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SECURITY CHALLENGES: MICROSCOPING THE GAPS IN ON-CAMPUS STUDENT HOUSING FACILITIES
Fredrick Simpeh¹ and Solomon O. Adisa²

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Submitted: 22nd March 2020
Accepted: 1st May 2020

Abstract
Purpose
The paper evaluates the provision and risk associated with the lack of security measures in the student housing facilities (SHFs) of a South African university, with the aim of providing empirical information that would help to improve the provision of security measures required in on-campus SHFs.

Design/Methodology/Approach
The study adopted a mixed method approach; questionnaire was used as an instrument to collect quantitative data, whereas observation and interview were used to collect qualitative data. Analysis of the quantitative data was done through relevant descriptive and inferential statistics using a three-step analysis approach while thematic analysis was used for the qualitative data.

Findings
The study found that the SHFs of the university lack security measures such as: CCTV, weapon detectors, electronics coded locks on doors, security alarm, access control with functional smart-card, and security patrols. It also became evident that the absence of the security measures, including those which were poorly provided, expose students to a high risk. Moreover, the study found that the gaps between the level of provision and risk associated with the absence or lack of the security measures were statistically significant.

Research Limitations
A holistic approach to addressing productivity in South African construction in the form of a qualitative model was evolved from the study.

Practical Implications
The findings from the study can assist the Safety Health and Environment (SHE) unit, facilities department, and hostel managers of the university to improve the provision of security measures at the various SHFs.

Originality/Value
Although several studies have been conducted on student housing, studies on SHF security measures are quite lacking. This study contributes to the body of knowledge in SHF security measures. Also, SHE unit, facilities department, and hostel managers of universities would benefit from this study.

Keywords: Provision, Risk, Security, Student housing facility, University.
of SHFs across the world [9]. These security lapses are prevalent in/on SHFs of universities in South Africa. The report on the monitoring committee for the review of the provision of student housing in South African universities, indicate that security and safety are major issues across South African universities [10]. Security of SHFs is not given the necessary attention. Ashley (2010) opined that the SHFs in the broader scope have been carried out [1, 12, 13]. However, studies which primarily examines on-campus university SHFs’ security measures from the infrastructure point of view are quite lacking. Thus, this paper investigates the level of provision of security measures, as well as the risk associated with lack of those security measures in the on-campus SHFs of one university in South African. The study provides empirical information that would help to improve the security measures in the SHFs and ensure that students feel safe at their respective on-campus residences.

Student Housing Facility And Associated Security Risk

Safety, security, health, and environmental management are now a fundamental consideration for facility management. Safety and security in the planning and design of education facilities such as SHFs for schools, polytechnics, colleges, and universities has vital impact on education outcome [4]. In buttress, Gopal and van Niekerk opined that safety and security of learning environments play a major role towards the academic achievement of students [10]. In fact, effective learning cannot take place in an unfavorable environment, such as poorly managed facilities, which exposes university occupants to danger [14]. Notwithstanding, studies reveal that students living in on-campus SHFs are confronted with security challenges at their respective dormitories. For example, Rodriguez et al. and Adisa et al. highlighted lapses in the security measures provided in/on SHFs of some South Africa tertiary institutions [11, 12]. Lungani reported after a first year Quantity Surveying student was murdered in an undergraduate residence on the 1st of May, 2018 at a particular university in Durban that South Africa tertiary institutions are becoming more dangerous to students to several risks and dangers such as accidents, theft, sexual harassment, assault, and worst of all, fatality. In South Africa studies of the SHFs in the broader scope have been carried out [1, 12, 13]. However, studies which primarily examines on-campus university SHFs’ security measures from the infrastructure point of view are quite lacking. Thus, this paper investigates the level of provision of security measures, as well as the risk associated with lack of those security measures in the on-campus SHFs of one university in South African. The study provides empirical information that would help to improve the security measures in the SHFs and ensure that students feel safe at their respective on-campus residences.

Eisenberg et al., revealed that students may be more at risks at some universities than others, because of differences in the way institutions consider the safety and well-being of their students [19]. Risk is perceived as a situation involving exposure to danger, fear, threat, harm, hazard, or loss because of presence or omission/absence of safety/security measures [20]. Several studies reveal that students place high importance on the measures provided in their residences to promote their safety [13, 21, 22, 23]. This is due to the risks associated with the non-provision or poor provision of security measures at SHFs, and the negative effect it has on learning outcome. The provision of adequate security measures in the management of facility is the responsibility of organisations by law, as a result, effort should be made to ensure compliance in order to protect against crime, violence, theft, accident and ensure a conducive environment [24]. Certainly, security lapses have dire consequences including crime, violence, theft, and accident. The lack of safety and security measures on campuses could lead to high mortality rate on campus [18].

The measures required to guarantee and promote security in SHFs include: close circuit television (CCTV), security guard on post, security alarm, access control with functional smart-card, weapon detector, fencing around the hostel, adequate lighting at night, security patrol around the hostel, emergency help line, notice board, written policy prohibiting vandalism, emergency protocol poster on the wall, security signs and security check point at the entrance of hostel as important requirements [7, 11, 24].

Research Methodology

This paper set out to assess the provision and level of risk associated with the absence/lack of security measures in the SHFs of a South African university. The study adopted a mixed method approach; both quantitative and qualitative data were collected. A questionnaire was used as instrument for collecting the quantitative data while observation and interview were used to collect qualitative data. The Safety, Health and Environment Officer in charge of the main campus from the SHE unit was interviewed. Moreover, the condition of the observatory was kept with the aim of identifying security measures that are provided across the university SHFs. Observations were made to complement the data provided by the students, as well as a report on the university security (SHF SHE unit). A closed-ended questionnaire was structured and administered to students. The survey was limited to students who were registered members of the university studying at South African tertiary institutions and used students in three sections, with the first exploring the background information of the respondents, the second gathered information regarding the provision levels of the security measures in the SHFs, and the third section sought the level of risk associated with the absence/lack of security measures in the SHFs. Both Quota and convenient sampling method were adopted for distributing the questionnaire. The quota sampling method helped to achieve equitable distribution of questionnaires across the SHFs. After the quota was determined, the questionnaires were conveniently delivered to students who have lived at least 12 months and above in the residence. This was done to ensure that only students who had a better understanding of security issues at their various residences participated in the study. Respondents were provided with a total of 13 variables to rate the level of provision of security measures and risk associated with absence/lack of those security measures using a five-point Likert scale, where, 1 = Not provided/ No risk, 2 = Poorly provided/ Low risk, 3 = Somewhat provided/ Moderate risk, 4 = Provided/ High risk and 5 = Well provided/ Very high risk. The respondents were also provided with the (unsure option). A total of 200 questionnaires were administered to students living in the on-campus SHFs that belong to the university. 180 questionnaires were returned from the respondents. However, 11 of the questionnaires were discarded because they were not well/fully completed. Consequently, a total of 169 questionnaires were properly completed and analysed.

Analysis of the quantitative data was done through relevant descriptive and inferential statistics while thematic analysis was used for the qualitative data. Statistical Package for the Social Sciences (SPSSv25) was used to analyse the quantitative data. The data gathered were analysed by first determining the reliability of the research instrument with Cronbach’s alpha coefficient. Cronbach’s alpha of 0.95 indicates a high level of internal consistency [25], Cronbach’s alpha value obtained for this study was 0.70 (provision) and 0.72 (risk) for the 13 security measures assessed. This implies that the scale questions used were reliable. The second stage was the use of mean score (MS) to determine the provision and the risk associated with absence/lack of security measures in the SHFs. The level of provision as well as the risk associated with lack of security measures in the SHFs were ranked. The third stage was the use of the paired t-test to determine gap in the provision and the risk attached to the absence of the security measures. The test was carried out to determine if the differences were statistically significant or not.

Findings and discussion

The condition of the SHFs were observed with the aim of identifying the security measures that were provided across the university SHFs as well as the lapses in the provision. This process helped to establish the facts surrounding the security issues in the SHFs from a different perspective and to gain deeper insight of what was been studied. Observations were carried out for the period of one week: Monday 15th April – Friday 19th April 2019. This was done after a permission letter was granted to the researcher.

The observations revealed that most of the SHFs lack CCTV, fencing around the hostel, electronic coded locks on the doors and weapon detectors at security checkpoints to the residence. Additionally, it was observed that while lighting was provided across the residences, the surroundings were sometimes dark at night due to inadequate lighting on campus especially where student residences were located. Another area of concern during the observations was the security guard at the entrance of SHFs. It was observed that some security guards did not always stay at post as required. The majority of the SHFs at the university have security gate but not controlled with functional smart card which allows strangers to gain free access to the SHFs. Only four SHFs were using biometric identification at the time of the observations.

Interview

A semi-structured interview was used to allow the interviewer to probe the views of the interviewee. It also ensured that definite answers were obtained from definite questions, while allowing for the further development of the answers provided. The respondent was first informed about the focus of the interview prior to the meeting; allowing her to adequately prepare for the interview in advance. The interview with the SHE officer was conducted on 22nd February 2019, between the hours of 9:00 am and 9:58 am.

At the time of the interview the safety officer pointed out that CCTV cameras were available in some of the SHFs. None of the CCTV in the SHFs were well-functioning at the time since the CCTV control room had been vandalised during the #FeesMustFall protest. However, she clarified that the control room was under renovation. In terms of

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access control with functional smart card, the safety officer indicated that there was no smart card access control in the postgraduate SHF. The officer, however, stated that most of the undergraduate SHFs had biometric system, although not all were in good working condition. The respondent revealed that security guards are expected to be on duty 24 hours a day. In terms of written policy prohibiting vandalism in the SHFs, the safety officer clarified that there is a rule book for the students which stipulates such policies. In terms of security patrol around the SHFs especially at night, the officer stated that it is expected that the security supervisor(s) would do hourly checks as well as campus security patrol.

Regarding electronic locks on the hostel doors, the officer stated that: “this can only be found at the postgraduate residence now; however, students are expected to use padlocks”. With regards to lighting at night in and around the hostel, the officer explained that campus require adequate lighting at night, especially in the immediate surroundings of the SHFs. She did acknowledge the need for improvement. Lastly, she confirmed that there was no specific fencing around all the SHFs, though there was a major fence that ran along the campus boundary. She indicated that though the main entrance gate was monitored and controlled, the exit at the rear side of the campus was not properly monitored always.

**QUESTIONNAIRE**

**Profile of respondent**

Table 1 below indicates that 40.8% (69) of the respondents are male while 59.2% (100) are female. This is an indication of a fair representation of both genders. 88.8% (150) are undergraduate students, 11.2% (19) are postgraduate students. 52.7% (89) of the respondents have been living in the residence for 3 years or more, 45.0% (76) for 2 years, 2.4% (4) for a period of 1 year. More than 97% of the respondents had lived in the hostel for 2 years or more, which is a good indication that most of the respondents have a good understanding and experience of the safety requirements of SHFs and the risk of non-provision. 4.7% (8) of the respondents are coloured, 93.5% (158) are black, and 1.8% (3) are white. A possible reason for these numbers could be relocation factor, since many black students come from other provinces (Eastern, Northern Cape, Limpopo, and Mpumalanga Province) of the country. This effect could necessitate their living in the on-campus residence. The age of the respondents who partook in the study ranged from less than 20 years (1.8%), 20 – 25 years (66.9%), 26 – 30 years (21.9%), 31 – 35 years (8.3%) and more than 36 years (1.2%). It is evident that over 98% of the respondents were above 20 years. This shows that most of respondents are matured and have a clear understanding of their needs.

**TABLE 1**

**PROFILE OF RESPONDENTS**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Respondents</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>69</td>
<td>40.8</td>
</tr>
<tr>
<td>Female</td>
<td>100</td>
<td>59.2</td>
</tr>
<tr>
<td>Total</td>
<td>169</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level of study</th>
<th>Respondents</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undergraduate</td>
<td>150</td>
<td>88.8</td>
</tr>
<tr>
<td>Postgraduate</td>
<td>19</td>
<td>11.2</td>
</tr>
</tbody>
</table>

**Level of provision of security measures in the SHFs**

The Mean Scores (MSs) obtained (see Table 2) indicate that lighting at night in/around the SHFs was ranked first as the most provided security measure with a MS of 4.02, whilst CCTV for monitoring was ranked as the most lacking security measure in the SHFs with a MS of 1.24. The findings further indicate that none of the measures was rated as “well provided”. Lighting at night in/around the SHFs with a MS of 4.02 and security guards on post with a MS of 3.61 were the security measures that were perceived as ‘provided’. Fencing around the SHFs with a MS of 3.07 and security checkpoints at the entrance of the SHFs with a MS of 2.99 were security measures that fell within ‘somewhat provided’. Security patrol around the SHFs with a MS of 1.81 fell within ‘poorly provided’. The MS of 1.24 obtained for CCTV for monitoring shows that participants perceived it as ‘not provided’.

*Level of provision of security measures in the SHFs*

<table>
<thead>
<tr>
<th>Years of living in the hostel</th>
<th>Respondents</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 years &amp; above</td>
<td>89</td>
<td>52.7</td>
</tr>
<tr>
<td>2 years</td>
<td>76</td>
<td>59.2</td>
</tr>
<tr>
<td>1 year</td>
<td>4</td>
<td>2.4</td>
</tr>
<tr>
<td>Total</td>
<td>169</td>
<td>100.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Race</th>
<th>Respondents</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coloured</td>
<td>8</td>
<td>4.7</td>
</tr>
<tr>
<td>Black</td>
<td>158</td>
<td>93.5</td>
</tr>
<tr>
<td>White</td>
<td>3</td>
<td>1.8</td>
</tr>
<tr>
<td>Total</td>
<td>169</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age group</th>
<th>Respondents</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 20 years</td>
<td>3</td>
<td>1.8</td>
</tr>
<tr>
<td>20 - 25 years</td>
<td>113</td>
<td>66.9</td>
</tr>
<tr>
<td>26 - 30 years</td>
<td>37</td>
<td>21.9</td>
</tr>
<tr>
<td>31 - 35 years</td>
<td>14</td>
<td>8.3</td>
</tr>
<tr>
<td>Over 36 years</td>
<td>2</td>
<td>1.2</td>
</tr>
<tr>
<td>Total</td>
<td>169</td>
<td>100.1</td>
</tr>
</tbody>
</table>

Other security measures rated as ‘not provided’ were access control with functional smart card, security alarm to sensitise in case of emergency, electronic coded locks on the doors at the hostel, and weapon detectors at security checkpoints. In fact, more than 60% of the respondents rated these measures as ‘not provided’.
### TABLE 2
LEVEL OF PROVISION OF SECURITY MEASURES IN THE SHFS

<table>
<thead>
<tr>
<th>SECURITY MEASURES</th>
<th>Response (%)</th>
<th>Mean score</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not provided</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unsure</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Lighting at night in/around the hostel</td>
<td>0</td>
<td>1.8</td>
<td>13.6</td>
</tr>
<tr>
<td>Security guard on post</td>
<td>0</td>
<td>1.2</td>
<td>17.2</td>
</tr>
<tr>
<td>Fencing around the hostel</td>
<td>1.2</td>
<td>29.0</td>
<td>7.1</td>
</tr>
<tr>
<td>Security checkpoints at entrance of the</td>
<td>87%</td>
<td>0%</td>
<td>7%</td>
</tr>
<tr>
<td>hostel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Security signs for warning</td>
<td>5.9</td>
<td>32.5</td>
<td>18.3</td>
</tr>
<tr>
<td>Written policy prohibiting vandalism</td>
<td>13.6</td>
<td>34.3</td>
<td>11.2</td>
</tr>
<tr>
<td>Notice board displaying security policies</td>
<td>8.9</td>
<td>45.6</td>
<td>17.2</td>
</tr>
<tr>
<td>Security patrol around the hostel</td>
<td>3.6</td>
<td>46.2</td>
<td>31.4</td>
</tr>
<tr>
<td>Access control with functional smart card</td>
<td>2.4</td>
<td>60.4</td>
<td>17.2</td>
</tr>
<tr>
<td>Security alarm</td>
<td>11.8</td>
<td>62.7</td>
<td>10.7</td>
</tr>
<tr>
<td>Electronic coded locks (doors at the</td>
<td>0.6</td>
<td>74.6</td>
<td>10.7</td>
</tr>
<tr>
<td>hostel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weapon detector at security checkpoint</td>
<td>4.7</td>
<td>80.5</td>
<td>7.1</td>
</tr>
<tr>
<td>CCTV for monitoring</td>
<td>4.1</td>
<td>77.5</td>
<td>15.4</td>
</tr>
<tr>
<td>Average mean score</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 3
RISK ASSOCIATED WITH ABSENCE/LACK OF SECURITY MEASURES IN THE SHFS

<table>
<thead>
<tr>
<th>SECURITY MEASURES</th>
<th>Response (%)</th>
<th>Mean score</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not provided</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unsure</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Absence of security guard on post</td>
<td>0</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Poor Lighting at night</td>
<td>0</td>
<td>0.6</td>
<td>1.2</td>
</tr>
<tr>
<td>Absence of weapon detector</td>
<td>0</td>
<td>0</td>
<td>0.6</td>
</tr>
<tr>
<td>Absence/lack of security alarm</td>
<td>0</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Poor access control</td>
<td>1.2</td>
<td>0.6</td>
<td>2.4</td>
</tr>
<tr>
<td>Lack of CCTV for monitoring</td>
<td>1.2</td>
<td>0.6</td>
<td>1.2</td>
</tr>
<tr>
<td>Lack of security patrol around the hostel</td>
<td>0</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>Loose/porous security checkpoints</td>
<td>0.6</td>
<td>0.6</td>
<td>1.8</td>
</tr>
<tr>
<td>Lack of fencing around the hostel</td>
<td>0</td>
<td>1.2</td>
<td>4.7</td>
</tr>
<tr>
<td>Absence of electronic coded locks(doors)</td>
<td>0</td>
<td>1.2</td>
<td>5.9</td>
</tr>
<tr>
<td>Lack of security signs</td>
<td>0.6</td>
<td>0.6</td>
<td>1.2</td>
</tr>
<tr>
<td>Lack of written policy (vandalism)</td>
<td>0.6</td>
<td>1.2</td>
<td>4.7</td>
</tr>
<tr>
<td>Lack of notice board (security policies)</td>
<td>0</td>
<td>1.8</td>
<td>6.5</td>
</tr>
<tr>
<td>Average mean score</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Risk associated with lack of security measures in the SHFs**

The MSs obtained reveals that the lack or absence of any of the security measures poses a high risk/very high risk. The MSs obtained ranged from 4.55 and 3.93. Most of the respondents responded in the range of ‘high risk’ to ‘very high risk’ for all security measures except for lack of notice boards to display security policies in the hostel. The absence of security guard on post was perceived to pose the greatest risk (4.55), followed by poor lighting at night (4.52). The overall mean score obtained is an indication that absence of these security measures in the SHFs would pose danger to the students. See Table 3.

**Level of provision versus level of risk of absence**

The paired t-test depicted in Table 4 reveals the gaps in the MSs. It is evident from the paired t-test (gap analysis) that most of the security measures have huge gaps. The least gap is -0.5 which is the lighting at night whereas the biggest gap is -3.23 which is weapon detector. Other security measures with very substantial gaps are provision of CCTV (-3.08), access control (-2.63), electronic coded locks on the doors (-2.60), security patrol around the hostel (-2.51), security alarm to sensitise in case of emergency (-2.79). Although the degree of differences demonstrated varies, the significant 2-tailed value obtained for all the measures were less than 0.05, demonstrating that there are statistically significant differences between the provision and risk associated with the lack or absence of the security measures.
TABLE 4
LEVEL OF PROVISION VERSUS LEVEL OF RISK OF ABSENCE

<table>
<thead>
<tr>
<th>SECURITY MEASURES</th>
<th>MS Provision</th>
<th>MS Risk</th>
<th>MS Difference</th>
<th>T value</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting at night in/around the hostel</td>
<td>4.02</td>
<td>4.52</td>
<td>-0.5</td>
<td>-5.057</td>
<td>0.000</td>
</tr>
<tr>
<td>Security guard on post</td>
<td>3.61</td>
<td>4.55</td>
<td>-0.94</td>
<td>-9.781</td>
<td>0.000</td>
</tr>
<tr>
<td>Fencing around the hostel</td>
<td>3.07</td>
<td>4.16</td>
<td>-1.07</td>
<td>-8.694</td>
<td>0.000</td>
</tr>
<tr>
<td>Security checkpoints at entrance of the</td>
<td>2.99</td>
<td>4.29</td>
<td>-1.30</td>
<td>-10.508</td>
<td>0.000</td>
</tr>
<tr>
<td>hostel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Written policy prohibiting vandalism</td>
<td>2.47</td>
<td>4.03</td>
<td>-1.49</td>
<td>-11.776</td>
<td>0.000</td>
</tr>
<tr>
<td>Security signs for warning</td>
<td>2.56</td>
<td>4.06</td>
<td>-1.50</td>
<td>-11.982</td>
<td>0.000</td>
</tr>
<tr>
<td>Notice board displaying security policies</td>
<td>2.05</td>
<td>3.93</td>
<td>-1.88</td>
<td>-15.409</td>
<td>0.000</td>
</tr>
<tr>
<td>Security patrol around the hostel</td>
<td>1.81</td>
<td>4.32</td>
<td>-2.51</td>
<td>-25.648</td>
<td>0.000</td>
</tr>
<tr>
<td>Electronic coded locks (doors at the</td>
<td>1.55</td>
<td>4.14</td>
<td>-2.59</td>
<td>-23.490</td>
<td>0.000</td>
</tr>
<tr>
<td>hostel)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access control with functional smart card</td>
<td>1.71</td>
<td>4.34</td>
<td>-2.63</td>
<td>-26.153</td>
<td>0.000</td>
</tr>
<tr>
<td>Security alarm</td>
<td>1.58</td>
<td>4.36</td>
<td>-2.79</td>
<td>-26.876</td>
<td>0.000</td>
</tr>
<tr>
<td>CCTV for monitoring</td>
<td>1.24</td>
<td>4.33</td>
<td>-3.08</td>
<td>-33.496</td>
<td>0.000</td>
</tr>
<tr>
<td>Weapon detector at security checkpoint</td>
<td>1.25</td>
<td>4.49</td>
<td>-3.23</td>
<td>-42.545</td>
<td>0.000</td>
</tr>
<tr>
<td>Mean average</td>
<td>2.30</td>
<td>4.27</td>
<td>-1.97</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Discussion

It can be deduced from the findings that most of the security measures are either poorly provided or not provided at all in the SHFs. In fact, measures including; CCTV for monitoring, access control with functional smart card, security alarm to sensitise in case of emergency, electronic coded locks on the doors at the hostel, and weapon detectors at security checkpoints were rated as ‘not provided’. The observations and interview conducted by the researchers established the lack of and/or poor provision of most of these security measures. For example, the interview with the SHE officer revealed that CCTV was not provided in some of the SHFs. The interview also revealed that the control room which was vandalised by students during the #FeesMustFall protest rendered most of security measures on campus non-functional. The provision of CCTV would certainly prevent crime and violence by minimising the presence of motivated offenders in and around university environment. Although participants rated lighting at night as ‘provided’, it was observed that lighting was not very well provided at night as surrounding and rear side of some SHFs were dark during the observation. This was confirmed by the SHE officer who indicated that some form of maintenance is required. The average MS of 2.29 obtained for the level of provision of security measures in the SHFs is an indication of ‘poor provision’. Other studies also highlighted the absence and/or poor provision of some of these security measures in the on-campus SHFs of some South African tertiary institutions [13, 14]. Without doubt, the absence or poor provision of security measures poses a high risk to the students residing in the on-campus SHFs. The MSs obtained in Table 3 reveals that the absence of all security measures poses varying levels of risk in the SHFs. Risk is a situation involving exposure to danger, fear, threat, harm, hazard, or loss because of presence or omission/absence of safety/security measures [20]. The overall MS (4.26) obtained reveals that respondents and interview conducted by the researchers established the absence/lack of provision of SHFs security measures would expose them to danger. This deduction is supported by other studies which indicate that students place high importance on SHF safety [13, 21, 22, 23]. The observations and interview conducted confirmed the absence of some security measures in the SHFs. The absence of security measures in the university infrastructure could result in theft, crime, and violence acts. On the extreme, the lack of safety and security measures on campuses could lead to death [18]. There are several instances in recent times when students were abducted, assaulted, molested, and murdered in/around their residence because of poor security measures. From the gap analysis (Table 4), it is obvious that most of the security measures have huge gaps; the significant 2-tailed value indicates that the gaps are statistically significant. Although the gaps are significant, the degree of significance and variance demonstrated varies. Therefore, as much as all the security measures need attention, the level of attention required would not be the same. Consequently, the level of attention required could be prioritized into three – high, medium, and low.

The specific measures that require urgent attention and categorised as high priority are: weapon detector, CCTV, security alarm to sensitise in case of emergency, access control with functional smart card, electronic coded locks on the doors at the hostel, and security patrol around the hostel. It is revealing that all these measures had gaps exceeding -2.50. Also, more than 60% of the respondents rated these measures as ‘not provided’. Moreover, the interview and observations did highlight lapses in these measures.

The second category of measures are fencing around the hostel, security checkpoints at entrance of the hostel, written policy prohibiting vandalism, security signs for warning, and notice board displaying security policies. It is worth noting that none of these measures was rated as ‘provided’, they were either rated as ‘somewhat provided’ or ‘poorly provided’. Although these measures are comparatively performing better than the first set of measures, their level of performance is unacceptable.

The third set of measures are categorised as low priority. These measures are security guards on post and lighting at night. In fact, these two measures were rated as ‘provided’ and had gaps below -1.00. The fact that the gaps between the provision and risk are significant indicates that improvements are required.

CONCLUSION

On-campus SHFs promote the living and learning experience and enhances students’ interactions. This cannot be achieved if security of students is compromised. Consequently, the provision of adequate security measures in the on-campus SHFs is essential. The study assisted in identifying security measures that are provided and those that are lacking, as well as the perceived risk of the non-provision of such security measures. The findings reveal that whilst the provision of the security measures is unsatisfactory, the absence/lack of security measures were perceived to pose a very high risk in the SHFs. The risk associated with the poor/lack of provision could be calamitous. This study contributes to the body of knowledge in SHF security measures. With specific reference to this case (university), it is recommended that these security measures (weapon detector, CCTV, security alarm, access control, electronic coded locks on the doors, and security patrol) be urgently improved whilst the other measures are not neglected. It is also recommended that SHE officers, facility managers, and university maintenance departments ensure a regular security and safety inspections of SHFs so that lapses that may result in safety risk could be identified and rectified timely. This recommendation should be adopted by other universities since there are evidence of security lapses in the majority of SHFs in South Africa. Furthermore, a study that expands the number of participating universities is recommended.
SATISFACTION LEVEL OF THE RDP HOUSING BENEFICIARIES IN BLOEMFONTEIN, SOUTH AFRICA
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Received: 8th April 2020
Accepted: 11th May 2020

Abstract
Purpose
The government of South Africa has, over the years, provided social housing for the less privileged citizens with income below R3,500 per month. The goal of the government is to encourage a cohesive society through a maintainable human settlement development and an excellent housing system supported by a funding mechanism for various groups with different income levels. The level of satisfaction of people who benefit from the South African government housing scheme has not been adequately investigated. The study, therefore, sought to examine the satisfaction level of the beneficiaries of the RDP housing programme in Bloemfontein.

Methodology
A quantitative study, which entailed a sample of 523 contractors in four South African provinces, and the circulation of a self-administered questionnaire, enabled the essential factors that contribute to poor productivity on South African construction projects to be determined. The data analysis entailed the computation of descriptive statistics.

Findings
The findings reveal that in terms of housing units, people are generally satisfied with items such as the house given to them, exterior finishes, the plot size, the house position whilst they are dissatisfied with items such as the climate condition of the house, noise control in the house, the sizes of the bedrooms, kitchen, lounge area, toilet and bath and the number of rooms. However, in terms of the entire housing community, respondents were satisfied with items such as electricity supply, drainage systems, transport services, and the availability of shops whilst they were not satisfied with the road network, water supply, and general safety level of the community. In all situations, where respondents indicate satisfaction, they were comparing the current situation to their previous living conditions before the allocation of the houses.

Value
The study has discovered the flaws in the implementation of the RDP social housing, which has generated dissatisfaction among the beneficiaries. The study thus gives an insight to the government the areas that need to be improved upon in future implementation of similar projects.

Keywords: Beneficiaries, Bloemfontein, government, housing programme, satisfaction, RDP house

INTRODUCTION
In 1994, after the government took office as the first government elected democratically in South Africa, the government promised to address the housing needs of the citizens with an extensive capital subsidy programme. As a newly elected government, the main focus was to eradicate the housing deficit experienced by the majority of the citizens as a result of the apartheid policies that excluded black South Africans from all the economic activities and social interventions. A White Paper on Housing was therefore introduced in 1994 to enable about 3.7 million housing units to be constructed for the citizens, which included subsidised stand-alone houses and rental housing. The African National Congress (ANC) also introduced the Reconstruction and Development Program (RDP) document in 1994, to fulfil the Constitutional requirement through the provision of housing facilities to the poor, low income and disadvantaged groups. Since 1994, the government has been constructing low-cost housing in the suburbs of urban areas. Accordingly, the Department of Human Settlement claims that since the inception of the RDP programme, the government at the end of 2010 constructed 2.85 million houses, which shelter more than 14.0 million people, at no cost to the beneficiaries.

The government RDP housing in Bloemfontein started in 1995, to do away with the informal settlements located mainly at the south-eastern corridor of the Bloemfontein metropolitan area. The houses are built around the periphery of Bloemfontein, where land was readily available for utilisation by the government. Originally, the houses were a single storey building comprising of 2 or 1 bedroom, lounge/kitchen, and toilet/bath; however, two-storey buildings were later constructed to maximise the use of space available. RDP housing is believed to accommodate more than 70,000 people in Bloemfontein.

Housing and human settlements, according to Godehart, stand at the convergence point of shelter, accommodation,
opine that aside from the facilities available and Elsinga and Joekstra, the residential improvement, tried to access how residents of residential satisfaction in Lagos, Nigeria: Feedback for the building of new houses and modification of existing empirical evidence to assisting policymakers in planning therefore welcomed as it will form a piece of effective owners and inhabitants see them as an important asset. These circumstances, housing is now perceived as an economic revival concurrently. Besides, housing, and human settlement arrangement have to be a crucial asset component for the poor. The notion worried about the philosophies of addressing housing as housing has now metamorphosed from being primarily neglected by society and the economic systems. Due to the variances in the meaning of satisfaction, various firms notion has been used to assist planners, housing designers, where the house is located. The housing satisfaction concepts are very vital in the enhancement of the quality feelings about the housing unit as well as the environment of the family. Ogu 24 also sees housing satisfaction as a concept normally used to assess people's perceptions and feelings about the housing unit as well as the environment where the house is located. The housing satisfaction concept has been used to assist planners, housing designers, developers, and policymakers who assist in the provision of housing. According to Porteous 18, when the RDP was first introduced, R15,000 per household was the maximum value and to be eligible, the monthly household incomes should be below ZAR 3,500, the people in the households should be adults with legal residency in South Africa, should have no formal housing, must have never benefited from state housing allocation, and must have dependents. Additionally, as stated by the Minister of Human Settlements in 2014, the beneficiaries who were 40 years and below would not be given a high priority 1. However, currently to qualify for RDP housing, ‘one must not be less than 18 years; must be married or single with dependants or co-habiting with a partner for a long time; or the applicant may be married, single, divorced or cohabitating with proven financial dependants; the combined monthly income of the household must not exceed R3 500; must be unemployed; must either be a South African citizen or a foreigner with a permanent residence permit; may not have received an RDP home before 5’. RDP housing is built primarily in the suburbs of cities where cheaper plots are obtainable. The houses entail a single storey building comprising of 2 or 1 bedroom, lounge/kitchen, and toilet/bath occupying 20 to 30m² and can also be the reconstruction of existing buildings 5.

After delivering about 2.7 million dwellings by the year 2014 19, the UN-Habitat highly praised the programme as a success 20. However, according to Gilbert, 21 evidence of criticism of the programme include the development of new buildings characterised by small, low-quality units, in less advantageous urban peripheries where land is believed to be cheap and uncontested. Also, the programme's capability to have significant effects on alleviating poverty and inequality is questioned. Quality housing allocation and economic strength is disputed, resonating deliberations on this subject 21. As Donaldson 22 suggests, the development of early post-apartheid did not have an appropriate structure, basic amenities, health facilities, educational facilities, open places, and other services. The main emphasis in the establishment and execution of RDP was to resolve the socio-economic imbalances that existed during the previous apartheid administration and to provide good social amenities for less privileged South Africans through the use of tax money 17. The government did not only consider the lessening of the poverty burden but also utilised the RDP to build tougher macro-economic environments. This approach, according to Fieuw and Mitinn 1, used by the ANC government aimed to achieve a “triple-win” that would address low-income households' needs, stimulate the stressed construction industry, and facilitate economic revival concurrently.

Reconstruction and Development Programme (RDP) Housing in South Africa

RDP housing is a South African socio-economic program executed by the ANC government under Nelson Mandela in 1994 after the discussions, negotiations, and consensus amongst the ANC, the Congress of South African Trade Unions (COSATU) and the South African Communist Party (SACP), and the civil society in general 17. The government, after the negotiation, committed to improving access to housing from 1994 significantly and substantially as more than 15 million people were staying in the informal houses, and the possibility of accelerated suburbanization was eminent 1. The need and right to housing were therefore recognized and was incorporated in Section 26 of the Bill of Rights in the 1996 Constitution, and the government, therefore, planned to build 1 million houses in five years to fulfill the ANC party's RDP election manifesto. Many scholars have investigated the residential satisfaction of the occupants having occupied the houses for a period of time. Jiboje 18, in his study titled “Post-occupancy evaluation of residential satisfaction in Lagos, Nigeria: Feedback for residential improvement,” tried to access how residents of a housing scheme are satisfied having occupied the facility for some time, however, his study concentrated on the privately-owned estate housing. Likewise, Diaz-Serrano 14 and Elisenga and Joeksha 13 tried to investigate the extent to which homeownership makes one become satisfied with the house they live in; however, their studies were done in Spain and The Netherlands respectively. Again, Nazyddiah and Mohit 16 researched the social housing programme and how satisfied are the inhabitants of Malaysia. Housing satisfaction research in South Africa, in particular, is hard to come by. Aglbavio and Thwala 13, did a study on the satisfaction level of the RDP dwellers in the Gauteng province of South Africa. Having studied the literature on housing satisfaction, it was evident that little has been done when it comes to the Free State province of South Africa; thus, it imperative to research the satisfaction level of those who are the beneficiaries of the government social housing the Free State. This study, therefore, investigated whether the beneficiaries within the social housing communities in Bloemfontein, Free State are satisfied with the houses allocated to them and the communities within which such houses are situated. According to Porteous, 18 when the RDP was first introduced, R15,000 per household was the maximum value and to be eligible, the monthly household incomes should be below ZAR 3,500, the people in the households should be adults with legal residency in South Africa, should have no formal housing, must have never benefited from state housing allocation, and must have dependents. Additionally, as stated by the Minister of Human Settlements in 2014, the beneficiaries who were 40 years and below would not be given a high priority 1. However, currently to qualify for RDP housing, “one must not be less than 18 years; must be married or single with dependants or co-habiting with a partner for a long time; or the applicant may be married, single, divorced or cohabitating with proven financial dependants; the combined monthly income of the household must not exceed R3 500; must be unemployed; must either be a South African citizen or a foreigner with a permanent residence permit, may not have received an RDP home before 5”. RDP housing is built primarily in the suburbs of cities where cheaper plots are obtainable. The houses entail a single storey building comprising of 2 or 1 bedroom, lounge/kitchen, and toilet/bath occupying 20 to 30m² and can also be the reconstruction of existing buildings 5.

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Housing satisfaction measurement factors

Productivity is a multi-dimensional concept that could be measured based on the two main indicators. These indicators depend on the objectives involved; the objectives, in turn, define the parameters included in its assessment concerning the benchmark housing satisfaction, according to Jiboje, 13, is made up of the following: (1) a respondent's needs and aspiration and the reality of the current residential context. Likewise, McCray and Day 23 define housing satisfaction as the level of acceptance exhibited toward the state of the current housing by an individual or a related member of the family. Ogu 24 also sees housing satisfaction as a concept normally used to assess people's perceptions and feelings about the housing unit as well as the environment where the house is located. The housing satisfaction concept has been used to assist planners, housing designers, developers, and policymakers who assist in the provision of housing. According to Porteous 18, when the RDP was first introduced, R15,000 per household was the maximum value and to be eligible, the monthly household incomes should be below ZAR 3,500, the people in the households should be adults with legal residency in South Africa, should have no formal housing, must have never benefited from state housing allocation, and must have dependents. Additionally, as stated by the Minister of Human Settlements in 2014, the beneficiaries who were 40 years and below would not be given a high priority 1. However, currently to qualify for RDP housing, ‘one must not be less than 18 years; must be married or single with dependants or co-habiting with a partner for a long time; or the applicant may be married, single, divorced or cohabitating with proven financial dependants; the combined monthly income of the household must not exceed R3 500; must be unemployed; must either be a South African citizen or a foreigner with a permanent residence permit, may not have received an RDP home before 5’. RDP housing is built primarily in the suburbs of cities where cheaper plots are obtainable. The houses entail a single storey building comprising of 2 or 1 bedroom, lounge/kitchen, and toilet/bath occupying 20 to 30m² and can also be the reconstruction of existing buildings 5.

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determining their customer’s/occupant’s satisfaction level. It is of no surprise that satisfaction evaluation has been perceived as widely adopted descriptive factors that are dependent on the individual point of view 30.

32. A quantitative research approach allows for measuring attitudes and the use of descriptive statistics to analyse data 33. There are numerous techniques for analysing data; however, in this study, the frequencies of the responses were generated and then, the mean and standard deviation scores were calculated for each of the research variables and ranked in descending order.

Sampling method and size
Sampling is the selection of manageable people from the entire population of which data are obtained in such a way that the researcher can generalize the findings to reflect the views of the entire population 34. To arrive at the representative sample size, the Manguang Municipality was contacted for the information regarding the total population of each of the seven communities and based on that sample size was derived for each community. The total population of the seven communities was about 494,860 at the time of the survey 5. The random selection technique was adopted to choose respondents from the target population within seven (7) government RDP housing communities in Bloemfontein. Welman et al. 35 suggest that if random sampling is used for gathering data in a study, then the sample size used should not necessarily be more than 500, irrespective of the size of the population. Taking the view of Welman et al. 35 into consideration, the sample size of 1893 used for this study is adequate. The distribution of the 1893 respondents in the seven communities in Bloemfontein is as follows: 396 in Namibia, 199 in Bloemside, 250 in Buchabela, 289 in Grassland, 295 in Batho, 271 in Rockland, and 233 in Turflaagte.

Response rate
A total of 2000 questionnaires were printed to be used for the survey, of which 1952 were used, and all of them were received back, indicating a 100% response rate. However, after screening all the questionnaires received, 1893 out of 1952 were used for the analysis. A total of 59 questionnaires were rejected due to some inconsistencies detected, and some of them were also not fully completed.

Data collection method
R programming language software 38 was used to calculate the P-values, generate the frequencies and percentages, and to analyse data using descriptive statistics such as mean scores, standard deviations, and rankings. The frequencies and percentages of responses were generated and reported to analyse the respondents’ profile, nature of the houses allocated to them, and the facilities available in the houses. To analyse respondents’ satisfaction level with the housing units and housing communities, the percentages, frequencies, mean scores, and standard deviation of responses were generated. The mean scores were used to enable them to have a better understanding of the questions being asked and hence assisted the respondents to respond appropriately. The survey was done by six research assistants over two months, between December 2018 and February 2019. Questions used in the questionnaire were derived from the review of the related literature and the government policy document on the RDP housing programme. The questionnaire was divided into four sections. Section three is a set of 18 variables that influence satisfaction with the housing units (see Table 4). These comprised variables such as the size of the plot, the position of the house, number of the doors, the house allocated to them, ventilation in the house, the drainage system around the house, safety of the house, exterior finishes, noise control in the house, number of rooms, privacy of the house, space around the house, size of the lounge area, interior finishes, the climate condition of the house, sizes of the bedrooms, size of the kitchen, and size of the toilet and bath which are related to their houses. Section four is a set of 7 variables that influence the satisfaction with the housing community (see Table 5). These comprised of variables such as shop availability, transport services, electricity supply, water services, drainage systems, general safety, and road networks. Respondents were required to indicate, by ticking the satisfied or unsatisfied column in each of the variables, whether they are satisfied or not concerning each of the listed variables concerning the houses allocated to them by the government. The survey questionnaire was designed as a close-ended type. According to Kotthar 37, close-ended questionnaires are easy to handle, simple to answer, and relatively quick to analyse.

Data analysis and interpretation
Based on the literature review about the factors that affect housing occupants’ satisfaction and the main objectives of the South African government social housing programme, the factors stated in Figure 1 were used to measure the satisfaction level of the social housing beneficiaries in this study. From Figure, the satisfaction measurement factors are divided into two main components; factors related to the housing units occupied by the beneficiaries and factors available in the communities where the houses are located.

Figure 1
Satisfaction measurement factors adopted for this study
Source: Researcher’s construct

RESEARCH METHODOLOGY

The purpose of the study was to assess the satisfaction level of the government RDP housing beneficiaries in Bloemfontein, South Africa, following a quantitative approach. This approach allows for the use of structured questionnaires surveys, enabling researchers to generalise their findings from a sample of the population 31
rank the variables in order of importance in descending order. For the purposes of analysis, it is important to note that the variables with more than 50% frequency were either categorised as being satisfied or unsatisfied and vice versa. If a variable has a frequency of more than 50%, then the respondents are satisfied with that particular variable, and if a variable has less than 50% frequency, then respondents are unsatisfied with that variable. P-values were then calculated to determine the significant levels of the variables measured. The P-values were set at 5% (p < 0.05), where a value of <0.05 (nearer to zero) means that the variable shows strong significance to be set as a factor to measure satisfaction with the housing units and housing communities.

FINDINGS

Respondent’s profile
Based on the frequency of occurrence, the demographic data of the respondents, as indicated in Figure 2 show that the majority (65.24%) are women, and most of the respondents are over 20 years. The majority (68.73%) of the respondents are also unemployed whilst a significant number (41% and 29%) of them received their houses between the years 2001 and 2010 and are not direct beneficiaries (renting or purchased) of the house, respectively.

FIGURE 2
RESPONDENTS’ PROFILE

Gender of the respondents

<table>
<thead>
<tr>
<th>Gender</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>34.60%</td>
</tr>
<tr>
<td>Female</td>
<td>65.24%</td>
</tr>
<tr>
<td>Non-binar</td>
<td>0.16%</td>
</tr>
</tbody>
</table>

Ages of the respondents

<table>
<thead>
<tr>
<th>Year of house allocation</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995 - 2000</td>
<td>6%</td>
</tr>
<tr>
<td>2001 - 2005</td>
<td>5%</td>
</tr>
<tr>
<td>2006 - 2010</td>
<td>27%</td>
</tr>
<tr>
<td>2011 - 2015</td>
<td>14%</td>
</tr>
<tr>
<td>2016 - 2015</td>
<td>14%</td>
</tr>
<tr>
<td>2016 &amp; over</td>
<td>6%</td>
</tr>
<tr>
<td>Unsure</td>
<td>3%</td>
</tr>
<tr>
<td>Not</td>
<td>9%</td>
</tr>
</tbody>
</table>

Number of rooms in the houses received by the respondents

Figure 3 shows the frequency results from the descriptive analysis. Respondents were asked to mark the number of bedrooms within the house allocated to them. This question was asked to enable the researchers to familiarise themselves with the number of rooms in the individual household and to compare it with the family sizes. Brevery, the essential parts of the communication are recorded below.

The site manager acknowledged the relevance of the identified CLP factors to the realities of South African construction. He further expressed that the variables connected with influence arrows are largely related except for the aspect that relates to the client. The site manager
Out of 1893 respondents interviewed, 90 (representing 4.75%) received a one-bedroom house whilst 1803 (representing 95.25%) of them received a two-bedroom house. None of the respondents received 3- and 4-bedroom houses.

Respondents views on the facilities available in their houses
Table 2 shows the frequency and rank results from the descriptive analysis of facilities available at the house. Based on the results, the most prevalent facility in the housing units of the respondents is electricity (37.13%), ranked 1, and water (36.19%), ranked 2.

### TABLE 2
FACILITIES AVAILABILITY WITHIN THE HOUSING UNIT

<table>
<thead>
<tr>
<th>Facilities available at the house</th>
<th>Frequency</th>
<th>Percentage (%)</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>1888</td>
<td>37.13%</td>
<td>1</td>
</tr>
<tr>
<td>Water</td>
<td>1811</td>
<td>36.19%</td>
<td>2</td>
</tr>
<tr>
<td>Bath or shower</td>
<td>564</td>
<td>11.27%</td>
<td>3</td>
</tr>
<tr>
<td>Kitchen Cabinet</td>
<td>463</td>
<td>9.25%</td>
<td>4</td>
</tr>
<tr>
<td>Porch or balcony</td>
<td>304</td>
<td>6.08%</td>
<td>5</td>
</tr>
<tr>
<td>Toilet</td>
<td>4</td>
<td>0.08%</td>
<td>6</td>
</tr>
</tbody>
</table>

Respondents views on the facilities available in their houses
Table 2 shows the frequency and rank results from the descriptive analysis of facilities available at the house. Based on the results, the most prevalent facility in the housing units of the respondents is electricity (37.13%), ranked 1, and water (36.19%), ranked 2.
Also, the respondents have a bath and shower and kitchen cabinet (ranked 3 and 4) in their house, respectively. A few respondents (6.08% and 0.8%) have a porch or balcony in their houses.

Respondent responses to their satisfaction level of the houses allocated to them

Respondents were asked to indicate whether they are satisfied or not concerning predetermined measurement factors, as indicated in Table 3.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Total N</th>
<th>Satisfied</th>
<th>Not satisfied</th>
<th>Mean</th>
<th>SD</th>
<th>Test P-Val</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shop availability</td>
<td>1893</td>
<td>92%</td>
<td>8%</td>
<td>1.09</td>
<td>0.28</td>
<td>0.000</td>
<td>1</td>
</tr>
<tr>
<td>Transport services</td>
<td>1893</td>
<td>87%</td>
<td>13%</td>
<td>1.13</td>
<td>0.34</td>
<td>0.000</td>
<td>2</td>
</tr>
<tr>
<td>Electricity supply</td>
<td>1893</td>
<td>82%</td>
<td>18%</td>
<td>1.18</td>
<td>0.39</td>
<td>0.000</td>
<td>3</td>
</tr>
<tr>
<td>Water Services</td>
<td>1893</td>
<td>67%</td>
<td>33%</td>
<td>1.33</td>
<td>0.47</td>
<td>0.000</td>
<td>4</td>
</tr>
<tr>
<td>Drainage systems</td>
<td>1893</td>
<td>52%</td>
<td>48%</td>
<td>1.48</td>
<td>0.50</td>
<td>0.191</td>
<td>5</td>
</tr>
<tr>
<td>General safety</td>
<td>1893</td>
<td>42%</td>
<td>58%</td>
<td>1.58</td>
<td>0.50</td>
<td>0.000</td>
<td>6</td>
</tr>
<tr>
<td>Road networks</td>
<td>1893</td>
<td>38%</td>
<td>62%</td>
<td>1.62</td>
<td>0.49</td>
<td>0.000</td>
<td>7</td>
</tr>
</tbody>
</table>

However, in terms of general safety within the communities (ranked 6; mean=1.43), Safety of the house (mean=1.44) and Exterior finishes (mean=1.48). With significance (p-value) levels of smaller than 0.05, all the variables in this test except noise control in the houses (p=0.079), were significant. Therefore, all the variables in this test except noise control in the houses were good factors to measure satisfaction with the housing units allocated to respondents.

Respondent responses to their satisfaction level of the housing community

Again, respondents were asked to indicate their satisfaction level in relation to the predetermined measurement factors about the housing communities they live. Table 4 shows the ranking results from the descriptive analysis and the significant results on the level of satisfaction. The results indicate that respondents are happy with shop availability (ranked 1; mean=1.09), the transport services (ranked 2; mean=1.13). Most respondents are also satisfied with the electricity (ranked 3; mean=1.18) and water supply (ranked 4; mean=1.33), in the community, and the drainage systems (ranked 5; mean=1.48).

The ranking results from the descriptive analysis and the significant results on the level of satisfaction indicate that they are satisfied with the size of the plot (ranked 1; mean=1.22), Position of the house (ranked 2; mean=1.23), Number of the doors (ranked 3; mean=1.25), The house allocated (ranked 4; mean=1.33), Ventilation in the house (ranked 5; mean=1.40), The drainage system around the house (mean=1.43), Safety of the house (mean=1.44) and Exterior finishes (mean=1.48). With significance (p-value) levels of smaller than 0.05, all the variables in this test except noise control in the houses (p=0.079), were significant. Therefore, all the variables in this test except noise control in the houses were good factors to measure satisfaction with the housing units allocated to respondents.

DISCUSSION OF THE FINDINGS

Nature of the houses allocated to the social housing beneficiaries

It was evident from the findings that most of the houses allocated the beneficiaries are 2-bedroom houses, and this was confirmed by the 95% of the respondents. A few of the beneficiaries received a one-bedroom house. This means the government normally supplies 2-bedroom houses in the social housing scheme. This was supported by the official at the Department of Human Settlement (DOHS), that they mostly construct 2-bedroom flat; however, in some extreme circumstances such as where the person is alone. The 1-bedroom consists of an open plan for bedroom, kitchen and lounge area with an enclosed toilet and bath area; whilst the 2-bedroom plan is made up of an open plan for lounge and kitchen with an enclosed area for the bedrooms and the toilet and bath (see Figure 3, pictures A and B). In many cases, however, the toilets are constructed outside the houses (but within the premises) with attached sink for washing purposes (see Figure 3, pictures D). About 70% of the respondents benefited from the houses with separate toilet. The DOHS also stated that the government does not construct more than 2-bedroom houses for the social housing programme. It was therefore not surprising that none of the respondents received 3- and 4-bedroom houses. These findings also confirm the findings of Aigbavboa and Thwala 12, where almost all the houses they visited in their study were made up of 2-bedroom flats. All the houses are constructed with traditional building methods using blocks and mortar with corrugated aluminum roofing sheets. Surprisingly, the houses are not of the same size; some are bigger than the others even though they are of the same design. This finding also confirms that of Pottie 39, where they identified different sizes of the same 1-bedroom design in Braamfischerville in Johannesburg.

Facilities available in the social housing units

It is clear that the basic facilities available in social housing are electricity, water. The third-ranked facility is shower/bath followed kitchen cabinet, porch/balcony, and Toilet facility. Concerning the third-ranked facility (bath/shower), respondents stated that the government did not fix the fittings, so they had to buy the fittings and install them by themselves. It must be noted that the social houses allocated after 2016 came with a shower/bath fully installed.
Other respondents stated that they have to install their kitchen cabinet as they were not supplied by the government whilst others constructed their kitchen cabinets when they did an extension in the house. This revelation was surprising as the designs (see figure 4) makes provision for kitchen installation. Perhaps, due to a lack of proper monitoring systems, contractors omitted the installation of the kitchen cabinet without being penalized. It also came to light that the social housing constructed after 2016 have a kitchen cabinet fully installed by the government before the allocations were made. Some of the beneficiaries also constructed the balcony as an extension of the house since the RDP houses do not make provision for balcony or porch (see Figure 4). Most of the houses constructed in the early days of the programme have their toilets situated outside the house but within the compound with sink attached to it (see Figure 3, picture D). The houses with toilets inside were mostly allocated after 2016. Even the houses with toilets, some respondents stated they had to install their own fittings as the contractors did not install any fittings for them before the houses were handed over to them. Like the case of the kitchen installation, contractors omit the installation of the toilet and bathroom fittings, and the inhabitants have no choice than to construct their toilet and bath.

Satisfaction level of the housing units allocated

From the findings, the majority of the respondent were happy with in terms of the size of the plot, position of the house, number of the doors, the house allocated to me, ventilation in the house, the drainage system around the house, safety of the house, and the exterior finishes. Respondents were of the opinion that as compared to the informal houses they used to stay, the current plot size is far better. Likewise, most of the respondents stated that the house is better as compared to the informal houses (shack) they used to stay. Also, about 32% of the respondents who indicated their happiness of the houses given to them received their houses within the last 5 years; hence their houses were constructed with fairly good finishes and were in good shape. The finding on the respondents’ satisfaction with the ventilation of the houses is in contrast with the findings of Aigbavboa and Thwala 12, and Moolla et al. 40 were the majority of the respondents’ ranked ventilation as dissatisfactory. The 2-bedroom flats have 2 doors, which is enough for such a number of rooms; thus, it was not surprising that respondents were happy with the number of doors available in the houses.

It was surprising that 57% of the respondents stated that they were satisfied with the drainage systems around their houses as there was no proper drainage system around the houses. Perhaps they are satisfied because their houses do not get flooded during the raining seasons. Again, exterior finishes of the houses are not in good shape, yet most (52%) of them were satisfied, even though a sizeable number (48%) were also not satisfied as their houses were not plastered and painted (Figure 5, picture A). It is interesting to note that, in all the measurement factors that the respondents indicated their happiness, they were comparing the current situation to the previous situations where they used to live in informal settlements (shack) where the safety of the structures was non-existing. One can, therefore, presume that it is not the occupants of these houses are absolutely satisfied with what they have, but in comparison with their previous living conditions, they have somewhat seen an improvement.
Respondents were not satisfied with the measurement factors such as noise control in the house, the number of rooms, the privacy of the house, space around the house, size of the lounge area, interior finishes, the climate condition of the house, size of the bedrooms, size of the kitchen, and size of the toilet and bath. Respondents complained bitterly about the lack of fencing around the houses (see figure 6, picture A), making it accessible by anyone at any time. Some respondents stated that they had used their resources to construct a fence around their houses to be safe (see figure 6, picture C). The majority of the houses have no insulation and ceiling, making noise control a difficult task (see picture A of figure 5). Respondents were also not happy with the sizes (66%) and number (53%) of the bedrooms. They indicated that the number of rooms in the house allocated to them is not enough to accommodate their families. They complained that the bedrooms are too small as compared to the standard bedroom. This is as a result of the limited square metre (20-30m²) area that the residents have no insulation and ceiling, making noise control a difficult task (see picture A of figure 5). Respondents were also not happy with the sizes (66%) and number (53%) of the bedrooms. They indicated that the number of rooms in the house allocated to them is not enough to accommodate their families. They complained that the bedrooms are too small as compared to the standard bedroom. This is as a result of the limited square metre (20-30m²) area that the residents have.
It was, however, interesting to note that respondents are satisfied with the drainage systems in the communities, as this is non-existent. There is barely any proper drainage system identified during the site survey interviews. Some pipes which we think were meant for the construction of drainage systems in one of the communities were seen lying along the roads (see Figure A and C of figure 7). However, a significant number of them (48%) are also not satisfied with drainage systems in their communities. In terms of general safety within the communities, 58% of the respondents stated that they are not satisfied with the safety issues as they feel unsafe when they go out to do their normal businesses. Some respondents indicated situations where people are attacked by the gang in broad daylight, taking all their personal valuables, and even warned us to be careful about our safety as we move around. This indicates how fragile the safety issues within the communities are. Not surprisingly, 62% of the respondents are generally not satisfied with the road network in social housing communities. The road networks in the RDP housing communities are untarred and at a deplorable stage with no proper linkages and drainage systems, making the movement of people very difficult, especially during the raining seasons (see Figure A and B of Figure 7). According to Narizan and Hashim, residents also rate their happiness based on the nature of the environment where they live. This means that residents may be happy if they stay in a healthy and safe environment, even though they may not be satisfied with their individual place of abode.

Conclusion and recommendation

Social housing is a noble idea that every government must undertake to bridge the gap between the ‘haves’ and ‘have-nots’ in the society and also to enhance the existing circumstances of disadvantaged individuals in the concerned country. It is, therefore, a good course of action that the government of South African, after coming into office in 1994, decided to embark on the social housing programme to enhance the lives of previously disadvantaged citizens. This study was done to find out if the recipients of the social housing programme are pleased with the houses allocated to them.

The results of the research have revealed that in general, the beneficiaries are satisfied with the social housing programme in terms of the house unit allocated to them, ventilation of the house, the safety of the house, the number of doors available within the house, the size of the plot, drainage systems around the house and the positioning of the house. However, the beneficiaries are not satisfied with the number of rooms within the house, sizes of the rooms, size of the kitchen, size of the lounge area, size of the toilet and bath, interior finishes, the privacy of the house, noise control mechanisms and the climate condition of the house. In all, 51% of the participants were happy with the measurement factors attributable to their housing unit whilst 49% of them were not happy. Concerning the beneficiaries’ satisfaction level of the housing communities, it was revealed that they are satisfied with water services, electricity supply, drainage systems, transport services, and shop availability. The respondents are, however, dissatisfied with the road network within the communities and general safety within the communities. A significant number of them also raised issues with the drainage problems within the communities. On average, 66% and 34% of the respondents were satisfied and not satisfied with the community measurement factors. It must also be emphasized that in most cases where the respondents were indicating their satisfaction, they were comparing their current situation to the previous situation where they were living in an informal settlement (shack structures). It must be stated that a sizeable number of people who were satisfied with the houses allocated them received their houses with the last 5 years, hence their houses were constructed with good finishes and in a fairly good state at the time of the survey. One can, however, conclude that social housing beneficiaries in the study communities are generally satisfied with the housing unit given to them and the communities where they live.

It is recommended that the government should revisit the RDP housing communities constructed in the early stages and renovate the houses and make them more comfortable for the occupants. Currently, most of the houses are not conducive to human habitation as compared to the recently built social houses. The government should also consider the family sizes in the allocation of the houses if the aim is to enhance the lives of the beneficiaries as currently, the number and sizes of the rooms are highly disproportionate to the family sizes, which makes it uncomfortable for the inhabitants. The government should also take measures to improve the road network and drainage systems within the RDP housing communities. The government should institute measures to ensure safety within the communities to enable people to go about their normal day to day activities without any fear of being harmed. These measures, if implemented by policymakers, will help people to have confidence in staying the RDP housing communities and thereby helping the government to achieve the aims of the social housing programme.

Limitation of the study

The study was conducted in seven RDP housing communities in Bloemfontein city. The findings can thus not be generalized in the whole Free State Province of South Africa.

Acknowledgement

My sincere thanks to the Central Research Fund (CRF) of the University of the Free State for funding this research. I also thank Mr. Sean van der Merwe of the statistics department of the University of the Free State for analyzing the research data.
References

THE CONTRIBUTION OF BIM TOWARDS ECONOMIC FEASIBILITY STUDIES IN QUANTITY SURVEYING PRACTICE: A SYSTEMATIC LITERATURE REVIEW

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Received: 20th April 2020
Accepted: 29th May 2020

Abstract

A potential usage of BIM, among others, has been identified as assisting with feasibility studies in quantity surveying practice, making it easier and more reliable. The purpose of this study is to gather and plot the contribution of BIM towards feasibility studies in the concept and viability phase as reflected in current construction literature.

Research Design

Through a comprehensive systematic literature review, the study only examined those articles that found contributions of BIM towards feasibility studies emanating from quantity surveyors (QSs). In doing so, these articles were critically appraised. The systematic literature review was conducted for 67 articles collectively, and seven themes where identified.

Findings

5 Dimensional (5D) BIM mainly contributes towards feasibility studies by making automated quantity take-off possible on designs that were done during the developmental phase of the feasibility study. The design produced during this stage, has minimal information. The disadvantage of BIM is its inability to contribute to other sections of the feasibility study, such as: other project cost, revenue estimate and calculation of the return. QSs will need to make use of both automatic features and personal knowledge and skills when developing a feasibility study while using 5D BIM. Currently, BIM contributes minimally towards feasibility studies and the efficiency and efficacy thereof. Additionally, the accuracy and usability of the data in the model is highly dependent on the expertise level of the professionals.

Value

This study contributed by providing some clarity on the usage of BIM concerning feasibility studies in the concept and viability stage. This could be of assistance in guiding QSs and their usage or future adoption of BIM.

Keywords: BIM, feasibility studies, quantity surveying, preliminary cost estimation, 5D BIM

INTRODUCTION

According to Wong [1], the dissatisfactory performance of quantity surveyors (QSs) is pushing the quantity surveying profession to pursue higher efficiency methods, as compared to the existing and traditional working methods. Economic feasibility studies entail the economic feasibility and benefits of construction projects and are compiled by QSs. It is seen as one of their core tasks as it supports decisions with regards to the continuation of a construction project [2]. Reliability and accuracy is thus imperative [3]. Although feasibility studies are vital in the construction industry, they often do not meet the quality requirements which leads to poor investment decisions [4]. Thirty percent of projects exceed the original project budget [5]. This means that the feasibility study misinformed the investment decision, which leads to client dissatisfaction [6]. Supporting this, a study indicated that 68% of errors occur within construction projects on preliminary cost estimates [6]. This study aims to provide clarity on the contribution of BIM towards feasibility studies in the concept and viability stage. This could be of assistance in improving the quality of feasibility studies and guiding QSs and their usage or future adoption of BIM. The main factors that influence the accuracy of feasibility studies are: the quality and amount of information available at the time, the time allocated for the preparation thereof, proficiency of the QSs and the tools and techniques used [7].

A feasibility study that is concerned with the economic benefit of the construction project consists of:

- a preliminary cost estimate of the construction works,
- project costs like professional fees,
- land cost,
- marketing fees etc.,
- an estimate of the income/revenue
- and a calculation of the potential return against the total project cost [8].

There are six construction phases: Inception, concept and viability, design development, documentation and procurement, construction and lastly close-out. The feasibility study is developed in the second phase, being the concept and viability phase. Furthermore, the preliminary cost estimate depends on quantification and costing of the items [9]. Building Information Modeling (BIM) consists of various dimensions: 3D (designed components), 4D (3D interlinked with time schedules), and 5D (4D interlinked with cost information). QSs utilize 5D BIM for cost estimation [10]. Quantity take-off can be automated by extracting quantities from BIM models with software tools such as Navisworks [11], Autodesk QTO, CostX, Innovaya, and Vico Take-off Manager [12, 13]. There are three methods to utilize automated BIM quantity take-off for cost estimation. The first option is to export quantities from BIM to an estimating software, secondly, BIM can directly be linked to the estimating software and lastly a BIM quantity take-off tool can be used [14]. Quantity take-off based on BIM provides an easier compilation and yet more accurate and detailed cost estimates of construction projects, contributing to a reduction of time and expenses [15]. An additional benefit of BIM models are the 3D visualization that makes the design easier to understand and interpret [16]. However, the QS is required to acquire the knowledge and skill of using digital software related to BIM over and above their traditional skills and knowledge for it to be beneficial [16].

METHODOLOGY

This study has been undertaken as a systematic literature review. The goal of the review is to present the contribution of BIM towards feasibility studies in quantity surveying practice based on the available literature. The primary database used was Google Scholar due to it being a large and multidisciplinary database that helps identify the most relevant literature. Wits E-Library was used to gain access to articles where Google Scholar did not grant it. A database search was conducted using the key words: “BIM” or “5D BIM”, “quantity surveying” or “cost engineering”, “feasibility study” or “studies”, and “cost estimation”. The timeline chosen for the search was 2010 – 2020 in order to make use of the most relevant literature. The search presented 84 articles that was then saved to a library. The titles and abstracts of these articles were reviewed. Articles were eliminated if: it was not relevant to the goal of the review; it was not peer reviewed; the studies were not conducted in the construction industry and not QS related; it is not in the English language; it was a duplicate. After the elimination, 29 articles remained. The full articles were then thoroughly reviewed and the relevant data was extracted. Analysis and presentation of the results followed and lastly the interpretation thereof.

A second search was conducted that included all phrases: “BIM” or “5D BIM”, “quantity surveying” or “cost engineering”, and “cost estimation”. Therefore, the second search excluded feasibility studies as a key phrase, since cost estimation is the section of the feasibility studies that utilises BIM. The same process applied in the first search was applied in the second search. The second search presented 365 articles. Only the 100 most relevant articles as presented by Google Scholar was taken into consideration. After elimination, 38 articles remained. A total of 67 articles were thus scrutinized while applying the key-words-in-context technique to identify themes. This process is illustrated in figure 1.

FIGURE 1

RESEARCH DESIGN

<table>
<thead>
<tr>
<th>Key phrases</th>
<th>Search 1</th>
<th>Search 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Articles found</td>
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<td>356</td>
</tr>
<tr>
<td>Relevant articles</td>
<td>29</td>
<td>38</td>
</tr>
<tr>
<td>Total</td>
<td>67</td>
<td></td>
</tr>
</tbody>
</table>
LITERATURE REVIEW

Seven themes were identified from the 67 articles.

Theme 1: Identifying feasibility studies as a potential use of BIM
BIM could potentially be used to contribute to feasibility studies [17-25] while making it more credible [21, 22]. BIM is also considered to be more beneficial towards feasibility studies than traditional methods [23]. The articles claim that BIM is beneficial towards the quality of feasibility studies, however the articles did not address how BIM can be utilized towards feasibility studies and lacks technical input. In addition, there is no reference to the construction stages applicable.

Theme 2: Feasibility studies can rely entirely on BIM
Feasibility studies can be prepared quickly and more accurately through 5D BIM [1]. It can provide an early opportunity for QSs to develop feasibility studies, while proving the maximized value to customers [10]. The method of preparing feasibility studies was explained by [24]; data of previous BIM models are used to cost similar projects. Of the 67 articles, 31 referred to automated quantity take-off of the designs only occur after the feasibility study stage, hence automated quantity take-off contribute minimally towards feasibility studies.

Theme 3: Lack of information available at feasibility stage
There are five levels of design in BIM, the first level (LOD 100) is used for feasibility studies. However this stage does not have much information yet [25], there are no detailed designs and information is limited [1, 7, 8, 15, 26, 27]. The most common complaint from QSs is that they are so busy dealing with assumptions that they do not have time to monitor the process [28]. Consequently, BIM is not contributing towards accuracy and efficiency of feasibility studies.

Theme 4: Automated quantity take-off minimally contributes towards feasibility studies
Of the 67 articles, 31 referred to automated quantity take-off through BIM to contribute to the preliminary cost estimate of the construction works [3, 9, 12, 14-16, 19-21, 27, 29-49] which is only one section of the feasibility study and is only really useful after a detailed design has been developed. Most of the design only occur after the feasibility study stage, hence automated quantity take-off contribute minimally towards feasibility studies.

Theme 5: What we put in is what we get out
The quantities and information that can be extracted from BIM is based on what is put in [50-52]. Cost estimation and feasibility studies rely highly on the completeness and accuracy of the digital designs [46], which needs to be established prior to the extraction of information [53]. Therefore, it all depends on who captured the data and how capable they are [54].

Theme 6: Issues regarding BIM and the execution of feasibility studies
5D BIM might have certain advantages, however QSs need to be 5D literate to make use of these advantages [16, 55] and technological constraints are significantly effecting the use of 5D BIM [44]. However, the software has not achieved a high efficiency yet, as the selection of the required elements from the designs and measurement are still based on manual procedures [36]. BIM does not assist with cost estimation itself, it only allows one to extract quantities that can be used for cost estimation. Thus, BIM needs further improvement to BIM-based cost estimation [87] as well as the expertise of the QS [18]. The process is not 100% automatic as there is still need for professional analysis and input to go into the model [58]. Furthermore, the challenge that goes with the extraction of quantities is the different measurement rules and standards that professionals face worldwide, as well as the various methods of building up the BIM model. This results in dissimilar quantities. For example, an opening could be created by using the opening tool, the opening family tool, edit profile tool or by void extraction, however, the only method that the openings gets identified is when it is created by using either the opening tool or opening family tool [59]. As conclusion, [43] proposed further standardization in construction by compiling construction elements’ reference books and databases for shared usage by architects, draftsmen, construction engineers and quantity surveyors for preservation of future management of the quantity take-off data.

Models are designed and developed by project team members other than the QS, therefore the first vital task for the QS is to evaluate the model for information richness and accurateness. Subsequently, numerous instances have been reported where the model lacked the required information to allow successful BIM-based measurements and quantity take-off [60]. Insufficient detail and a lack of information within BIM models causes design mistakes and erroneous estimates [54]. This causes QSs to spend more time examining the accuracy of the BIM prior to the extraction of the quantities, and sorting and splitting take-off items after extraction [60]. Furthermore, the QS relies on the naming of items, when the naming convention is altered by the designers, the link to the correct item and cost is lost [61]. Therefore, full automation of building quantities extraction might be undependable and still need a substantial amount of human involvement, to evaluate the data extracted from a BIM when compiling estimates [62], Smith [63] concluded that the three greatest issues of BIM are the quality and completeness of the models, access issues to the models due to designers not providing full access and compatibility problems with the software.

In addition to this, Olatunji and Sher [54] argues that while it is beneficial to extract quantities with one button, the quantity surveyor never comes to understand the building.

Theme 7: Quantity surveyors rarely use BIM for cost estimation
QSs are not using BIM for cost estimation [40, 49, 65] but rather prefers traditional methods [36, 64]. This could be because the design team does not issue the 3D models to the Qs [60]. QSs prepare cost estimates without following a design [18, 20, 66]. Furthermore, Qs have limited knowledge with regards to 5D BIM [49]. It is noted that some firms only use automated quantity take-off to the extent that they are feasible as much of the information is not processed by BIM.
available on the BIM models [50, 51]. Another survey done by Karamaena and Domingo [46] indicated that only 10% of QSs use BIM regularly and of the 10%, only 8% use it for the extraction of quantities. In Hong Kong it is mandatory to use BIM in the construction stages after the feasibility stage, but not for the feasibility stage itself [47], thus not recognising benefits of BIM in the feasibility stage. Ngo’s [12] survey concluded that only 7% made use of BIM and 93% of QSs stick to the traditional methods of cost estimation. Although, Babatunde et al. [11] found that 47% of quantity surveying firms have adopted BIM for detailed cost estimation. However, there has been limited studies on the cognitive reasoning that a professional follows when making decisions and linking the activities to form part of cost estimations [51], Xu et al. [51] claim that the aforementioned factors are seldom documented and that those particulars are not accessible to other professionals.

Summary
This study has been undertaken as a systematic literature review to report the contribution of BIM towards feasibility studies in quantity surveying practice. Seven articles mentioned that BIM could potentially contribute to feasibility studies. Four studies claim that feasibility studies can fully rely on BIM, however, eight studies emphasised feasibility studies and BIM contributes minimally towards feasibility studies and the efficiency and efficacy thereof. Additionally, the accuracy and usability of the data in the model is highly dependent on the expertise level of the professionals.

CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER STUDIES
5D BIM mainly contributes towards feasibility studies by making automated quantity take-off possible on the design that has been done at the time of developing the feasibility study. These designs however, provide minimal information that can contribute towards the cost estimation and does not have the QSs’ trust. This also means that BIM does not contribute to the other sections of a feasibility study: other project cost, revenue estimate and calculation of the return. QSs will need to make use of both automatic features and personal knowledge and skills when developing a feasibility study while using 5D BIM. Therefore, currently, BIM contributes minimally towards feasibility studies and the efficiency and efficacy thereof. Additionally, the accuracy and usability of the data in the model is highly dependent on the expertise level of the professionals.

Only a few studies were done that directly addressed feasibility studies and BIM. Further empirical studies should be conducted to understand the needs and requirements of QSs and developers, with regards to the collaboration of feasibility studies and BIM. Research on how feasibility studies can contribute to BIM could also be beneficial. Therefore this study recommends further research on how BIM could contribute to feasibility studies and vice versa. If BIM cannot adequately contribute to the quality of feasibility studies, then alternative methods for improvements should be researched considered. This study contributed by providing some clarity on the usage of BIM concerning feasibility studies in the concept and viability stage. This could be of assistance in guiding QSs and their usage or future adoption of BIM.

References
WOMEN AND OCCUPATIONAL HAZARDS IN CONSTRUCTION

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Received: 12th June 2020
Accepted: 7th July 2020

Abstract

Purpose of this Paper
Although gender inequalities exist in the workplace, very little is known about the gender-differences in working conditions in the construction industry. This paper examines the issues relating to women’s occupational health and safety in the construction industry.

Design/Methodology
A comprehensive review of studies available in the Web of Science (WoS) and Scopus database focusing on gender relations in occupational exposures and outcomes in construction between 2000 and 2020 was conducted. Key terms such as gender, women, health, safety, and construction were used to retrieve 47 related documents.

Findings
Most of the articles included in this study were conducted in the United States of America, the United Kingdom, Canada, South Africa, Philippines, and Australia. Women were found to suffer from occupational injuries and accidents that were gender-specific, unique to their gender, and less prominent among men. It was revealed that a gender-sensitive approach to health and safety might be beneficial in the analysis of men’s and women’s occupational health and safety experiences. Findings showed that to promote the health and ensure the safety of women on construction sites, factors needing consideration are physical work capacity, personal protective equipment, and anthropometry, biological and physiological composition.

Originality/Value
This study provides insights on the occupation hazards experienced by women and discusses recommendations on how to address health and safety concerns of women involved in construction activities.

Keywords: Construction, gender, gender differences, women’s health, workplace safety

INTRODUCTION

Health and safety expectations of men and women are affected by macro-level influences, including social structures that shape the way people live and behave (1). For a complete understanding of occupational health and safety issues, it is increasingly recognized that it is important to consider gender (12,18).

Gender determined by socio-cultural beliefs of identities, roles, and functions attributed to masculinity and femininity is evident in the different health behaviors and safety-seeking attitudes of individuals (2). Gender refers to social and cultural constructs rather than the biological characteristics of men and women. It is determined by socio-cultural beliefs of identities, roles, and functions attributed to men and women. Gender is perceived as a socially constructed attribute that prescribes relationships, norms, responsibilities, and roles of men and women. Empirical evidence suggests that gender, which is associated with social and cultural practices through which men and women, live, behave and express themselves based on sex and gender identities attributed to an individual’s perception of their gender on the constructs of masculinity and femininity may influence health and safety attitudes (3) (10,17).

Studies undertaken on health and safety in male-dominated occupations have identified hemicmasculinity associated with strength, aggression, courage and undertaking dangerous activities that put workers’ health and safety at risk, as the most appreciated form of masculinity (4-6,10). Conceptualizations of masculinities have been adopted to examine occupational health and safety issues in traditionally masculine professions (1). Men’s lifestyle and health-seeking behaviors have been portrayed as an ideal representation of masculinities (9) (10,10). A gender-relations approach recognizes the significance of differences and gender dynamics, and it’s influences on health and safety opportunities and challenges at work (11).

Construction has not been an obvious career choice for women all over the world as a result of the strongly held masculine perception that they are not suited for the industry and related challenges they encounter (11-14). For example, the terrain of physical work and ergonomic hazards is one challenge. Legislative frameworks have aimed to amend past inequalities in the construction industry and promote the inclusion of women in core construction activities and management functions (15). Despite the advocacy for liberalisation and feminisation concerning gender roles, traditional stereotypes regarding occupations continue to dominate both in theoretical discourses and practice (16). Gender disparities exist in the workplace, which sometimes influences occupational health and safety practices. Women all over the world constitute a minority in the construction workforce and, compared to their male counterparts, have unique health and safety needs as construction work exposes them to high risks of injuries and fatalities (14).

Numerous construction activities have been found to pose substantial health and safety hazards to women workers (17). In Europe, North America, and Africa, women workers compared to men are more susceptible to work injuries and hazards because of their physiological characteristics (18). Women workers are more prone to die in work-related car accidents and homicides compared to their male counterparts (17). Between 2009 and 2019, an average fatality rate recorded for women construction workers was found to be significantly higher than the average fatality rate for women workers in other industries, indicating that women were more likely to experience health and safety risks in construction than in any other industry (11,15). Men and women are vulnerable to different types of occupational health hazards (14,19). Statistical data on health and safety shows that explicit gender differences exist in occupational health and safety (12,14). Women are exposed to work-related accidents and injuries that are specific to their gender. Several studies have identified very few studies focusing on gender-specific health and safety hazards (12) (19) (23). Therefore, there is less knowledge of occupational health and safety issues faced by women than by men. The horizontal and vertical segregation of working conditions, especially in male-dominated occupations, has been identified as one of the reasons for different work-related health and safety threats between men and women (12,14). The inequalities in labor put women at higher risks of injuries and accidents (21). Women in non-traditional occupations such as construction are subjected to greater risks of discrimination and harassment (22).

Women compared to men are exposed to more severe musculoskeletal disorders, fatigue, stress, and cardiovascular conditions because of repetitive activities, standing postures, and overexertions (10,17,19). Men and women are differently exposed to toxins, radiations, and chemicals that could affect their reproductive health (11), in men, sperm quality and sexual performance may be affected (16). Women are exposed to risks that can have adverse effects on breastfeeding, fertility, pregnancy outcomes, and menstrual health (27). Further aggravating women workers’ health and safety are the deficient health and safety regulations covering them (24). High probabilities of exposure to health and safety hazards combined with poor policies, labour conditions, and advocacy towards the protection of women can place women in perilous situations in the management of their health and safety needs (6,24). Previous studies on occupational health and safety have explored variances in workplace injuries and accidents based on biological differences (12,25).

AIM OF THE STUDY

This study examined the current health and safety challenges faced by women in construction. Previous studies undertaken in the subject area were identified to: (i) examine existing labour issues about women health and safety in the construction; (ii) identify gender-differences in working conditions relating to occupational health and safety issues encountered by construction workers and (iii) identify research gaps relating to women’s workplace health and safety in construction.

Data Source And Method

The Scopus and Web of Science (WoS) databases were selected as data sources for this study because of their comprehensiveness and wide coverage of publications (26) (27). Scopus and WoS are considered as a major scientific research database. They are regarded as fast-growing databases in terms of providing researchers with information on the most prominent academic literature in any scientific domain (28) (29) (30) (31). The database and retrieval strategy were initially selected to prepare a data source with enough accuracy and robustness. A two-step screening was conducted to filter relevant publications from the retrieval results based on types of publication types and other criteria.

The online retrieval was conducted on March 25, 2020, and 9537 data records were obtained. A keyword search was conducted to retrieve all related publications. Initial descriptors adopted for the study were “Gender AND “Women AND “Construction AND “Workplace” AND “Gender role” AND “Health” AND “Safety.” The literature
selection focused on journal articles and conference proceedings that addressed issues of women's health and safety at the workplace as it relates to gender in construction. Journals and conference papers are considered more reliable sources of literature review and provide detailed information compared to other sources [30][31].

In the first selection stage, reports, trade publications, and editorial materials were excluded from the data set. After filtration, a total of 4662 relevant publications were used for the second stage of literature selection. A preliminary review was further conducted by reviewing the titles, abstracts, and keywords of the 4662 publications. For a further selection and elimination of extraneous evidence, four filter criteria were applied to select publications that aligned with the research topic and theme.

The filter criteria were as follows:
1. Articles that did not present studies conducted in medicine, health sciences, engineering, gender studies, and occupational health and safety and were not construction related.
2. Articles that did not present studies on issues of women's health and safety on construction sites written in English language.
3. Articles that did not present construction safety-related studies conducted from 2000 to 2020.
4. Articles that focused on other aspects of health and safety but did not directly address issues of women's health and safety in construction concerning gender. For instance, evidence that only addressed one primary area of interest, such as women's health or only to gender, or only to issues of occupational risks and workplace culture were excluded.

After conducting the two-stage literature selection, a total of 47 publications remained, including 45 journal articles and two conference papers. Articles reviewed for the study were predominantly published in the US, UK, Canada, South Africa, Philippines, and Australia. An outline of the research design for the study is presented in Figure 1.

![Flowchart of Research Design](image_url)

**FIGURE 1** FLOWCHART OF RESEARCH DESIGN

**TABLE 1** RESULTS OF DATABASE SEARCH

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<tr>
<th>Filter Criteria</th>
<th>Document Output</th>
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<tr>
<td>Database Search</td>
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<td>Exclude Books, trade publications and book series</td>
<td>4662</td>
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<tr>
<td>Refine by language, construction related documents, gender, women construction health and safety</td>
<td>Find Output + 47 documents</td>
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**Are Men And Women Exposed To The Same Risks?**

Issues of gender and sexuality have been commonly ignored in occupational health and safety analysis [32]. There is a limited understanding of the gap between the health and safety issues of men and women [16]. Many studies have suggested that health problems arising from work can vary between individuals; therefore, there is a need to consider gender in the study of health and safety issues [33]. Several links have been found between occupational workplace exposures and health differences between men and women, or individuals with more masculine or feminine roles in the workplace [34].

Feminine work is associated with the responsibility of child and household care, flexible work hours compared to one's partner, and working in a female-dominated environment. In contrast, masculine work is associated with being the family breadwinner and working in a male-dominated environment [35][36]. Women and men experience health and safety issues differently and have distinct interactions with their working conditions [11].

As increasing numbers of women undertake non-traditional employment such as construction work, several gender-related issues regarding the differences in occupational health and safety risks among men and women have been raised [17][37][38]. Although a man and a woman might work in the same environment, their exposure to working conditions and work demands vary [33][38][39][40]. Due to their biological and physiological composition, women executing construction work have been termed as vulnerable workers with unique health and safety requirements [40]. Preventive and responsive safety mechanisms implemented by men and women are also different [3]. Women suffer from work-related accidents and injuries particular to their gender and methods of dealing with the different exposures vary compared to men [16]. Women in construction work are more prone to work-related car and fall accidents compared to their male counterparts [17]. In the UK, 37% of work-related accidents and 50% of workplace injuries and fatalities occur among women [4][15]. Of women involved in car fatalities, 30% are truckers [48].

Numerous studies have argued that occupational stress could lead to health problems such as musculoskeletal and cardiovascular disorders, insomnia, and depression [36][41]. Gender differences exist in the prevalence of musculoskeletal disorders resulting from exposures in the workplace [38]. Musculoskeletal disorders are common among men and women, but women are at a higher risk as many of the tools and pieces of equipment are not designed for them [41]. In comparison to men, women undertake more monotonous and repetitive tasks [34].

They have been found to remain in the same job longer than men, therefore increasing the chances of exposure to long-lasting risk [35]. Significant degrees of repeated movements put demands on the human body, resulting in overuse of muscle tissues and joints [42]. In the analysis of the health effects of repetitive work, it is, therefore, crucial to distinguish between moderate repetitive work and the highly monotonous activities undertaken by many women [42]. Also common in women are reproductive diseases [18]. Equipment, tools, and Personal Protective Equipment (PPE) for work is designed only to fit the male body leaving women with the dilemma of finding comfortable PPE with the right fit [14]. Uncomfortable work tools expose women to unsafe ergonomic conditions [34].

Prior efforts to address the issue of gender inequalities in the workplace have focused primarily on social inequalities [21]. This is a result of findings from previous studies that have suggested a relationship between workplace discrimination and its influence on workers’ health [42]. Gender inequalities in working conditions influence the health and safety of workers [20][43]. Women are predominantly concentrated in low-wage employment and dangerous work, which impacts their work environment and exposure to hazards [15]. Gender inequalities within and outside the work environment affect the occupational health and safety of women and further provides a platform for extensive discrimination of health and safety issues [14]. It has been conclusively shown that women’s occupational health and safety should be protected and supported by addressing health and safety issues specific to women [15]. Although the Occupational Health and Safety Act of numerous countries provides for the monitoring and promotion of a safety culture in construction work and also protects construction workers, there are no gender-specific provisions concerning health and safety conditions on construction sites [16][33].

Occupational Health and Safety regulations in high-risk occupations have focused majorly on activities performed by men and rarely on dangerous work performed by women in similar work [13]. Exposure of women to occupational health hazards have been underestimated, and analysis has been based on the male population [32]. Research on occupational health and safety issues has left the experiences of women invisible by commonly describing safety hazards through male-dominated occupations [33][34].
As women continually undertake construction work, their health and safety remain a subject of concern [14]. Empirical evidence suggests that an obstacle to the success of women in the construction has been linked to poor health and safety conditions [17] [38] [57]. There are health and safety problems specific to women’s construction. Numerous construction activities pose substantial risks to women workers [15] [37]. Women working on construction sites have identified lack of adequate sanitary facilities, masculine workplace culture, ergonomics, and reproductive hazards and ill-fitting PPE’s as the health and safety concerns that affect them [40]. Women undertaking male-dominated work are also susceptible to forms of stressors [14].

A considerable amount of literature has revealed that women in high-risk occupations may encounter health and safety hazards because of ill-fitting clothing and equipment provided at work [14] [16]. Reports suggested that ill-fitting PPE’s were a significant obstacle for women workers in construction [44]. PPEs and clothing worn by women are poorly fitted and designed for the male body, thereby preventing women from executing tasks safely [14] [24]. Respirators, safety boots, overalls, hard hats, and safety goggles provided may not fit the women because of their body shape and size [14]. Inadequate PPEs are cumbersome and increase the rate at which injuries and accidents to women workers occur in construction [15].

A study on women at work found a link between the adequacy of PPEs and job satisfaction and self-efficacy of women [14]. Women workers were found to be more productive when wearing PPE’s with the right fit [6]. A survey of the use of PPEs on construction sites found that women who had to wear extra items of clothing underneath their protective clothing to be able to fit as they were too large [44]. A similar study by the National Institute of Occupational Safety and Health (NIOSH) revealed that in the United States, 46% of women experienced difficulty in getting the right fit of protective shoes, 41% could not easily find their size of working gloves. In comparison, only 14% of PPE manufacturers produced women’s sizes of the standard construction tools [15].

Construction work often requires considerable physical effort, which involves working on informal sites and handling of materials and equipment [49]. Construction injuries are majorly caused by overexertion, falls, and collision with objects [13] [42]. High physical work demands are a primary source of work-related accidents [45]. Handling different construction tools and equipment and exposure to extreme environmental conditions could increase the risk of accidents, resulting in psychological stress and psychosocial strain [14] [47]. A considerable amount of studies revealed that women are not taken into consideration in the design of construction tools and equipment as these tools are often designed for men [15] [16] [44]. Women experience difficulties and physical challenges when lifting heavy objects [48]. Considerations regarding the body size of women are required when lifting and handling standard construction tools [14] [40]. Men and women come in different sizes, and their degree of muscular strength and pelvic structures vary [46]. Men usually possess a stronger body, larger hands, and better grip [43].

Lifting heavy objects is the most common cause of musculoskeletal diseases [15] [16]. Worldwide, musculoskeletal injuries and disorders are the most compensated occupational illness and prevalent among women bricklayers compared to other construction workers [44]. Data on injuries to women in construction showed that women were at higher risk of nerve disorders, carpal tunnel syndrome, sprain, and strain conditions compared to men [41].

Women at the early stages of pregnancy are at risk of exposure to hazardous chemicals and activities involving prolonged standing, climbing, and lifting. Some of these activities put them at further risk in the later stages of their pregnancy [46]. Predominantly, a considerable number of studies have reported that female construction workers usually must work within a few days of their due date and then resume work shortly after delivery [14] [49].

In male-dominated workplaces, the safe placement of women before and during pregnancy remains a challenge [20]. The vulnerability of pregnant women to workplace hazards is recognized by law [14]. The need for specific risk assessments cannot be overemphasized. Yet, employers are not obliged to conduct these assessments until a formal notice of her pregnancy is provided by the female employee [46]. Studies have found that many employers who identified risks during their assessment took no action [14] [50] [51].

Access to proper sanitary facilities has been identified as a drawback for women working construction sites as most employers fail to provide clean and adequate hygiene facilities to their workers [15]. A survey of women workers in construction in Chicago found that majority of the women had worked on sites where sanitary facilities were inappropriate and dirty [14]. Consequently, they contact bladder and urinary tract infections.

In previous years, before the link between health, safety and gender were established, occupational health and safety policies and regulations have ignored the distinct health effects of workplace hazards on men and women [14]. Gender-neutral policies have been developed with the assumption that all workers experience the same risks except for regulations prohibiting pregnant women from undertaking dangerous work [42]. In the Philippines, women working in high-risk occupations were found to be unaware of the types of substances they were in contact with at work. Information on the contents of these substances was not available to workers [24].

Labor supply and demand factors have been identified as reasons for labor gender segregation [51]. Arguments on labor supply focus on women’s preference for female-dominated employment while labor demand arguments emphasize on reasons why employers recruit men and women for different jobs [6]. Emphasis has traditionally been on preventing risks in dangerous male-dominated work such as construction, where ineffective risk management and safety policies can result in high workplace fatalities. Poor policies ignore and undercompensate for work-related injuries and accidents experienced by women. Findings from the study showed that the health and safety needs of women had been given very little attention. The belief that work undertaken by women is safe has hindered proper examination of the occupational health and safety hazards experienced by women. Health issues identified among women are usually attributed to unfitness for the tasks at hand.

The review further identified gaps concerning the health and safety of women at the workplace. Institutionalized stereotypical gendered interactions at the workplace may reinforce the expression of dominant masculinities in men and women. Workplace cultures influence the way individuals interact and behave within it. The culture is not gender-neutral but is built along the lines of gender. Women workers in male-dominated workplaces may encounter a range of criticism for not conforming to stereotypical

CONCLUSION AND RECOMMENDATIONS FOR FURTHER STUDIES

Gendered interactions and perceptions of gender are deeply rooted and often ignored. Consequently, discriminations based on gender may not be easily recognized unless stereotypes and institutionalized gendered practices and their influences on workplace attitudes, choices, and experiences are carefully examined. Emphasis has traditionally been on preventing risks in dangerous male-dominated work such as construction, where ineffective risk management and safety policies can result in high workplace fatalities. Poor policies ignore and undercompensate for work-related injuries and accidents experienced by women. Findings from the study showed that the health and safety needs of women had been given very little attention. The belief that work undertaken by women is safe has hindered proper examination of the occupational health and safety hazards experienced by women. Health issues identified among women are usually attributed to unfitness for the tasks at hand.

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masculine standards such as aggressiveness, toughness. Fear of facing consequences of their rebellion and violation of such stereotypes may force women to accept similar risks as men. An examination of the influence of gender roles and gendered workplace interactions on workers’ health and safety may provide information that could be used to develop and adopt effective occupational health and safety management systems in masculinised workplaces.

With the entry of more women into the male-dominated construction workplace, it is important to establish the role gender plays in health and safety hazards in construction. The study recommends that occupational health and safety management examine workplace health and safety issues from a gender-sensitive perspective by investigating how gendered socialization processes and existing workplace cultures can influence certain health and safety-seeking behaviors.

A gender-sensitive approach to workplace health and safety recognizes the differences between men and women workers, identifying the differences in risk exposures, working conditions, and developing strategies that would accommodate the health and safety needs of everyone. Considerations should be given to the effect of gender on workplace health and safety and the experiences of women to integrate the specific needs of women in the development of health and safety promotion policies.

ACKNOWLEDGMENTS

The financial assistance of the National Research Foundation (NRF) towards this research is hereby acknowledged. Opinions expressed and conclusions arrived at are those of the author and are not necessarily to be attributed to the NRF.

References

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JOURNAL OF CONSTRUCTION

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Effective communication
The paper should be written and arranged in a style that is succinct and easily followed. An informative but short title, a concise abstract and keywords and a well-written introduction will help achieve this. Simple language, short sentences and a good use of headings all help to communicate information more effectively. Discursive treatments of the subject matter are discouraged. Figures should be used to aid the clarity of the paper. The reader should be carefully guided through the paper.

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Preparation of the manuscript

Length
Although there is no length limitation, papers should preferably be between 3,000 and 6,000 words in length (8 to 12 pages). Longer papers will only be accepted in exceptional cases and might be subject to serialization at the discretion of the editor.

Layout
The manuscript must be in English, typed and 1.5 line-sped 10-pt Arial font type on one side of A4 paper only, with a 3cm margin on the left-hand side. All other margins are to be 2cm. All text should be linked to the left and right margins i.e. paragraphs should not be indented and text should be justified. One-line spacing should be left between paragraphs and double line spacing before a new heading. Leave one line space between a heading and the following paragraphs. All headings should be in 12pt bold capitals. Paragraphs and sub-paragraphs should not be numbered.

The pages should be numbered consecutively. There should be no loose addenda or notes or other explanatory material. The manuscript should be arranged under headings and sub-headings.

Title page (page 1)
The first page of the manuscript must contain a concise and informative title, a secondary running title of not more than 75 characters and spaces, the name(s), the affiliation(s) and address(es) of the author(s) and the name, address, telephone, fax and email of the author who will be responsible for correspondence and corrections. The title should be in 12pt bold capitals; the name(s) of the author(s) in 10pt bold upper and lower case and the affiliation(s) and address(es) in 10pt upper and lower case with a single line space between each.

Abstract and keywords (page 2)
To produce a structured abstract, complete the following fields about the paper. There are four fields which are obligatory (Purpose, Design, Findings and Value); the other two (Research limitations/implications and Practical implications) may be omitted if they are not applicable to the paper. Abstracts should contain no more than 150 words. Write concisely and clearly. The abstract should reflect only what appears in the original paper. Provide no more than 5 keywords.

Purpose of this paper
What are the reason(s) for writing the paper or the aims of the research?

Design/methodology/approach
How are the objectives achieved? Include the main method(s) used for the research. What is the approach to the topic and what is the theoretical or subject scope of the paper?

Findings
What was found in the course of the work? This will refer to analysis, discussion, or results. Research limitations/implications (if applicable) If research is reported on in the paper this section must be completed and should include suggestions for future research and any identified limitations in the research process.

Practical implications (if applicable)
What outcomes and implications for practice, applications and consequences are identified? Not all papers will have practical implications but most will. What changes to practice should be made as a result of this research/paper?

What is original/value of paper?
What is new in the paper? State the value of the paper and to whom. All headings and sub-headings should be in 10pt bold capitals and the keywords themselves should be in 10pt bold upper and lower case.

Introduction (page 3)
The introduction should clearly state the purpose (aims and objectives) of the paper. It should include key references to appropriate work, but is NOT the place for a comprehensive historical or literature review.

Discussion
The discussion should emphasize the implications and practical significance of research findings, their limitations, and relevance to previous studies. Acknowledgements: A short acknowledgement section of one paragraph is permissible at the end of the text.

Conclusions
Conclusions should state concisely the most important propositions of the paper, as well as the recommendations of the authors based on the propositions.

Illustrations
Illustrations must accompany the manuscript and should be included in the text. Photographs, standard forms and charts must be referred to as Figure 1, Figure 2, etc. They should be numbered in the order in which they are referred to in the text. The figure identification and accompanying descriptive and any reference should be one line space immediately below the figure and linked to the left margin. Illustrations should be submitted in a form ready for reproduction, preferably as high-resolution .jpg files. Diagrams and drawings should be drawn in black ink on white paper. Alternatively they should be high quality laser computer printouts from reputable computer software drawing packages.

Drawings and diagrams must not exceed 140mm in width and all dimensions must be in mm. Annotation must be in upper and lower case lettering, the capital of which should be 3mm high.

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Tables
Tables must be located close to the first reference to them in the text and must be referred to as Table 1, Table 2, etc. and be numbered in the order in which they are referred to in the text. The table identification and accompanying informative description and any reference should be one line space immediately above the table and linked to the left margin. The table identification should be in bold. Identify all statistical methods and sources of data. Tables should only have horizontal lines, the heading and bottom lines being in bold. All words should be in upper and lower case lettering. The headings should be aligned to the left of their column, start with an initial capital and be in bold. Units should be included in the heading. Any explanations should be given at the foot of the table, not within the table itself.

COMPONENTS OF EXPENDITURE

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Symbols, abbreviations and conventions in papers must follow the recommended SI units. Where non-standard abbreviations are used, the word(s) to be abbreviated should be written out in full on the first mention in the text, followed by the abbreviation in parentheses.

References:
The numbered superscript reference system must be used. References in the text should be numbered consecutively [1], etc. References should be collected at the end of the paper as they appeared in the manuscript.

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If no person is named as the author the body should be used for example: Royal Institution of Chartered Surveyors (1980) Report on Urban Planning Methods, London.

Endnotes

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