Availability of reliable cost data for whole life costing in the Tanzania building construction industry

AVAILABILITY OF RELIABLE COST DATA FOR WHOLE LIFE COSTING IN THE TANZANIA BUILDING CONSTRUCTION INDUSTRY

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Abstract

Whole life costing plays a major role in ensuring that value for money is attained from the inception of a building to its end of life. Availability of reliable cost data is essential ensuring that whole life costing is undertaken with utmost precision. This study explores the availability of reliable cost data for whole life costing in the Tanzania building construction industry. It aims at realising the key sources of cost data as well as analysing their reliability. It will also suggest ways to improve cost data availability in the industry. The research involved the use of questionnaire survey and structured interviews to collect data from quantity surveyors and other industry professionals respectively in Tanzania. The study revealed that in-house and market survey as the most familiar and most used sources of cost data in the Tanzania building construction industry. It also realised that running cost data, which are crucial for undertaking whole life costing, did not have a source in Tanzania which is contrary to other countries. The study also revealed that despite cost data sources being considered reliable, they still lacked credibility as most respondents still had doubts about them. To improve the availability of reliable cost data for whole life costing, the study suggests that the Tanzania building construction industry should adapt to the online information service which will ensure easy and fast access to reliable cost data. The industry should also engage in the collection and sharing of running cost data which is essential for whole life costing.

Keywords: Building Construction Industry; Cost Data; Tanzania; Whole Life Costing.

1. INTRODUCTION

Cost data availability is a very important aspect of the building construction industry. The accuracy of cost data plays a major role in ensuring the level of confidence in decision making. Cost data for building construction projects helps to render key decisions on whether to build or not. Additionally, it helps to monitor and meet projects time and budget during execution. The building construction industry faces criticism globally on high construction costs and unpredictability due to inconsistent cost data, challenged to innovate and reduce costs (Robson *et al.,* 2016). Improving project management performance by reducing project time and cost, Hu (2008) encourages proper reuse of cost data.

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Whole life costing plays a major role in ensuring that value for money is attained from the inception of a building to its end of life. There have been many definitions of whole life costing that have evolved over the years, BSI (2008), OGC (2007), Boussabaine and Kirkham (2004), Gluch and Baumann (2004) and El-Haram et al. (2002) but for this study, it will be defined according to Kishk et al. (2003); it is a tool to assist in assessing the cost performance of construction work, aimed at facilitating choices where there are alternative means of achieving the client's objectives and where alternatives differ, not only in their initial cost but also in their subsequent operational costs. Results of whole life costing are often put into question due to lack of enough cost data (Sterner, 2000), and when they are available, they are usually inconsistent or not relevant for usage (El-Haram *et al.,* 2002). Manege and Kennedy (2020) and Sandaruwan et al. (2021) revealed that lack of reliable cost data is one of the key barriers to whole life costing application in the Tanzania building construction industry. According to Munro (2018), a problem in cost data availability in the building construction industry is getting worse. This study is aimed at exploring the availability of reliable cost data for whole life costing in the Tanzania building construction industry. It will investigate the key sources of cost data as well as analyse their reliability and suggest ways to improve cost data availability. The study is important to the Tanzania building construction industry as it will help to re-evaluate its cost data availability and look to improve, therefore ensuring accuracy in cost estimations and thus bringing value for money to projects.

Quantity surveyors are cost experts entrusted with keeping building construction projects within budget and ensuring value for money is attained. According to Eke (2007), quantity surveyors are considered encyclopaedias of information on all junctures of building costs, thus from inception to end of life. According to Hoar (2007), quantity surveyors should be responsible for undertaking whole life costing, even though Hunter et al. (2005) believe that it should be undertaken by anyone in the industry so long as they have enough knowledge of it. Therefore, this study will focus primarily on quantity surveyors as they are directly linked to the use and need of cost data as well as undertaking whole life costing and backing up their views with other industry professionals.

2. LITERATURE REVIEW

2.1 COST DATA FOR WHOLE LIFE COSTING

Historical cost data is usually acquired from previous and existing projects. The use of historical cost data should be done with great caution as changes in prices may have significant impacts on construction costs (Atinuke, 2010). According to Sayed et al. (2020), reliable cost data are needed for accurate cost estimates, which is a key factor for a successful project. Building construction stakeholders, specifically quantity surveyors, use cost data for the following reasons (Ashworth, 2004): approximate estimates for proposed schemes, cost planning during design, contract estimating for tendering purposes, agreement of variations in final accounts, calculation and settlement of contractors' claims, loss adjustment valuations, maintenance management. According to Atinuke (2010), cost data is essential to quantity surveyors for future projects cost forecast, different projects cost comparisons, contractor's unit rates negotiations, monitoring and controlling of construction costs and design cost planning. Agyekum et al. (2018) portray that the unavailability of cost data is one of the key obstacles to the utilisation of non-traditional cost estimate models. According to Sayed et al. (2020),

reliable cost data is needed to ensure accuracy and success in building construction cost estimates.

The cost of running a facility often surpasses the initial design and construction costs, with estimates that up to 85% of expenditure over the life of a building is associated with running the facility (Edirisinghe *et al.,* 2017). Thus, to attain value for money it is essential to look at whole life costs of a building rather than focusing on capital cost only. According to Manege and Kennedy (2020), despite most construction professionals being knowledgeable of whole life costing in Tanzania, it is still not widely practised and one of the key reasons being lack of reliable cost data. Thus, for whole life costing to be applied there is a tremendous need for availability of reliable and accurate cost data. Whole life costs consist of the following cost elements (Manege and Kennedy, 2020): non-construction costs, income, externalities and life cycle costs (construction, operation, maintenance and end of life). To implement whole life costing, all the needed cost data need to be readily available. The difficulty in accessing running cost data (operation and maintenance cost data) for buildings makes it difficult for building construction professionals to undertake whole life costing and forecast the financial expenditure of a building (Stride *et al.,* 2020). However, Ashworth et al. (2013) encourage the use of facility managers in buildings as the best source for running cost data.

2.1.1 Cost data sources

The use of accurate cost data generated from reliable sources ensures that objective, rather than subjective, decisions are made in the industry (Moon *et al.,* 2007). A reliable source of cost data needs to be accurate, up to date and consist of well-stored records. It is unlikely that a building construction professional can hold sufficient cost data to offer a suitable base for whole life costing and other cost plans covering a wide range of building types. Therefore, collection and storage of cost data for building projects can be done from several sources depending on availability. The following are the most common sources of cost data in the building construction industry.

In-house: This is one of the major sources of cost data in the building construction industry (Ashworth, 2004), based on successful contractors' tenders. It is sometimes referred to as the priced bill of quantities source of data. It is considered the cheapest, fastest and most comprehensive source. Its importance comes from the fact that it is homemade, meaning that owners are familiar with the projects. It is often considered the most accurate and reliable source although it can be disputed that it can be subjected to peculiarities in tendering, like errors from lack of accurate cost data and other human errors in preparing it. Therefore, it is important to treat the cost data from this source with great care, taking into consideration each project in its uniqueness. The following factors are the cause for variations in rates and prices in the building construction industry: the size of the project, type of the project, location of the project, contract conditions of the project, market conditions and contract implications. The more details available in a project the more it will be subjected to variability, making the cost data less reliable (Ashworth, 2004). According to Hu (2008), it can be difficult to collect and store cost data for in-house sources, due to different building construction projects being undertaken by multiple practitioners thus, cost data is scattered and subjected to loss. Therefore, there is a need to be extra vigilant in ensuring that all the cost data is collected and stored to be used for future projects.

Market survey: This entails having a feel or knowledge of what is going around in the current building construction market. The survey involves asking around to get the latest cost data in the building construction industry from different industry stakeholders. This will involve asking other building construction professionals (Architects, Quantity surveyors, project managers, engineers), labour unions, plant hiring and purchasing companies, builders' merchants, subcontractors and suppliers of building components (Atinuke, 2010). Common practice involves asking suppliers and builders merchants their prices and quotations, thus providing cost data to help with estimates for tendering. Material suppliers are also known to produce material price lists from time to time, which come in handy to industry practitioners while undertaking cost estimates. Building construction professionals in the industry act as a source to one another by communicating to enquire on certain cost data they are missing. Even though this is highly practised, data collected from colleagues in the industry may not be reliable as some might decide not to disclose correct cost data and sometimes the cost data might not be relevant or outdated. It is therefore important to treat the information collected from colleagues with the utmost caution.

Technical press: Also known as price books, the technical press is common in developed countries where technical magazines and journals are available in the building construction industry to publish cost information. They normally entail basic material prices, elemental cost analysis, cost indices and labour rates. They are considered a fast point of reference and in some instances, they help with inflation to keep the players aware of price changes. Technical presses are not common in developing countries due to lack of competition in construction projects as compared to developed countries. In some developing countries like Nigeria where it is available (Atinuke, 2010), it is considered the least comprehensive and trusted source because of its inconspicuousness of the source of information. The government in developing countries is the main client who is not money conscious as the private client in developed countries, thus, technical press in developed countries is more common because private clients push for them as they are engaged more in construction projects and are after value for money.

Online information service: This is one of the most reliable and the fastest source of cost data. Also known as cloud-based, this is a source where cost data can be accessed online from electronic devices (phones, tablets, computers), therefore making it the most reliable, easy to access and fastest source of cost data in the modern world. BCIS in the United Kingdom is a major example of an online information service. Formerly known as Building Cost Advisory Service was established in 1962, BCIS is considered the largest disseminator of cost data in the world (Ashworth, 2004). Its main functions include collection, storage, analysis, selection and publishing of data. Even though its focus was on providing reliable cost data for quantity surveyors, it now allows subscriptions from architects, engineers and contractors. The service works on a reciprocal basis whereby it exchanges cost information between members who can supply it with information. Apart from publishing capital costs, BCIS also furnishes its users with running costs which can help perform whole life costing to get the best value for money in the long run. Another current similar online information service is the Building Cost Information Service Malaysia (BCISM) from Malaysia.

3. METHODOLOGY

A literature review was conducted during the initial stages of the study to gain in-depth knowledge from different sources such as journal articles, conference proceedings, books, and electronic sources. This revealed the knowledge gap and existing knowledge on the research problem. This study is descriptive and follows a mixed method research strategy (Creswell, 2014). It's descriptive as it describes the availability of reliable cost data for whole life costing in Tanzania building construction industry (Kothari, 2004). Sequential explanatory mixed method research strategy was adopted, which involves conducting a quantitative method, followed by a qualitative method to expand on initial findings (Saunders *et al.,* 2016).

The questionnaire survey was adopted for a quantitative approach, where quantity surveyors were considered, as they are key personnel engaged in cost data and undertaking whole life costing in the building construction industry in Tanzania. The questionnaire survey adopted the use of both web and mobile internet self-completed questionnaires (Saunders *et al.,* 2016), thus web links to the questions were sent to the respondents. The use of internet questionnaire was adopted to facilitate reaching a large number of respondents in different geographical zones in Tanzania. Stratified probability sampling was used to categorise them into two strata: class one contractors and consulting firms. This technique is considered free from bias as it ensures a sample that accurately reflects the population being studied (Saunders *et al.,* 2016). Purposive random sampling was then used to select respondents from each category or strata, according to Trochim (2006) a researcher is bound to get information from a sample of the population that one thinks knows most about the subject matter.

According to the Tanzania building construction industry, there are 140 class I contractors registered with the Contractors Registration Board (CRB, 2021) and there are 134 quantity surveying consulting firms registered with the Architect and Quantity surveyors Registration Board (AQRB, 2021). To determine the sample size for the study, equation 1 was used as per Saunders et al. (2016). The study considered a level of confidence of 80% (z = 1.28), a margin of error (e) of 10%, percentage belonging (p) of 50% and percentage not belonging (q) of 50%, which brought a minimum sample size (n) of 40.96. Equation 2 was then used to attain an adjusted minimum sample size for each group from the minimum sample size as seen in table 1. A total of forty-two (42) questionnaires were returned out of sixty-three (63) which were distributed, equivalent to 66.67%. In contractors, 22 responded out of 32 which is equivalent to 68.75%, and in consultants, 20 responded out of 31 which is equivalent to 64.52% (Table 1). Golland (2002) depicts that a response rate of 30-40% is good and that over 50% is considered excellent.

$$n = p \times q \times \left[\frac{z}{e}\right]^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where: n is the minimum sample size required.

p is the percentage belonging to the specified category.

q is the percentage not belonging to the specified category.

z is the z value corresponding to the level of confidence required.

e is the margin of error required.

$$n' = \frac{n}{1+\left(\frac{n}{N}\right)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Where: n' is the adjusted minimum sample size.

n is the minimum sample size.

N is the total population.

Table 1. Population, sample size and response rate

Quantity Surveyors	Population	Sample size (n') / Distributed	Responded	Response percentage (%)
Class I Contractor	140	32	22	68.75%
Consulting Firms	134	31	20	64.52%
Total	274	63	42	66.67%

Upon analysing the questionnaire survey data, a series of structured interviews were carried out as a qualitative approach, to gain a deeper understanding and provide more insight into the same. A structured interview was adopted as its more economical and provides a safe basis for generalisation (Kothari, 2004). The population for this study was limited to quantity surveyors, architects, project managers and engineers still active in the building construction industry in Tanzania. The interview included a mixture of face-to-face and telephone interviews (Saunders *et al.,* 2016) in which digital voice recording was used to aid in capturing information upon consent from the interviewees. Convenience random sampling technique was used to select the interviewees. Twenty (20) building construction professionals working in the industry were interviewed to reach data saturation (Saunders *et al.,* 2016). Table 2 shows the general information of the interviewees.

Table 2. Interviewee background information

Interviewee Code	**Designation**	**Years of Experience**
INT 1	Quantity Surveyor, Consultant	4 years
INT 2	Quantity Surveyor, Consultant	6 years
INT 3	Quantity Surveyor, Consultant	7 years
INT 4	Quantity Surveyor, Consultant	10 years
INT 5	Quantity Surveyor, Contractor	6 years
INT 6	Quantity Surveyor, Contractor	6 years
INT 7	Quantity Surveyor, Contractor	8 years
INT 8	Architect, Consultant	5 years
INT 9	Architect, Consultant	6 years
INT 10	Architect, Consultant	6 years
INT 11	Architect, Consultant	11 years
INT 12	Architect, Contractor	5 years
INT 13	Project manager, Consultant	7 years
INT 14	Project manager, Consultant	8 years
INT 15	Project manager, Contractor	3 years
INT 16	Project manager, Contractor	5 years
INT 17	Project manager, Contractor	5 years

INT 18	Engineer, Consultant	5 years
INT 19	Engineer, Consultant	6 years
INT 20	Engineer, Consultant	3 years

Data analysis entails closely related operations, undertaken to summarise the collected data and organise them to address the research objective (Kothari, 2004). Data collected through questionnaires were analysed in frequency and percentage using Statistical Package for Social Sciences (SPSS), in which charts and tables were used to present the interpreted data. The use of thematic analysis was adapted for the interviews, Saunders et al. (2016) entails that it involves coding qualitative data to identify themes for further analysis related to the research question.

4. ANALYSIS AND DISCUSSION

4.1 FAMILIARITY OF COST DATA SOURCE

This question was focused on identifying the most commonly used sources of cost data and realising the familiarity of other sources in the Tanzania building construction industry. The results, as seen in figure 1 revealed that for in-house sources 2.4% of the respondents were 'Not familiar' and 97.6% were 'Familiar and used'. For market survey: 2.4% of the respondents were 'Not familiar', 9.5% were 'Familiar but never used' and 88.1% were 'Familiar and used'. For technical press: 33.3% of the respondents were 'Not familiar', 2 52.4% were 'Familiar but never used' and 14.3% were 'Familiar and used'. For online information service: 71.4% of the respondents were 'Not familiar', 23.8% were 'Familiar but never used' and 4.8% were 'Familiar and used'. This response clearly shows that the most familiar and used source of cost data is in-house followed by market survey. It also relays that the online information service source of cost data is the most unfamiliar source followed by the technical press.

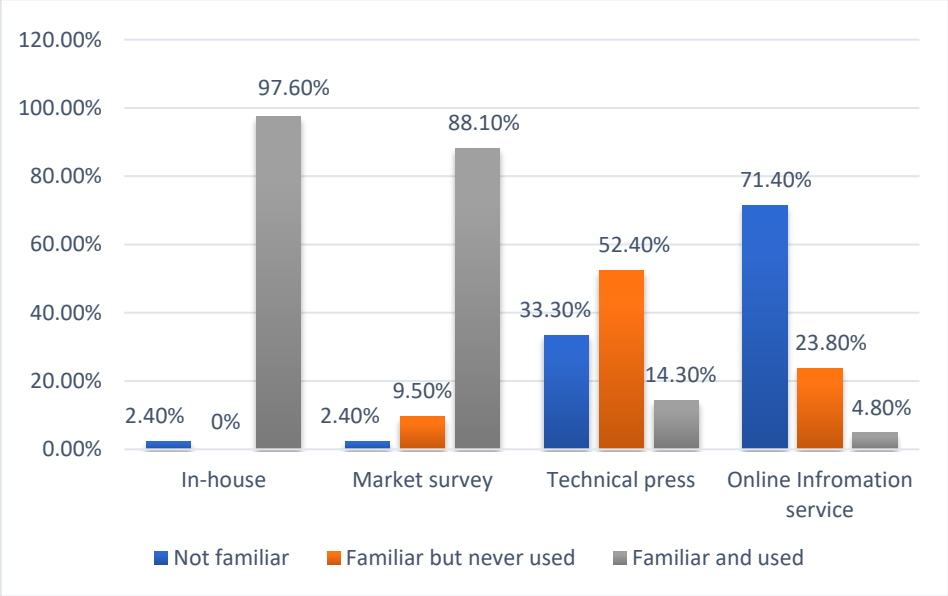

Figure 1. Respondents on familiarity of cost data sources

To generate an in-depth understanding of the source of cost data, the interviewees were asked to name their sources of cost data. Only two sources of cost data were named, in-

house and market survey, in which all the interviewees named In-house as their source and several included market survey. According to interviewee INT 1, "*we have our own cost data in the company which we refer to when in need. We also do enquire from our suppliers and other colleagues in the industry for certain costs that we do not have*". And interviewee INT 2 mentioned, "*We are engaged with so many suppliers with different kinds of materials and they have their price lists of the materials they supply so depending on the item that I need, I can ask them, like how much do you sell this cement or this bucket of paint, so I get from suppliers or from people I know but mostly it's from suppliers. We also store all the cost data that we collect for future use*". While interviewee INT 3 responded, "*Our main source is our own records from previous projects, and we get others from our suppliers whom we ask for different prices when we lack them. Also, I use experience quantity surveyors to get information"*. The interviewees INT 4, INT 10 and INT 15 mentioned that their cost data comes from the archives that they keep from previous projects and encounters.

Interviewee INT 12 responded, "*We have our database, in which after we purchase let's say a certain material, we will store the information for later projects. In labour, it's the same thing we have our labour rates which we use, and we change them depending on the situation or location. We also consult other people in the industry if we need help*". Interviewee INT 16 went forth and said, "*Mostly I consult experts of different items example for electricity I would consult with them to get the cost data also we have our records that we can check*". And interviewee INT 18 said, "*we have inhouse data that's been collected from previous projects and if we miss any cost data, we usually call other people in other companies to see if they can help*".

The interviewee's responses back up the questionnaire's findings that in-house and market surveys are the most commonly used sources of cost data in the Tanzania building construction industry. They also show that there is no awareness of the other sources of cost data: technical press and online services. The findings above align with Ashworth (2004) that in-house is a major source of cost data in the building construction industry.

4.2 RUNNING COST DATA SOURCE

According to Manege and Kennedy (2020), whole life costing plays a vital role in ensuring long term value in a building is attained but in order to undertake it, there is a need to have reliable running cost data (maintenance and operation cost data). Therefore, this question was aimed at realising whether the respondents had a source for running cost data. The results as seen in figure 2 revealed that 61.11% of the respondents said no and 38.89 said yes. This shows that the majority of the respondents do not have a source for running cost data.

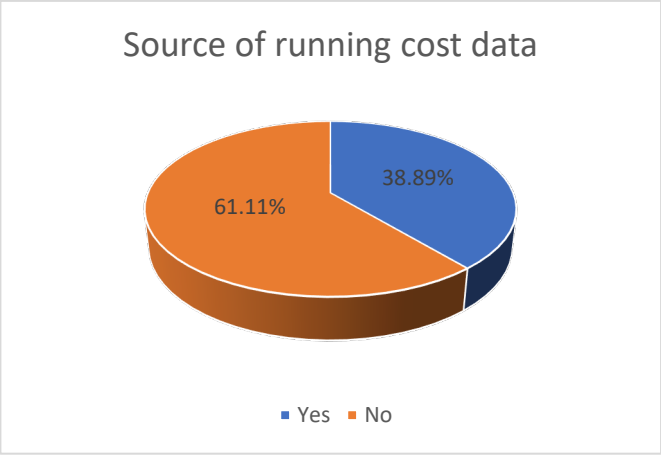

Figure 2. Respondents on having a source for running cost data

Although some of the questionnaire respondents highlighted having sources for running cost data, it was contrary to the interviewees, where all responded to not having a source for it. And according to interviewees INT 6 and INT 17, said that they had no idea how they would even get them. However, interviewee INT 2 went further to say, "*It's very difficult to get those, maybe until I start to use the building for some time then I can start to notice like if I switch so much the AC, this is what the energy consumption will be. But for now, I don't have a source"*. This clearly shows that there lacks a source of running cost data that can help in whole life costing undertakings (Manege and Kennedy, 2020; Sandaruwan *et al.,* 2021) and other cost estimations needed in the building construction industry.

4.3 RELIABILITY OF COST DATA SOURCES

In order to understand the reliability of cost data sources, the respondents were asked to assess how reliable they thought their cost data sources were. This question was focused on realising how the quantity surveyors in the Tanzania building construction industry were confident in their sources of cost data. The results, as seen in figure 3 revealed that 28.57% of the respondents were 'Not sure', 66.67% believed they were 'Reliable' and 4.76% believed they were 'Highly reliable'. The response demonstrates that despite the majority believing that their sources are reliable, some are unsure if they are and only a few believe that they are highly reliable.

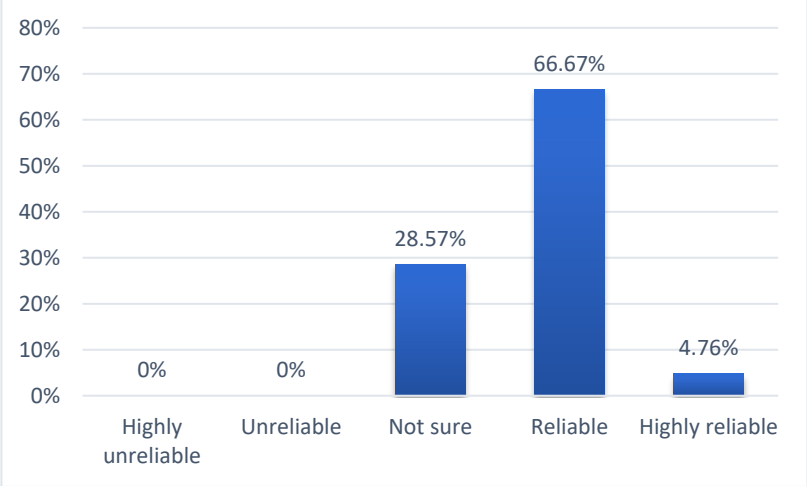

Figure 3. Respondents on reliability of cost data sources

According to the interviewees, the majority responded that they thought their source of cost data was reliable, although many were quick to justify that not all the time, they considered them to be so. The level of reliability according to most interviewees relied much on being successful on tenders and execution of projects. According to interviewee INT 2, they said, "*Yes, I think they are reliable. Because what I plan from the planning stage up to the execution there is no difference, meaning that if am planning to use this much for the construction and when I start executing the work, the final cost that I calculated is almost the same as what I use*". This was further supported by interviewees INT 8, INT 11, INT 13, INT 14 and INT19 who believed that the cost data from their source was reliable as he has used the same sources for years and is yet to find fault in them. Interviewee INT 7 went forth to say, "*Yes, I have gotten several projects by using the data from my sources. But it's fair to say that sometimes the data can be misleading in project types that you have not done before, I end up being either too low or too high*".

Contrary to those who believed that the cost data sources were reliable, interviewee INT 3 responded that "*They are not entirely reliable, but they are the only ones we have. They sometimes tend to mislead us in tenders, and we end up losing the tenders*". Interviewee INT 20 responded that they are not very sure as to whether the cost data from their sources are reliable as they can be contradicting from one source to another, a similar response was received from interviewees INT 5 and INT 9. This was further supported by interviewee INT 1 who elucidated that "*If you get from your friend, how can you believe that it's reliable data, you may find that you apply it and you end up getting a loss or the project ends up failing. They are mostly not realistic. And there is not any place you can confirm that it's realistic or not because you don't have a place to benchmark"*.

This analysis helped realise why most of the responses from the questionnaire believed that their cost data sources were reliable but not highly reliable, as most believed that the cost data from their sources did get them through successfully in multiple tenders and projects but not all. This can be depicted that the cost data sources in the Tanzania building construction industry are considered reliable, but they lack credibility as the practitioners cannot account for them fully.

5. CONCLUSION AND RECOMMENDATION

This study looked at exploring the availability of reliable cost data for whole life costing in the Tanzania building construction industry. The study was conducted through a mixture of questionnaires and interviews as means of data collection from quantity surveyors and other building construction professionals respectively. It aimed at revealing what are the key sources of cost data as well as familiarity with other sources among industry professionals. It also went further and looked at the reliability of the cost data sources.

The study revealed that in-house and market survey were the most familiar and used sources of cost data in the Tanzania building construction industry and that online information service was the most unfamiliar source. Running cost data which are crucial for undertaking whole life costing did not have a source according to the findings, therefore making it difficult to undertake whole life costing. The study also revealed that despite cost data sources being considered reliable, they still lacked credibility as most respondents still had doubts about them.

To improve cost data availability in Tanzania there is a need to have improved sources of cost data that will facilitate the availability of reliable cost data for whole life costing undertakings and other estimates. Building construction professional bodies across the country should look at addressing this challenge by moving from reliance on in-house and market survey sources to online information services like the BCIS as this will ensure that quantity surveyors and other industry professionals have a place to benchmark their cost data as well as ensure the reliability of the cost data provided. Also, much emphasis should be given to ensuring there is availability of running cost data, as this will ease and promote whole life costing in the industry.

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