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- The variety of methods for estimating the initial costs of building projects may seem confusing at first, and the confusion is compounded by the fact that the names of these approaches vary from author to author. However, there is one simple common underlying idea:

$$\text{COST} = \text{AMOUNT} * \text{UNIT PRICE} \qquad (3\text{-}1)$$

or more specifically:

$$\text{Estimated COST} = \text{Estimated AMOUNT (number of units)} \times \text{estimated UNIT PRICE} \qquad (3\text{-}1A)$$

- Note the use of the term **COST** for the performance variable to be calculated or estimated. It is the result of the calculation. The term **PRICE** is used for the unit price; this is the context variable whose value is not under the designer's control but depends on the market or on others' decisions. The **AMOUNT** is the direct or intermediate design variable, controlled directly or indirectly by the designer.
- The equation is conceptually the same as it would be for a final account or bill for the building, except that in an estimate the amounts or the unit price, or both, are not definitively known but only are predicted or estimated. As long as the quantities appearing on the right-hand side of the equation are estimates, the resulting cost figure will be an estimate too.

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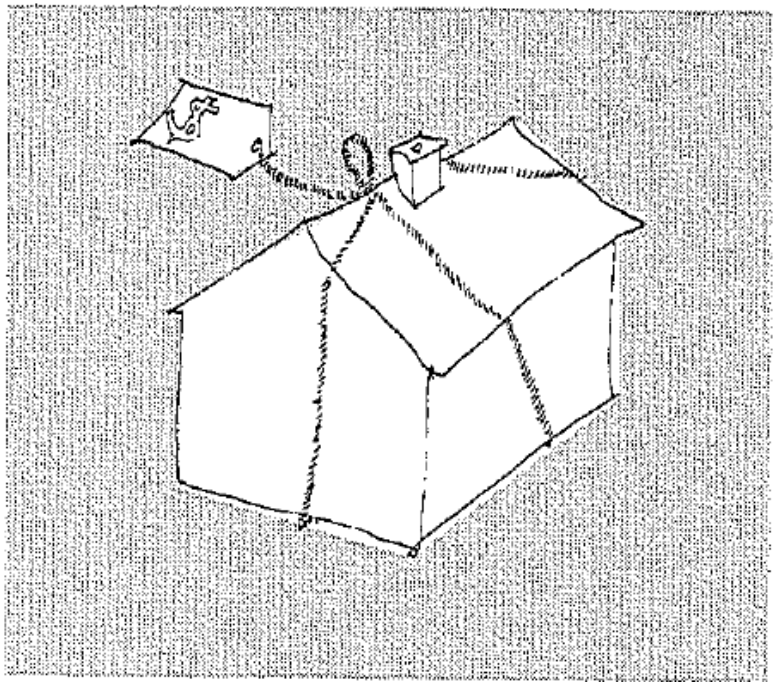
- **Whole Unit Method** *(Whole Building Method).* This is, strictly speaking, not an estimating method as such because there is only one unit. The unit referred to is the whole building—for example a house (one-family residence) or a school, assuming some standard type and size. The costs quoted in data sources using this method usually are total initial project cost, not mere building construction cost, and it is not always clear which of the two concepts is meant.



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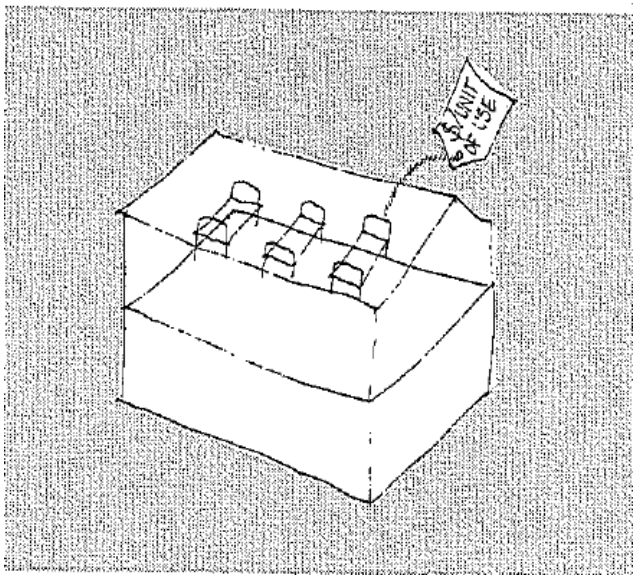
- **Unit-of-Use Method** *(Order of Magnitude Estimate).* Many building types are characterized by repetition of units of use or user stations. For example, the size of hospitals often is expressed in terms of the number of hospital beds. Cost then is estimated by using a unit price per bed. Other examples are schools (student stations), office buildings (office worker stations/desks), and even airports, whose cost can be estimated by the number of boarding gates and the price per gate. Of course, the unit price in each case includes the cost of the shared common service facilities. This method is used in very early stages of the project, and as a basis for comparison with other projects of the same type and overall scope. This type of estimate also is referred to as an order of magnitude estimate. Again, care must be taken to ascertain whether data quoted refer to building construction costs or total project cost.



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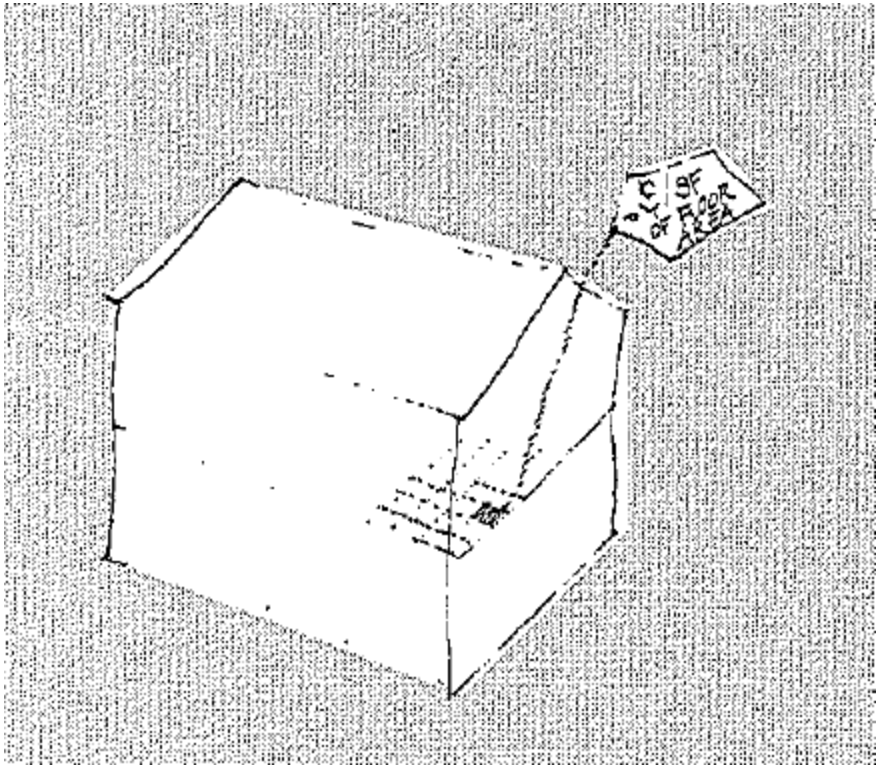
- **Area Method** *(Square Foot Method).* This is one of the most common estimating methods, and is based on the unit of total floor area or gross floor area. Estimating by price per square foot is most common in the United States. Most European and many overseas countries use the unit of square meters—but often do not use the area method as the predominant cost estimating



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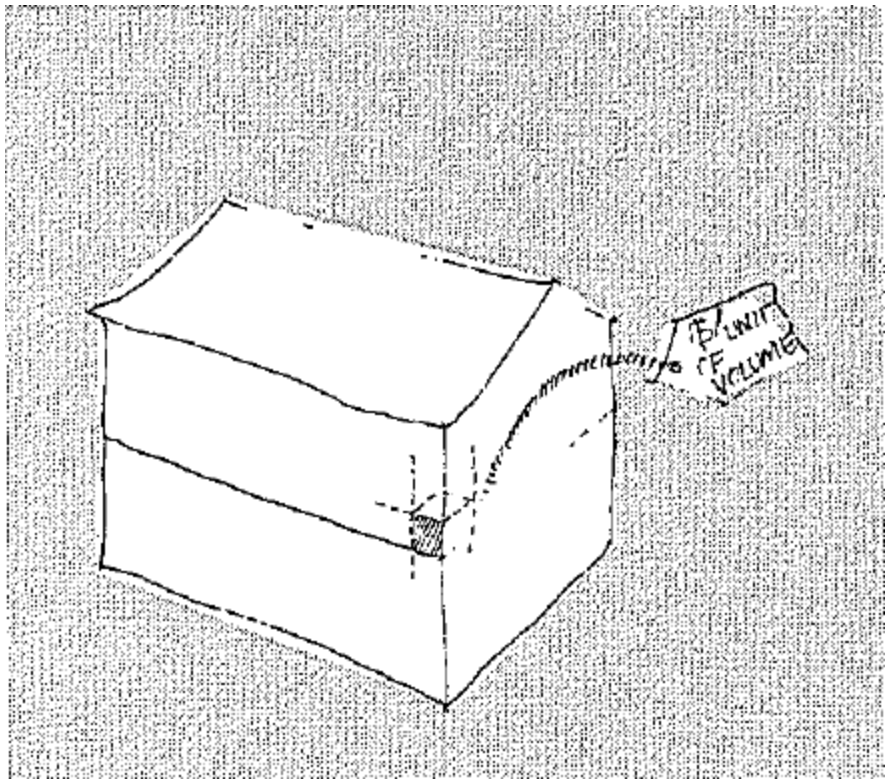
- **Volume Method** *(Cubic Foot Estimate).* The size of the project here is measured not by floor area but by units of space volume, for example, cubic feet or cubic meters. This method, using cubic meters, is more common in the United Kingdom and Europe than in the United States.



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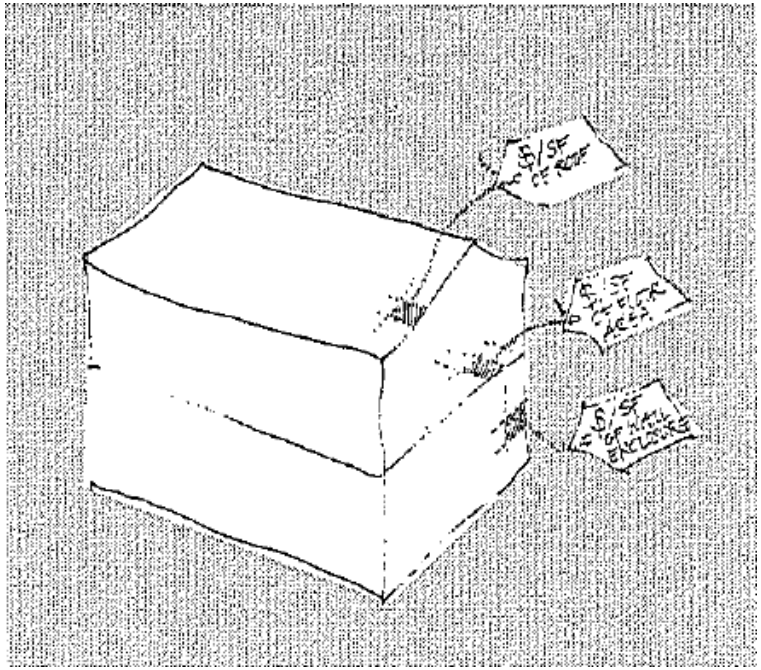
- **Enclosure Method**. An issue of principal interest to the architect is the relationship between cost and building form. Because neither the area method nor -the volume method is sensitive to differences in the geometry of buildings, a number of efforts have been made to develop estimating methods that do consider the effect of building geometry and the relationship between the surface of buildings and the enclosed space—hence the name "enclosure method." Some of the approaches that use this name actually are modifications of the area method. The method we will use for this purpose considers area units of the actual building surface, roof area, external walls, and so forth, in addition to floor space, and corresponding unit prices.



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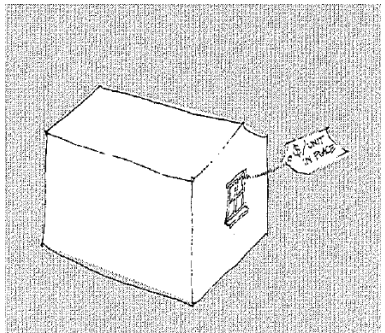
- **Systems Method**. The base unit here is the same as for the area method, but listed separately for each category of subsystems of the building; for example, structure, mechanical system, foundations, and so on. For each system, unit prices are given as TL per square meter of total floor area, and also as percentages of area method unit prices.
- **Trade Breakdown Method**. This is conceptually similar to the systems method, but here the basis for the breakdown into categories is not the subsystem but the share of the work done by the different "trades participating in the construction of the building.
- **Quantity-Survey-Based Methods** *(Unit Price Estimates).* A number of variations of estimating methods are based on actual counts (the quantity survey) of various items, materials, components, and so forth, to be used in the building. The unit referred to in the other name for this method (unit price estimating) is the actual physical building part, or the measuring unit for quantities of building material. This method requires detailed construction drawings and specifications and therefore cannot be used until quite late in the delivery process. Important distinctions between methods of this type consider the question of whether unit prices are quoted as in-place prices (that is, as finally installed in the building) or as suppliers' shelf prices to which the cost of labor in the installation of each item, as well as overhead and profit, would have to be added to arrive at in-place prices.



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- **Owners' and Architects' Estimates versus Contractors' Estimates**. Because of "the difference in focus on in-place versus suppliers' prices plus labor and over-head, a distinction, often is made between owners' and architects' estimates, which are mainly concerned with in-place prices, and contractors' estimates, which are concerned with the relationship between materials, labor, and overhead costs. Of course, such distinctions could be made for other estimating methods as well, but they usually are applied to quantity-takeoff-based methods.

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- Each of the estimating methods listed above can be refined in various ways to allow for more specific distinctions and therefore more precise estimates. The refinements consist of making additional distinctions within the chosen units, or applying different unit prices "adjusted" for the specific conditions of the building under consideration.
- **Building Type***:* The data manuals that list unit prices for area method estimating almost always list prices by building type. Commonly, data for 25 to 40 or 50 different types of buildings are distinguished and *a*ssembled in the cost data manuals.

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- **Quality:** In addition, most provide for distinctions according to quality levels, for example, by listing low (or 1/4), median, and high unit paces. The quartile figures mean that in the sample of projects surveyed to obtain the data, 25% of the projects had unit prices at or below the figure given under the 1/4 column, 50% were at or below the price listed under median, and 75% were at or below the prices given for 3/4 conversely, this means that 25% of the projects had unit prices higher than the figure given in the 3/4 column. This allows an owner to specify whether the project under consideration should be seen as an economy, standard, or luxury one and to apply the appropriate unit prices for the estimate.

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- **Size**: Because of the phenomenon of economy of scale, large buildings tend to have lower unit prices than very small projects. To account for this, the data sources provide information on the average size of the projects that were used to compile the unit price data, and some mechanism for adjusting the unit price for the size of building planned. Sometimes this is a graph of a curve (as, e.g., the Means Area Conversion Scale), sometimes a table of factors. The factor found in the graph or table then is multiplied by the standard unit price to find the unit price for the size of building in question.

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- **Locality:** To obtain a reasonably accurate estimate, it is necessary to adjust the national or regional average prices for the specific location. Most manuals provide tables of adjustment factors for the major cities around the country, the factor found in the table for the city of the project (or the closest nearby city) is multiplied by the unit price to obtain the appropriate unit price for the project

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- **Building Height**: Because the height of a building usually influences the cost, the data sources will provide some means for taking this into account when estimating. Some manuals already make distinctions for height within the building type (for example, Means distinguishes low-rise, mid-rise, and high-rise apart-ment buildings and office buildings), and others offer additional adjustment factors to be applied after reading the building type unit price from the tables. In spreadsheets designed to assist the designer in exploring different solutions, it may be advantageous to use (and, if necessary, to construct) an equation in which the height appears as a variable that can be changed as the design solution changes. For example, the effect of height can be expressed as an exponential function as follows:

$$PRC_n = PRC_1 * (1 + hf)^n$$

- Where PRCn is the desired price for a building with *n* floors; hf is an adjustment coefficient (the rate at which the price rises with the number of floors; to be established from a given set of data), and *n* is the number of floors.

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- **AREA METHOD:** Among the different cost positions making up the overall cost of a project, not only is the element of building cost usually the most significant in terms of magnitude, but it also is the one that commands the most interest on the part of architects, as it is directly related to the building design decisions for which architects are responsible, Of the several approaches available for estimating the initial cost of the building, the area method is the one most commonly used in the early stages of the project.
- The area method is an approach to estimating the initial cost that describes the building in terms of the total floor area provided. **The total floor area** is the **sum total of all the floor area in the building, measured from the outside of the building exterior walls**. It will be referred to as **TFA**.
- The relationship between **Total Floor Area (TFA)** and Net areas—usually **Net Leasable Area (NLA)**— plays an important role in the use of this method. Specifically, the **Net to Gross Ratio (NGR)** formed by **NLA/TFA** (or its inverse, the **Gross to Net Ratio, GNR: TFA/NLA**) is widely used both as an indicator of floor plan efficiency and to establish the probable size of the overall building when only the program in terms of the required NLA is given- For each building type, there are standard guidelines for the average or acceptable NGR. The required NLA of a program is divided by the NGR to obtain the overall TFA. The TFA then is multiplied by the appropriate unit price, BLDPRC (for example, in TL per square meter of TFA), to calculate the estimated building cost:

$$BLDCST = TFA*BLDPRC$$

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- The program for a hypothetical office, building in Ankara, Turkey calls for 100,000 square meter of Net Leasable Area. How much will the building cost?
- The only available data manual is from last year, the planning is estimated to take two years. The end of the construction period thus will be up to three years later than the last available unit price information.
- The building should be of high quality; the site allows for on-ground parking and then will leave an area of about 20,000 m2 for the building footprint.
- The data manual lists 55 TL, 68 TL, and 80 TL/m2 of TFA, respectively, for low-, median-, and high-quality office buildings.
- The median range for this type of office is given as 52,000 m2
- First, TFA must be found; the standard NGR for office buildings is given as 0.80 or 80%, and 100,000 divided by 0.8 is 125,000 m2 TFA. The height of the building will be at least 125,000/20,000 = 6,25 floors or more; we will assume seven floors.
- Low-rise, mid-rise, and high-rise prices are given as 61 TL, 80 TL, and 95 TL, respectively, in this category; this would correspond to a height increase factor of about 4% per floor- Applying an exponential factor for seven floors:

$$61 \times (1+0,4)^7 = 80,27 \text{ TL}$$

- Which would correspond closely enough to the mid-rise figure given in the manual.

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- The locality adjustment factor for Ankara is 0.84; thus the unit price should be adjusted as:

  80,27 x 0,84 = 67,43 TL per m2 of TFA

- The building size is 125,000 m2. However, the data manual lists 52,000 m2 as the typical average size of the samples from which the unit prices were developed. Using the Means Area adjustment factor diagram, we calculate first a project size factor of 125,000/52,000 = 2,4 and read from the graph an approximate cost multiplier of 0,93. So, the unit price for the project will be:

  67.43 x 0.93 = 62,71 TL/m2

- The total cost of the building will be 125,000 x 62.71 = 7,838,737 TL, or roughly 7,840,000 TL that is, if the building were to be built during the year for which the manual provided its data.
- We still have to allow for price increases due to inflation for the three years between the manual's data and the expected completion date. If inflation runs at an annual rate of 5%, we must calculate the compound amount factor of $(1 + 05)^3 = 1.16$ and multiply it by the above result to get the final expected cost: 7,840,000 X 1,16 = 9,075,780 TL
- Remember that this kind of early estimate can have an error range of up to ±15%, which means that the final cost could lie anywhere between 7,7 and 10,4 million Turkish Liras. It therefore is not meaningful to calculate these figures to a very high degree of precision.

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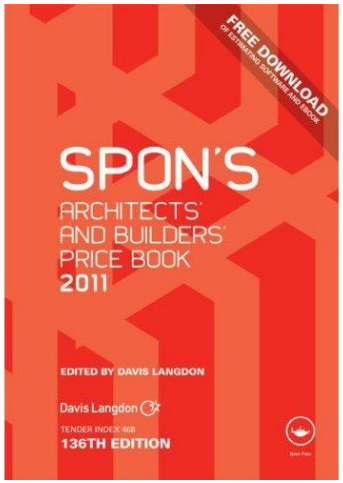

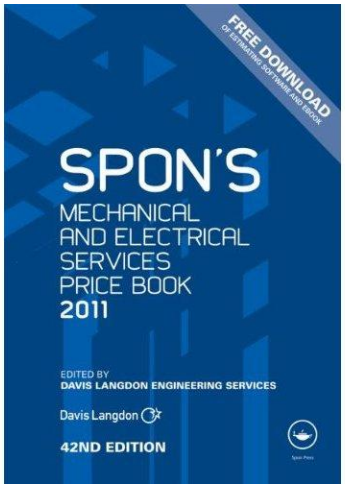

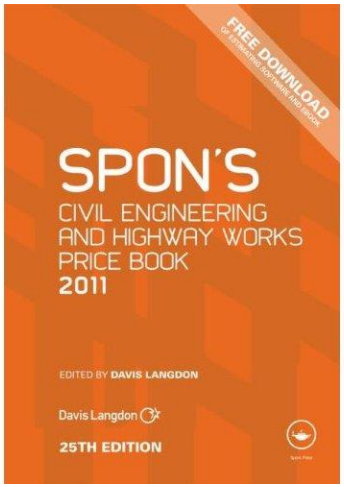

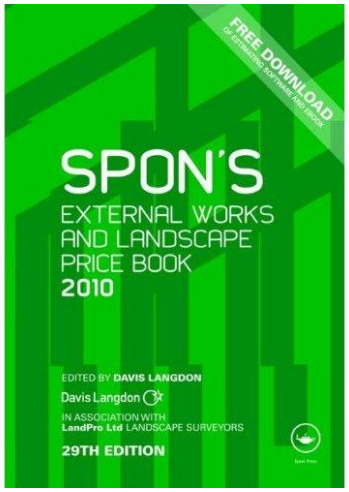

Building Price Data Manuals

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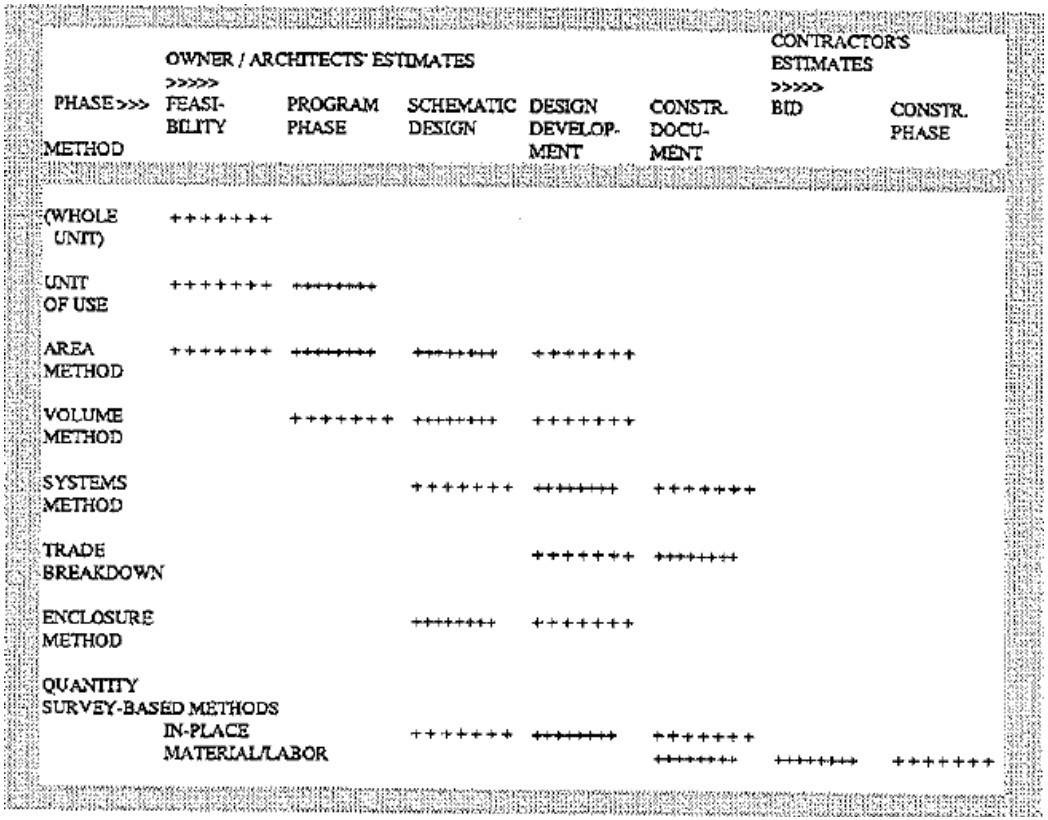
- The methods of estimating initial cost listed in the preceding brief survey are based on widely differing assumptions regarding the precision and the information detail needed to actually perform the estimate. These requirements determine the usefulness of each method for a given stage in the delivery process. The figure below gives a rough overview of the applicability of the various estimating methods to different project phases.



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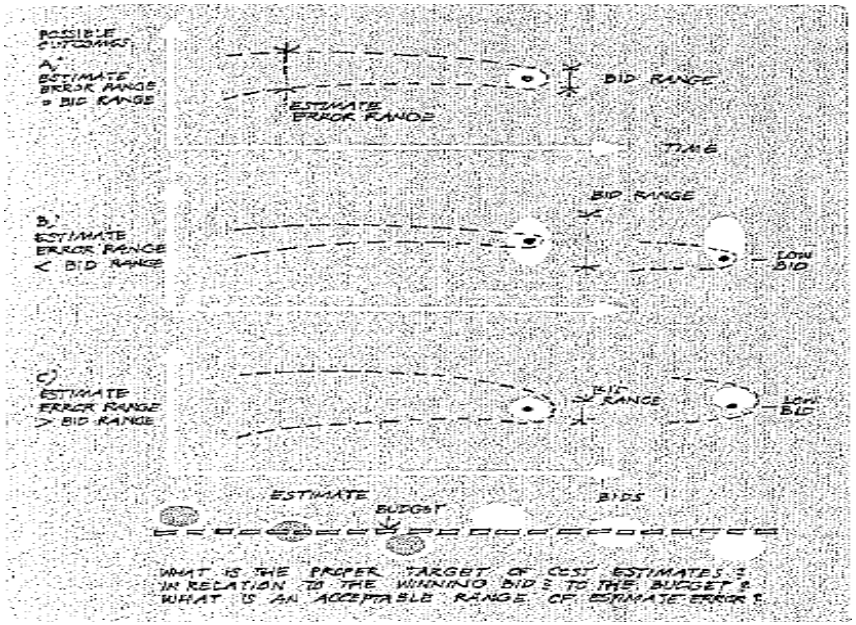
- Negative publicity about architects' work with public projects often has to do with cost overruns, that is, with projects ending up costing more than estimated- How reliable are the estimating methods?
- Early in the process, an estimate may be considered good if it is within around 15% of actual cost or budget. Later on, a 10% or 5% difference may be too much for the client's comfort However, the range of bids for a project quite often is much wider than that. The accuracy of an estimate can be known only after bids have been opened; but a client can get more reassurance from knowing that an estimator has had a consistent record of accuracy, with many estimates falling within 5% of the low bid, than from the precision of a given estimate in Turkish Liras.



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- The benefit of reducing our ignorance about the expected initial cost, that is, of trying to increase the precision of estimates in the hope of **improving their accuracy**, must be weighed against the **cost of preparing an estimate**. Given reliable data and conditions in which the data are applicable, precision is achieved through more work, that is, simply by ascertaining more details about the building and applying their unit prices. Thus the cost is mainly the cost of the time spent on the estimate. Whereas unit-of-use and area method estimates can be established within a matter of hours for most Types of projects, more detailed estimates will require more time—from a matter of days to several weeks, using conventional procedures. This is no more than we would expect, given what we know about the detail of available information about the building as the plans are refined.
- Two main strategies can be seen for addressing this dilemma- One is that of increasing detail and precision early on- This is a main factor in alternative delivery methods such as design-build project delivery: bring the contractor into the design team from the beginning, and make sufficiently detailed decisions early enough that a firm price can be guaranteed to the owner even though not all aspects of the building have been worked out.
- The second strategy would be to change the estimating methods used in early stages. Advances in computer technology are making it possible to reduce the time and cost required for using estimating methods that previously were meaningful only at later stages—systems estimates and quantity-takeoff-based methods; these then can be applied much earlier to many "what-if alternatives to find the best among several solutions.