

# Total Cost of Ownership

## An introduction to whole-of-life costing

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# What is Total Cost of Ownership?

## TCO my car

Buying and using a car involves a series of expenses and hopefully some income on resale. To TCO your car you need to identify all possible costs and revenue over the period of your ownership eg:

### Expenses:

- initial purchase price
- on-road costs
- ongoing fuel consumption
- insurance
- vehicle licences
- WOFs
- regular servicing and spares.

### Income:

- re-sale price.

Total Cost of Ownership (TCO) is an estimate of the total costs of goods, services or construction works over the whole of their life. It's the combination of the purchase price plus all other costs you will incur, less any income you receive. For example: the initial purchase price plus installation costs, operating costs and ongoing maintenance less the residual value on disposal.

## Why is TCO important?

The procurement principles encourage us to make balanced procurement decisions. This includes getting the best value for money. It means accounting for all costs and benefits over the lifetime of the goods or services.

Part of good procurement is achieving the right price. Best value for money is the lowest whole-of-life cost. This involves identifying the initial purchase price and estimating all future costs and returns.

A procurement decision based on the initial purchase price only, rather than the total costs over the whole-of-life, could fail to recognise the real costs to your agency.

## When should I use TCO?

TCO can be used at various stages in procurement:

- in a business case to assess the costs, benefits and risks associated with the investment
- when assessing different business models, maintenance options or solutions on a comparable cost basis
- to understand the different cost drivers in the life of a procurement
- by a supplier when bidding for a contract to demonstrate the total benefits and value being offered – especially where the initial purchase price is higher than competitors, but the total cost of ownership is lower
- in selecting the best supplier by assessing the comparative whole-of-life costs of competing bids
- in managing the contract to track actual expenses and income against budget
- as part of a benefits realisation exercise.

## Is TCO only relevant to goods?

The concept of TCO is easy to understand in terms of goods, such as buying cars or leasing printers. It can also apply to services such as a building maintenance agreement or providing training.

## Tip of the iceberg

The initial purchase price is usually just the 'tip of the iceberg' in terms of the costs you will incur. There are hidden costs lurking under the water line. You need to look beyond purchase price to identify all other expenses and income over the whole-of-life of the goods or service.

However, every procurement is different. So what needs to be included in the TCO calculation will vary. The goal is to arrive at a figure that accurately reflects the full costs and income to your agency.



### Direct costs

Direct costs are attributed to a specific good or service. In construction, the costs of materials used eg wood, cement, doors, fittings and labour are all direct costs.

### Indirect costs

Indirect costs are not attributed to a specific good or service. In manufacturing these include eg rent, taxes, maintenance of equipment.

## Types of costs

There are two broad types of costs:

- direct or 'hard' costs
- indirect or 'soft' costs.

Indirect costs are further broken down into:

- fixed costs (rent, insurance premiums, salaries)
- variable costs (electricity, paper, pens and other consumables, overtime).

It should be noted that the cost of depreciation is excluded from a TCO calculation.

## TCO models

There are many TCO models. Two of the most commonly used are:

- **Life cycle costs:** a cradle-to-grave economics model
- **Cost breakdown structure:** the breakdown of a project into cost elements, based on work breakdown structure

## Estimating whole-of-life

TCO calculations aim to identify all of the obvious and hidden costs of ownership across the full ownership life or life cycle of the acquisition. However, there is often room for judgement and sometimes different opinions in deciding what is the appropriate lifespan to analyse.

Difference methods are used to identify the appropriate lifespan. These include:

- **Depreciable life:** The number of years over which an asset will be depreciated. In each year of its life a depreciation expense is calculated (the amount is usually set by local tax laws and accounting standards). Each year the \$ value of the annual depreciation is deducted from the \$ value of the asset. When the \$ value of the asset reaches \$0 that is the end of the depreciable life of the asset.
- **Economic life:** The number of years in which the acquisition returns more value to the owner than it costs to own, operate, and maintain. When these costs exceed returns, the acquisition is beyond its economic life.
- **Service life:** The number of years the acquisition will actually be in service.

## Costs from a distance

If you are considering awarding a contract to a supplier who operates from a location some distance from yours, you should find out how this impacts on costs. Impacts could include:

- additional admin costs, such as national or international toll calls to discuss issues
- any travel or accommodation expenses, either for your staff to travel to meetings with the supplier, or for the supplier's staff to travel to your site for meetings or to make repairs
- costs associated with time zones, for example, will support staff charge for 'overtime' rates to discuss problems with you during NZ business hours
- cost of delivery of parts, including customs charges and exchange rate fluctuation risks.

## Identifying costs and benefits

To identify costs and benefits you need to work through the whole of the life of the acquisition, consider when a cost or benefit may occur and estimate the value. Some costs will be one-off, others will be recurring – so you need to know how many years you intend to use the product, equipment or services.

In some cases there may be some residual value in the equipment or parts eg selling fleet vehicles. However, there can also be costs associated with disposal.

### Example: types of whole-of-life costs for a piece of equipment

Purchasing	Operating	Disposal
<ul style="list-style-type: none"> <li>market research</li> <li>specialist advice in assessing business needs and options</li> <li>developing the business case</li> <li>the tender process</li> <li>purchase price of the equipment</li> <li>other accessories or attachments</li> <li>delivery costs (freight) and insurance</li> <li>installation and configuration costs</li> <li>staff training</li> <li>initial licenses</li> <li>warranties</li> <li>annual insurance</li> <li>cost of change.</li> </ul>	<ul style="list-style-type: none"> <li>consumables such as ink cartridges, paper</li> <li>self- maintenance kits</li> <li>technical support for users</li> <li>regular maintenance or servicing</li> <li>spare parts</li> <li>energy such as electricity or fuel usage</li> <li>upgrades</li> <li>breakdowns and repair costs</li> <li>cost of replacement service during a breakdown such as hiring another machine or outsourcing the work</li> <li>IT costs such as hosting</li> <li>annual insurance</li> <li>extended warranties</li> <li>costs of any person who operates or supports the equipment.</li> </ul>	<ul style="list-style-type: none"> <li>decommissioning costs, possibly involving technical specialists</li> <li>transportation of the machine away from the work site</li> <li>fees for disposal of parts, particularly if any are dangerous, for example, cathode vacuum tubes or chemicals</li> <li>migrating data or removing confidential data</li> <li>costs of any interim arrangements between different providers</li> <li>cost of change</li> <li>site clean-up.</li> </ul> <p>Remember to add back any money received on the resale of the equipment!</p>

## Estimating costs and benefits

### 1. Product

In the following example an agency needs to buy a fridge for its staff canteen. It has the option of buying second-hand or new. To assist in the decision making process a quick TCO is done.

#### Assumptions:

- The fridge will be used for 5 years.
- The second-hand unit will be 4 to 5 years old.
- The second-hand unit will not come with a warranty. It is likely to break down once during the additional five years of its life. Costs will be associated with a repair and spare parts.
- Failure of the unit could lead to the loss of perishable food items and health and safety issues for staff.

#### Result:

Even though the new fridge is initially more expensive, it is likely to cost less over a five-year period, and remain fully functional for the whole time. In addition, it will present less health and safety risk.

Example TCO calculations: fridge

Cost / benefit item	Option 1 Second hand	Option 2 New
purchase price	\$500	\$1,000
delivery costs	\$50	free by supplier
extended warranty	not available	\$75
electricity consumption over 5 years	\$500	\$200
maintenance	\$200	nil
spare parts	\$250	nil
<b>Total costs</b>	<b>\$1,500</b>	<b>\$1,275</b>
less value on resale	nil	\$250
<b>Total cost of ownership</b>	<b>\$1,500</b>	<b>\$1,025</b>



## 2. Goods and service

In the following example an agency wants to purchase a contracts management service and obtains 2 quotes.

### Assumptions:

- The service will be for a period of 5 years.
- Some level of software customisation will be required regardless of which supplier is selected.

### Result:

Supplier A's initial set up costs are cheaper. However, Supplier B's annual operating costs are cheaper. Over the whole of the life, which is 5 years, Supplier B's offer is significantly more competitive.

Example TCO calculations: contracts management system

Cost / benefit item	Supplier A	Supplier B
Initial costs:		
hardware	\$5,000	\$6,000
software	\$12,000	\$10,000
customisation	\$5,000	\$8,000
initial training	\$5,000	\$5,000
transition costs	\$800	\$1,200
<b>sub total</b>	<b>\$27,800</b>	<b>\$30,200</b>
annual operating costs:		
annual licence fees	\$2,000	\$500
data storage and hosting	\$5,000	\$6,000
user support service	free	free
software upgrades	\$3,000	free
additional training	\$3,000	free
<b>subtotal (for each year)</b>	<b>\$13,000</b>	<b>\$6,500</b>
<b>subtotal (over 5 years)</b>	<b>\$65,000</b>	<b>\$32,500</b>
<b>Total cost of ownership</b>	<b>\$92,800</b>	<b>\$62,700</b>
Note: there is no residual value		

### 3. Services

When you buy services, like cleaning or maintenance, the complexity of the TCO will depend upon the complexity of the contract. For example, when setting up a simple contract for cleaning services you will need to consider whether or not the price includes consumables such as cleaning products and brushes.

Some of the key elements incorporated in the cost of ownership for a service may include the following table.

#### Types of costs for services

maintenance services	vehicle	IT system
Cost of the time of your staff or the supplier performing the maintenance	Mechanic's time	Computer engineer's or programmer's time
Consumables	Brake fluid, transmission fluid, coolants, cleaners	Computer disks, cables
Parts	Batteries, brake pads, bulbs, filters, wipers, spark plugs	Fans, surge protectors, video cards, graphics cards
Hire of specialised equipment	Diagnostic equipment, such as electronics testing	Diagnostic equipment
Removal and disposal of obsolete parts or contaminated consumables	Worn tyres, broken parts, batteries	Video cards, graphics cards
Lost revenue of costs associated with unscheduled maintenance	Cost of alternative transportation eg taxis or rental vehicles	Loss of use of the system for entering data eg invoices and payment

## Going to market

A good way to get detailed TCO information is to ask for it in your tender. When you are ready to make your approach to market make sure that you ask suppliers the right questions to elicit the right information.

One way to do this is to ask suppliers to prepare a TCO for their own product or service. It's a good idea to attach a standard model TCO spread sheet to your tender for suppliers to complete. This makes it easier for them to compile the information and easier for you to compare bids.

However, in doing so, there are a couple of things you should plan for. These include:

- Take a 'no surprises' approach. Socialise the idea that you will be looking for TCO information in your early market engagement discussions.
- Be clear about your needs so that suppliers can produce accurate TCO information that is tailored to meet your needs.
- Give suppliers sufficient time to prepare detailed, comprehensive TCO calculations. This information is critical to your decision making and should not be rushed.
- Be prepared to answer suppliers' questions about TCO and ensure that all suppliers are provided with the same information at the same time.

## What are 'hard' and 'soft' benefits?

A traditional TCO model identifies tangible 'hard' benefits. These are benefits that are capable of monetary value. That means that only items that can be valued in dollars are usually included.

However, there are sometimes nonmonetary 'soft' benefits that arise. These types of benefits cannot be sufficiently quantified financially, but can contribute to increased quality, performance, or results.

Examples of intangible benefits include:

- improved employee morale
- heightened customer satisfaction
- better relationship with the supplier.

## Quality considerations

### Quality standards

Some types of goods and services have recognised quality standards.

An example includes Mean Time Between Failures (MTBF).

This measure is sometimes used for technical equipment. The supplier through its testing process is able to determine an average time for a part of the product to fail. Based on the anticipated times that repairs may be necessary and the costs of the parts.

The quality of a product or service may have a considerable impact on the overall cost of owning it.

Regular repairs or maintenance additional to the purchase price will add to the overall cost, and are likely to result in loss of productivity until the item is fixed. When a device or service is critical to the core business of the agency, an outage may result in a stand still where staff cannot perform their work.

The quality of the item may also impact on its life. A higher quality product may last longer than a poorer quality one, and so the purchase price will be spread over more years.

Some quality issues to think about:

- What standards have you used to determine quality? What are the usual measures for that product or service?
- 'Leading edge' or 'bleeding edge'? Has it been fully tested, or is the supplier using you as their guinea-pig? How could you mitigate such risk?
- 'End of line' equipment - it may be inexpensive but will it have the capacity to meet your ongoing needs? Will it still be supported by the supplier in a few years?

## How do I calculate TCO?

### Formulas

Broadly speaking, the method is to research, estimate and calculate all costs and benefits over the whole-of-life. There is no standard formula that is used for all TCO calculations. What needs to be taken into account will always depends on the specific nature of the procurement.



### Cost categories

There are some common concepts and categories used to describe different types of costs and benefits. The most common are listed in the following table.

Cost category	Characteristics
<b>Initial Equipment Costs</b>	<p>This is usually the purchase cost and other related initial costs such as:</p> <ul style="list-style-type: none"> <li>• pilot / development</li> <li>• initial licensing</li> <li>• legal costs</li> <li>• packaging and delivery</li> <li>• deployment, installation and testing.</li> </ul>
<b>Preventive Maintenance</b>	<p>This is maintenance conducted to keep equipment working and / or extend the life of the equipment. This includes scheduled overhaul of the equipment or scheduled replacement of parts. For example, having your car serviced regularly, including changing the oil and lubricating moving parts will reduce the chance of the car breaking down.</p> <p>Costs may include labour, spare parts and consumables such as lubricants, screws or paint. Indirect costs may include the hire or replacement equipment, security software.</p>
<b>Technology Refresh</b>	<p>‘Technology Refresh’ is the adoption of newer technology to meet changing needs or to reduce the risks created by outdated technology. It may include</p> <ul style="list-style-type: none"> <li>• upgrading existing systems</li> <li>• adding new technology to the system</li> <li>• replacement of custom-built or off-the-shelf system components</li> <li>• disposal of any obsolete components.</li> </ul> <p>Costs may include the cost of the replacement equipment, installation and testing. For example, upgrading software may need system / data storage changes.</p>
<b>Facilities</b>	<p>Costs of facilities may range from the rental of space to accommodate a machine or computer system to alterations to a building, for example, to house a generator. It may also include costs of project managers to oversee the transition.</p>
<b>Training &amp; Education</b>	<p>In many circumstances, for example, the installation of new equipment or software, staff must be trained in how to use it and administer it. Training costs may include:</p> <ul style="list-style-type: none"> <li>• the development of the training module</li> <li>• printing materials such as workbooks and job aids</li> <li>• hire or purchase of equipment, ranging from data-shows to computers</li> <li>• contracting a trainer</li> <li>• hire of venue</li> <li>• refreshments, meals, and transport</li> <li>• staff time away from their usual duties.</li> </ul>

Cost category	Characteristics
<b>Other Costs</b>	Additional costs, outside of those listed above, may be hard to foresee, and are likely to be specific to the type of product being purchased.
<b>Resale value</b>	When a product or system is taken out of use, there may be a resale or salvage value eg a car or office equipment.
<b>Disposal cost</b>	When an item comes to the end of its useful life there may be costs associated with its disposal eg disposing of hazardous items such as cathode ray tubes in some computer monitors which can explode if damaged and emit toxic gasses.
<b>Preventive maintenance</b>	<p>Preventative maintenance is a series of regular inspections, adjustments, and lubrication designed to keep equipment in satisfactory operating condition.</p> <p>Preventative maintenance is a fixed cost that can be analysed and budgeted.</p> <p>The quality of the preventative maintenance can be a major factor in the total cost of ownership.</p>
<b>Minor corrective maintenance</b>	<p>Corrective maintenance consists of activities that are carried out to identify and repair a fault so that the failed equipment, machine or system can be returned to its usual working state.</p> <p>Minor corrective maintenance usually takes the form of spare parts that are on hand or are easy to install. If the equipment is covered by a service contract, these parts are usually included.</p> <p>Usually, minor corrective maintenance would be less than 5 percent of the value of the equipment.</p> <p>Minor corrective maintenance should be expected and accounted for in the maintenance budget.</p>
<b>Major corrective maintenance</b>	<p>Major corrective maintenance is unexpected and needs a financial and operational decision about whether or not to repair the item.</p> <p>Major corrective maintenance usually falls in the range of 6 percent to 50 percent of the value of the equipment.</p> <p>An outage that requires major corrective maintenance usually results in significant downtime. For critical equipment, this could have an impact on the financial operation or service levels of the facility.</p> <p>Most mechanical and electrical equipment that is maintained according to the equipment's specifications will last longer and need less major corrective maintenance.</p>
<b>Predictive maintenance</b>	<p>Predictive maintenance techniques help determine the condition of in-service equipment in order to predict when maintenance should be performed.</p> <p>The intervals between predictive maintenance are settled on by the operational condition of the equipment.</p> <p>Operational condition is usually determined by non-intrusive testing such as vibration analysis, infrared scanning, and ultrasonic scanning.</p>

### Time value

When we say that money has 'time value', we mean that a dollar received today is worth more than a dollar to be received at any future time.

Generally speaking, we would prefer to receive money today rather than the same amount in the future.

For example, if you receive \$100 today and invest it at an interest rate of 5% per annum, after a year, it will be worth \$105, at face value.

At the same time, inflation at 1% p.a. will have reduced the value of the money by \$1.05 to \$103.95.

## Time value of money

The 'time value' of money (TVM) is a concept that is important when thinking about TCO. It is the value of a sum of money taking into account the amount of interest that it could earn over a period of time. When calculating TCO you may need to take into account what money will be worth at the future time that you need to pay it out.

### Example

Imagine that you need to buy a new car but, as you don't have the money at present you must borrow the entire purchase price. Two dealers offer to sell you identical cars for \$21,000, on these terms:

- Dealer 1: asks for cash on delivery, which means you have to borrow money now
- Dealer 2: will provide you an interest-free loan for one year which means you don't need to borrow money for one year.

It would make sense to buy the car from Dealer 2, because you will save the interest costs for the first year, and the effect of inflation will further reduce the amount you have to pay.

## Present value

'Present value' is the value of a sum of money at the present time, in contrast to some future value it will have when it has been invested.

In the previous example Dealer 2's offer was clearly cheaper because of the interest-free loan for one year. However, if Dealer 1 offered the car at a lower price, say \$20,000, you would need to be able to compare the two offers by determining the present value of each. The formula to calculate present value is as follows:

$$\text{Present Value} = \frac{\text{Future Value}}{(1 + \text{Discount / Interest Rate})^{\text{Number of years}}}$$

### Example

Assume that you would like to put money in an account today to make sure your child has enough money in 10 years to buy a car. You want to give your child \$10,000 in 10 years, and you know you can get 5% interest p.a. from a savings account during that time. How much should you put in the account now?

$$\text{Present Value} = \frac{\$10,000}{(1 + 0.05)^{10}} = \$6,139.13$$

Thus, \$6,139.13 will be worth \$10,000 in 10 years if you can earn 5% each year. In other words, the present value of \$10,000 in this scenario is \$6,139.13.

## Net present value

Net present value (NPV) is a very important tool for comparing the value of different initiatives or projects. It forecasts the likely financial outcome.

Calculating it will tell if:

- the initiative will provide a return to the business relative to the cost of financing the investment
- the NPV provides a standard yardstick by which to measure one project or investment against another.

NPV illustrates that even though a product can deliver profit it does not mean that it is a good investment for the business.

### The formula

$$\text{Net Present Value} = \text{initial investment} + \frac{\text{net income (year 1)}}{(1 + \text{discount /interest rate})^1} + \frac{\text{net income (year 2)}}{(1 + \text{discount /interest rate})^2}$$

### Example

An agency has to set up a small printing operation to provide information to clients who will pay a cost-recovery fee for the service. The agency needs to cost the equipment on a commercial basis. The cost of staffing for the equipment will not be included in the business case as the work will be done by existing staff. The agency expects to invest \$500,000 for the equipment for their new operation. They estimate that:

- the first year net income will be \$200,000
- the second year net income will be \$300,000
- the third year net income will be \$200,000.

The expected return of 10% is used as the discount rate.

Initial Investment	Income Year 1	Income Year 2	Income Year 3	
\$ 500,000.00	+ $\frac{\$ 200,000.00}{110\%}$	+ $\frac{\$ 300,000.00}{110\% \times 110\%}$	+ $\frac{\$ 200,000.00}{110\% \times 110\% \times 110\%}$	
= -\$ 500,000.00	+ \$181,818.18	+ \$247,933.88	+ \$150,262.96	= \$80,015.03

**Note:** the initial investment is a negative value, and the income is a positive value.

**Note:** the investment is cash-positive over the three year term.



## Other things to consider

### Opportunity costs

The cost of any activity, measured in terms of the value of the loss of potential gain from option(s) not selected when another option is chosen.

The costs or benefits can be:

- tangible, such as the loss of income that could have been generated using another option, or
- intangible, such as the loss of a particular functionality that is useful but not critical.

#### Example

A small agency had the choice of spending some money on either sending some promising staff on an exchange to an Australian agency or an upgrade to the staff café.

They decided to upgrade to the staff café, resulting in morale increases. The lost benefit or opportunity cost is the experience that the staff would have gained on the exchange.

### Benefits to others

Sometimes a benefit may not be of value to the agency that purchases the goods or services. For example awarding a contract to a New Zealand company may create jobs and increase tax revenue. It could boost the local economy.

In the health sector, a benefit may be to the patient, not the Ministry of Health. A patient becoming mobile sooner than expected may result in greater initial cost to the health system because as soon as their hospital bed is freed up another patient requiring services will occupy that bed.

The principles of procurement encourage us to make balanced procurement decisions. This includes considering the social, environmental and economic effects of the deal.

### Cost of change

Any change will result in impacts and costs for the agency and its clients.

**Direct costs of change** may include:

- commissioning or decommissioning systems
- costs associated with handover and transition
- training costs: design, development, delivery and materials

- communications costs: design, development, delivery and materials
- event costs: workshops, group meetings and road shows
- fees for change management consultants
- change management materials.

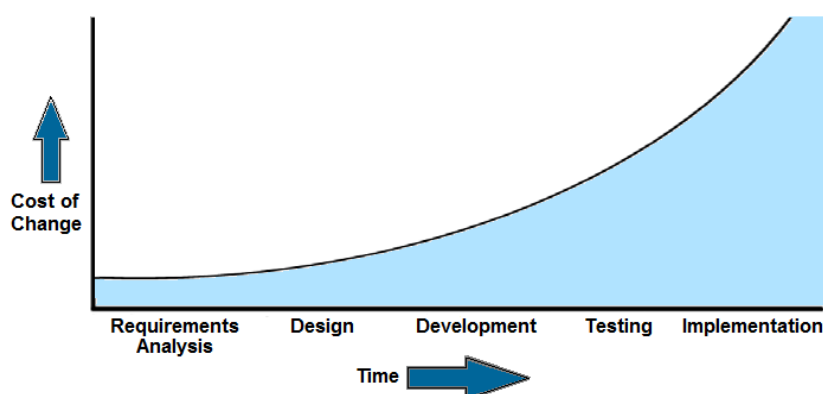
**Indirect costs of change** may include:

- negative impacts on customers.

The cost of change may also include the relative cost of managing a changed requirement through the life of the project, because it was missed or misunderstood.

When errors are made, or systems in the process of development are re-designed, it takes time (and therefore money) to make the changes and test them.

If an error is discovered early in the development process, it is less time-consuming and expensive to correct than if it is discovered later in the process.



## Re-tender costs

Close to the point where a contract expires, the agency may go through a tender process again to set up the contract for the next period.

There is a certain cost involved in tendering or re-tendering for a supplier. Examples of the costs may include:

- staff time to write an RFP and evaluation document
- the time of other staff to review documents, take part in the evaluation, sign off, and so on
- costs of documents - such as paper and printer consumables.

In the case of a simple procurement, these costs may be absorbed by the agency easily. If the procurement is complex, a lot of staff time will be required and this can be expensive.

## Sunk costs

Sunk costs are costs that have already been incurred in the past and which cannot be recovered if the project is called off, for instance early market research and document preparation.

## Hidden costs

Hidden costs are charges that may be difficult to notice, for example, because they are not included in the basic price.

An example is expenses that are not included in the purchase price of an equipment or machine, for example, delivery charges, maintenance, supplies, training, support and upgrades.

## Benefit realisation

Benefit realisation is the process of making sure that a planned change or process results in the benefits that were forecast.

To do this, the benefits must be

- identified and defined
- tracked, analysed and measured to ensure that they are genuine benefits.

When a request is made for a product or service to be bought, the business case will include a number of reasons why the product or service is needed. However, in many cases, the results are not analysed after the purchase or service to ensure that the benefits were achieved. If several business cases are produced at the same time, they may put forward similar benefits – and each person or team may claim the benefit as a result of their own project.