, and regulatory institutions.

Identifying how costs are distributed across stakeholders helps policymakers assess whether regulatory impacts are **concentrated on particular sectors, regions, or population groups**. This can inform decisions about regulatory design, implementation timelines, and potential mitigation measures.

Small and medium scale enterprises make up a significant share of industry in several sectors of the Indian economy. Identifying and quantifying costs can help policymakers consider the impacts of each option on small and medium sized businesses, and in particular on their ability to continue to operate and compete effectively in the market.

6.4. Identifying Costs in Practice

Identifying regulatory costs requires a combination of analytical methods and stakeholder engagement. Policymakers often rely on consultations with regulated entities, industry associations,

and subject matter experts to understand the costs that may be imposed by the proposed regulation.

Surveys and interviews can help estimate the time and resources required to comply with regulatory requirements.

Administrative data and industry reports can provide information on compliance investments and operational costs.

Policymakers may also examine similar regulations implemented in other jurisdictions to estimate potential cost impacts.

Detailed evidence and examples

Case Studies

Comprehensive Cost Identification in Environmental Regulation

i) The U.S. Clean Air Act Amendments

The CBA of the 1990 amendments to the Clean Air Act which was undertaken by the United States Environmental Protection Agency. It systematically identified multiple categories of regulatory costs across stakeholders.

It found that firms were required to incur substantial **substantive compliance costs**, including investments in pollution control technologies and modifications to industrial processes. These were accompanied by **administrative costs** related to emissions monitoring, reporting, and regulatory compliance systems.

In addition, the analysis accounted for **indirect economic costs**, as firms passed on part of the increased production costs to consumers through higher prices. The assessment adopted a long-term perspective, recognising that many costs would be incurred upfront while benefits would accrue over time.

ii) Administrative and Compliance Costs in Multi-Jurisdictional Regulation - EU Data Protection Reform

The European Commission's Impact Assessment on data protection reform identified administrative and compliance costs arising from divergent national implementation of data protection rules, particularly for firms operating across multiple Member States.

It found that differences in national notification requirements imposed significant procedural burdens, as firms must comply with multiple legal regimes simultaneously. This was illustrated through an example of a company operating in 15 Member States that would have to navigate varying notification obligations, fees, and legal requirements. As a result, the firm would incur legal advisory costs of approximately €10,000 and total notification-related costs of €12,475, including compliance procedures and fees.

It also quantified the broader systemic cost impact of fragmentation. Notification requirements alone generated an administrative burden of approximately €130 million annually, while the overall administrative burden linked to fragmentation across the EU amounted to about €2.9 billion per year. These costs arose not only from direct financial expenditures such as notification fees, but also from the time and resources required to understand varying legal requirements, prepare documentation, and ensure compliance across jurisdictions.

6.5. Methods and Data Requirements for Estimation of Costs

Once costs associated with regulatory options have been identified, the next step is to quantify, wherever possible, their magnitude and significance.

Cost estimation can be a combination of monetised, quantified, and qualitative approaches. The choice of approach depends on the nature of the cost, the availability of reliable data, and the expected significance of the impact. These approaches are discussed in greater detail below.

Quantifying and monetising the cost impacts allows systematic comparison of costs across policy options. It also enables policymakers to understand how costs are distributed across stakeholders (firms, households, government etc), over the lifetime of the regulation.

Cost estimation can be undertaken through different but complementary approaches. These approaches vary in terms of the level of precision they offer and the type of data they require. In most analyses, a combination of methods is used to reflect the diversity of cost components.

6.5.1. Monetised Estimation

Monetised cost estimation involves expressing costs in monetary terms so that they can be compared across regulatory options. This approach is particularly useful where costs are clearly defined and measurable from market transactions or where reliable proxies can be used to estimate economic value.

For example, capital costs may be estimated using market prices of equipment and installation, while operational costs may include labour, maintenance, and energy consumption. Where costs occur over time, they must be adjusted to reflect their present value, taking into account discounting and inflation.

In situations where market prices do not fully reflect the economic value of resources, alternative valuation techniques may be required. Time spent on compliance activities is often valued using wage rates, while the cost of capital may be estimated using expected rates of return. Such approaches allow analysts to approximate the opportunity cost of resources even in the absence of direct price signals.

Where uncertainty exists, ranges or sensitivity analysis may be used to reflect variability in estimates.

6.5.2. Quantification Without Monetisation

Quantification without monetisation is used where costs can be measured in physical or operational terms but cannot be reliably converted into monetary values.

Costs may be expressed in units such as time, number of transactions, volume of output, or number of affected entities. For example:

- administrative burdens can be measured as the number of hours required to complete reporting obligations,
- regulatory requirements affecting licensing may be quantified in terms of applications processed annually.

A structured approach to quantification involves identifying the relevant activity, estimating the time or effort required per unit, and multiplying this by the number of occurrences. This approach allows analysts to build up cost estimates in a transparent and replicable manner.

Quantified estimates may later be monetised if reliable valuation parameters become available. For instance, if hourly wage rates of those who work on reporting obligations become available, they can be used to monetise the costs of complying with the reporting obligations.

Quantification can be particularly useful in stakeholder engagement, as regulated entities often find it easier to validate estimates expressed in operational terms rather than monetary values (which can lead to more disagreement). It also supports comparison across options by highlighting differences in scale and intensity of compliance requirements.

6.5.3. Qualitative Assessment

A qualitative assessment may be used for cost components that cannot be reliably quantified or monetised. A systematic qualitative approach involves clearly describing the nature of the cost, the mechanism through which it arises, and the stakeholders affected. It also requires an assessment of the likely direction of impact, its potential magnitude, and the time horizon over which it may materialise. This helps ensure that qualitative assessments are consistent and comparable across policy options.

Qualitative analysis is particularly important in cases where regulatory interventions may have unintended consequences, such as impacts on market competition, via discouraging innovation or creating barriers to entry which are hard to monetise or even quantify.

Qualitative assessments may be supported by evidence from case studies, expert judgement, or comparable international experience. Where appropriate, structured scoring or ranking systems may be used to organise qualitative information and facilitate comparison.

6.5.4. Choosing the Appropriate Approach

The choice of estimation approach depends on the nature and significance of the cost being assessed. High-impact cost components that are likely to influence decision-making should be prioritised for detailed estimation, including monetisation or rigorous quantification where feasible. This ensures that the most material aspects of the analysis are supported by robust evidence.

For cost components that are less significant or subject to high uncertainty, qualitative assessment may be more appropriate. Attempting to monetise such costs may introduce additional error without improving decision quality. A proportionate approach therefore balances analytical effort with expected benefits in terms of improved decision-making.

Data availability is another key consideration. Where reliable and representative data is available, more detailed estimation methods can be applied. In contrast, where data is limited, analysts may need to rely on proxies, benchmarks, or qualitative descriptions.

6.6. Data Requirements and Sources

Cost estimation - and in particular monetisation of costs, relies on the availability of data. Different cost categories rely on and can be informed by different types of datasets.

Administrative data provides information on regulatory processes, compliance requirements, and enforcement mechanisms.

Market data can be used to estimate the costs of inputs such as labour, equipment, and services.

Firm-level data captures how regulated entities respond to regulatory requirements, including changes in behaviour and operational adjustments.

Primary data collection methods include surveys, interviews, and stakeholder consultations. These methods are particularly useful for capturing firm-level impacts that are not available in administrative datasets. Designing effective surveys requires careful consideration of sampling, questionnaire structure, and validation of responses to ensure reliability.

Secondary data sources include industry research and reports, government/public datasets (such as data available with national statistical or sample survey agencies) and reports, academic studies, and industry benchmarks.

International comparators may be used to fill data gaps, especially in cases where similar regulations have been implemented in other jurisdictions. Such comparisons require adjustment for differences in market structure, exchange rates, price levels and regulatory design, to ensure that estimates remain contextually appropriate.

Analysts should assess whether data is representative, current, and methodologically sound in terms of how it has been produced/sourced. Where limitations exist, triangulation across multiple sources can improve robustness by reducing reliance on any single dataset.

6.6.1. Building an institutional evidence and database

A well-functioning RIA system should not treat data collection as an entirely new exercise every time a regulation is proposed. Regulatory agencies and governments should progressively build an institutional evidence base containing data that can be reused across RIAs, subject to appropriate legal, confidentiality and data-quality safeguards. Such a database may include information on the number and characteristics of regulated entities, market structure and concentration, prices and quantities, consumer complaints and grievances, enforcement actions, compliance costs, entry and exit, investment, employment, transaction volumes, regulatory outcomes and other indicators relevant to the sectors within the regulator's mandate. Where possible, these data should be maintained in structured and machine-readable formats so that they can be updated periodically and used across successive assessments.

The implication is that the starting point for a new RIA should ordinarily be a review of the existing evidence base. Before commissioning a new survey, asking regulated entities to submit information, or undertaking primary research, the regulator should determine what information is already available within its own records and elsewhere in government. This may include licensing and registration databases, supervisory returns, inspection records, complaints and grievance databases, enforcement records, market-monitoring information, consumer surveys, previous RIAs, post-implementation reviews, academic studies and data collected by other regulators. The regulator should then identify the evidence gap: what information is still unavailable but is necessary to compare the regulatory options. New data collection can then be directed specifically at filling that gap.

This approach has two important advantages. First, it reduces the cost and time involved in conducting RIA. Secondly, it can improve consistency across RIAs because different assessments can draw on common definitions, datasets, indicators and historical series. For example, if a regulator maintains a reliable time series of consumer complaints, switching rates, market concentration and compliance costs, a subsequent RIA concerning the same market can use these data as its baseline rather than asking stakeholders to reproduce information that the regulator already possesses. New research can then focus on the incremental questions raised by the proposed intervention—for example, the likely behavioural response to a new disclosure requirement or the additional compliance cost associated with a particular regulatory option.

The need for such institutionalisation is particularly important because some of the most useful RIA evidence is generated through the regulator's ordinary regulatory and supervisory activities, rather than specifically for RIA. Complaints, enforcement actions, licensing applications, market-monitoring returns, supervisory data and periodic consumer surveys can all provide information about the functioning of a market and the prevalence of the problem that a proposed regulation seeks to address. In this respect, RIA should be connected to the wider regulatory-policy cycle.

For instance, the **UK Data Service** identifies existing administrative and monitoring data and existing large-scale survey data as important sources for evaluation and states that, where possible, existing administrative or other data should be used because this can be cost-effective and may cover the entire population of interest.

At the same time, an institutional database should not become a justification for relying indefinitely on old information. Existing data are useful only to the extent that they remain relevant, reliable and sufficiently granular for the question being examined. Markets change, business models evolve, new technologies emerge and the incidence of a regulatory problem may shift over time. A database that is not periodically updated can therefore create a false impression of evidence-based decision-making. This also suggests that regulators should maintain an inventory of data sources and evidence gaps alongside the substantive database itself. For each important market or regulatory domain, the regulator could document what data are routinely available, their frequency and coverage, their definitions, limitations and responsible data custodian, as well as which important variables are currently unavailable.

6.7. Methods for Estimating Costs for key costs of regulations

Different categories of costs may require different estimation techniques.

- **Compliance Costs:** Compliance costs are typically estimated using a bottom-up activity-based costing approach. This involves estimating the cost per firm or activity and then aggregating across all affected entities. The approach requires identification of all relevant compliance activities, estimation of time and resources required for each activity, and scaling based on the number of affected firms.
- **Government and Enforcement Costs:** Government costs include the resources required to implement, monitor, and enforce regulations. These may include staffing, training, infrastructure, and operational expenses. Estimation typically relies on budgetary data, staffing plans, salary band information, and historical expenditure patterns in similar contexts.
- **Impact on competition, small businesses:** These impacts eventually impose costs on consumers. These may include changes in prices, output levels, variety and quality of products in the market. It can also have longer term impacts on consumers by influencing investment decisions, and the ability to compete and innovate.

Estimating such costs often requires scenario analysis or economic modelling, as they cannot be directly observed or quantified. Microeconomic tools, market simulation exercises etc may be used to forecast alternate scenarios for prices and outputs in the market.

Market-based valuation relies on observable prices for goods and services. Where such prices are unavailable, proxy measures may be used to estimate the value of time.

Shadow pricing is used to adjust for market distortions and reflect the true economic cost of resources. This is particularly relevant in cases where subsidies, taxes, or market imperfections affect observed prices.

Cost transfer methods involve adapting estimates from existing studies or comparable jurisdictions. These methods require careful adjustment to ensure that differences in context are appropriately accounted for. Consistency in valuation methods is essential to ensure that cost estimates are comparable across policy options.

6.8. Addressing Uncertainty and Data Gaps

Uncertainty is an inherent feature of cost estimation. It arises from limitations in data, the need to make assumptions about behaviour change, and unpredictability of future markets and broader economic conditions.

Sensitivity analysis is a useful tool to address uncertainty in cost estimation. It can be used to test how cost estimates might change when key assumptions are varied. It also helps identify which parameters have the greatest influence on outcomes. Scenario analysis can be used to explore different possible futures, such as best-case and worst-case scenarios.

Where precise estimates are not possible, ranges may be used instead of point estimates. This provides a more realistic representation of uncertainty and avoids overconfidence in results.

Case Studies: Applying Cost Estimation Methods

Scenario-Based Cost Estimation and Discounting in Practice - UK Transport Analysis Guidance (TAG)

A practical example of cost estimation methods is provided in the UK Department for Transport's Transport Analysis Guidance (TAG). The framework estimates costs and benefits by comparing two scenarios: a **"without-scheme" scenario**, which represents how the transport system would evolve if the proposed intervention is not implemented, and a **"with-scheme" scenario**, which reflects conditions after the intervention is introduced. Cost estimation focuses on the difference between these two scenarios, ensuring that only the **incremental impacts of the policy or project** are captured rather than overall system costs.

The framework requires that costs be assessed over a long-term appraisal period, typically 60 years, to account for both **initial investment costs** and ongoing impacts such as maintenance, operation, and system performance. Costs are expressed in **real terms to remove the effects of inflation**, and then converted into **present values using discounting**, which reflects the principle that costs incurred in the future are valued less than costs incurred today.

At the same time, the approach recognises that not all costs can be fully monetised. While many impacts, such as infrastructure expenditure and operating costs, are expressed in monetary terms, others are captured using **quantitative indicators or structured qualitative assessment** within a broader appraisal framework. This ensures that important but hard-to-measure impacts are still incorporated into decision-making.

This case illustrates how real-world cost estimation combines **scenario-based comparison, long-term valuation, discounting techniques, and mixed methods** to produce a comprehensive and policy-relevant assessment of costs.

Cost Estimation Under Data Constraints - World Bank Safer Schools Framework

Another practical example of cost estimation under real-world constraints is provided in the World Bank's cost-benefit analysis framework for safer school investment projects. In this case, cost estimation is undertaken at an ex-ante stage where detailed project information such as exact school selection, location, and intervention type is not fully available. As a result, the analysis adopts a simplified but structured approach to estimating costs.

In the absence of precise project-level data, total costs are assumed to be equal to the **allocated investment budget**, which serves as a proxy for intervention costs. For instance, the total cost of intervention is taken as **US\$12 million**, with a conservative assumption that all expenditure occurs at the beginning of the project.

To improve the robustness of these estimates, the framework also relies on **unit cost proxies**, such as cost per square metre of construction, and available market data where possible. However, given uncertainties regarding the number of schools and the type of intervention

required, the analysis incorporates **assumptions on intervention mix**, such as the proportion of schools to be retrofitted versus replaced. These assumptions are based on available evidence and prior project experience, rather than exact project specifications.

The framework also allows for flexibility in how costs are distributed over time. While costs may be spread across multiple years, the analysis often assumes that **all costs are incurred upfront** in order to produce a conservative estimate. This approach simplifies modelling and avoids underestimating the present value of costs in situations of uncertainty.

This case illustrates how cost estimation in practice often relies on **budget-based proxies, unit cost approximations, and simplifying assumptions**, particularly when detailed data is unavailable. It also highlights the importance of making these assumptions explicit to ensure transparency and credibility in the analysis.

6.9. Using Proxies for Estimation of Costs

A proxy is a substitute value used when a cost cannot be directly observed or priced. Proxies are employed where direct cost measurement is not feasible. Their appropriateness depends on how closely they approximate the underlying economic value:

1. **Shadow Prices:** Shadow pricing is used where market prices are absent or distorted due to externalities, market power, or policy interventions. It seeks to approximate the true social opportunity cost of a resource.

For example, if an intervention leads to greater greenhouse gas emissions, the cost of these emissions on society may be proxied by prices of emissions in a regulated emissions trading market. However, there also exists studies that estimate the true marginal social cost of additional emissions and this reflects the actual negative externality of the added emissions and is the appropriate metric to use as the shadow price. This is usually much higher than the price of a tonne of carb on emissions in regulated emissions trading schemes.

1. **Proxies for Time Costs:**

- **Wage rates**

The wage rate proxy rests on the assumption that time devoted to compliance represents an opportunity cost equal to what the same hour could produce in the next best use. The standard approach is to value this time at the relevant wage rate, or a multiple of it.

- **Cost of capital**

Time delays or any additional time added to approvals, permitting or production processes impose costs on suppliers. These can be monetised using the cost of capital for the relevant industry and applying it to the amount of delay. Cost of capital data is usually available from macroeconomic lending information on interest rates for different industries.

1. **Budget Allocations as Cost Proxies:** At early stages of appraisal, total budget allocations may serve as a proxy for costs where detailed estimates are unavailable. While useful for high-level decisions, this approach lacks granularity and limits comparison across alternative designs within the same budget envelope.
1. **Unit Cost Proxies:** Unit-based estimates (e.g., cost per facility, per kilometre, or per beneficiary) allow scaling from known benchmarks. The reliability of a unit cost proxy depends critically on the comparability of the reference project: a cost-per-kilometre estimate for urban road construction is unlikely to provide an adequate proxy for a rural highway project in hilly terrain.
1. **Cost Transfer:** Cost transfer is the practice of adapting monetary values from an existing study to a new policy context. The key risk is 'valuation error' arising when the study context differs from the application context in ways that affect the value being transferred.

Some useful standardised Proxy Databases

Cost estimation can be supported by **standardised proxy values maintained by governments or international institutions**. These can be used when primary data is unavailable, improving consistency, comparability, and methodological rigour across appraisals.

The New Zealand Treasury's CBAX tool provides a centralised database of monetised impact values which can be used where context-specific estimates are unavailable. CBAX is a spreadsheet model containing over 274+ New Zealand-specific monetised impact values covering health, education, justice, housing, and subjective wellbeing.

These values are drawn from non-market valuation studies and adjusted to reflect a common time period and discount rate, ensuring consistency across analyses. The tool also standardises key assumptions, so that proxies and their associated assumptions are governed together rather than separately. This illustrates how proxies can be embedded within governance frameworks to ensure consistency and reduce duplication of analytical effort.

At the international level, benchmark repositories enable cross-country transfer of proxy values where domestic data is lacking.

However, while undertaking a RIA, care should be taken to adjust cost estimates from other countries using conversion to Indian rupees using Purchasing power parity (PPP) data from the World Bank's International Comparison Program. The World Bank's price benchmarking frameworks further support the estimation of costs using international cost comparisons and standardised indices.

International proxy values also require careful adjustment for the local context. They should be treated as context-dependent approximations, supported by transparent assumptions and, where possible, tested through sensitivity analysis.

6.10. How to Frame Assumptions Credibly

The credibility of cost estimates depends not only on the quality of the data but on the quality of the assumptions that underpin it. The following steps can help improve the credibility of cost estimates in an RIA.

1. **Grounding Assumptions in Evidence:** Effort should be made to allow each assumption regarding a cost to be traceable to a data source: published data, a comparable study, expert judgement obtained through a structured technical process, or stakeholder consultation. Where evidence diverges, analysts should either justify a central estimate or carry alternative values into sensitivity analysis.

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2. **Distinguishing Assumptions from Facts:** A source of analytical error can be the treatment of contestable judgements as settled facts. For example, values drawn from other jurisdictions should not be used without testing their applicability to local context. Making these distinctions visible prevents decision-makers from placing unwarranted confidence in cost estimates.
 3. **Documenting Assumptions Transparently:** Maintaining a structured record of assumptions, including their sources, plausible ranges, and impact on results improves both internal consistency and external credibility.
 4. **Proportionality: Matching Rigour to Significance:** Not all assumptions require equal scrutiny. The analytical effort devoted to validating and testing an assumption should be proportional to its influence on the overall cost estimate.

When Assumptions and Proxies Work, and When They Don't

Assumptions and proxies enable cost estimation under uncertainty, but their reliability depends on the conditions under which they are applied. Assumptions and proxies perform well under three conditions:

- **Contextual similarity:** Values drawn from comparable settings are more likely to approximate true costs. Unit cost estimates and transferred values are most reliable when adjusted for differences in geography, scale, and implementation conditions.
- **Stability of relationships:** Proxies depend on a consistent relationship between the observed variable and the underlying cost. For example, wage rates are a reasonable proxy for time costs where labour markets reflect opportunity costs. Where distortions are significant, proxy validity weakens.
- **Evidence grounding:** Assumptions supported by empirical data, prior studies, or structured judgement are more credible than those based on convention. Transparent justification reduces the risk of systematic bias.

Failure typically arises from predictable patterns rather than random error:

- **Optimism bias:** Cost estimates tend to be systematically underestimated at the appraisal stage. Empirical evidence shows persistent cost overruns across infrastructure projects, reflecting both cognitive bias and incentive structures.
- **Transfer errors:** Proxies based on cost or benefit transfer fail when the reference context differs materially from the application context. Differences in income levels, regulatory systems, or baseline conditions can distort transferred values.
- **Structural breaks:** Historical data becomes unreliable where technologies, markets, or regulatory environments are changing. In such cases, past relationships no longer provide a stable basis for estimation.
- **Unrealistic behavioural assumptions:** Assuming full compliance, immediate adoption, or cost-minimising behaviour without accounting for real-world constraints can significantly distort estimates.

Assumptions and proxies should be treated as context-dependent inputs rather than fixed parameters. Their validity must be assessed in each application, and their limitations made explicit.

Dealing with uncertainty: Sensitivity Analysis: Testing the Robustness of Assumptions

Sensitivity analysis is the primary tool for addressing uncertainty in cost estimation. The core question a sensitivity analysis asks is: if a key assumption changes, by how much does the cost estimate change? Sensitivity analysis allows the testing, under different scenarios, of the

strength and robustness of the assumptions, the data, and the logic of the intervention that underlie the economic analysis.

1. **One-Way Sensitivity Analysis:** The simplest form varies a single assumption at a time while holding all others constant. This produces a clear picture of how sensitive the cost estimate is to each individual assumption.
2. **Multi-Way and Scenario-Based Sensitivity Analysis:** Multi-way sensitivity analysis varies combinations of assumptions together, producing a set of scenarios that represent coherent alternative worlds rather than arbitrary permutations. A 'best case' scenario combines the most favourable plausible values for all key assumptions; a 'worst case' scenario combines the least favourable. The range between these scenarios gives decision-makers a sense of the full range of outcomes that the analysis considers credible.
3. **Switch Value/Threshold Value Analysis:** Switch value analysis identifies the value of a key assumption at which the CBA recommendation would reverse, typically the assumption value at which net present value passes through zero or the benefit-cost ratio passes through one. Switch value analysis involves identifying the values of 'critical variables and assumptions that might switch the recommendation from viable to not viable.'
4. **Monte Carlo Simulation:** Monte Carlo simulation extends sensitivity analysis by modelling uncertainty across multiple assumptions simultaneously through probability distributions rather than single-point estimates. This allows decision-makers to assess not only the range of possible costs but also their likelihood, including the probability that a project meets decision thresholds such as a positive net present value. It also captures the cumulative and interactive effects of multiple uncertainties, and helps identify which assumptions contribute most to overall variability in results.

Case Study: Monte Carlo Simulation in SCBA: Lake Grevelingen (Netherlands)

Monte Carlo simulation was applied in the socio-economic cost-benefit analysis of development options for Lake Grevelingen, involving tidal restoration, flood protection, and energy generation. Key uncertain variables, such as investment costs, energy prices, ecological benefits, and fisheries output, were assigned probability distributions and simulated across 10,000 iterations. The results showed an expected net present value of approximately €248 million, with only a 23% probability of a positive outcome, highlighting significant uncertainty. The analysis also revealed that benefits were more variable than costs and that a few key assumptions, particularly energy prices and ecological impacts, drove most of the variability. This case illustrates how Monte Carlo simulation helps quantify uncertainty, identify key risk drivers, and provide probability-based insights for decision-making.

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