EXPRO National Manual of Assets and Facilities Management

Volume 4, Chapter 3

Cost Indices

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1.0 PURPOSE

The purpose of this document is to provide Entities with comprehensive knowledge for the analysis of cost schedules associated with financial models used to measure the performance of asset Operations and Maintenance (O&M) processes, and to calculate the probable long-term implications of an asset's replacement as part of a lifecycle model

Throughout the construction sector, Cost Indices are used as strong indicators of:

- Average movement of costs over a fixed period of time
- Fixed list of representative materials and services related to the construction industry

For the services sector, the Cost Indices used are similar to those within the construction industry, however, here the indices tend to move more slowly.

In broad terms, Cost Indices determine change in the prices of inputs to the service-related activities over a given period of time. However, it should be noted that the terminology used in the context of Cost Indices for service-related activities varies between countries. Cost Indices measurement can be applied across all the aspects of the financial management of the asset O&M activities. Such elements include, but not limited to:

- Labor
- Transport
- Fuel
- Accommodation
- Materials (e.g., wood, steel, copper, lead, aluminum, bitumen-based road topping)

It should also be noted that there can be a considerable variation in the inclusion/exclusion of the above elements, therefore, a set of parameters should be agreed upon prior to the compilation of Cost Indices, in order to avoid inconsistency and errors in the reports.

2.0 SCOPE

The scope of this document is to understand the basics of Cost Indices and their utilization within the O&M sector. A common use of Cost Indices is in the development of Cost Estimation and the adjustment price levels.

The Entities shall develop and build up specific indices directly related to their geographical location and sector. In this manner, the information gathered will be more accurate, as information used from other geographical locations has the potential to be incorrect and will impact on any resulting indices.

For the purpose of developing any service-based Cost Indices, the inputs should be grouped and used from a pre-determined selected basket of items, i.e., 'material' can be one basket that would include e.g., steel, concrete, cement.

Furthermore, it is assumed herein that some data has already been collected to develop an O&M Cost Indices for KSA.

3.0 DEFINITIONS

Term	Definitions
Asset	An item, or thing, that is of potential or actual value to an organization. The value will vary between different organizations and their stakeholders, and can be tangible or intangible, financial or non-financial
Asset Management	Asset management is the coordinated activity of an organization to realize value from assets
Condition Assessment	The process of periodic physical inspections, assessments, measurements, and interpretation of the resultant data to indicate the condition of a specific asset
Operating Expenditure	Financial Resources used to maintain assets
Acronyms	
CA	Condition Assessment
NMA&FM	National Manual of Assets and Facility Management
O&M	Operations and Maintenance
OPEX	Operating Expenditure
SAMA	Saudi Arabian Monetary Agency
U.S	United States

Table 1: Definitions

4.0 REFERENCES

- British Standards (BS 7543) – Guide to Durability of Buildings and Building Components
- Building Services Research and Information (BSRIA) – Lifecycle Costing
- Building Services Research and Information Association (BSRIA) – Lifecycle Management
- Chartered Institution of Building Services Engineers (CIBSE) Guide M
- Institute of Workplace and Facilities Management (IWFM) – Asset Management
- U.S Department of Energy (DOE 0430.1C) – Real Property Management
- U.S Department of Energy (DOE G 433.1.1A) – Nuclear Facility Maintenance Management Program Guide to User

5.0 RESPONSIBILITIES

Role	Description
Asset Management Team	Team responsible for maintaining records of the assets' condition and maintenance details
Operations Team	The team responsible for undertaking operational management duties of the repaired, replaced, altered, or extended assets or systems
Entity	• Prepare plans for Condition Assessment (CA) including frequency • Ensure that CA is aligned with Government Regulations and the details laid out in the NMA & FM guide • Identify or source the appropriate resources to carry out the exercise • Train or brief (whichever is more appropriate depending on the resources) the selected resources to ensure uniformity across all asset categories and conformity to the NMA & FM • Liaise with the selected resource to ensure an effective and efficient program, including required shutdowns and possible access requirements • Manage and oversee the delivery of the CA activity according to the agreed strategy and plans

Role	Description
	• Assist in the compilation of the CA Report, particularly in the prioritization of assets and possible future requirements for the use of assets • Plan and implement recommendations established by the CA Report
Service Delivery Team	• Understand, develop, and prepare Asset Management System requirements to undertake policy development, scenario modeling and cope with the complexity of work for each entity • Provide and train competent and authorized personnel to empower and steward champions to support the implementation of Asset Management System design • Follow agreed procedures and commit to project timelines • Carry out job risk assessments, support development of Risk Assessment and Method Statement (RAMS) across the Entity • Provide a detailed report, and advise based on facts and evidence in collaboration with the Entity

Table 2: Responsibilities

6.0 PROCESS

The complete Financial Planning considerations are covered within the National Manual of Assets and Facility Management (NMA&FM), Volume 4, Financial Planning. Cost Indices are one of the key components within Phase-3 Budgeting, Refer to Figure 1 below.

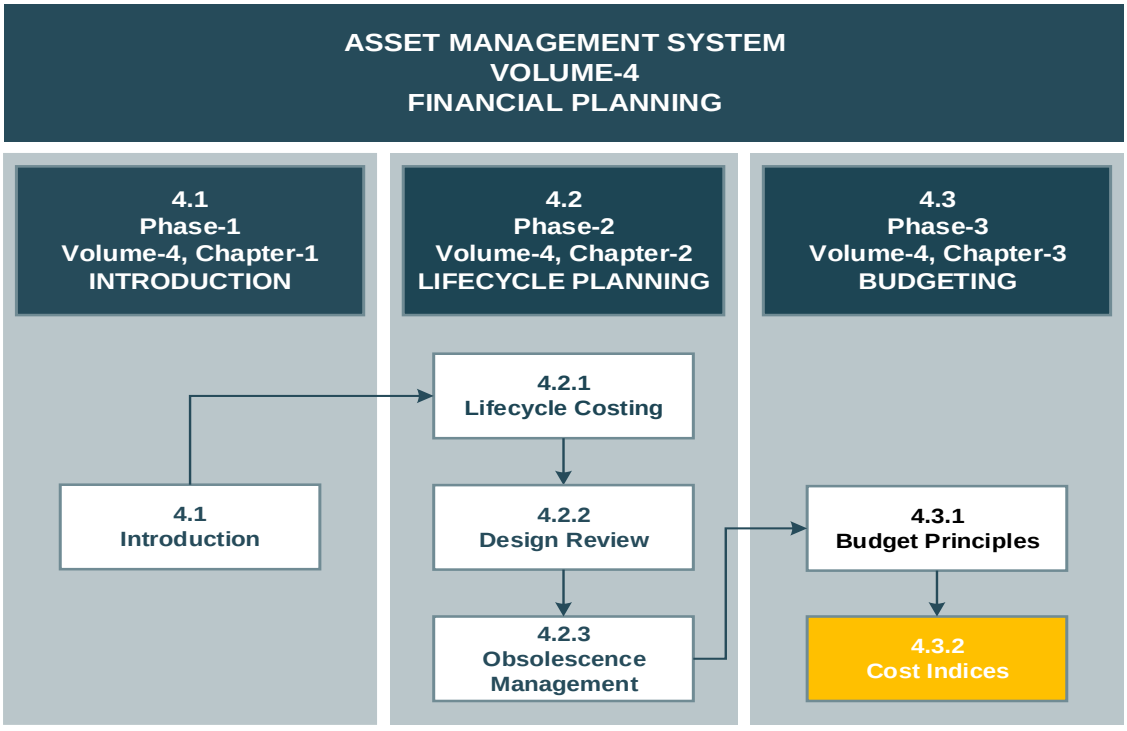

Figure 1: Asset Management System

A Cost (or Price) Index is defined as “a normalized average (typically a weighted average) of prices relative to a given class of goods or services in a given region, during a specific interval of time.”

Cost Indices are typically lists of prices used for comparative purposes which, when effectively used, not only indicate the difference in price of something across differing geographies, but also how that price has changed over time (positively or negatively), and therefore, provide a budgeting function (or procurement/construction estimator) with statistical information on which to base the acquisition of new assets or the potential cost of assets replacement in several years’ time, as part of a lifecycle program.

6.1 Cost Indices Development

To develop an input-based, Cost Indices measurement tool, standardization has to be agreed upon regarding which physical elements are to be measured and the values of these measurements e.g., materials should be part of material category and should not be mixed with other elements.

The starting point for indices development is a list of carefully specified buckets or components, from which the total input/output costs of a project or any cost activity, based on Cost Base/Work Base Structure are accumulated. Input Cost Indices measure changes in the price of specified inputs (items or activities) to the process, by monitoring separately the cost of each measured item. This generally involves the compilation of a weighted index of the wages and materials costs. Initially, a representative basket of goods and services are identified, together with the man hours of particular trades and the identified metrics of the goods. See flow chart of Cost Indices Development Process in Figure 2 below.

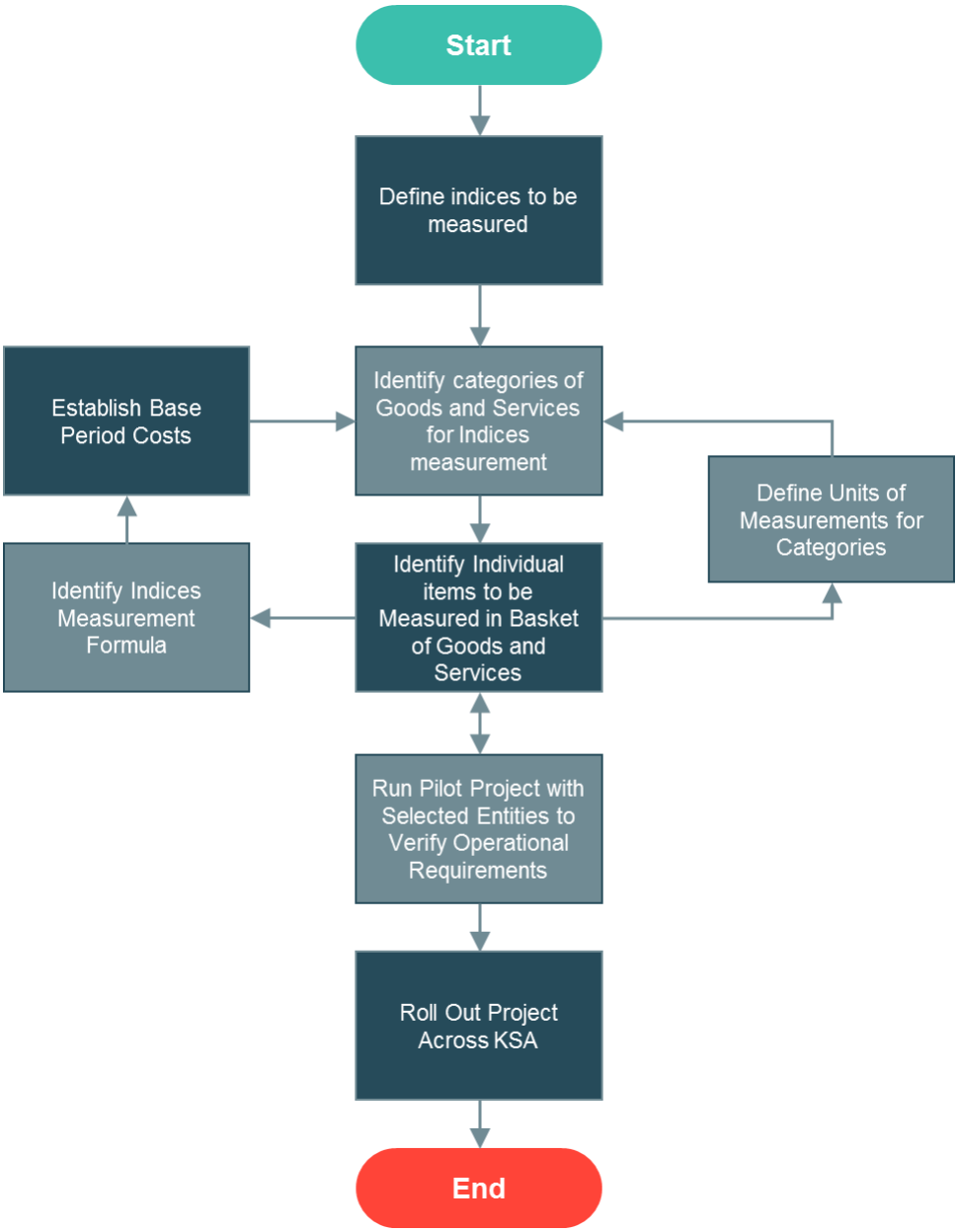

Figure 2: Cost Indices Development Process

There are several formulaic methodologies e.g., Laspeyres, Paasche, Walsh, Marshall Edgeworth, Bowley, however, most commonly used for O&M is 'Laspeyres Index'. The methodology and formula it uses in the development of Cost Indices, is discussed later in this document.

Due to the need for the indices to be used within the O&M sector, it is imperative that these are developed and are readily available, thereby allowing, initially, on-going analysis to be carried out on a regular basis over a relatively short timeframe, normally every month. The analysis and dissemination of this information should be carried out at the Government Departmental level.

6.2 Practical Measurement Considerations

Cost Indices are represented as simple index numbers; these number values indicate relative change but do not represent absolute values. This means that an index number can be compared with another for measurement purpose, but as the number does not have an absolute value, therefore, it has no meaning outside of the index use.

A Cost Index generally selects a base year and that year equates to 100, every year after (or before) that is expressed as a percentage of the base year. A base year is generally where the prices are normalized throughout the basket items, and can be utilized for developing Cost Index that can be manipulated in the fiscal years estimates and for the upcoming years. In the example below, the base year is 2000.

Year	Annual Basket Cost	Equation	Percentage	Index Value
2000	2.50	2.50/2.50	100%	1.00
2001	2.60	2.60/2.50	104%	1.04
2002	2.70	2.70/2.50	108%	1.08
2003	2.80	2.80/2.50	112%	1.12

Table 3: Cost Index Example

When an index is normalized in this way, the meaning of the 1.12 index value is that the total cost of something (the same thing, whatever that may be, in the same place) is 12% more in 2003 than in 2000 for instance, and 8% more than the cost in 2001.

Other Cost Indices e.g., inflation, growth factor, tax rates, depreciation rates, are disseminated from Ministry of Finance or can be obtained from Saudi Arabian Monetary Agency (SAMA).

6.3 Methodology

The methodology used to compile Cost Indices for a defined basket of items will use what is generally termed as ‘Standard Factors’. This method is mainly used for the compilation of input Cost Indices.

For any given period, a representative sample (basket of items or services) is selected and the quantities of each factor used to build it (e.g., materials, labor, transport, machinery) are valued. Changes in the costs are determined by monitoring the cost of each factor. The representative sample chosen initially is used only for weighing purposes (in this procedure, base-weighted index is taken as 100).

As stated earlier, it is critical that the representative basket of items is consistent across all Entities. SAMA issues quarterly Cost indices for several items, including e.g., food, accommodation. Food Cost Index should not be used for accommodation, as the items in those input and output baskets are different and not of similar nature. Refer to Figure 3 below for more details on Price Indices Cost Structure.

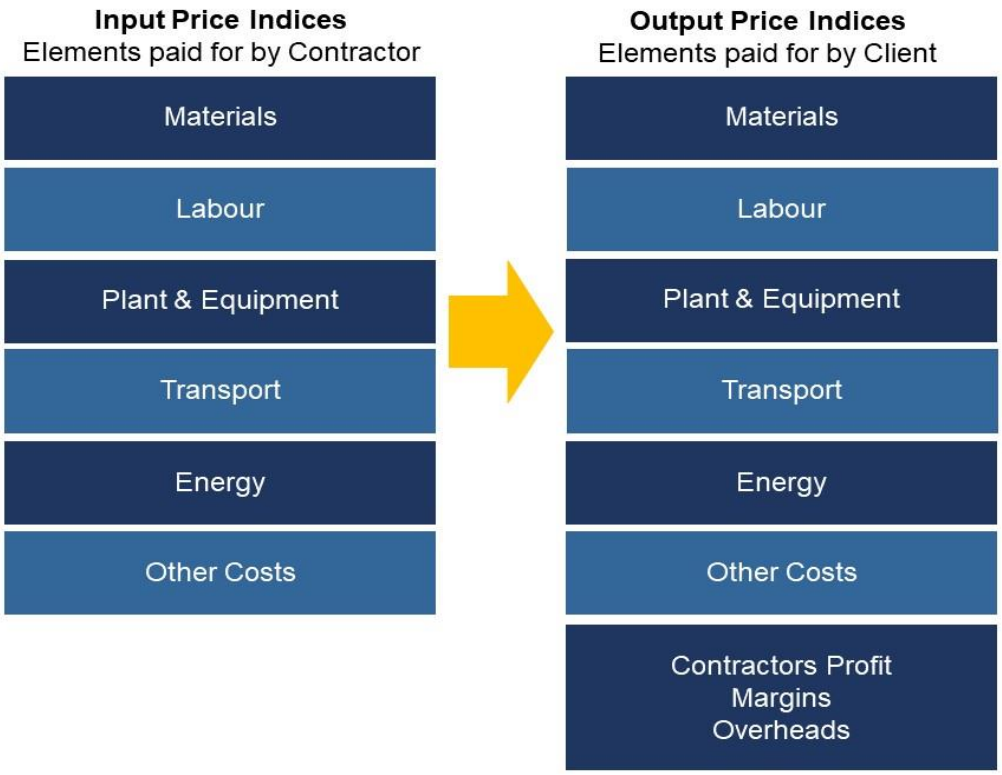

Figure 3: Price Indices Cost Structure

For the purpose of the input-based development of Cost Indices, the appropriate methodology would be the use of base-weighted indices as this is most widely used in the Asset Management, O&M industry. In this instance, the Laspeyres index formula is best suited.

The Laspeyres Price Index is an index formula used in price statistics for measuring the price development of the basket of goods and services consumed in the base period. The index identifies how much a basket of goods or services that an Entity bought in the base period would cost in the current period. This is defined as a fixed-weight, or fixed-basket, index that uses the basket of goods and services and their weights from the base period.

The choice of the index formula depends on the availability of data. In comparison to other formulas, the Laspeyres Index does not require information on the quantities of goods or services in the basket for the current period. Therefore, in practice the Laspeyres formula is usually preferred for the calculation of price indices which are typically compiled and released rapidly i.e., before consumption or production, information for the current period could have been collected. It is because of this that the Laspeyres method is the preferred option for the purposes required by NMA & FM, compared to other methods such as the “Paasche or Price” formulae.

As previously identified in Figure 3, the six main elements used to develop a Cost Indices dataset are the costs associated with:

- Materials
- Labor
- Plant and Equipment
- Transport
- Energy
- Other Costs

These headings have been used to identify a representative sample of goods and services within each grouping together with the Units of Measure (UOM). A base month is then identified, at which a sample is taken of each item cost. Costs are then regularly checked on a monthly basis and by using the Laspeyres

Indices as the reference month (always the same) and the month being measured, it is possible to calculate the Cost Indices.

The check sheet (Cost Indices Check sheet) in **Attachment 1** can be used to identify the cost and measured quantity of the basket of goods and services for the base month and for each month after that, during the on-going periods of analysis.

The content of the basket of goods and services can be adjusted at any time provided there is prior agreement with all Entities. In this manner, continuity of the measured items can be maintained, and consequently the level of accuracy.

Carrying out the analysis on a monthly basis allows for a very quick turnaround in the on-going development of the Cost Indices which can then be distributed to all departments of the Entities as required.

6.3.1 Laspeyres Index Explanation

The index commonly uses a base year figure of 100, with periods of higher price levels shown by an index greater than 100 and periods of lower price levels by indices lower than 100.

The formula for the Laspeyres Price Index is as follows:

$$\text{Laspeyres Price Index} = \frac{\Sigma\,(Pi,t) \times (Qi,0)}{\Sigma\,(Pi,0) \times (Qi,0)} \times 100$$

Where:

- **Pi,t** is the price of the individual item at the observation period
- **Pi,0** is the price of the individual item at the base period
- **Qi,0** is the quantity of the individual item at the base period

The numerator is the total expenditure for all items at the observation period using base quantities, and the denominator is the total expenditure for all items at the base period using base quantities. The Laspeyres Price Index can be better understood when rewritten as follows:

$$\text{Laspeyres Price Index} = \frac{\text{Sum of [Price at Observation Period x Base Quantity]}}{\text{Sum of [Price at Base Period x Base Quantity]}} \times 100$$

The information regarding the change in the prices and quantities of each individual item of goods or services in a hypothetical basket is provided below. For ease of calculation, the measurement period has been assumed to be annual.

	Item Price in Year		
Item	**Year 0**	**Year 1**	**Year 2**
Good A	$5	$10	$7
Good B	$10	$12	$13
Good C	$20	$25	$24

Table 4: Item Price

	Item Quantity in Year (Basket of Goods or Services)		
Item	**Year 0**	**Year 1**	**Year 2**
Good A	100	125	150
Good B	200	225	250
Good C	300	325	350

Table 5: Item Quantity

Using the formula for the Laspeyres Price Index:

$$\text{Laspeyres Price Index in Year 0} = \frac{(\$5 \times 100) + (\$10 \times 200) + (\$20 \times 300)}{(\$5 \times 100) + (\$10 \times 200) + (\$20 \times 300)} \times 100 = 100$$

$$\text{Laspeyres Price Index in Year 1} = \frac{(\$10 \times 100) + (\$12 \times 200) + (\$25 \times 300)}{(\$5 \times 100) + (\$10 \times 200) + (\$20 \times 300)} \times 100 = 128.23$$

$$\text{Laspeyres Price Index in Year 2} = \frac{(\$7 \times 100) + (\$13 \times 200) + (\$24 \times 300)}{(\$5 \times 100) + (\$10 \times 200) + (\$20 \times 300)} \times 100 = 123.53$$

Therefore, the price indices were as follows for each year:

- Year 0 (Base Year) = 100
- Year 1 = 128.23
- Year 2 = 123.53

Note that, with this index, the only changes are the prices over the years. The quantities for each of the basket of goods remain the same throughout the years.

6.3.2 Advantages of the Laspeyres Price Index

The advantages of this index include:

- Easy to calculate and commonly used
- Cheap to construct
- Quantities for future years need not to be calculated – only base year quantities (weightings) are used
- Presents a meaningful comparison, as changes in the index are attributable to the changes in price

7.0 ATTACHMENTS

1. EOM-ZL0-TP-000002 - Cost Indices for Goods and Services Check Sheet

Attachment 1: EOM-ZL0-TP-000002 - Cost Indices for Goods and Services Checklist

Cost Indices for Goods & Services Checklist														
Item (SAR) / Basket	Unit of Measure	Ref Cost Month 0	Cost Month 1	Cost Month 2	Cost Month 3	Cost Month 4	Cost Month 5	Cost Month 6	Cost Month 7	Cost Month 8	Cost Month 9	Cost Month 10	Cost Month 11	Cost Month 12
Materials														
Wood	Linear (m)													
Gypsum Board	m^2													
Rolled Steel Plate	m^2													
Reinforcing Bar	Linear (m)													
Aluminum sheet	m^2													
Lead flashing	Linear (m)													
Copper cable	Linear (m)													
Copper pipe	Linear (m)													
Fiber Optic cable	Linear (m)													
Ceramic Tiling	m^2													
Vinyl Flooring	m^2													
Paint	liter													
Concrete	m^3													
Tarmac	m^3													
Aggregate	m^3													
Consumables	As per Sub-basket													
Labor														

Cost Indices for Goods & Services Checklist														
Director	CTC/Hour													
Manager	CTC/Hour													
Supervisor	CTC/Hour													
Technician	CTC/Hour													
Driver	CTC/Hour													
Cleaner	CTC/Hour													
Laborer	CTC/Hour													
Plant and Equipment														
Road Sweeper	Cost/Item													
Floor Scrubber	Cost/Item													
Cherry Picker	Cost/Item													
“Bobcat” Digger	Cost/Item													
Compressor	Cost/Item													
Pneumatic Tools	Cost/Item													
Janitor Trolley	Cost/Item													
Car Wash Trolley	Cost/Item													
Testing Equipment	Cost/item													
Scissor Lift	Cost/Item													
Transport														
Saloon Car	Cost/Item													
Minibus	CTC/Hour													
Pickup Truck	Cost/Item													
30-Seater Bus	Cost/Item													
Golf Car	Cost/item													

Cost Indices for Goods & Services Checklist														
Delivery Vehicle	Cost/Item													
Energy														
Electricity	kW/Hour													
Gas	m^3													
Petrol	Per gallon													
Diesel	Per gallon													
Other Costs														
Staff Accommodation	Per employee													
Visa Costs	Per employee													
Office Cost	m^2													
Entity Specific														