



HOW UTILITIES CAN USE COST ESTIMATION SOFTWARE IN CAPITAL BUDGETING

Introduction

Capital budgeting is used to determine whether future investment plans are financially sound. It is deployed to prioritize the allocation of capital, and while doing so factors in profitability, environmental risks, and internal risks. Utility companies are in a unique position in that they do not depend solely on net present value (NPV)

or internal rate of return (IRR) of the project while choosing an investment, but are rather driven by regulatory guidelines and revenue requirements.

Revenue requirements include, operating costs, depreciation, income and other taxes, and allowed return on capital. Effective utilization of budgets and

maximum possible returns depend on accuracy of estimates. Investment decisions are based on parameters such as urgency, lowest costs, lowest present value, regulatory incentives, etc. But the most important input for capital budgeting is an accurate estimate vis-a-vis revenue requirements.

Here are methods that are generally used for cost estimation:

- **Analogous Estimation**

This technique uses historical data for similar projects. The differences in historical and current projects are adjusted in the estimates. The benefits of analogous estimation is that it is fast, cost effective, and delivers results quickly. The drawback is that it is low on reliability.

- **Parametric Estimation**

This technique requires statistical modeling. It uses historical data of key cost drivers to estimate different parameters such as size, duration, and key cost drivers. Accuracy is high when the drivers

are limited in number but for complex projects the details and the cost drivers are many and this could potentially lead to complexities.

- **Bottom-Up Estimation (BUE)**

This technique requires estimation of individual work items which are then rolled up to the cost or estimate at the project level. This method is reliable and accurate but time consuming. Granular information is required for this technique to be reliable and accurate.

- **Project Management Estimating Software**

This estimation software is a mix of the BUE and parametric estimation where in statistical models are developed by software and the level of granularity are configurable. Project management estimating software offers detailed and accurate estimates quickly and with minimal effort. The software however needs to be customized to the needs of the utility and the type of the project being executed. Project management estimating software can help utilities optimally utilize available resources.



Estimation Software & Utilities

It is imperative for utilities to get the right project estimates, make the right investments, and beat competition. The regulated environment of the industry makes it mandatory for every utility to be transparent and accurate in its estimates. They must report baseline data for their estimates to satisfy regulatory requirements.

For example, The Water Services Regulation Authority (Ofwat), UK has the following obligations for utilities operating in the authority's area,

- **Annual performance report**- All companies (including small water companies) are required to submit their annual performance reports from 2015-16 onwards to demonstrate compliance with price controls.
- **Charging**- Regulation and overseeing the different charges set by the company. These charges are based on cost estimates, thus the estimates become critical.
- **Information and Assurance**- Utilities are required to be transparent and provide customers and stakeholder's information regarding the performance of the company.
- **Engaging with customers**- Every utility needs to inform their customers and enable them to secure the lowest possible bills and best possible service

Here are some ways a water utility in the UK can benefit from an estimation software package,

- Act as a trust builder with the regulatory authority by providing a detailed analysis and basis of the planned expenditure with easy access to data for audit purposes.
- Increase credibility of the estimates and better utilization of available resources. Also increase confidence in the capital investment programme by producing an automated project scope, based on simple design parameters.
- Accurate estimates when based on

historical costs can move the costing of a company to a 'should cost' model of working and increase effectiveness of the estimation process.

- Consistent and standard method of estimation which is free from user or estimator induced discrepancies. Project design can be integrated in the software and ensure standard engineering processes are followed.
- Flexibility to make it an open access tool for all stakeholders inside the organization leading to increased transparency and confidence.
- Be utilized as a historical costs data storage platform and to store data in an organized and standardized manner.

Utilities need to note the following when getting a cost estimate from an estimation software,

- Accuracy of any statistical model depends on the 'historic data' that is being fed to the model.
- Data if not stored or used properly can lead to inaccuracy of the model and hinder estimates. Correct indexation of the historical data is key.
- Regression analysis delivers a mathematical model, selection of the right model with right indexation for the cost estimation is crucial.



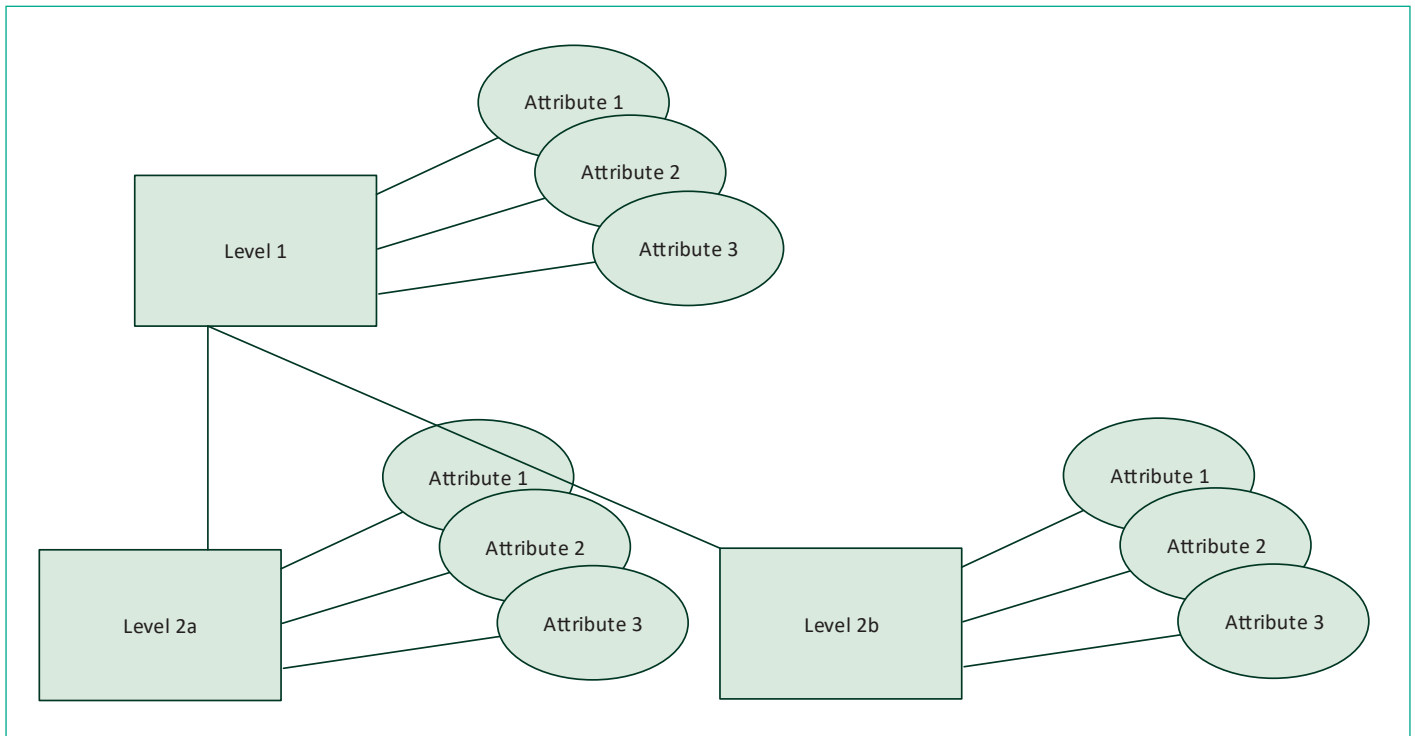
Historical Data

- **Considerations for selecting the right cost model for estimates:**

- Accuracy of historical data - Asset hierarchy followed by the utility determines how the cost data is stored. Estimates in scenarios where granular levels of hierarchies exist tend to be efficient.
- Capturing variables that affect cost is important as this data is the input for cost models.

- Capturing data across asset hierarchy (vertical) and tagging the data with the right attributes (horizontal) lays the groundwork for regression analysis and estimation software becomes accurate.
- Attribution of cost data helps identify similar and correct data points, and enable regression analysis to generate multiple models for similar data sets differentiated by attributes.

The statistical model below can be made for Level 2a with Attribute 1 under Level 1 with attribute 2 which could be much more accurate than if all the data points at level 2a are considered for the statistical model. The tagging of the data points with right (pre-defined) attributes aids in the selection of the right data set for the creation of the statistical models.



- **Normalization of data points**

Historical data belonging to different time periods and need to be normalized to a common reference to make the results of the model consistent. This ensures that the data is analyzed along current timelines and that the results are not skewed by outdated costs.

- **Regression Analysis (Simple or Multiple Variable depending on the data)**

Analysis of historical data for estimation is driven by the relationship of the variables with the cost. In mathematical terms 'Cost', the dependent variable in the model might have several parameters as independent variables.

This particular phenomenon can be explained by taking a simple example of a pumping station in waste water treatment. The cost of a pump is dependent on the

power rating (in Kilowatts) of the pump's motor. But the same cannot be said about a pipe. The cost of a pipe depends on the diameter, length, and material of the pipe. The selection of the method of regressing the data depends on the number and type of the independent variables. Few examples are below.

- When there is only one variable and it is quantifiable, simple regression is suitable and expression for the cost is determined by the independent variable. The expression can be of any degree (linear, exponential, logarithmic, power, or polynomial).
- In cases where more than one independent quantifiable variable exists, multi-dimension regression analysis are suitable and the expression of the statistical model is derived based on independent variables.

- Quantifiable variables can be classified as independent variables for regression analysis (multiple or simple) and property defining variables can be used in selection of data points in groups as attributes. This grouping increases accuracy when determining the estimates of the cost, where property variables are known.
- Variables that do not directly impact cost are derivatives of other variables and need not be included in the regression as independent variables as it might end up skewing the results (for e.g. 'area' and 'thickness' of a concrete slab have direct impact on the cost and the 'volume' of the slab is derivative here and it should not be included in regression).



Referring to the Right Cost Model and Correct Indexation

The estimated cost read-off from the cost model is dependent on the selection of the cost model based on the attributes for the estimated entity. This means if some of the attributes are not known then rather than making an assumption one should refer to the cost model where that attribute is not known. For example, if a cost estimate is required for a pipe of 1m and 200mm diameter where the material of the pipe is not known. The correct thing to do would be to have a model where in the material

of the pipework is not being considered as a parameter for filtering the points and a higher level model is used for the estimation.

This example has only two possibilities because of only one property/attribute being defined. In real life scenarios there would be entities with multiple properties and while estimating also some of the properties might be known and some might be unknown, to cater to these scenarios the estimating software should

be flexible enough to enable the user to choose multiple combinations to get the right cost model.

To aid optioneering (generation of multiple estimation options), the use of AI tools (e.g. Nia) could be considered, as these tools may find correlation with similar solutions that would not be considered by the project team under normal circumstances, and may help the company derive even greater value from their investments.

Extension of the Estimation Solution to BIM

Using information models allows the designer to build the project in a simulated 3D environment where assets can be seen and the physical site can be represented in the 3D simulation. The estimation software can be extended to have an interface and the project site can be built as a 3D model for better understanding of cost as well as physical design for the estimators.

This integration of the design and

estimation can make it easier for the engineers to see the effect of the design decisions on the cost almost in real time. For example –designers can perform what-if analysis by changing the location or any other property of a specific design element and verify the impact on the estimate in real time. This integration enables non-technical users to see the project in a user-friendly way where they are able to

navigate the work site and make changes to the design with direct implication on cost known to them attributed to the change done. This integration can be brought in later on to the estimating software as a stepping stone with enriched digital experience for the project design and estimation process.





Conclusion

- Cost estimation software can become an excellent tool for estimators and budgeters but the most important aspect of the software is the data that is the basis of the cost models. Extensive and accurate data sets lead to accurate and correct cost models.
- The backbone of any estimation software is accurate data capturing with the attributes required. Lack of mature processes can lead to inaccurate, unreliable plans and estimates.
- Estimation software can transform business processes for planners and estimators if the solutions are dynamic in terms of providing feedback when actual costs are fed into the system in real-time.
- A key aspect of adapting a digital ecosystem is to ensure that capital projects go through a rigorous automated scoping and estimation process using state-of-the-art software technologies rather than unreliable, error prone manual methods.

3D modelling (BIM) takes the user experience in the estimation process to the next level through quality and efficiency. In this era of continuous technology disruptions where software impacts every facet of an enterprise, Utilities that embrace software such as cost estimation for capital budgeting have an edge over others that do not.

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