

Construction and Civil Engineering Work: Designing a Time-Space Index

Michel Mouyelo-Katoula² and Adalbert Nshimyumuremyi³

Summary:

Pricing in the construction sector is resource intensive compared to many other sectors. In most of the countries participating in the ICP, prices collection for the program has been largely disconnected with the regular price collection processes aiming at producing inter-temporal price indices. Inter-temporal price indices for the construction sector are often calculated using a basket of construction material and labor prices. This approach doesn't permit to take into account the inter-temporal fluctuations of productivity nor to address correctly the problem linked to the trade-off between labor and equipment tradeoff. This article presents the Basket of Construction Components (BOCC) approach that was developed with a view to eradicate both these problems. The BOCC approach provides a much simpler and better defined price comparison tool that can help to drastically reduce the resources and the expertise required for price data collection. Due to its simplicity, it is plausible that the basket can be adapted to be used in national inter-temporal price comparisons.

Key words: Price indices, basket of construction components approach, ICP

Résumé :

La collecte des prix dans le secteur de la construction requiert des moyens importants comparativement à plusieurs autres secteurs. Dans la plupart des pays participant au PCI, la collecte des prix a été en grande partie déconnectée du processus de collecte régulier des prix nécessaires au calcul des indices des prix temporels. Les indices temporels des prix pour le secteur de la construction sont souvent calculés en utilisant des prix correspondant à un panier de matériaux de construction et de travail. Cette approche ne permet pas de prendre en compte les fluctuations de productivité dans le temps, ni de traiter correctement le problème lié à la distinction entre le travail et les équipements. Cet article présente l'approche du panier de composantes de construction (BOCC) qui a été développé afin de répondre à ces deux problèmes. L'approche BOCC fournit un outil de comparaison des prix beaucoup plus simple et mieux défini qui peut aider à réduire de façon significative les ressources et l'expertise exigées pour la

¹The views expressed in this paper are those of the authors and do not necessarily represent those of the African Development Bank.

²Manager, Statistical Capacity Building Division, AfDB, Tunis, Tunisia Manager

³ICP Principal Statistician, Statistical Capacity Building Division, AfDB, Tunis, Tunisia.

collecte des prix. Sa simplicité permet d'adapter le panier à des comparaisons temporelles des prix au niveau national

Mots clé s: *Indices des prix, approche du panier de composants de construction, PCI*

1. Introduction

The International Comparison Program (ICP) is a global statistical initiative aimed at producing estimates of price levels, expenditure values, and purchasing power parities (PPPs) that allow for cross-country comparisons of price levels, and economic aggregates in real terms. The Africa component of the program is managed and coordinated by the African Development Bank (AfDB) and is commonly referred to as ICP-Africa.

Tasks involved in the ICP-Africa include: (i) compiling GDP aggregates in compliance with the 1993 System of National Accounts (SNA); (ii) disaggregating GDP into detailed categories for which expenditure and price data can be obtained; (iii) conducting nation-wide price surveys for samples of items representing all main components of GDP; (iv) computing price ratios for identical/comparable items across countries/space, thus generating elementary PPPs; and (v) aggregating elementary PPPs for all GDP components.

As an important GDP component, Gross Fixed Capital Formation (GFCF) is divided into Machinery and Equipment, and Construction and Civil Engineering for which specific data collection exercises are being conducted by countries participating in the ICP-Africa.

Pricing in the construction sector is resource intensive compared to many other sectors. The pricing of the components involved in a construction project requires expertise that is not normally available within National Statistics Offices (NSO). The expertise that is required includes a familiarity with the usual means and methods of the sector as well as experience with recent evolution of the construction costs. This kind of expertise must be mobilized by the NSOs (typically on a consulting basis) from construction, engineering, or architectural companies or Government departments.

Given that the level of effort required, and the related cost of that effort, is directly linked to the number and the complexity of the construction

components to be priced, there is a need to focus on a relatively short list of components. These selected components might be representative and comparable with regards to means and methods, and can be broadly illustrative of the major capital-intensive systems in the constructed facilities. In this regard, the Basket of Construction Components (BOCC) approach was developed with a view of reaching this objective.

In September 2004, the Technical Advisory Group (TAG) for the International Comparison Program (ICP) recommended the use of the Basket of Construction Components (BOCC) approach for price comparisons in the construction sector. This recommendation was based on detailed studies that were conducted under the aegis of the AfDB and World Bank between 2002 and 2004.

The BOCC approach was formalized in a series of three reports that were produced and submitted to the AfDB and the World Bank. (Walsh and Sawhney, 2002, 2004, 2005). The first report entitled “*An Implementation Framework for the Basket of Construction Components Approach*” provides the theoretical and conceptual underpinnings for the BOCC method. The second report entitled “*Process for Implementation of the Basket of Construction Components Approach*” highlights and explains the hierarchical structure of the BOCC approach. Key definitions of the BOCC concepts are also provided in this report. The third report entitled “**Identification of Construction Systems and Components for the BOCC Approach**” provides a list of Construction components in the form of Standard Product Descriptions (SPD). The report serves as a basic guideline for the complete implementation of the BOCC approach at the national level.

This article synthesizes the contents of these three reports, first as a guideline for the ICP national coordinators and second as a tool for further improving national price data collection in the construction sector. The AfDB is currently preparing a technical complement to this work in order to address the question of the inter-temporal comparisons under the BOCC approach.

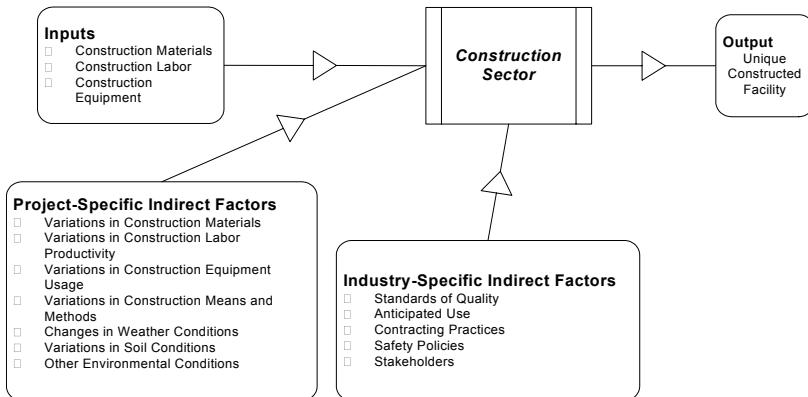
2. The complexity of comparisons in the construction sector

The complex and variable nature of the construction sector makes it a difficult sector to integrate into standardized econometric systems and in many ways can be termed as a “comparison resistant” sector. The construction industry consists of a fragmented array of contractors, subcontractors,

and suppliers. The construction industry supply chain is extremely complex as there are no formalized industry structures that represent all of its stakeholders. Its primary output is a series of projects, each resulting in a uniquely constructed facility. The industry is typified by temporary, contract-driven relationships between the participants of a given project, and this condition makes satisfactory characterization and collection of national statistics very difficult to achieve. The lifecycle and timeline of construction projects further complicates collection of prices and their relationship to expenditures in national accounts. It is common to find construction projects with duration ranging from a few months to several years. Furthermore, the industry does not really “exist” within a given nation as all projects at some point in their supply chains for materials, equipment, or labor, reach out into the interconnected global industry.

Construction products are highly customized to the needs and wishes of the construction consumer. In fact, there is no “production line” for constructed facilities; each and every project is specific to the eventual owner, at the foundation level at a minimum. The net result of this customization from the perspective of international comparison is that it becomes very difficult to compare one project to another. The external influences that are at work on the constructed product are correspondingly unique, and exist primarily at the project level (see figure below). Economic activity in the construction sector consists of the conversion of materials, labor, and equipment into the unique constructed facility. Variations in these inputs and in the common means and methods used to orchestrate and install them, exist between regions of the world, between nations, and even internally within nations.

The figure below depicts the conversion of inputs to a constructed facility output, and the influencing factors at the project and industry levels.



Because these factors never combine in quite the same way twice, each constructed facility is unique. The cost of a construction project is directly influenced by the selection of means and methods of putting materials in place, the materials themselves, and the labor and equipment rates in use at that time and place. However, there are a number of indirect influences that affect these choices. A number of these indirect factors are represented in the figure above, termed “indirect” here because they modify the selection of materials, equipment, labor, or methods, but do not appear on the bills of quantities themselves. Because construction outputs are inherently difficult to compare, this study was conceived and conducted to further develop concepts for the necessary price comparisons in the construction sector.

3. The different methods used for price comparisons in the construction sector

Spatial comparison of construction sector pricing can be performed using a number of approaches. In a broad sense these approaches can fall under one of the following three categories:

- 1. Pricing a basket of standard (hypothetical) construction projects :** This approach has been used for the past rounds of ICP comparisons. The crux of this approach is to ask countries to price using the unit price approach a number of standard construction projects. The instrument used in the pricing effort is called the bill of quantities (BOQ). BOQs for standard residential, non-residential and civil engineering projects are used for price collection.
- 2. Pricing a basket of construction inputs—material, labor, and equipment :** This approach is primarily used for temporal construction indices developed by countries or regions. Such use makes the method appealing, at least at first blush, as it carries the suggestion that temporal comparisons already available might be fit within the framework of spatial comparison and augment the utility of both types of comparison. This approach requires only that one monitors the prices for goods and/or services included in the basket, and compare them to prices at some other time (or, in the case of PPP, at some other place).
- 3. Pricing a basket of construction components :** This approach resembles the basket of construction inputs approach in that it revolves around the concept of pricing a fixed set of items. As the name suggests the basket that is used for price comparison consists

of construction components. Construction components are tangible units of a construction project that consume inputs such as material, labor, and equipment. In hierarchical terms construction components lie somewhere between the construction inputs and construction projects.

Traditionally price calculations for the construction sector in the framework of the ICP are realized by generating estimated costs for 20 standard construction projects, for which bills of quantities (BOQ) and specifications have been developed. According to the procedures that were established by Eurostat in the early stage of the ICP, each bill of quantities requires price estimation for 10 to 20 chapters, each consisting of 100 to 1000 individual construction items. The 1993 ICP round was conducted using this particular method and significant concerns arose regarding the resources needed to collect these price data. Subsequently the standard project method (SPM) was modified. A “reduced bill of quantities” approach was set-up, in which many of the individual items were eliminated. However, a substantial number of prices still remained to be gathered. There is today a strong concern that the level of efforts and of resources required for this process may hamper the development, and even the continued undertaking, of price comparisons in the construction sector.

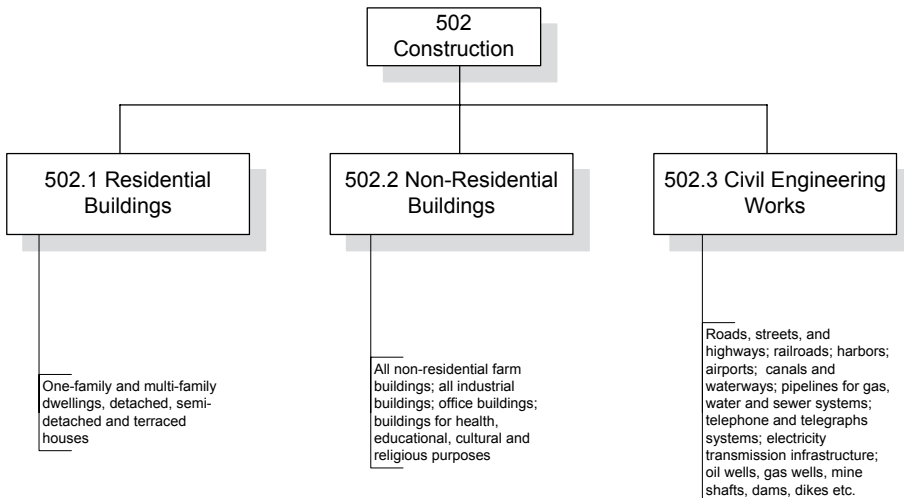
Some partners of the ICP program have also cast their doubts on the accuracy of the data collected and on the credibility of the price estimation process in the construction sector.

In addition the price estimation at the construction project level has many pitfalls. Many authors have pointed out that there can be a very wide range in project cost estimates, and that these estimates can compare very poorly to the actual cost of the construction projects. The primary predictor of estimate accuracy is the effort expended to produce the estimate, which raises obvious concerns about the ICP given the disparate resources among NSO's.

Given that the level of effort required, and the related cost of that effort, is directly linked to the number and the complexity of the components to be priced, there is a need to focus on a relatively short list of components. These selected components might be representative and comparable in regards to means and methods, and which can be broadly illustrative of the major capital-intensive systems in the constructed facilities. The BOCC approach is aimed at reaching this objective.

4. The BBOC approach in 2005 ICP round

The construction sector can be divided into 3 categories of works referred to as “basic headings”. These are: residential buildings, non-residential buildings, and civil engineering works. Codes attached to each category relate to the ICP-Africa classification.



The BOCC approach builds on three main concepts: project, system and component.

A **project** is the entirety of a construction enterprise, resulting in a relatively well defined facility for essentially a single purpose. Examples include the construction of a building, the construction of a campus of buildings more-or-less simultaneously, or the construction of a section of roadway including interchanges, bridges, and drainage appurtenances.

A **system** is a set of related components within a project that satisfy a given function. For example, the structural system within a building is intended to denote that set of components that serve the purpose of supporting the building, and would include foundations, columns, beams, girders, headers, and so on. It would not include the heating and ventilation equipment or non-structural exterior cladding. Systems are defined as shown in the following tables :

Construction Systems for the Residential Sub-sector

System Name	System Explanation
Site-work	Construction components related to site preparation of a residential construction project
Substructure	Structural components and related work items below the ground surface that are part of a residential construction project. These components are load-bearing and transfer all the loads from the superstructure to the ground below
Superstructure	Structural components and related work items above the ground surface that are part of a residential construction project. These components are load-bearing and provide resistance to live and dead load on the building
Exterior Shell/Building Envelope	Construction components that form the exterior shell of a residential construction project. They are non-load-bearing members that rest upon the superstructure of the building
Interior Partitions	All interior walls and opening in the building
Interior and Exterior Finishes	All construction components in place for the purpose of satisfying a cosmetic function, including for example paint or plaster.
Mechanical and Plumbing	All construction components related to providing climate control or water services such as heating and cooling systems, hot and cold water systems, fire fighting systems etc.
Electrical	All construction components related to distribution of alternating current and direct current including electrical fixtures for a residential construction project

Construction Systems for the Non-Residential Sub-sector

System Name	System Explanation
Site-work	Construction components related to site preparation of a non-residential construction project
Substructure	Structural components and related work items below the ground surface that are part of a non-residential construction project. These components are load-bearing and transfer all the loads from the superstructure to the ground below
Superstructure	Structural components and related work items above the ground surface that are part of a non-residential construction project. These components are load-bearing and provide resistance of all types of live and dead load on the building
Exterior Shell/Building Envelope	Construction components that form the exterior shell of a residential construction project. They are non-load-bearing members that rest upon the superstructure of the building
Interior Partitions	All interior walls and opening in the building
Interior and Exterior Finishes	All construction components in place for the purpose of satisfying a cosmetic function, including for example paint or plaster
Mechanical and Plumbing	All construction components related to providing climate control or water services such as heating and cooling systems, hot and cold water systems, fire fighting systems etc.
Electrical	All construction components related to distribution of alternating current and direct current including electrical fixtures for a non-residential construction project

Construction Systems for the Civil Engineering Works Sub-sector

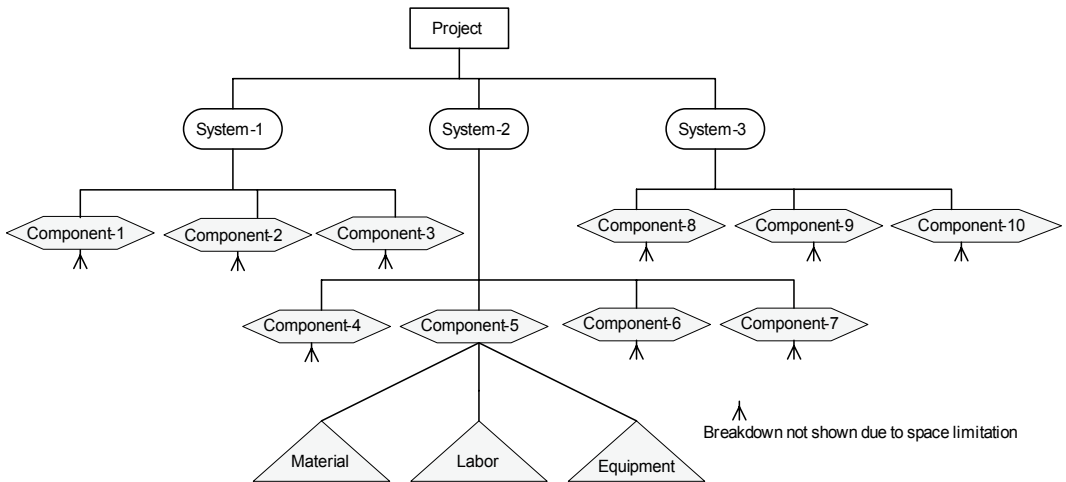
System Name	System Explanation
Site-work	Construction components related to site preparation of a civil engineering project including earthwork, earthmoving, and surface treatments such sidewalks and pavements
Substructure	Structural components and related work items below the ground surface that are part of a civil engineering project. These components are load-bearing and transfer all the loads from the superstructure to the ground below

System Name	System Explanation
Superstructure	Structural components and related work items above the ground surface that are part of a civil engineering project. These components are load-bearing and provide resistance to live and dead loads
Mechanical Equipment	Equipment installed on civil engineering projects such as pumps, turbines, boilers, air handling equipment, cooling towers, vessels etc. including all connecting pipes and valves. Mechanical includes utility systems (steam, compressed air, and refrigeration), process systems (rotating pumps, compressors, agitators, filters, etc.) special vessel design (tanks, pressure vessels), etc.
Electrical Equipment	Equipment installed on civil engineering projects for power distribution systems, substations, power distribution panels, motor control centers, lighting, communications, etc.
Underground Utility	Any underground line, system or facility used for producing, storing, conveying, transmitting, or distributing communication or telecommunication, electricity, gas, petroleum and petroleum products, coal slurry, hazardous liquids, water under pressure, steam, or sanitary sewage. These include wires, ducts, fiber optic cable, conduits, pipes, sewers, and cables and their connected appurtenances installed beneath the surface of the ground

A **component** is a combination of materials in their final intended location which can be clearly identified to a simple purpose within the project; the building blocks of a system. For example, a column is a component. A component will in general consist of some materials manipulated in some way, transported to a final location at the project site, and connected to other components with labor and equipment as appropriate to means and methods employed in a given country.

The relationship between projects, systems, and components is illustrated in the figure below. In this figure a hypothetical project is shown consisting of three systems. Each system is further broken down into its constituent components; with each component made up of material, labor and equipment. In essence, this taxonomy supports a hierarchical decomposition of the project into smaller “chunks”. The cost contribution of each component to the total system and project costs can then be developed, using standard construction cost estimating and accounting principles, by

rolling up along the branches of the tree. Costs for any given component can be developed from the unit costs of materials (including any necessary consumables) and the expected quantity of materials to create that component, labor rates and labor factors, and equipment rates and factors. Experts specialized in the estimation of construction costs are generally very skilled and experienced in making these calculations. A similar breakdown could be conducted for any of the systems in a project, of course.



The fundamental conceptual basis of the BOCC is to measure relative prices at the level of the construction component. A construction component is a production unit that can be fully defined as a portion of a complete construction project. The construction component thus falls between a construction project (e.g., a complete structure) and a construction work item (e.g. a piece of reinforcing steel). The construction component can be thought of as an aggregation of several construction work items, including the material actually put in place, the labor and equipment required to accomplish that task, and any consumables that might be required (e.g. formwork, blades, or waste lumber). Because the labor, equipment, and consumables are directly included in the price, the construction component also inherently accommodates differences in productivity, the labor equipment tradeoff, and differences in means and methods of construction.

Pricing of the construction components is intended to include the price of the good itself, any consumables required in the construction process, and the cost of the labor or equipment required to install it. The price could be further adjusted to include appropriate markups (taxes, fees, profit, etc.).

The advisability of and methods for inclusion of markups depend to some extent on the methods used in the national accounts.

To ensure that all countries price the same construction components, 34 specific forms have been provided which need to be completed by each country. Each form relates to the Structured Product Description (SPD) of a particular component.

Each form is identified by the code and name of the component (Example: 5.02.00.0.01 Aggregate Base). It contains 3 sections - (a) Source Information, (b) Quantity and details, (c) Pricing information which must be completed carefully. Any additional comments has also to be provided. All 34 forms have to be completed. These forms are completed at the country level.

5. Expenditure weights in the BOCC approach

Some components can be appropriate to more than one construction basic heading (sub-sector). The Civil Engineering Works sub-sector poses specific problems as it includes a wide array of possible projects. This sub-sector equally incorporates a small drainage enhancement project, with a value equivalent to a few thousand dollars, and an enormous dam or airport with a value of several billion euros. Finding common building blocks for both of these projects is not easy. Of course, this problem would arise for any system of measurement, but for this sector some common elements may still be identifiable. Earthwork is nearly always a part of civil engineering works, as is concrete placement. Additional civil engineering related components such as site preparation, haulage, mass concrete, asphalt concrete, and utility/drainage works represent systems of civil engineering works that are almost included in every projects.

System of weights

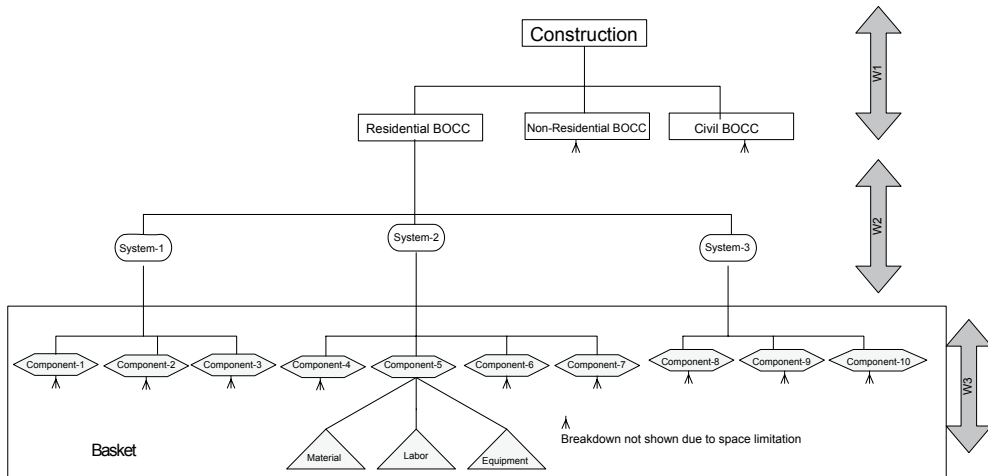
The BOCC approach uses three types of weights:

W1, for the aggregation at the level of the construction sub-sectors, i.e. for the residential, non-residential and civil engineering baskets,

W2, for the aggregation at the level of the systems,

W3, at the level of the components for the inclusion of labor productivity and of the labor/equipment tradeoff.

These three levels of aggregation are shown in the table below.



The weights W_3 are designed within the BOCC approach and are not required to be identified explicitly.

Procedure for Calculating W_2

National experts have to review the listing of the systems for the residential, non-residential, and civil engineering sub-sectors. They review pricing information on ongoing projects for the three sub-sectors and tabulate the percentage contributions of the systems.

The procedure for calculating W_2 involves the following steps :

Step 1: Selection of Bills of Quantities.

The experts retrieve samples of bills of quantities (BoQ) related to construction projects that were designed in 2005 as well as those designed in 2006. These BoQs are requested from architects, contractors or from the Ministry of work.

The samples must relate to the following projects:

For residential buildings

- o Single-family residences
- o Bungalows
- o Apartment buildings and the like,

For non-residential buildings

- o Farm buildings
- o Office buildings
- o Buildings for health purpose (e.g. hospital ward)
- o Buildings for educational purpose (e.g. a primary school)
- o Buildings for cultural or religious purpose (e.g. a church or a mosque)

For civil engineering works

- o Metalled roads
- o Farm track
- o Laterite track
- o Bridge
- o Water and sewer systems
- o Telecommunication structures

It is recommended that at least 2 categories of projects be selected under each sub-sector. For instance, under residential building, single-family residences and apartment buildings could be selected. Under civil engineering works, metalled roads, laterite tracks and bridges could be included in the samples. Categories included in the selection of BoQs must reflect the construction market in the country (or at least in the capital city and some other major towns), in terms of the representativity of relevant construction projects.

For each category, there is a need to use as many project BoQs as possible. For example, for single-family residences, 3 (or more) types of villas of different sizes and costs can be selected.

There is no need to generate new data for this process; rather, the data collection required consists of the collection of cost data for past projects.

Step 2: Mapping BoQ into construction systems

Every item in the priced BOQ needs to be classified as belonging to one of the systems. Each line item in the BOQ must be mapped to a particular system. It is not necessary to have an extremely detailed BOQ for this purpose. A “roll-up” BOQ that lists only the principal divisions and a few major categories within each division is sufficient and somewhat easier to work with for this stage. With such a BOQ, the mapping of the line items to the appropriate systems can be accomplished in a few minutes.

Suppose that we have a BOQ. We must arrange the BOQ in the form of a table where the first column will show the item descriptions, the second column will indicate the units, the third relates to quantities and the fourth to unit rates or unit costs or unit prices. The fifth column contains the item costs.

Item Description	Unit	Quantity	Unit Rate	Item Cost
3.1 Building concrete 150 kg cement 5 cm thick	m3	4	100	400
3.2 foundations reinforced concrete for strip and independent foot ings 350 kg cement	m3	19	140	2660
3.3 Rough formwork for item 3.2	m2	97	12	1164
3.4 Reinforced concrete for anchor ages lintels parapet and upright	m3	41	140	5740
3.5 Rough formwork for item 3.4	m2	574	12	6888
3.6 Reinforced concrete 250 kgs for slab 10 cm thick	m2	260	12	3120

We have to map each of the 6 BOQ items into construction systems. We will add a sixth column to the table, to indicate the system which a particular item belongs to. For instance, the first item belongs to substructures whereas the other items belong to superstructures.

The table below illustrates the result of the mapping process.

Item Description	Unit	Quantity	Unit Rate	Item Cost	System Identification
3.1 Building concrete 150 kg cement 5 cm thick	m3	4	100	400	Substructure
3.2 foundations reinforced concrete for strip and independent footings 350 kg cement	m3	19	140	2660	Superstructure
3.3 Rough formwork for item 3.2	m2	97	12	1164	Superstructure
3.4 Reinforced concrete for an chorages lintels parapet and upright	m3	41	140	5740	Superstructure
3.5 Rough formwork for item 3.4	m2	574	12	6888	Superstructure
3.6 Reinforced concrete 250 kgs for slab 10 cm thick	m2	260	12	3120	Superstructure

Step 3: Aggregation of BOQ costs by systems

At this stage, costs shown in the fifth column must be aggregated by system, so that the total cost for each system contained in the project can be estimated. For example, the total cost for substructures is equal to 400 in the example above as only one BOQ item belongs to substructures. The total cost for superstructures is equal to 19572 (i.e. $2660 + 1164 + 5740 + 6888 + 3120$).

In the example above, the project cost by system is as follows:

Systems	Total cost
Substructure	400
Superstructure	19572

This process is repeated for all systems in each of the three baskets.

6. Conclusion

Information on construction and civil engineering has a particular interest to Africa, particularly in view of its critical link to infrastructure development, a key area of emphasis in the New Partnership for Africa's Development (NEPAD). PPPs and price level indicators in general, and related data on construction costs and expenditure in particular, provide extremely

useful information about the macroeconomic environment within which investment is taking place.

However in most of the countries participating in the ICP, prices collection for the program have been largely disconnected with the regular price collection processes aiming at producing inter-temporal price indices. Inter-temporal price indices for the construction sector are often calculated using a basket of construction material and labor prices. This approach doesn't permit to take into account the inter-temporal fluctuations of productivity nor does it address correctly the problem linked to the trade-off between labor and equipment. There is therefore a need for a method that could possibly eradicate both these problems.

The BOCC approach provides a much simpler and better defined price comparison tool that can help to drastically reduce the resources and the expertise required for price data collection. Due to its simplicity, it is plausible that the basket can be adapted to be used in national inter-temporal price comparisons. These two features together will also further the goal of making the ICP more sustainable.

Because it is less resource intensive to price, the proposed basket can easily be used to generate multiple observations. By using the BOCC approach, the NSOs can collect prices for the construction sector at a larger number of locations within their country including both urban and rural locations, and at several times over the course of a year.

Due to the design features of BOCC it can also potentially impact the national accounting procedures used for the construction sector in a country. The accounting procedures used by national accounts in ICP countries for the construction sector show large variations. Probably most countries base their estimates on building permits, public works budgets, and some ad hoc valuation of non-permit buildings and private non-building projects. It is likely that the BOCC approach could improve existing valuation methods and thereby improve the accounting procedures for the construction sector within the national accounts.

The BOCC approach can provide some guidance in comparing other comparison resistant sectors, such as the rental housing sector. The comparison in the rental housing sector is often complicated due to the importance of government programs (such as subsidies) and limited availability of rental housing in some areas. One suggested improvement is to use the "quantity" approach in which the volume of housing is derived by multiplying

the quantity indicator and the quality indicator. The BOCC approach for residential sector has enough flexibility to be applied for various studies related to housing.

References

Dubner, M., and McKenzie, R. (2002) “*Construction Industry Purchasing Power Parities Obtaining Comparable Prices.*” Conference on the International Comparison Programme. Australian Bureau of Statistics. Washington, D.C.

Heston, A. (1999) “*ESCAP Comparisons of Real Gross Domestic Product and Purchasing Power Parities, 1993*” United Nations, Bangkok, 1999.

OECD (2001) “*Source and Methods: Construction Price Indices*”.

Stapel, S. (2002) “*The EuroStat Construction Price Survey: History, Current Methodology and New Ways for the Future*”, World Bank Report, June 2002.

United Nations (1992) *Handbook of International Comparison Program.*

Walsh, K.D. and Sawhney, A. (2002) “*International Comparison of Cost for the Construction Sector: Toward a Conceptual Model for Purchasing Power Parity*”, World Bank Report, June 2002.

Walsh, K.D. and Sawhney, A. (2004), *An Implementation Framework for the Basket of Construction Components Approach*, African Development Bank and World Bank Consultants Report, June 2004.

Walsh, K.D. and Sawhney, A. (2004), *Process for Implementation of the Basket of Construction Components Approach*, African Development Bank and World Bank Consultants Report.

Walsh, K.D. and Sawhney, A. (2005), *Identification of Construction Systems and Components for the BOCC Approach*, African Development Bank and World Bank Consultants Report, February 2005.

Ward, M. (2003) "*Pricing Construction Projects Using Prototype Models*," paper presented to the 1st Regional Meeting on the International Comparison Program in Western Asia, 24-27 June 2003, Beirut, Lebanon, available at www.escwa.org.lb/icp/activities/regional/24-27june/papers.htm (last accessed 8 July 2004).

World Bank (2006), *ICP 2003-2006 Handbook*.