International Comparison Program

[05.01]

Lessons learned from use of Basket of Construction Components

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Lessons learned from use of Basket of Construction Components

1. Background

The underlying principle of the BOCC was that the construction costs of residential and non residential buildings and civil engineering works could be compared by pricing the major components going into the construction of each. A set of 34 components were identified of which 12 were basic input items such as building materials, types of labor and rental costs for four types of equipment. The data collection form for each basic item captured average purchaser costs for different quantities such as three different measures of cubic meters of concrete. Costs of skilled labor were obtained for 6 different kinds ranging from bricklayers to machine operators. There was overlap in the basic components. Even though concrete was treated as a basic component, so were sand, cement, and aggregates which make up concrete.

The 22 composite components included parts of the construction process such as earthwork, a column footing, or an interior wall. The data to be collected for each composite component included the materials, labor, and equipment; however, the main objective was to obtain the total cost of each component which was the comparison variable. It should be noted that there was considerable overlap between the composite components and basic items. For example, a structural footing is a composite component, but the total cost included concrete, reinforcing steel, and different kinds of skilled and unskilled labor which were basic items and also priced separately. The difference was that the concrete, etc., in the composite component was included as a total cost while an average price was captured for the basic item.

The idea to price composite components was that it would be easier to get the cost of components than for an entire project. In addition, it was assumed that the components were fundamental parts of construction projects that were comparable across countries. By obtaining the total cost of a component, the relative trade-offs between countries of labor vs. capital were captured. In other words, the component costs reflected the relative contributions of labor, equipment and materials. *Although the costs of the composite components were assumed to be more easily obtained than the data for the Bills of Quantities, it still required the input of experts for the data collection.*

The component costs were based on the purchaser prices of the material, labor, and rental of equipment. These costs do not include any profit margin or overhead expenses for architects

and other construction experts. The comparison based on costs assumes that the profit margins and overhead costs are proportional to overall costs across countries.

The basic and composite components were combined into different sets of systems for residential and non residential dwellings and civil engineering projects. The systems for residential dwellings are: Sitework; Substructure; Superstructure; Exterior shell; Interior partitions; Interior/exterior finishes; Mechanical and plumbing; and Electrical. Table 1 shows the basic items and composite components associated with each system for residential buildings.

Table 2 shows the composite components and basic items going into the **Site Work** system. Note there are three composite components. The comparison variable for each is the total cost. The composite components obtain the combined total cost of materials, labor, and equipment. It is pointed out that the total cost, for example, of labor will be correlated to the average input costs of the different types of workers. Some additional points are that:

- Each System for PPP estimation was to be treated like a basic heading which meant there would be no weights applied to the composite component costs and basic item prices within each system.
- The basic input items are not independent—concrete includes cement, sand, and aggregates.
- The sidewalk composite component includes concrete (which is made up of cement, sand, and aggregates)
- If the total cost were provided for every composite component and average prices for every basic item, there would be 24 variables for comparison purposes across countries for the Site work system.
- Even though there would not be quantity weights, there is an implicit weighting. For example, the composite components make up only 3 of the 24 items. Sand, because it is priced for three different quantities, also makes up three of the 24. Concrete which reflects the prices of sand, cement, and aggregates could be said to make up half of the variables being compared. Skilled labor with six different types has twice the weight of the composite components.
- A review of the other systems in Table 2 shows a similar pattern. The basic component—sand—appears in 6 of the 8 systems, skilled and unskilled labor in 7 of the 8 systems. One could say from this that the two most important things to price for residential housing were sand and labor.

Once the PPPs for each system were computed, the next step was to weight these to the residential PPP. These system weights, or W2 weights, were to be determined for the country as a whole. Regions and countries were advised to use construction experts to obtain the system weights for the country as a whole. *In general, it was difficult for countries to furnish the system weights. As a result, system weights were determined for each region for the residential and non residential, and civil engineering basic headings.*

Countries within the region in effect received the same weights for aggregation.

2. Data review

The costs of the complex components and the prices for the basic items were reviewed by expert consultants. A global office review showed there was considerable noise in the data. The review process was by triage with implausible data removed because there was not sufficient time to send the data back to countries.

3. Lessons Learned

- The services of expert consultants were required to collect the data for the composite components and to do data validation across countries, so it was still an expensive process.
- The BOCC comparison method was essentially a comparison of basic components. The extra cost to obtain composite component costs was not reflected in the weighting in the estimation process.
- Countries were not able to develop a set of system weights that reflected the overall residential, nonresidential, and civil engineering sectors even with input from expert consultants.
- Time for data validation needs to allow for a second review by countries

4. Thoughts for 2011

- Increase the number of basic items to be priced.
- Use the 2005 product specs for basic items as a starting point which provide different measures of quantities and types of labor, for example
- Determine the relative importance of each basic item at the country level for some selected buildings and construction projects relevant to the regional economy. For example, each country could provide weights for a single family dwelling, a two story flat, a school, and a section of a roadway.
- If weights cannot be provided, a fall back solution would be to simply calculate item PPPs for the basic items which is essentially what was done in 2005.
- Seek information on profit margins, but be willing to assume relative equality across countries rather than making haphazard guesses..
- Emphasis should be in the collection of good data on input prices and the willingness to say what they represent.

Table 1. Systems for Residential Buildings (basic components in Italics)

System	Component
Site work	Aggregate base Earthwork Exterior sidewalk *Concrete* *Aggregate* *Portland cement* *Sand* *Backhoe*
	Unskilled labor *Skilled labor*
Substructure	Aggregate base Column footing Aggregate *Portland cement* *Reinforcing steel* *Sand* *Concrete* *Backhoe* *Plywood*
Superstructure	Structural column round Structural column square *Concrete* *Aggregate* *Portland cement* *Reinforcing steel* *Sand* *Structural steel* *Plywood* *Unskilled labor* *Skilled labor*
Exterior shell	Aluminum frame window *Sand* *Portland cement* *Unskilled labor* *Skilled labor*
Interior partitions	Masonry interior wall *Portland cement* *Sand*
	Plywood *Unskilled labor* *Skilled labor*
Interior/exterior finishes	Exterior wall cement plaster Interior ceiling plaster Interior wall plaster *Exterior paint* *Interior paint* *Portland cement* *Sand* *Plywood* *Unskilled labor* *Skilled labor*
Mechanical and plumbing	*Unskilled labor* *Skilled labor*
Electrical	Electrical service point *Unskilled labor* *Skilled labor*

Table 2. Site work system for residential buildings

Composite Components			
	Aggregate Base	Includes aggregate, labor, equipment	Total cost
	Earthwork	Includes labor and equipment	Total cost
	Sidewalk	Includes concrete, labor, and equipment	Total cost
Basic components	Aggregate for concrete	1.00 cubic meter	Average price
		50.00 cubic meters	Average price
		100.00 cubic meters	Average price
	Portland cement	10.00	Average price
		100.00	Average price
		200.00	Average price
	Sand for concrete	1.00	Average price
		50.00	Average price
		100.00	Average price
	Concrete	10.00	Average price
		100.00	Average price
		1,000.00	Average price
	Unskilled labor	All	Average price
	Skilled Labor	Bricklayer	Average price
		Plumber	Average price
		Carpenter	Average price
		Steel worker	Average price
		Electrician	Average price
		Machine operator	Average price
	Backhoe	Rate / hour	Average price
		Rate/ day	Average price
			Average price

15.02.00.0.23 Portland Cement

Observation:
Auto Calc

Source Information:

- Date of price collection (dd/mm/yyyy):
- Country:
- Describe source of price

Material Supply
Informal or temporary sales location
Average, Price Index data collection

- Price is for year:

2005

Details:

Cement to be priced shall be ordinary Portland Cement that is used for typical concrete work in a variety of residential, non-residential and civil works projects. Cement used for these purposes is generally categorized into the following categories:

Type I—for use when the special properties specified for any other type are not required
Type IA—air-entraining cement for the same uses as Type I, where air-entrainment is desired
Type II—for general use, more especially when moderate sulfate resistance or moderate heat of hydration is desired
Type IIA—air-entraining cement for the same uses as Type II, where air-entrainment is desired
Type III—for use when high early strength is desired
Type IIIA—air-entraining cement for the same use as Type III, where air-entrainment is desired
Type IV—for use when a low heat of hydration is desired
Type V—for use when high sulfate resistance is desired

Even though the roman numerals based designation of the types may be prevalent in only certain regions of the world the general categorization is applicable worldwide. Whichever type of cement is most commonly used in the country should be priced.

Quantity and Packaging:

- Package size (kg):
- Package type (paper sack, cloth sack, etc.):
- Volume effects:
  - Price for single package:
  - Discount for larger quantities:

Source:

- Domestic:
  Manufacturer:
- Imported:
  Country of origin:
  Manufacturer:

Product Characteristics:

Percent volcanic ash:
Fineness:
Compressive Strength (MPa):

Pricing Information:

Material Costs *(in national currency)*

Type				
Ordinary Portland Cement				
Ordinary Portland Cement				
Ordinary Portland Cement				

Comments *(if any):*

15.02.00.0.29 Skilled Labor

Observation:

Auto Calc

Source Information:

- Date of price collection (dd/mm/yyyy):
- Country:
- Describe source of price

General Contractor
Specialty Contractor
Average, Price Index data collection
Other ( )

- Price is for year:

2005

Details:

Provide details of the compensation of employees for the following six kinds of skilled workers

- bricklayer,
- plumber,
- carpenter,
- structural steel worker,
- electrician,
- machine operator.

A **skilled worker** is one that has had training in one of these trades. The training may consist of an apprenticeship, on the job training, or training in a technical college or similar institution.

Compensation of employees includes wages and salaries (before deductions for social contributions such as health or retirement benefits, income taxes, or trade union dues) *plus* social contributions made by the employers, *plus* in-kind benefits such as meals or housing.

You may report one of the following:

- Rates per hour for regular hours (i.e. excluding overtime)
- Rates per day (specify the regular number (excluding overtime) of hours worked per day)
- Rates per week (specify the regular number (excluding overtime) of hours worked per week)

Depending on the choice to report rates per hour or per day or per week, you will need to impute rates for Social Security Contributions and Income in Kind and record them in the table below.

The rates should refer to skilled labor employed on a construction project near a major urban center.

Pricing Information:

Compensation of employees (*in national currency*)

•						
Bricklayer						
Plumber						
Carpenter						
Structural steel worker						
Electrician						
Machine operator						

Comments *(if any):*