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ASSESSMENT OF CRITICAL BARRIERS TO TENDER PRICE INDICES DEVELOPMENT IN THE GHANAIAN BUILDING INDUSTRY

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ABSTRACT

The development of the tender price indices (TPI) in developed countries expands to over some decades in terms of its application. In contrast, these indices are not available in developing countries owing to the fact that their development is constrained by some perceived critical barriers. Thus, the aim of the study was to identify the critical barriers to the development of tender price indices. Using the quantitative research method, data were collected from quantity surveyors and then analysed using the mean score and principal component analysis (PCA). The findings highlighted five (5) underlying critical barriers, namely poor procurement and estimating, erratic external and project conditions, data unavailability, technological implications, and weak knowledge base. The findings suggest that there is an urgent need for practitioners to build their capacity in order to facilitate the development of TPI. It is further recommended that these barriers should be addressed meticulously as it serves as the basis for the advancement of knowledge of the tender price index in Ghana and other developing countries.

Keywords: Critical, tender price index (TPI), principal component analysis, Ghana

1. INTRODUCTION

Clients need to be notified in advance of their possible future financial commitments and cost consequences at the design advancement stage (Ng et al., 2004). Quantity surveyors are generally expected to provide a likely tender price for the client's specification at an early stage of any project. It is fairly simple to modify the historical construction cost to those of current date by using the suitable past tender price index (TPI). Thus, it is often difficult to prepare the current cost up to the date of tendering (i.e. the tender price) owing to the unforeseen future market situation (Ng et al., 2000), though, a precise forecast of TPI in a few quarters ahead is crucial for all practitioners in the construction industry TPI is used for many practical purposes in the construction industry, including establishing the level of individual tenders, adjusting for time, pricing, cost planning, forecasting cost trends and general comparisons (Tysoe, 1981). It then reflects the expected market situations (Ng et al., 2000). Consequently, TPI measures the tender price movements of the building industry as it covers most of the items usually built into the price for providing the output of construction activity (Goh, 2005; OECD, 1997; Rowlinson and Walker, 1994). This helps clients to make an informed decision. Accordingly, TPIs represent the cost a client has agreed to pay for a building and corresponds to the price offer made by the contractor in the tender. However, in this study TPI was approved as an output index on the average building prices within a specified period of time, i.e. the agreed price to be paid by the clients/owners (Wong et al., 2010).

Forecasting of the TPI is relevant to construction company stakeholders. The studies of Wong and Ng (2000) reflect the trend of contractors' pricing in bills of quantities for approved tenders through competitive tendering processes (Ho, 2013). It involves the appraisal of building costs which is done based on cost data updated by the forecast tender price index (Tysoe, 1981; Smith, 1995, Ng et al., 2004). The price reflects the contractors' opinions about future costs for labour and materials and their expectation of the market's effect on profit margins. TPIs are built by comparing the prices of a proportion of the items within a sample of approved tenders in a time frame against the price of likely items in a base schedule of rates. It denotes constituents of the reducers used to obtain the building industry's real new output price indices (Yu and Ive, 2008). The indices are computed for each tender within the sample and the average is taken to give the final index for the time being. The raw indices are used to produce the published index for the period. Hence, different sources of information can be used in producing the indices depending on the market conditions that pertains within a particular geographical location and time frame. However, the methods adopted in their development are similar.

The correctness of the tender price index is as a result of their use and form, time horizon and data availability (O'Donovan, 1983; Bowerman and O'Connell, 1987). However, according to Akintoye (1991) and Akintoye and Fitzgerald (2000), it is mostly hard in practice to have correct indices because of future market events and increase in prices of construction resources. Consequently, to predict the movement of the TPI accurately is never an easy task, as it could be affected by a series of socio-economic factors (Fitzgerald and Akintoye, 1995; Ng et al., 2000). In Ghana, studies reveal that there is a continuous movement in prices of construction output (Osei-Tutu and Adjei-Kumi, 2009; Amoah-Mensah, 1996), thereby exerting a greater influence on tender prices. This trend is expected to continue because factors responsible for the increased price trend remain the same (Adobor, 2013). Furthermore, Laryea (2010) indicated that the inability of quantity surveyors to provide quality and reliable estimates at all times is as a result of a lack of effective cost planning in the industry. However, this problem can also be attributed to a lack of tender price indices in the construction industry of Ghana. Similarly, Ssegawa (2003), as cited by Hassanein and Khalil (2006), argued that in most developing countries such as Ghana, no organisation has endeavoured to compile and publish construction data and the unavailability of such information has stalled the planning and pricing of projects. However, in developed countries such as Hong Kong, the United Kingdom (UK) and the United States of America (USA) there are established institutions which are engaged in the development of tender price. The Building Cost Information Service of the UK, the Architectural Service Department of Hong Kong and the Engineering News Records of the USA are examples of such institutions. Nevertheless, construction professionals in developing countries are not able to adopt their end products because of the extent of the influence that cultural differences has on their decisions. These cultural differences are related to the values, attitudes and norms and these militate against developing of TPI in developing countries such as Ghana (Robinson, 2007; Muriithi and Crawford, 2003). Similarly, Tarek et al. (2012) opined that it is even more difficult to adopt or maintain a scientific strategy to measure decisions that work in one country in another owing to the diversity and complexity of construction organisations that exist in different countries. Hence, the idea behind the article was to identify the critical barriers to the development of TPI in developing countries using Ghana as a case study.

In the next section, the critical barriers to tender price index development are outlined, followed by the research methodology. The penultimate section focuses on discussing the findings, while the final section provides the conclusion of the critical barriers to the development of TPI and its limitations, and outlines recommendations for further studies.

2. LITERATURE REVIEW

According to the Organization for Economic Co-operation and Development (OECD, 1996; 1997) and the Statistical Office of the European Communities (EUROSTAT, 2001) developing indices for different countries comes with associated difficulties: variations in climate, culture, degree of wealth, law standards, and physical characteristics (e.g. geographic size, population density, terrain), among others. There is a significant difference between countries in the inclusion/exclusion of items such as land, utility connection, fixtures, and transport (*Ibid*). The method of British building price indices was developed in the late 1960s, and needs to be adapted to the current trend of contract management practices (Marco and Graham, 2008). In addition, the advancement in economic theories in the development of indices has not been incorporated in recent studies. Most studies on construction price indices are about predicting and modelling using time series or other factors but there has been a lack of uniformity about data output. Generally, it cannot be implemented in modern construction management practices (McCaffer et al., 1983; Fellows, 1991; Akintoye and Skitmore, 1994; Akintoye et al., 1998; Ng et al., 2004). The Royal Institution of Chartered Surveyors (RICS, 2006) discovered that there have been variations over the period between 1985 and 2004 in the management methods from lump sum design-bid-build (traditional procurement) with the bill of quantities (BoQs) to lump sum design-and-build. This growing trend continues in both developed and developing countries because the design- and-build management path is adopted in private finance initiative schemes and their variants.

Moreover, the Department of Trade and Industry (DTI), the Building Cost Information Service (BCIS) and Davis Langdon (DL), as cited in Yu and Ive (2008), use the traditional procurement method for their TPI computation. However, the diminishing popularity of the design-bid-build would expose the TPI to larger sampling errors. Thus, emphasis needs to be placed on measuring the price movements in the design-and-build contracts. In addition, estimating purchasing power parities for the construction sector is a difficult task since the output is unrelated. There is even a high variation in designs, the use of materials, and standards for the construction of buildings and infrastructural projects between countries, regions and localities (Van Mulligen, 2003). Balk (2008) further indicated that indices problems range from the two dimensions, namely decomposition of a value ratio into price and quantity index numbers, and unavailable of quantity data to consider price indices for which all detailed price and quantity information is available. Again, Balk (2008) reiterated the use of a representative sample of commodities in considering the operational cost of getting detailed price and quantity information about all the transactions which are not given precise information, rendering the indices developed incapable of making any informed decisions. In a related development Cruywagen (2014) opined that accuracy of the index, sample size, change in quality and unit rate is among several problems with indices development. Van der Walt (1992) indicates that the need for getting an absolute number over a period is crucial so that it is a given economic mechanism of the general trend in change over time. The correctness of the indices is linked to the sample size to a large extent since the larger the number of respondents, the more detailed the index that is provided will be (Cruywagen, 2014; Yu and Ive, 2008). Ferry et al. (2003) posit that a good example of priced bills of quantities is required to exclude bias such as regional differences. In a related development, Cheung (2005) declared that there are wrong perceptions of the connection between the degree of details and forecasting accuracy and also stated that a lack of performance assessment, misunderstanding, fatalism, and unexplainable of variables among others, are some of the difficulties with cost forecasting.

Though the literature is ambiguous about the real number of priced bills of quantities that are needed for an index, authors that mention the BCIS's tender price index concludethat the BCIS looks at sampling 80 projects per quarter. The DTI also samples 66 projects and the DL samples 15 projects (Cruywagen, 2014; Yu and Ive, 2008;

Akintoye, 1995) though this requirement is barely met. Also, building quality and specifications have changed over a period because of advances in building technology. As a typical index will measure the line of building costs of a typical building, changes in quality may not be considered. One way of overcoming this problem is to inspect the basket of items regularly so that the constituents and their weights reflect the changes in standards and technology (Marx, 2005). The unit rates in bills of quantities can differ. The causes of these differences are the changes in methods by tenderers to determine/calculate? such rates, allowances made for profit, and inflation (Marx, 2005).

Table 1: Summary of the critical barriers to development of TPI

Problems	Sources
Unanticipated future market condition	Wong and Ng, 2000
Differences in climate, culture, level of affluence, legislative standards, physical characteristics	OECD,1996,1997; EUROSTAT, 2001
Not keeping up with current trend of contract management practices	Yu and Ive, 2008
Lack of consistency about data output, due to lack of capacity; advances in building technology	McCaffer et al., 1983; Fellows, 1991; Akintoye and Skitmore, 1994; Akintoye et al, 1998; Ng et al., 2004
High variation in designs, use of materials, estimating purchasing power parities, standards for the construction of buildings, decomposition of a value ratio into price, quantity index numbers, use of a representative sample of commodities, lack of precise information about quantities	Van Mulligen, 2000; Balk, 2008
Accuracy of the index, sample size, change in quality and unit rate	Cruywagen, 2014
Procurement route, data availability	Ng et al.,2004
Allowances made for profit and inflation	Marx,2005

Misconception relationship between the level of details, lack of performance evaluation, misunderstanding, determinism and inexplicability, lack of concrete theoretical dimension, market conditions and inflation	Cheung, 2005

3. RESEARCH METHODOLOGY

A quantitative research method approach was adopted for this study. A questionnaire was developed and administered to a total sample size of 123 comprising quantity surveyors from various chartered quantity surveying firms in good standing with the Ghana Institutions of Surveyors (GhIS), development offices of all public universities and polytechnics and Architectural and Engineering Service Limited (AESL). Respondents were quantity surveyors with a high level of educational background with 60 per cent having a bachelor's degree, 37 per cent with a master's degree and 3 per cent with a doctorate. All respondents were affiliated to GhIS with 5 per cent as fellows, 85 per cent as members and 10 per cent as corporate members. This was supported by respondents' extensive experience in the construction industry as more than half of them (62%) had accumulated over six (6) years' experience, 15 per cent with 11 to 15 years' experience, 8 per cent had 16 to20 years' experience, and 15 per cent had more than 20 years' experience. Out of the 123 questionnaires which were administered, a total of 80 questionnaires were retrieved. However, upon further checks a total of 76 of the questionnaires were identified as valid, representing a response rate of 62 per cent which is similar to other studies (Dansoh, 2005; Eyiah and Cook, 2003; Kheni, 2008). Additionally, this response rate was deemed adequate because it satisfies the recommendations of several researchers, namely that a sample size of 30 for any group could be deemed representative (Sproull, 1995; Ott and Longnecker, 2001).

3.1 Data analysis

Barriers hamper the development and operationalisation of systems. In developing TPI, there are some critical barriers (CBs), hence this section sought to evaluate these critical barriers to the development of the TPI in the Ghanaian building industry. To achieve this, a total of twenty-eight (28) variables were identified from both the literature and the preliminary survey. Questionnaires were administered to quantity surveyors based on a Likert scale with a range from the least level of severity to the highest level of severity, using purposive and snowballing sampling techniques. The overall aim was to establish the basis for the analysis for the variables identified. Data generated from the survey were subjected to two separate analyses using the IBM Statistical Package for

Social Sciences (SPSS) Version 23. The first analysis was to rank the critical barriers based on their mean score; the second was to explore the underlying relationships among the critical barriers through principal component factor analysis (PCFA). PCFA has the ability to reduce data to an easily understood structure.

Before embarking on the statistical evaluations, the internal consistency was checked, thus the dataset was subjected to a reliability scrutiny employing the Cronbach's alpha. The consistency examination was performed to examine the reliability of critical barriers and their measure to establish whether the twenty-eight (28) variables mirror the construct they were intended to statistically measure (Ameyaw, 2014). From the data set, the overall alpha value recorded was 0.812 which is greater than the 0.70 recommended (Eybpoosh, 2011; Oyedele, 2013). This suggests a good internal consistency and reliability of the data obtained from the field survey and thus the five-point scale system is reliable (Table 2).

3.2 Ranking of critical barriers to tender price index development

A mean score test was performed to determine the relative importance of each identified variable. The significance level was also set at 95 per cent in accordance with predictable risk levels. In addition, when two or more variables scored the same mean, the highest ranking is assigned to the one with least standard deviation (Field, 2005). The mean indices ranged between 2.45 and 4.28: however, variables ranging from 3.50 to 4.28 were considered as higher severity and highest severity. From Table 3 unstable inflation rate, availability of data, high variation in designs, unanticipated future market condition, lack of institutional leadership, lack of knowledge by professionals, change in quality and unit rate, and lack of capacity were considered as highest severities in terms of critical barriers (CBs) to TPI development. On the other hand, misunderstanding and inexplicability of specifications, differences in climate and culture, use of a representative sample of commodities, allowances made for profit, advances in building technology, lack of current trends in contract management practices, advancement in technology, relationship of misconception between the level of details, procurement route, lack of established calculation principles, legislative standards, lack of precise information about quantities, level of affluence, standards for the construction of buildings, physical characteristics of projects, lack of performance evaluation, lack of theoretical basis and decomposition of a value ratio into price were considered as of higher severity in terms of CBs. Overall, unstable inflation was ranked first with a mean of 4.28, availability of data ranked second with a mean of 4.09 followed by high variation in designs as third with a mean of 3.96. Further analysis showed that the variables recorded standard deviations of less than 1.0

except unanticipated future market condition and availability of data, suggesting consistency in the respondents and little variability in the dataset (Field, 2005). However, the variables with standard deviation greater than 1.0 suggest that there were differences as to how these variables were rated by the respondents.

Table 3: Mean score ranking of critical barriers

	Factors	Mean	Std. Deviation	Ranking	Cronbach's alpha
CB 19	Unstable inflation rate	4.28	0.81	1	
CB 17	Availability of data	4.09	1.00	2	
CB 9	High variation in designs	3.96	0.79	3	
CB 1	Unanticipated future market condition	3.93	1.02	4	
CB 31	Lack of institutional leadership (GhIS, KNUST, BRRI)	3.86	0.95	5	
CB 8	Lack of consistency in construction data output	3.83	0.79	6	
CB 30	Lack of knowledge by professionals	3.74	0.82	7	
CB 20	Change in quality and unit rate	3.71	0.83	8	
CB 21	Lack of capacity	3.70	0.82	9	
CB26	Misunderstanding and inexplicability of specifications	3.66	0.72	10	
CB 2	Differences in climate	3.64	0.74	11	
CB 3	Culture	3.64	0.74	11	
CB 15	Use of a representative sample of commodities	3.63	1.04	12	
CB 23	Allowances made for profit	3.62	0.82	13	
CB 22	Advances in building technology	3.59	0.84	14	0.812
CB 7	Lack of current trend in contract management practices	3.58	0.70	15	
CB 28	Advancement in technology	3.57	0.93	16	
CB 24	Relationship of misconception between the level of details	3.57	0.84	17	
CB 16	Procurement route	3.57	0.79	18	
CB 27	Lack of established of calculation principles	3.55	0.87	19	
CB 5	Legislative standards	3.54	0.92	20	
CB 14	Lack of precise information about quantities	3.53	0.81	21	
CB 4	Level of affluence	3.53	0.79	22	
CB 12	Standards for the construction of buildings	3.51	0.86	23	
CB 6	Physical characteristics of projects	3.50	0.90	24	

CB 25	Lack of performance evaluation	3.50	0.77	25
CB 18	Lack of theoretical basis	3.50	0.87	26
CB 13	Decomposition of a value ratio into price	3.50	0.87	27

3.3 Data reduction of the critical barriers

Factor analysis has become one of the most common statistical tools used by researchers in construction management studies. This is because of multiple interrelated variables or parameters within the industry (Ameyaw, 2014; Kissi et al., 2014; Chang 2012; Dogbegah et al, 2011; Ahadzie, 2007). It is aimed at finding groupings for related variables, thus it is ideal for reducing many variables into a more easily understood framework (Field, 2005). Factor analysis is founded on the concept of the ability to statistically manipulate empirical relationships among numerous variables to help reveal the assumed construct of the relationship (Neumann and Kreuger, 2003; Kissi et al., 2014). It is therefore ideal for reducing many variables to a better understood structure, thereby condensing information contained in the original variable into smaller set of elements (factors) with minimum information loss (DeCoster, 1998; Ahadzie, 2007). In this study, principal component analysis (PCA) was used to group related variables for the objective one on the critical barriers to TPI development. PCA was appropriate for achieving this objective owing to the fact that the objective was to reduce the variables into constructs that can explain the phenomena under study.

Factor analysis was adopted to detect the underlying relationships among the twenty-seven (27) critical variables. According to Ahadzie (2007), Oyedele (2013) and Kissi et al. (2014), this technique helps to statistically reduce variables to an easily understood framework. Factor analysis was more appropriate because there are many variables and its structure was not known (Field, 2005).

The suitability of the factor analysis is tested using the Kaiser-Meyer-Olkin (KMO) measure of adequacy and Bartlett's test of sphericity. From the data analysis, the KMO test was at 0.665 (Table 4) suggesting the data set was appropriate as it has exceeded the recommended threshold of 0.5 (Ahadzie, 2007). In addition, the value of the Bartlett’s test of sphericity was good as it recorded 1266.708 and with a significance of (*p=0.000*), which, according to Ameyaw (2014), indicates that the correlation matrix is not an identified matrix.

Table 4: KMO and Bartlett’s test

Kaiser-Meyer-Olkin measure of sampling adequacy		.655
Bartlett's test of sphericity	Approx. Chi-square	1266.708

	Df	378
	Sig.	.000

Based on the principal component factor analysis, five components with an eigenvalue greater than 1.00 and varimax rotation after seven iterations, explaining 68.14 per cent of the total variance explained were used. Further analysis on the extracted variable loadings into the various components indicate strong item loadings where each variable was greater than the recommended item loading of 0.32 (Tabachmic and Fidell, 2001; Ameyaw, 2014). These loadings indicate their level of contribution to the underlying components as having a relatively high factor loading above 0.60, supporting the suitability of the sample size.

Table 5: Extracted variables and their attributes

No	Components	Loadings	Eigenvalue	% of Variance	Cumulative % Variance
Poor procurement and estimating			4.624	16.516	16.516
CB26	Misunderstanding and inexplicability of specifications	.913			
CB20	Change in quality and unit rate	.765			
CB15	Use of a representative sample of commodities	.759			
CB23	Allowances made for profit	.759			
CB21	Lack of capacity	.757			
CB25	Lack of performance evaluation	.670			
CB24	Relationship of misconception between the level of details	.552			
CB16	Procurement route	.509			
Erratic external and project conditions			4.351	15.540	32.055
CB4	Level of affluence	.831			
CB3	Culture	.822			
CB1	Unanticipated future market condition	.809			
CB2	Differences in climate	.786			
CB9	High variation in designs	.772			
CB19	Unstable inflation rate	.725			
CB6	Physical characteristics of projects	.679			
Data unavailability			3.408	13.172	45.228
CB14	Lack of precise information about quantities	.791			
CB17	Availability of data	.765			
CB18	Lack of theoretical basis	.739			
CB8	Lack of consistency in construction data output	.701			
CB5	Legislative standards	.700			
CB13	Decomposition of a value ratio into price	.690			
Technological implications			3.116	12.130	58.007
CB27	Lack of established calculation principles	.941			
CB28	Advancement in technology	.846			
CB12	Standards for the construction of buildings	.827			
CB22	Advances in building technology	.827			
Weak knowledge base			2.558	10.136	68.143
CB31	Lack of institutional leadership (GhIS, KNUST, BRRI)	.910			
CB7	Lack of current trends in contract management practices	.888			
CB30	Lack of knowledge	.864			

The five principal components and their associated variables are reported in Table 5 and are interpreted as follows:

- **Component 1**: Poor procurement and estimating;
- **Component 2**: Erratic external and project conditions;
- **Component 3**: Data unavailability;
- **Component 4**: Technological implications; and
- **Components 5**: Weak knowledge base.

4. FINDINGS AND DISCUSSION

This section presents the discussion of the findings of the identified critical barriers to the development of TPI:

4.1 Poor procurement and estimating

The principal component accounts for 16.52 per cent of the total variances and contains eight specific factors including misunderstanding and inexplicability of specifications (0.913), change in quality and unit rate (0.765), use of a representative sample of commodities (0.759), allowances made for profit (0.759), lack of capacity (0.757), lack of performance evaluation (0.670), relationship of misconception between the level of details (0.552) and procurement route (0.509) (Table 5). The figures in the brackets indicate the loading of each variable's impact on the component. This component was termed Poor procurement and estimating. Generally, methods of procurement and estimating remain an important basis for the development of TPI, since TPIs are developed on the basis of rates at which the BoQs were priced through an acceptable procurement route. According to BCIS (2008), it is necessary to integrate the modern procurement methods into the traditional procurement in TPI development. In support of this, Ye and Ive (2008) argued that estimating the purchasing power of construction parties is difficult to determine since outputs are unrelated, hence there is a need to concentrate on the trend in building prices. Furthermore, specification serves as a basis for pricing: however, Cheung (2005) argued there is continuous misunderstanding and inexplicability of specifications, hence there is a shortfall in prices within the predetermined sum (Jaggar et al., 2002). On the other hand, performance evaluation and capacity of professionals in the industry are key factors to the development of TPI: thus, effective and efficient human resources will reduce the level of errors in estimating, thereby ensuring accuracy (Akintoye and Fitzgerald, 2000). To develop a credible TPI, it is necessary to establish a good sample commodity from the BoQ, though items with high cost weight must be considered (Cruywagen, 2014; Yu and Ive, 2008). Notwithstanding the fact that unit rates may differ from one bill to another: there is a need to have a well-established yardstick against which unit rates should be considered for the indices. Furthermore, allowance made for profit must be well established owing to the influence profit allowance implications have on the actual contracts. Further indications are that contractors are more likely to reduce profit allowances in order to bid low so as to win a contract. However, Mbachu (2011) cautions that this may lead to frivolous claims and disputes during the project implementation phase and indices developed later may not be credible. Finally, levels of details of all documentation relating to indices must be precise concise and easy to understand by end users.

4. 2 Erratic external and project conditions

The second component was labelled Erratic external and project conditions and accounted for 15.54 per cent of total variance not explained by the first components. Seven variables loaded onto component two which included Level of affluence, Culture, Unanticipated future market condition, Differences in climate, High variation in designs, Inflation rate, and Physical characteristics of projects recording respective loading values of 0.831, 0.822,0.809, 0.786,0.772,0.725 and 0.679 (Table 5). This postulation agrees with the views of Aziz (2013) and Azhar et al. (2008) on the effect of inflation and changes of prices of construction materials which have accounted for variation with its repercussion on effective cost planning practices. All these are attributed to the changes in prices of materials emerging from frequent changes in inflation. Heintz, and Ndikumana (2010) argued that in sub-Saharan African countries such as Ghana there is a need to examine inflation dynamics that lead to various inflation changes. Furthermore, levels of affluence and the culture of people or the society in which the indices are developed remain crucial variables as the level of affluence may influence the type of buildings and price level to be considered. In the Western world, the OECD and EUROSTAT (1996; 2001) have argued that there are differences between countries in terms of items to be excluded or included; for instance, some cultural practices may not be accepted in certain societies. In addition, the physical characteristics of projects have considerable influence on the final cost of project with further influences on the individual items which are sampled for TPI development. Cong et al. (2014) argued that the buildability and complexity of a project can influence the cost of the structure. Although many of the anticipated variations in projects happen in the latter part of a project, in some cases contractors are aware of these variations in design during tendering, hence allowances are made based on their tendering price. Lastly, Wong et al. (2010) conjectured that unstable and unanticipated market conditions exist, making it difficult to obtain accurate predictions of TPI.

4.3 Data unavailability

This component accounted for 13.17 per cent of the total variance not explained by the former two components. It encompasses six variables: Lack of precise information about quantities (0.791); Availability of data (0.765); Lack of theoretical basis (0.739); Lack of consistency in construction data output (0.701); Legislative standards (0.700) and Decomposition of a value ratio into price (0.690) (Table 5). The component's variables have an inherent barrier as Data unavailability. This component supports Balk's (2008) argument that indices have two dimensions of critical barriers, namely decomposition of a value ratio into price and unavailable quantity data. To accurately develop an estimate of construction cost for a project, among others, it is dependent on information and data availability. Not giving precise information will render the indices developed incapable of making any informed decisions (Balk, 2008). It is therefore an important variable in developing accurate project cost estimates (Anderson et al., 2009). With this importance attached to cost data in estimating the cost of a project, the lack of such cost data in the construction industry consequently limits the reliability of TPI. Accordingly, there is a lack of uniformity about data output (Akintoye et al., 1998; Ng et al., 2004) which makes it difficult to be used for developing TPI. Additionally, there are no prescribed or standard grounded theories backing the development of TPI in the construction industry, as most development is hinged on ad hoc theories in econometrics. Further breakdowns of the basket items for the TPI must be checked so as to select items with a higher weighting. The kind of analysis of the input data must be checked as well since garbage in will produce garbage out.

4.4 Technological implications

Principal component 4 accounts for 12.13 per cent of the total variance of CBs and consists of four variables. These are Lack of established calculation principles, Advancement in technology, Standards for the construction of buildings and Advances in building technology. All these variables recorded high levels of impact, ranging from 0.941 to 0. 827. The loadings were 0.941, 0.846, 0.827 and 0.827 respectively (Table 5). Based on these loadings the component was characterised as Technological implications. This postulation agrees with the assertion by Yu and Ive (2008) that the advancement of economic theories have not been incorporated in indices development. Advancement in the knowledge of building technology make it difficult to develop an accurate and reliable index: obtaining a more realistic measurement in a more complex design comes with misunderstanding. Although technological advancement is accepted in every sphere of life, the need to change the basket for developing TPI is based on the situations that pertain within the geographical context in which the study is undertaken (OECD,1996; EUROSTAT, 2001). Moreover, Cruywagen (2014) argued that there is lack of understanding calculation principles for TPI development. However, Wong (2001) indicated the studies on TPI vary depending on the geographical locations.

4.5 Weak knowledge base

Component 5 comprises three (3) variables, which accounted for 10.14 per cent of the total variance. These are: Lack of institutional leadership (0.910), Lack of current trends of contract management practices (0.888) and Lack of knowledge (0.864) (Table 5.4). This component was termed Weak knowledge base. This supports Dib's (2007) assertion that the construction industry generally suffers from what is described as the "islands of knowledge syndrome". Indeed, the Centre for Construction Research and Training (2012) argued that knowledge attainment of employees in construction is lower as compared to that of other industries. However, it is important to note that in developing TPI, an in-depth understanding of all levels in the construction process and method of construction must be established (Hassainein and Khalil, 2006). In obtaining a credible TPI, an institutional leadership remains a vital tool as it serves as an innovation drive in the construction industry. This aligns with the views of Opoku and Fortune (2011) and Bonssink (2007), namely that the role of leadership in improving performance is critical. In support of this assertion, it is imperative that in the development of TPI, the lack of institutional leadership to take a concretive decision is tackled. Since Ghana is a developing country, it is more necessary to establish a high level of institutional leadership than any other in order to create and improve opportunities in understanding the knowledge that surrounds TPI usage and application.

5. CONCLUSION AND RECOMMENDATION

The tender price index continues to be one of the leading indices for forecasting of prices of contracts in the building industry. However, its development in developing countries such as Ghana is faced with several barriers. This study therefore sought to highlight the critical barriers to TPI development. Through quantitative research and principal component analysis, five main critical barriers were identified, namely: poor procurement and estimating, external and project conditions, data availability, technological implications and a weak knowledge base. The findings indicate that there is an urgent need for practitioners to examine the identified barriers by building the necessary capacity to facilitate the development of TPI. It is further recommended that these barriers must be addressed methodically as they serve as a firm basis for the advancement of knowledge on tender price index development in the Ghanaian building industry. Although data for the study was sited within the Ghanaian building industry context, the findings can be applied in other developing countries with similar characteristics as those of the Ghanaian environment. In addition, owing to the exploratory nature of the research, it is recommended that further studies should be conducted to confirm the constructs identified aimed at reducing the uncertainty of the research outcome.

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