The Association of Schools of Construction of Southern Africa (ASOCSA) has been fairly active since the previous issue of the Journal of Construction (JoC). Achievements include application to the Department of Education to have JoC included on the list of approved journals, ASOCSA being registered as a Section 21 company, cementing of the relationship with the Council for the Built Environment (CBE), with CBE agreeing to sponsor the ASOCSA conferences for the next three years, participation of ASOCSA in the recent CBE symposium, and discussions with universities in Tanzania and Lesotho which have expressed interest in becoming members of ASOCSA, and the ASOCSA website, www.asocsa.org, going live.

Drawn from Zambia, Nigeria, Malaysia and South Africa, the papers in this issue clearly confirm the appeal of JoC to a broad spectrum of authors. In particular the papers address the issue of risk identification on community-based projects in Zambia, assessment of the quality of masonry blocks in Nigeria, plant and machinery health and safety management in Malaysia and the skills shortage of built environment professionals in South Africa. We hope that you will find these papers, though diverse and predominantly international in nature, of interest. We also welcome any comments you might have relative to all or any of papers.

Special thanks to each of the contributing authors and reviewers for their contributions to the papers in this issue.

Theo C Haupt
Cape Town, South Africa
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RISK IDENTIFICATION ON COMMUNITY-BASED CONSTRUCTION PROJECTS IN ZAMBIA

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ABSTRACT
The need to improve the socio-economic wellbeing of the citizenry has placed huge challenges on the provision of better social infrastructure in developing countries like Zambia. To help with meeting the challenges, inputs from local communities have been incorporated in infrastructure development in Zambia. The involvement of local communities in infrastructure development minimises construction costs compared to conventional construction modes and also instills a sense of responsibility in the community to look after the constructed infrastructure. However, the involvement of local communities in construction introduces a number of risks during the execution of the projects as the individuals involved may not be conversant with construction and the procedures involved in the procurement process. The consequences of not assessing and managing construction risks are that projects may experience time and cost overruns and lead to poor quality structures. The first step in the risk management process is risk identification. This paper discusses and highlights the results of the study that identified the risks involved in the procurement of community-based infrastructure projects in Zambia. The identified risks were classified into six categories, namely: project initiation, community contribution and participation, budget and finance, skilled labour, material procurement and technical supervision and quality control. Three risk factors were identified in the category of project initiation, five in the category of community contribution and participation, three in the category of budget and finance, three in the skilled labour category, four in the category of material procurement and three in the category of technical supervision and quality control.

KEYWORDS:
Risk Management, Risk Identification, Brainstorming, Community-based Construction

INTRODUCTION
Construction projects the world over are subject to tight constraints and uncertainties that constitute risks that threaten their smooth implementation [1]. Community-based construction projects are no exception. One way to achieve project objectives is by identifying and planning for the unexpected or unanticipated risks in the construction management process. The means by which uncertainty is systematically managed to increase the likelihood of meeting project objectives in construction is risk management [2]. Risk management, which is an on-going process due to the dynamic nature of many risks in construction, follows three main steps outlined below that may be repeated throughout the life cycle of a project [2,3].

• Risk identification – identifies all the risks that might impact the project, documents them and their characteristics.
• Response development – defines the risks, including their potential negative impacts, assigning probabilities to the risks and developing a strategy to reduce their possible negative consequences.
• Control – which involves the implementation of the risk strategy and continued monitoring of the project for secondary risks.

Construction management is risk management and it is imperative that risk management techniques are applied in all construction activities. All potential risks in community-based construction projects should therefore be identified, classified and analysed to determine the probability of occurrence and impact on project objectives should they occur. Thereafter, reduction measures that may include avoidance, transference, acceptance or mitigation are put in place.

This paper outlines the first step in risk management of community-based construction projects, which is risk identification. It describes the process of identifying risks in community-based construction projects in Zambia using the brainstorming technique. At independence in 1964, the population of Zambia was slightly above four million. By the early nineties, the population had more than doubled thereby putting a lot of pressure on the few socio-economic service infrastructures such as schools and hospitals that did not proportionately increase in relation to the population growth due to unfavourable economic factors. There was, therefore, need for the government to construct more schools, health centres and other infrastructure such as roads and bridges. Construction of infrastructure using traditional methods of contracting proved too costly, given the economic recession that had befallen the country.

In order to minimise costs of construction in view of scarce resources and to instil a sense of ownership after the projects were commissioned, the community-based mode of construction was introduced. In this concept, communities were required to participate in the procurement process of projects by contributing 25 percent of the cost of the project in terms of local labour and materials such as burnt bricks, crushed stones, river sand, building sand and timber. Other materials not available locally would be procured through a tender process at district or provincial level. A district technical team would monitor and supervise the project to ensure conformity to project guidelines up to handover stage. In the case of projects directly under the Ministry of Education, the provincial building officers assisted by district building officers would supervise the project.

In a significant number of cases, the execution of community-based projects has not been managed properly, thereby compromising the quality and durability of the structures constructed.

STUDY METHODOLOGY
Brainstorming is the most common risk identification technique used in risk management [4]. The process involves getting subject matter experts, project team members, risk management team members and anyone else who might benefit the process in one
place and asking them to start identifying possible risk events (5).

Brainstorming was chosen as the method for identifying risks in the study. It was applied in the form of group discussions with project management committees at community level in each of the nine provinces of Zambia to identify potential risks affecting their particular projects using seven guiding questions after a pilot study. Table 1 shows the sample project units for the brainstorming sessions. A sample of the list of guiding questions for brainstorming sessions is shown in Appendix A.

DATA COLLECTION FROM GROUP BRAINSTORMING SESSIONS
The data was collected between July 2006 and March 2007 and attendance for each of the brainstorming meetings ranged from 13 to 28. A number of risks were identified during the meetings.

Based on the research topic and the reviewed literature, the identified risks were classified into six categories as follows:

- Project initiation.
- Community contribution and participation.
- Budget and finance.
- Skilled labour.
- Materials procurement.
- Technical supervision and quality control.

STUDY RESULTS
Risks may or may not adversely affect a project (2). It is therefore important to identify the risks that would have a moderate or high probability of occurrence. The identified risks for each category were analysed to determine the percentage affirmative response by the nine group brainstorming sessions for each of the cited risks. This was one way to establish the priority order of the risks. A good description of a risk is essential to understanding it and a clearly defined risk would make it easier to predict impact of the event (2). It was therefore prudent that identified risks were clearly defined. In this study, a combined minimum affirmative response of 50% was considered good enough for identification of intermediate risks. Therefore, all risks that received affirmative responses of 50% or more of the brainstorming sessions were considered as moderate to high in terms of importance.

PROJECT INITIATION RISKS
Since the community initiated most community-based construction projects as beneficiaries, it was important that risks pertaining to project initiation were identified. Figure 1 shows a summary of the identified project initiation risks after analysis. From Figure 1, risks that scored more than 50% of the responses were considered to be of high significance under the category of project initiation.

Therefore, identified project initiation risks were:

- Unconfirmed sources of funds.
- Lack of technical advice.
- Lack of consensus.
- Lack of community sensitisation.
- Poor organisation.
- Lack of contributions.
- Delays in commencement.

COMMUNITY CONTRIBUTION AND PARTICIPATION RISKS
One of the major activities carried out by the beneficiary community for a project was to provide upfront locally available materials and unskilled labour. The materials may include crushed stones, river sand, building sand, sawn timber and burnt bricks in some cases. In the process of preparing upfront materials, a number of risks that could manifest were identified. Figure 2 shows a summary of the identified community contribution and participation risks after analysis.

From Figure 2, risks that scored more than 50% of the responses were considered to be of high significance under the category of community contribution and participation.

Therefore, identified community contribution and participation risks were:

- Adverse weather conditions.
- Logistical problems.
- Lack of cooperation.
- Non-conformity to standard specification.
- Inadequate bricks.

The risks identified during brainstorming sessions under the category of community contribution and participation are described in Table 2.

**Table 1: List of sample projects.**

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Province</th>
<th>District</th>
<th>Name of Project</th>
<th>Type of Project</th>
<th>Project Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Central</td>
<td>Mkushi</td>
<td>Kasokota School</td>
<td>Classroom block construction</td>
<td>Completed</td>
</tr>
<tr>
<td>2</td>
<td>Northern</td>
<td>Kaputa</td>
<td>Kaputa School</td>
<td>Classroom block rehabilitation</td>
<td>Completed</td>
</tr>
<tr>
<td>3</td>
<td>North-Western</td>
<td>Kasempa</td>
<td>Lufupa School</td>
<td>Classroom block construction</td>
<td>On-going</td>
</tr>
<tr>
<td>4</td>
<td>Copperbelt</td>
<td>Ndola</td>
<td>Northrise School</td>
<td>Classroom block construction</td>
<td>On-going</td>
</tr>
<tr>
<td>5</td>
<td>Luapula</td>
<td>Mansa</td>
<td>Lukangaba School</td>
<td>Classroom block construction</td>
<td>On-going</td>
</tr>
<tr>
<td>6</td>
<td>Western</td>
<td>Kalabo</td>
<td>Namatindi School</td>
<td>House construction</td>
<td>On-going</td>
</tr>
<tr>
<td>7</td>
<td>Lusaka</td>
<td>Chongwe</td>
<td>Chinyunyu School</td>
<td>House construction</td>
<td>On-going</td>
</tr>
<tr>
<td>8</td>
<td>Southern</td>
<td>Namwala</td>
<td>Kabulamwenda School</td>
<td>Laboratory construction</td>
<td>On-going</td>
</tr>
<tr>
<td>9</td>
<td>Eastern</td>
<td>Nyimba</td>
<td>Fumba School</td>
<td>Classroom block and house constr.</td>
<td>On-going</td>
</tr>
</tbody>
</table>

**Figure 1: Identified project initiation risks.**

Therefore, identified project initiation risks were:

- Unconfirmed sources of funds.
- Lack of technical advice.
- Lack of consensus.

The risks identified during brainstorming sessions under the category of project initiation were described in Table 2.

**Figure 2: Identified community contribution and participation risks.**

Therefore, identified community contribution and participation risks were:

- Adverse weather conditions.
- Logistical problems.
- Lack of cooperation.
- Non-conformity to standard specification.
- Inadequate bricks.
Table 2: Description of Project Initiation risks.

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Identified Risk</th>
<th>Description of Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unconfirmed sources of funds</td>
<td>Unreliable or unconfirmed sources of funding discouraged participation and hindered full cooperation with regard to material contribution</td>
</tr>
<tr>
<td>2</td>
<td>Lack of technical advice</td>
<td>Lack of clarity on the requirements for the project led to acquisition and preparation of wrong materials not meeting the standard engineering specifications</td>
</tr>
<tr>
<td>3</td>
<td>Lack of consensus</td>
<td>Communities’ failure to reach consensus on need and type of project led to some members not fully participating in the project</td>
</tr>
</tbody>
</table>

Table 3: Description of community contribution and participation risks.

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Identified Risk</th>
<th>Description of Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Adverse weather conditions</td>
<td>Heavy rainfall, flooding in the rainy season and other environmental conditions made it difficult to prepare materials for projects. This led to delayed implementation plans.</td>
</tr>
<tr>
<td>2</td>
<td>Non-conformity to standard specifications</td>
<td>Shapes and sizes of bricks varied due to lack of quality control measures at production. This led to poor quality brickwork.</td>
</tr>
<tr>
<td>3</td>
<td>Inadequate bricks</td>
<td>Bricks not moulded in adequate quantities in relation to project targets. This led to delayed implementation.</td>
</tr>
<tr>
<td>4</td>
<td>Logistical problems</td>
<td>Problems relating to transportation of materials in view of poor state of feeder roads posed difficulties in mobilisation of materials. This led to delayed implementation.</td>
</tr>
<tr>
<td>5</td>
<td>Lack of cooperation</td>
<td>Community members were unwilling to cooperate and contribute to the project due to government policy of free education. Some community members expected government to execute the projects.</td>
</tr>
</tbody>
</table>

Figure 3: Identified budget and finance risks.

BUDGET AND FINANCE RISKS

Financing is a major input in the implementation of any construction project and community-based construction projects are no exception. It was on this premise that risks associated with budgeting and financing of these projects were identified at group discussions.

Figure 3 shows a summary of the identified budget/finance risks after analysis. The respective percentage responses by the nine brainstorming sessions are indicated.

From Figure 3, risks that scored more than 50% of the responses were considered to be of high significance under the category of budget and finance. Therefore, identified budget and finance risks were:

- Delayed financial disbursements.

The risks identified during brainstorming sessions under the category of budget and finance are described in Table 4.

SKilled LABOUR RISKS

As is the case in all construction projects, skilled labour plays a pivotal role in the implementation of community-based construction projects. It was therefore prudent that risks associated with this resource were identified during brainstorming sessions.

From Figure 4 risks that scored more than 50% of the responses were considered to be of high significance under the category of skilled labour. Therefore, identified skilled labour risks were:

- PMCs incompetent to recruit skilled labour.
- Unavailability of skilled labour in the locality.
- Incompetent labour.
Unavailability of non-local materials in local shops.
- Lengthy tender processes.
- High transportation costs.
- Substandard materials purchased.

The risks identified during brainstorming sessions under the category of material procurement are described in Table 6.

TECHNICAL SUPERVISION AND QUALITY CONTROL RISKS

Quality is one of the three factors used to measure the success of any construction project including community-based ones. It was therefore important that risks that would impede the achievement of good quality work in community projects were identified.

Figure 6 shows a summary of the identified technical supervision and quality control risks after analysis.

The risks identified during brainstorming sessions under the category of skilled labour are described in Table 5.

MATERIAL PROCUREMENT RISKS

Procurement of non-local materials is an important aspect in the timely execution of construction projects. This was also true about community-based construction projects and it was therefore imperative that risks associated with this aspect of project implementation were identified.

Figure 5 shows a summary of the identified material procurement risks after analysis. The respective percentage responses by the nine brainstorming sessions are indicated.

From Figure 5 risks that scored more than 50% of the responses were considered to be of high significance under the category of material procurement. Therefore, material procurement risks were:

- Unavailability of non-local materials in local shops.
- Lengthy tender processes.
- High transportation costs.
- Substandard materials purchased.

The risks identified during brainstorming sessions under the category of material procurement are described in Table 6.

TECHNICAL SUPERVISION AND QUALITY CONTROL RISKS

Quality is one of the three factors used to measure the success of any construction project including community-based ones. It was therefore important that risks that would impede the achievement of good quality work in community projects were identified.

Figure 6 shows a summary of the identified technical supervision and quality control risks after analysis.

The risks identified during brainstorming sessions under the category of skilled labour are described in Table 5.

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Procurement of non-local materials is an important aspect in the timely execution of construction projects. This was also true about community-based construction projects and it was therefore imperative that risks associated with this aspect of project implementation were identified.

Figure 5 shows a summary of the identified material procurement risks after analysis. The respective percentage responses by the nine brainstorming sessions are indicated.

From Figure 5 risks that scored more than 50% of the responses were considered to be of high significance under the category of material procurement. Therefore, material procurement risks were:

- Unavailability of non-local materials in local shops.
- Lengthy tender processes.
- High transportation costs.
- Substandard materials purchased.

The risks identified during brainstorming sessions under the category of material procurement are described in Table 6.

TECHNICAL SUPERVISION AND QUALITY CONTROL RISKS

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Figure 6 shows a summary of the identified technical supervision and quality control risks after analysis.

The risks identified during brainstorming sessions under the category of skilled labour are described in Table 5.
The respective percentage responses by the nine brainstorming sessions are indicated.

From Figure 6 risks that scored more than 50% of the responses were considered to be of high significance under the category of technical supervision and quality control. Therefore, technical supervision and quality control risks were:

- Lack of work schedules.
- Insufficient supervision.
- Inappropriate materials.

The risks identified during brainstorming sessions under the category of technical supervision and quality control are described in Table 7.

### DISCUSSION OF RESULTS

All risk events irrespective of their consequences on completion time, cost and quality should be identified. A number of community-based construction risks by category were identified during the brainstorming sessions with PMCs in the study reported in this paper.

In the category of project initiation, the identified risks were unconfirmed sources of funding, lack of technical advice and lack of consensus. The three risk factors are important in the initial stages of a community project. It is vital that the community has firm assurance regarding funding of their project so that they can be motivated and fully participate in its implementation. Since most community members are non-technical, it is important that details of technical aspects of the project are availed to them so that they can appreciate the full extent of their involvement. The lack of technical advice in terms of project scope, material specifications and quantities may lead to problems during implementation. Absence of consensus at project initiation may lead to apathy during implementation. It is only when the community has been fully sensitised about their role and benefits of the project that consensus can be reached and full cooperation achieved.

The risk factors identified in the category of community contribution and participation included adverse weather conditions, logistical problems, lack of cooperation, non-conformity to standard specifications and inadequate bricks. In many cases, heavy rainfall has affected both the preparation of materials such as bricks and actual execution of works. It is therefore a significant risk factor that requires a good risk management plan. Since most of the projects are located in rural areas which lack good roads, logistical problems have posed a big challenge in the implementation of community projects and is therefore an important risk.
factor requiring good planning. Lack of cooperation is another risk factor that is important in the category of community contribution and participation since the community is mandated to contribute materials and unskilled labour. The other important factor is that of materials not conforming to standard specifications. This has created problems relating to quality control and quality of work. For example, large size, ungraded crushed stones may not produce good quality concrete. In many cases inadequate bricks in relation to the project targets have been prepared or moulded, leading to delayed execution. This has posed a great challenge especially since moulding of bricks is a seasonal activity. In the category of budget and finance, identified risk factors were delayed financial retirements, inadequate budget due to delayed implementation and delayed financial disbursements. Funds for the project are released in phases.

Delayed retirements for funds already used has led to delayed release of funds for the next phase because the financial regulations stated that no funds would be released for the project before retirements of used funds were submitted to the funding agency. Another important factor in this category is the inadequacy of the budget due to delayed implementation arising from other risk factors. Price escalations often led to budget overruns and it is important that measures are taken to avoid such scenarios. Delayed disbursement of funds in some cases as a consequence of delayed retirements is yet another risk factor that has led to delayed project implementation. There is therefore need to devise ways of addressing problems arising from these risk factors.

The important risk factors identified in the category of skilled labour included incompetence of PMCs to recruit labour, unavailability of skilled labour in locality of projects and incompetence of skilled labour. According to community-based projects guidelines, the PMC is responsible for recruitment of skilled labour. In many cases, members of the committee are not qualified to interview and recruit labour and this has subsequently led to poor workmanship and poor quality work. Very little construction activities take place in most rural areas where the projects are located. This means that there is a shortage of skilled labour in the locality of projects. In some locations, semi-skilled personnel are found. This scenario has often led to poor quality work and needs to be addressed. As indicated, where some skilled labour may be available, the levels of competence are low and this leads to the third risk factor in this category, namely incompetent labour. This scenario also requires addressing in order to improve the quality of work.

In the category of material procurement, the identified risk factors were unavailability of non-local materials in local shops, lengthy tender processes, high transportation costs and purchase of substandard materials. Since most community projects are located in rural areas, non-availability of non-local materials is a significant risk factor that calls for proper forward planning and mitigation. The tender process is an important step in materials procurement to ensure value for money, transparency and accountability. However, the process tended to take a long time thereby delaying the implementation of projects. It is imperative that the procurement process is done timeously by way of good planning. The high cost of transportation is an important risk factor that requires mitigation especially since most of the projects are remotely located and the road network is rather poor. Another important risk factor in this category is purchase of substandard materials. A number of poor quality materials are available on the market and the pricing of these tends to be on the lower side. Unfortunately the tender regulations are such that the lowest bidder secures the order. This scenario impacts negatively on the quality of work. There is therefore need to devise ways that will ensure that quality materials are purchased.

The identified risk factors under the category of technical supervision and quality control included lack of work schedules, insufficient supervision and inappropriate materials. Out of the nine sample projects visited, only one had a semblance of a work schedule. This was a serious omission since projects have a life span. The absence of work schedules is an important risk factor in that it is difficult to track progress and mitigate implementation hurdles. Due to low levels of competence amongst the local skilled labour, insufficient supervision is an important risk factor that requires forward planning and mitigation. Another important risk factor in this category is use of inappropriate materials provided by the community. There is need to devise ways of ensuring quality at the preparation of materials.

CONCLUSIONS

A number of risks occur in the implementation of community-based projects. The involvement of the community in construction projects minimises the cost of construction in addition to instilling a sense of ownership within the beneficiary community. However, if the identified risks are not managed properly, the poor infrastructure constructed will attract high maintenance costs sooner rather than later. In some cases total re-investment in infrastructure development may be required within a short period of time. It is therefore imperative that risk management techniques are employed to assess, mitigate and control the risks in each of the six categories throughout the life cycle of the project. If a risk management plan cannot be devised and effected, then it is recommended that the conventional ways of procurement should be employed through the already existing public service structures.

REFERENCES

APPENDIX A – QUESTIONNAIRE FOR BRAINSTORMING DISCUSSIONS.

UNIVERSITY OF ZAMBIA
SCHOOL OF ENGINEERING
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

RISK MANAGEMENT IN THE PROCUREMENT OF COMMUNITY-BASED CONSTRUCTION PROJECTS IN ZAMBIA.

LIST OF GUIDING QUESTIONS FOR BRAINSTORMING SESSIONS WITH PROJECT MANAGEMENT COMMITTEES.

PROVINCE...............................................................................................................................................

DISTRICT.............................................................................................................................................

NAME AND TYPE OF PROJECT ...............................................................................................

NAME OF IMPLEMENTING AGENCY............................................................................................

DATE OF MEETING.........................................................................................................................

1. Project Initiation
   • What were the problems encountered by your committee during the initiation of your project?
   • Which of the identified problems had a greater effect on project implementation, starting with the one that caused the greatest impact to the one that had the least effect?
   • How did the PMC and other stakeholders solve the problems that caused serious impact?

2. Community contribution and participation
   • What were the problems encountered by your committee regarding community contribution and participation in your project?
   • Which of the identified problems had a greater effect on project implementation, starting with the one that caused the greatest impact to the one that had the least effect?
   • How did the PMC and other stakeholders solve the problems that caused serious impact?

3. Budget/Finances
   • What were the problems encountered by your committee regarding the budget/finances for your project?
   • Which of the identified problems had a greater effect on project implementation, starting with the one that caused the greatest impact to the one that had the least effect?
   • How did the PMC and other stakeholders solve the problems that caused serious impact?

4. Skilled labour
   • What were the problems encountered by your committee regarding skilled labour for your project?
   • Which of the identified problems had a greater effect on project implementation, starting with the one that caused the greatest impact to the one that had the least effect?
   • How did the PMC and other stakeholders solve the problems that caused serious impact?

5. Material procurement
   • What were the problems encountered by your committee pertaining to procurement of materials for your project?
   • Which of the identified problems had a greater effect on project implementation, starting with the one that caused the greatest impact to the one that had the least effect?
   • How did the PMC and other stakeholders solve the problems that caused serious impact?

6. Technical supervision and Quality control
   • What were the problems encountered by your committee pertaining to technical supervision and quality control for your project?
   • Which of the identified problems had a greater effect on project implementation, starting with the one that caused the greatest impact to the one that had the least effect?
   • How did the PMC and other stakeholders solve the problems that caused serious impact?

7. Other challenges
   • What other problems apart from the above did you encounter in the implementation of your project?
   • Which of the identified problems had a greater effect on project implementation, starting with the one that caused the greatest impact to the one that had the least effect?
   • How did the PMC and other stakeholders solve the problems that caused serious impact?
Construction Management and Quantity Surveying at UJ

The Department of Construction Management and Quantity Surveying at the University of Johannesburg is in a unique position that the merger between the former Technikon Witwatersrand and the former Rand Afrikaans University has placed it firmly in the Faculty of Engineering and the Built Environment of the New Exciting University of Johannesburg.

This has provided an opportunity for the Department to relook at its current offerings and redevelop these in line with the vision and mission of the University of Johannesburg.

This Department recognises that the National Diploma: Building and the Bachelor of Technology Degrees as offered by the former Technikons have serious flaws. This was established by a National Research Project that was undertaken in 2004 and 2005.

The Department is thus using this opportunity to re-curriculate its programmes to align it with the National Requirements as expressed by the Standard Generating Bodies for both Quantity Surveying and Construction Management and an Programme review process undertaken in 2007.

This new National Diploma and Bachelor of Technology degrees have been developed to satisfy the needs of both the Contracting and Consulting fraternities of the Construction Management and Quantity Surveying sector.

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Vision:

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ASSESSMENT OF QUALITY OF SANDCREETE BLOCKS IN KADUNA STATE-NIGERIA

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ABSTRACT
The spate of collapsed buildings experienced in the recent past has drawn the attention of the Nigerian construction industry to quality issues. This study assessed the quality of sandcrete blocks produced in five block making factories in Kaduna State. On-site personal observations provided the basis of determining the materials used, the mix ratio, the batching method, quantity of water added, the curing method and the duration of curing. Further, laboratory tests were done to determine the silt content; water absorption; drying shrinkage and moisture movement; and the wet compressive strength. It was found that block-making factories did not comply with the basic rules of block production. Consequently, there were lower values of average wet compressive strength when compared with the British Standard 6073:1981 of 2.8N/mm² and NIS 87:2000 of 2.5N/mm². Recommendations include making it mandatory for all block-making factories to undertake periodic testing of their blocks so as to ascertain the conformity of their products with the specifications.

KEYWORDS:
Sandcrete Blocks, Wet Compressive Strength, Quality, Fine Aggregate, Standard

INTRODUCTION
As a result of the human need for shelter and decent environment, the use of cement has generated a lot of support in house building, drainage construction, bridge construction and the production of concrete poles for electrification among others [1]. With the central role of shelter for comfort, safety and convenience of mankind, attention on a daily basis is directed in Nigeria at providing composite materials for building houses. Notable among these is the production of sandcrete blocks.

British Standard 6073: 1981 Part 1 defines a block as a masonry unit of larger size in all dimensions than specified for bricks but no dimension should exceed 650mm nor should the height exceed either its length or six times its thickness [2]. Concrete blocks are divided into three types as stated in BS 2028: 1970 [3]. These are:-

Type A Dense aggregate concrete blocks.
Type B Lightweight aggregate concrete blocks.
Type C Lightweight aggregate blocks for non-load bearing walls.

Types A and B are suitable for load bearing walls and can be used for rendered external walls, all internal walls and partitions, panelling in framed buildings. Type C blocks are used for internal work only, such as for partitions and panelling to framed buildings.

Due to the apparent simplicity in its set-up and relative low cost, block-making requires no formal qualification to set up a factory judging from the proportion of the population that constitutes the bulk of the operators. As would be expected, certain objectives must be met in the blocks produced - paramount among these is the quality of the end product.

The quality of products and services is the major concern of every consumer and producer [4]. Therefore, it has become an important decision factor in all decision environments.

WHAT THEN IS QUALITY?
There is conflict relative to opinions about the concept of quality [5]. The building owner has an implicit expectation of quality for his/her building; the designer has his/her own professional view of quality depending on architectural and engineering tradition and the manufacturers and constructors have to make commercial judgments about quality as it relates to price. On the other hand, stipulated codes and regulations impact on projects, with a collective view of quality, which may itself conflict with those of other participants. The result of all this confusion is very often a frustrated client, a disillusioned designer, a commercially embarrassed contractor and distrusted manufacturers.

Quality
Quality means compliance with specification [6]. Quality may also be viewed as the totality of features required by a product or service to satisfy a given need [7]. Quality affects all we do but it is a concept that people have difficulty in defining [8]. Quality, therefore, covers all those characteristics of an item or service which ensures that it meets its required function. From the above, quality can be described as:

(i) Getting it right the first time.
(ii) Having value for money.
(iii) Customer satisfaction.
(iv) Consistent conformance to specification.
(v) Fitness for purpose.

Quality therefore, is a summation of all those characteristics which together make a product acceptable to the market. These days, quality is targeted in the Nigerian Building Industry due in part to the changing attitudes and competition in the global market as well as the spate of collapsed buildings.

Irrespective of how well designed a production process is, a certain amount of variability will always exist [4]. These variations include:

(i) Chance variation, which is mostly due to environmental influences such as temperature, radiation, noise etc. It is usually not detectable and may be unnoticed.
(ii) Assignable variations that are sources of variability that are not part of chance and are generally larger than the chance causes. Four sources of assignable causes are man (the operator’s error); machine (the condition of manufacturing machine); materials (raw materials if not of best quality) and method (this is an interplay of man, machine, inflow and outflow of materials). It was as a result of these assignable causes or variations that this paper sought to assess the quality of sandcrete blocks produced in Kaduna State.
**Dimensional Changes**

Sandcrete blocks will undergo some dimensional changes owing to variations in the ambient moisture and temperature conditions. The drying shrinkage is the reduction in length obtained when a saturated sample is dried under certain conditions and the moisture movement is the increase in length of the sample when again saturated. Lightweight concrete blocks are liable to high drying shrinkage and moisture movements but with suitable precautions, these can keep sufficiently small. The drying shrinkage and movement depend on the cement and in particular its fineness, the richness of the mix, the water/cement ratio and the kind of curing in particular at early ages.

The average values of the drying shrinkage should not exceed the values stated below:

<table>
<thead>
<tr>
<th>Block Type</th>
<th>Drying Shrinkage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.04</td>
</tr>
<tr>
<td>B</td>
<td>0.06</td>
</tr>
<tr>
<td>C</td>
<td>0.08</td>
</tr>
</tbody>
</table>

while the average moisture movement should not exceed 0.05% [3]

It is important not only that blocks should be well made, cured and adequately dried by the manufacturer, but also that they should be protected from moisture as much as possible from the time they leave the factory until the completion of the building [9]. Unless such precautions are taken the resultant shrinkage will often result in cracking.

**Water Absorption**

The average water absorption of common buildings bricks should not be more than 25 percent by weight after immersion in water for 24 hours [9] and is the ratio of the increase in weight to the weight of the dry sample expressed as a percentage. In a production factory, it was observed that the determination of water absorption is used for quality control as a result of its simplicity and less time consuming than the measurement of porosity [10].

**Materials**

Since at least three-quarters of the volume of a sandcrete block is made up of fine aggregate, it therefore not surprising that its quality is of considerable importance. Not only may the aggregate limit the strength of sandcrete block, as poor quality fine aggregate cannot produce strong sandcrete blocks but, the properties of fine aggregate greatly affect the durability and structural performance of sandcrete blocks. The fine aggregate should be clean and free from deleterious matter and should mainly pass the 4.76mm BS test sieve. Sand should not contain very fine particles such as silt and clay, which will produce concrete that requires high water content or chemical impurities, which may affect the setting and hardening of the blocks [10]. When clay or silt exists as a coating to the sand particles it is likely to result in a poor bond between the particles and the cement and in weaker and less durable concrete. The silt content in sand should not be greater than six percent.

**Compressive Strength**

The compressive strength of a sandcrete block depends on variables that affect it during production. These include the amount of cement, fine aggregate, water, degree of compaction, the curing conditions, the age of the cement and the type of weather. The Nigerian Industrial Standard [13] specifies that the lowest compressive strength of individual load bearing blocks shall not be less than 2.5N/mm² and average compressive strength of five blocks shall not be less than 3.45N/mm². The compressive strength of sandcrete materials increases with increased cement content [14]. However, strength alone is not to be taken as an indication of durability [15]. It has been established that the properties of a sandcrete soil that will influence its rate and ease of mixing include its degree of fineness, density and sharpness. Moreover, the relative proportions and the number of components will considerably influence the rate of mixing [16].

**Materials and Methods**

Two approaches were adopted in the study, namely personal observation and laboratory tests. The former was carried out to determine

(i) The materials used that make up the product.
(ii) The mix ratio of the blocks produced.
(iii) The batching method used.
(iv) The quantity of water added to each mix.
(v) The curing method and duration of curing before disposing the blocks.

The State was divided into five zones and a town selected from each of the zones. The towns were Birni-Gwari in the west; Zaria in the north; Kagoro in the south; Saminaka in the east and Kaduna in the centre. A well known block-making factory was selected from each of the towns. A total of 95 blocks sized 50mm x 225mm x 225mm were randomly selected from the five factories for the following tests:

(i) Water absorption test (15 blocks).
(ii) Drying shrinkage and moisture movement (20 blocks).
(iii) Wet compressive strength (60 blocks).

The wet compressive strength was to determine the worst condition the sandcrete block could be subjected to. The test was carried out after 28 days of age of the block samples. The block samples previously measured were immersed in water and allowed to drain under damp sack before bedding on both faces with mortar. Finally, the samples were soaked in water for four days prior to crushing. All the tests were carried out in the Civil Engineering Department Laboratory, Ahmadu Bello University, Zaria.

**Results and Discussion**

(i) Materials used: It was discovered that all five factories used soft sand (sand which contains silt in it and smooth when compressed by hand) and sharp sand (sand which is coarse when compressed by hand) and cement. In as much as this could enhance the bonding of the cement and sand grains in the green state, it could have a deleterious effect on the compressive strength of the blocks. Also, the ratio of sand was found to be two parts of soft sand to three parts of sharp sand.

(ii) The mix ratio in all the factories was 1:10. This finding may not be unconnected with the low value of wet compressive strength obtained, which was lower than the minimum standard required (2.50N/mm²) [13].

(iii) Batching method: It was observed that the batching method adopted was the same at the five factories. The batching was by volume using a wheel barrow to measure the sand. To an extent, what was referred to as ‘full’ depended on who is in charge and hence the consistency of one batch differed markedly from another.

(iv) Addition of water: There was no scientific basis of adding water as it was done at the discretion of the operators in
all the factories. The addition of water beyond the water to cement ratio of 0.45 tended to prolong the setting time and reduce the strength of the blocks [1].

(v) The curing method and duration of curing: In all five factories, this was done by spraying water twice in a day and for maximum of two days in an open place.

1.9 CONCLUSIONS

The paper considered the materials and production of sandcrete hollow blocks. The various tests and analyses carried out were aimed at determining the quality of sandcrete hollow blocks produced in Kaduna State. The following conclusions were reached, namely:

(i) The block samples attained an average wet compressive strength of 0.47N/mm²; 0.58N/mm²; 0.55N/mm²; 0.50N/mm² and 0.55N/mm² for factories A; B; C; D and E respectively. These values were lower than the British Standard of 3.5N/mm² and NIS 87:2000 of 2.5N/mm².

(ii) The mode of curing in all the factories was by spraying/sprinkling water on the blocks twice daily for two days. This method of curing especially at the early stages could have negative effect on the strength. This is due to the fact that most of the water required for hydration process must have evaporated.

(iii) The average water absorption of the block samples was 9.76%.

(iv) The moisture movement of the block from all the factories exceeded 0.05% specified by the British Standard. The average moisture movement was 0.075%.

(v) The average drying shrinkage of 0.03% conformed to 0.04% specified by British Standard.

(vi) The average silt content for all the factories exceeded the 6% specified by British Standard.

Table 1: Result of silt content for the five block-making factories in percentages.

<table>
<thead>
<tr>
<th>Factory</th>
<th>Sharp sand</th>
<th>Soft sand</th>
<th>Average silt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zaria</td>
<td>6.25</td>
<td>11.70</td>
<td>8.98</td>
</tr>
<tr>
<td>Kaduna</td>
<td>4.55</td>
<td>10.59</td>
<td>7.57</td>
</tr>
<tr>
<td>Birnin-Gwari</td>
<td>6.25</td>
<td>13.64</td>
<td>9.95</td>
</tr>
<tr>
<td>Saminaka</td>
<td>9.09</td>
<td>14.61</td>
<td>11.85</td>
</tr>
<tr>
<td>Kagoro</td>
<td>7.14</td>
<td>15.14</td>
<td>11.14</td>
</tr>
</tbody>
</table>

Table 2: Result of water absorption for the five factories.

<table>
<thead>
<tr>
<th>Factory</th>
<th>Water absorption(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zaria</td>
<td>10.11</td>
</tr>
<tr>
<td>Kaduna</td>
<td>10.05</td>
</tr>
<tr>
<td>Birnin-Gwari</td>
<td>6.48</td>
</tr>
<tr>
<td>Saminaka</td>
<td>8.77</td>
</tr>
<tr>
<td>Kagoro</td>
<td>13.37</td>
</tr>
</tbody>
</table>

Table 3: Result of drying shrinkage and moisture movements for the factories.

<table>
<thead>
<tr>
<th>Factory</th>
<th>Zaria</th>
<th>Kaduna</th>
<th>Birnin-Gwari</th>
<th>Saminaka</th>
<th>Kagoro</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drying shrinkage (%)</td>
<td>0.025</td>
<td>0.038</td>
<td>0.031</td>
<td>0.033</td>
<td>0.021</td>
<td>0.030</td>
</tr>
<tr>
<td>Moisture movement (%)</td>
<td>0.072</td>
<td>0.074</td>
<td>0.067</td>
<td>0.092</td>
<td>0.071</td>
<td>0.075</td>
</tr>
</tbody>
</table>

Table 4: Wet compressive strength of the five factories after four days of immersion in water in N/mm².

<table>
<thead>
<tr>
<th>Sample Number</th>
<th>Zaria</th>
<th>Kaduna</th>
<th>Birnin-Gwari</th>
<th>Saminaka</th>
<th>Kagoro</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.473</td>
<td>0.600</td>
<td>0.572</td>
<td>0.494</td>
<td>0.381</td>
</tr>
<tr>
<td>2</td>
<td>0.472</td>
<td>0.598</td>
<td>0.580</td>
<td>0.470</td>
<td>0.567</td>
</tr>
<tr>
<td>3</td>
<td>0.472</td>
<td>0.610</td>
<td>0.620</td>
<td>0.495</td>
<td>0.475</td>
</tr>
<tr>
<td>4</td>
<td>0.480</td>
<td>0.522</td>
<td>0.569</td>
<td>0.605</td>
<td>0.563</td>
</tr>
<tr>
<td>5</td>
<td>0.499</td>
<td>0.624</td>
<td>0.558</td>
<td>0.502</td>
<td>0.525</td>
</tr>
<tr>
<td>6</td>
<td>0.491</td>
<td>0.531</td>
<td>0.534</td>
<td>0.520</td>
<td>0.477</td>
</tr>
<tr>
<td>7</td>
<td>0.463</td>
<td>0.565</td>
<td>0.601</td>
<td>0.474</td>
<td>0.604</td>
</tr>
<tr>
<td>8</td>
<td>0.477</td>
<td>0.490</td>
<td>0.548</td>
<td>0.471</td>
<td>0.599</td>
</tr>
<tr>
<td>9</td>
<td>0.459</td>
<td>0.552</td>
<td>0.558</td>
<td>0.471</td>
<td>0.561</td>
</tr>
<tr>
<td>10</td>
<td>0.411</td>
<td>0.633</td>
<td>0.496</td>
<td>0.561</td>
<td>0.591</td>
</tr>
<tr>
<td>11</td>
<td>0.433</td>
<td>0.614</td>
<td>0.563</td>
<td>0.476</td>
<td>0.609</td>
</tr>
<tr>
<td>12</td>
<td>0.516</td>
<td>0.656</td>
<td>0.400</td>
<td>0.477</td>
<td>0.558</td>
</tr>
<tr>
<td>Mean strength</td>
<td>0.471</td>
<td>0.583</td>
<td>0.550</td>
<td>0.501</td>
<td>0.547</td>
</tr>
<tr>
<td>Std. seviation</td>
<td>0.027</td>
<td>0.047</td>
<td>0.052</td>
<td>0.042</td>
<td>0.068</td>
</tr>
<tr>
<td>Coeff. of variation</td>
<td>5.73%</td>
<td>8.06%</td>
<td>9.45%</td>
<td>8.38%</td>
<td>12.43%</td>
</tr>
</tbody>
</table>
RECOMMENDATIONS
Generally, the quality of the blocks produced by the various factories did not comply with either the British or the Nigerian Industrial Standards. In the light of this, the following measures are recommended so that the quality of blocks produced could be enhanced.

(i) It should be mandatory for all block-making factories to undertake periodic testing of their blocks so as to ascertain the conformity of their products with the specifications.
(ii) The users should always demand a certificate of test from block-makers to ascertain that the blocks being purchased are of good quality.
(iii) The use of soft sand should be discouraged. As indicated in the test results, soft sand contains higher percentage of silt which has a serious effect on the strength of sandcrete blocks.
(iv) For standard curing, the blocks should be left under cover and kept wet by watering twice daily for at least seven days so that adequate strength can be developed.

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ABSTRACT
Recently the Malaysian government raised awareness of health and safety policies through the enforcement of guidelines as well as conducting site health safety seminars and certifications. The construction industry ranks second in Malaysia in contributing to the number of accidents on worksites. The consequent impact of loss of profits and unhealthy and unsafe workplaces is considerable. National statistics suggest that construction plant and machinery cause many accidents on site. This paper discusses the importance of health and safety management of construction plant and machinery by designing and proposing an application model that can be used as a guideline for improved management. Considering that ‘health and safety management’ is a new management concept in Malaysia, this study examines the extent of health and safety management in Malaysia and makes suggestions for improving, particularly, the management of construction plant and machinery. The proposed model will define the basic concept of health and safety management for construction plant and machinery and generically highlight key aspects.

KEYWORD:
Health and Safety Management, Construction Plant and Machinery, Health and Safety, Accidents

INTRODUCTION
Occupational Safety and Health (OSH) performance in Malaysian workplaces continues to be poor. Accidents and occupational diseases still occur and are cause for concern. Available national statistics as evidenced in Figure 1 indicate that the percentage of workplace accidents is increasing. Further, many minor accidents go unreported.

Working in the construction industry, especially when plant and machinery are involved, is very hazardous and failure to address health and safety may result in objects, plant and equipment falling on workers, being pressed by or between objects and being struck by moving heavy loads as shown in Figure 2.

Current practices in Malaysia relative to health and safety management systems suggest that there is a lack of the mission, vision and objectives of health and safety management as well as a lack of awareness and drive among management executives to realise health and safety due to overemphasis on productivity. The safety management of machinery and plant has been somewhat loose. Further, health and safety policies are in place merely to give the semblance of safety management. While there are genuine concerns about poor health and safety practices, there is a lack of effective measures to reduce accidents. Further, there are differences in approaches to complying with regulations and the interpretation of them. Health and safety management has in recent times migrated from a strict compliance orientation to one that is performance oriented.

HEALTH AND SAFETY MANAGEMENT
Health and safety management is concerned with influencing human behaviour and with limiting the opportunities for mistakes to be made, which would result in harm or loss. It is also the process of enabling workers to increase control over, and to improve their health. To do this, health and safety management must recognise the failures of people to do what is expected of them and/or what is healthy and safe. Generally, health and safety management techniques are aimed at the recognition and elimination of hazards, and the assessment and control of those risks which remain. It involves the functions of planning, identifying problem areas, coordinating, controlling and directing the activities at the work site, all aimed at the prevention of accidents and ill health.

Organisation and Management
An organisation is a system of consciously coordinated activities or forces of two or more people. As such it has objectives, structures, rules and procedures aimed at the primary goal of producing profits or supplying services. All organisational activities can be viewed as forms of management but with different responsibilities and personal control. Therefore, management is the attainment of organisational goals in an effective and efficient way.
manner through planning, organising, leading and controlling organisational resources.

Planning involves defining goals for future organisational performance and deciding on the tasks and use of resources needed to attain them. Organising involves the assignment of tasks, the grouping of tasks into departments and the allocation of resources to departments. Leading uses influence to motivate employees to achieve organisational goals. Controlling involves monitoring the activities of employees, determining whether the organisation is on target towards its goals, and making corrections as necessary.

All these management functions are important in organisations as they bring together knowledge, people and resources to perform tasks and attain goals in an efficient and effective manner. Effectiveness refers to the degree to which the organisation achieves a stated goal and efficiency refers to the use of minimal resources to produce desired volumes of output. In general, health and safety management brings a more comprehensive approach, allowing participation and contribution of all levels of management and the workforce. The improvement of healthy and safe working conditions depends ultimately upon people working together, whether governments, employers or workers.

A safe and healthy work environment should do more than keep employers out of the trouble with regulatory agencies [1]. Pressure from state and federal agencies in the area of workplace safety fluctuates in accordance with the prevailing political climate. But the need to maximize the performance of employees and organisations is constant. Health and safety should be a key element in the plan of an organisation for gaining a competitive advantage in the global marketplace. It is an approach rooted in organisational performance and global competitiveness.

Construction Plant and Machinery

Construction Plant Management (CPM), is a concept in construction management that refers to any essential appliances used for the erection and maintenance of building work. It includes site machinery, scaffolding, transport and general equipment of the builder yard. Examples of plant and equipment include concrete mixers, scaffolding and cranes.

PROBLEM

In 2001, the Malaysian Trade Union Congress carried out a brief survey among members of its affiliates. The survey found that the lack of awareness among management and the workforce was the main reason for the occurrence of accidents in the workplace. Analysis of the findings of the survey revealed that:

• 26% of the respondent companies did not have an OH&S policy.
• 40.5% reported that their OH&S policy where it existed was not being implemented.

At present, health and safety management in Malaysia focuses on the overall setup and establishment of health and safety structures that highlight health and safety committee participation, roles and responsibilities for executing health and safety policies and health and safety plans.

METHODOLOGY

The research reported in this paper sought to determine the components, which are essential for the effective health and safety management of construction machinery and plant on construction sites. The objectives of the research therefore were:

• To identify current health and safety practices relative to construction plant and machinery and compliance with health and safety regulations and construction practice in Malaysia.
• To develop a model of safety management for construction plant and machinery.

Generally, the research conducted comprises the following steps, namely:

a) Information and data collected from various primary and secondary sources such as published books, regulation and journals.
b) Findings from questionnaires distributed to 25 selected contractors descriptively analysed relative to actual health and safety practices for construction plant and machinery. Informal interviews were conducted during site visits with contractors, construction site management and other responsible agencies including National Institute of Occupational Safety & Health (NIOSH) and Construction Industry Development Board (CIDB).
c) Statistical analysis of data in order to derive specific findings that could inform recommendations for improvement.

HEALTH AND SAFETY MANAGEMENT MODEL FOR CONSTRUCTION PLANT

Construction plant management derives from the need to enable construction work involving plant and equipment to proceed according to programme without exposing workers to unnecessary hazards [2]. The concept strategically involves three stages comprising inputs, conversion processes and outputs as illustrated in Figure 3.

Each stage is described as follows, namely:

![Figure 3: The construction plant management sub-system [2].](image-url)
Input
As the starting point for construction plant management, the input involves the three key aspects of:
(i) Plant Policy (Strategic Input) addresses broad strategic issues relative to plant and equipment. However, it depends on the nature of project and the scope of the contract. The nature of the construction project determines the spread of activities for contractors. It should be noted that the plant policy differs in accordance with the different types of construction such as, for example, conventional or industrialised systems.
(ii) Market Intelligence (Tactical Input) determines the need for new or special plant that will be presented to the top management, along with the overall plant strategy. The decision on whether the new or special plant will meet the need will be determined by the top management. Identification of the right types of equipment and plant will depend on the particular need on the site.
(iii) Construction Operation (Operational Input) involves, for example, pre-tender planning as the main basis for assisting contractors to identify and select plant for the project. In addition, the nature of the project will determine the types of plant that can be used. For instance, demolition projects require different ranges of plant and equipment compared to an industrialised building system.

Conversion Process / Tools and Techniques
The conversion process comprises of the following aspects:
(i) Analysis of Plant Requirements based on the types of plant and the duration of project.
(ii) Investigation of Plant Resources involves investigation of plant resources based on factors which include the ability of the contractor to perform its own fleet management, purchasing of new plant, hiring of plant from other companies and leasing arrangements between the contractor and the plant supplier. The factors that may influence this investigation are economical, types and condition of the existing fleet of the contractor, types of project, duration of leasing required, availability of plant operators and the location of the plant depot within the construction site.
(iii) Delivery to Site of the plant involves consideration of the transportation of plant, police permits, routes to take, timing of delivery, need for ancillary equipment for unloading and skilled labour for the delivery and unloading processes.
(iv) Security on Site concerns the aspect of theft and safety of the site environment.
(v) Operating within the Law (Legal Framework) which should be in accordance with the Factories and Machinery Act 1986 and Occupational Safety and Health Act 1994.

Output
The output of construction plant management is to produce the plant schedule that encompasses the types of plant versus month and maintenance schedules.

DEVELOPMENT OF HEALTH AND SAFETY MANAGEMENT MODEL
The Project Quality Management model is used as a basis for the health and safety management model and is conceptually divided into three major elements or processes. Basically, the model defines the process of ‘input-conversion process-output’ as the method of achieving the management goals and objectives. Input is considered as the planning effort, the strategies or the approaches used in achieving the output, while the conversion process is the measuring and conversion process which is also known as ‘tools and techniques’ that should contribute to expected result.

The model is developed in two stages. The first stage model development concentrates on making comparisons between key health and safety elements and quality management processes and is informed by construction OH&S management guidelines and regulations. The outcome resulting from the first phase is used for the second phase. The second phase is considered as the final model. The second phase model is developed by applying it to the construction plant management model. The development of the model is based on the integration of three management models namely, health and safety management, quality management and construction plant management. It may be illustrated as follows:

(a) Quality management + safety management = First stage model
(b) First stage model + construction plant management = Final model

First Phase Model
The first phase model is based on the identification of health and safety processes and involves several procedures such as
- Using similar processes as featured in a quality management model.
- Comparing and evaluating health and safety management key elements and making comparison with processes of quality management.

Previous studies confirm that quality and health and safety management are similar in approach [1]. The Project Quality Management model consists of three components, namely planning, assurance, and control. As for health and safety management, the key elements of health and safety management consist of five areas, namely policy, organising, planning and

Figure 4: First development of health and safety management application model (Author’s research).
implementation, measurement, and review. The central idea of identifying the health and safety key elements depends upon continual feedback, certainly from reviews and audits, but also during the earlier stages, so that there is a continual, dynamic system in place. This model is adopted in Malaysia with some variations to suit the existing practice and the early development of a safety and health programme locally. Taking into account similar concepts, elements and systems, the health and safety management model is developed as depicted in Figure 4.

Final Model
The method of developing the final model is by applying the first development model to construction plant management. The integration of these two models contributes to a more comprehensive model as shown in Figure 5. Conversion processes include the requirements of the project and the health and safety regulations thereby linking them with each other. In general, the main goal for management is to provide a ‘Healthy and Safe Workplace’. The output of the model includes the production of a health and safety activities schedule, maintenance schedule of the plant and equipment and accountability of workers in implementing safe work procedures while operating the plant and equipment.

CONCLUSION
The fact that construction H&S is still in its early developmental stage in Malaysia explains why only selected guidelines are being followed and Acts are being enforced. It may take a couple of years before a final series of guidelines covering all aspects of construction work can be introduced and enforced. This study suggests that a more comprehensive application model developed from a theoretical model can be used to guide health and safety management. The application model in fact is a substitute for the non-existence of compliant guidelines or requirements for the healthy and safe management of construction plant and machinery. The findings of the study suggest that an unsatisfactory safety culture and lack of responsibility for health and safety in general prevails in Malaysia. The lack of management control has led to a lowering of performance standards. These standards may involve, for example, training, communication, and health and safety programmes.

RECOMMENDATIONS FOR FUTURE RESEARCH
Future research is recommended on the following aspects, namely:
- A study on construction plant management with reference to the Construction Plant and Equipment Management Standards as established in U.K. Comparison of the theory may possibly be developed through this comparative analysis [3].
- The newly established Occupational Safety and Health Management System guidelines, also known as Malaysian Standards, should be used as the main subject of future research on health and safety management for construction plant and machinery in Malaysia.

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You see a plan  
We see a development

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UNIT FOR THE STUDY OF CONSTRUCTION PROCESSES (USCP)

The Unit under the leadership of Prof John Smallwood serves as an avenue for rendering community service, conducting research, publishing, and disseminating information. The USCP’s research areas include all areas of the built environment, but focus on construction health and safety, education and training, facilities / maintenance management, housing, and industry performance. This is further complemented by a range of postgraduate research studies.

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THE SOUTH AFRICAN BUILT ENVIRONMENT PROFESSIONALS SKILLS SUPPLY PIPELINE: IS IT BLOCKED OR BROKEN?

Llewellyn van Wyk
CSIR Built Environment, Pretoria

TERMS OF REFERENCE
The Council for the Built Environment (CBE) is a statutory body established in terms of the Council for the Built Environment Act (Act 43 of 2000). The CBE is mandated by the Act to promote ongoing human resource development within the six applicable professions, and to consult and provide advice regarding the development of appropriate and relevant legislation and national policies.

The CBE appointed the CSIR to undertake a study into the nature of the BEP skills supply pipeline. The full study is titled Skills Audit. This paper is a summary of all the reports constituting the full study. This paper is limited to summarising the individual research reports, and deriving conclusions and preparing recommendations to ensure the sustainable and appropriate supply of BEP to meet South Africa’s current and future developmental needs. The paper has sought to cross-reference findings against the views of analysts in the related fields.

The skills audit research brief included undertaking four specific sub-studies as well as a quantitative and qualitative survey:

1. Identification and analysis of government policy aimed at redressing imbalances of the past in South African BEPs.
3. Analysis of migration patterns (nationally and internationally) of South African BEPs.
4. Description of the nature and comparability of the supply of BEP skills by institutions of higher education.

METHODOLOGY
The raw material was obtained by extensive literature searches including internet, books, published papers, journal articles, newspaper articles and unpublished reports. The related web pages were downloaded and saved.

Following the preparation of a preliminary report based on the above, specific research questions were identified. These questions were converted into research questionnaires and interviews were held with identified experts in the field, such as career guidance counselors and life orientation teachers, heads of academic departments, representatives of the various statutory professional councils and voluntary associations as well as final-year students, and the results were incorporated into a final set of findings of this project. Additional quantitative data were obtained through analysis of various databases and published statistics.

SUB-STUDY 1
The report found three policies impacted directly on the BEP, namely:

- Targeted procurement by Government.
- Interventions in the Higher Education (HE) landscape.
- Categories of registration in the BEP landscape.

The report finds that the implementation of targeted procurement has been successful in terms of creating access to business opportunities for Black and female BEPs and for enabling the formation of black- and women-owned practices. However, the report finds that the policies have created an unsustainable demand for black professionals resulting in some unintended consequences including poor service delivery arising out of inexperience, skewed salaries and job-hopping.

With regard to interventions at the curricula and HE institutional level, the report finds that the aims of promoting race and gender equity in built environment (BE) programmes has not been achieved, and that there is not the HE responsiveness to curricula content as envisaged in the National Qualifications Framework (NQF).

With regard to the new professional categories of registration, the report finds that progress is being made in terms of transforming the demographic profile of the BEP. However, the report also found various factors, such as a lack of awareness by graduates of the purpose of registration, the voluntary nature of registration and unnecessary complexity of the registration process itself were impeding registration following graduation and therefore retarding the pace of transformation. The report finds that a significant impediment to full professional registration for those registered as candidates has to do with difficulties in obtaining internships, access to mentors and mentorship programmes that cease due to pressures of work. These and other factors of a more personal kind have resulted in candidates taking in excess of three years to complete their candidate registration requirements. The report finds that women may experience specific problems with regard to completing their registration process, due to personal matters (familial problems or marriage) and/or the availability of site work opportunities.

SUB-STUDY 2
The impact was analysed for remedial measures aimed at addressing skills shortages in South African BEP. The report finds that the major remedial measures have to do with:

- The introduction of the Skills Development Act.
- Issues surrounding the HE sector with regard to the disconnection between academic content and industry needs.
- The introduction of the recognition of prior learning (RPL).

With respect to the Skills Development Act, the report finds that the mechanism established to facilitate skills development and training, namely the sectoral education and training authorities (SETAs) have failed to address education and training needs and BEP post-graduate level.

With regard to the disconnection between academia and industry, the report finds that graduates have skills sets that do not match the skills sets needed by industry, thus raising significant issues with regard to employability of BEP graduates.

With regard to RPL, the report finds conflicting views surrounding the values of RPL as a skills development tool and/or as a transformation tool. While some respondents acknowledged that provision has been made to recognise RPL in, for example, the Categories of Registration of the statutory councils, they note that there is insufficient evidence to determine the extent of this provision, or the impact thereof. At skills development level,
respondents noted that due to the over-subscription at tertiary institution level, tertiary institutions were able to pick the best applicants from a qualification perspective.

SUB-STUDY 3
The report found that the data kept by national departments is inadequate to make a definitive assessment of the extent and impact of national and international migration of South African BEPs. However, the report recorded conflicting views from respondents on how extensive emigration was and how significant its impact was within the BER. The report notes, however, that South African BEPs will be actively recruited by foreign companies because of the global shortage of high level skills, that South African BEPs will be attracted to international employment positions by the remuneration and the quality of life offered, and that South African BEPs will be pushed by internal factors such as high levels of crime and a deteriorating personal quality of life with regard to personal and family security, travel times, choices with regard to modes of travel, deteriorating infrastructure, quality of service, especially public services, etc.

SUB-STUDY 4
The study examined whether there were obvious distinctions between various tertiary institutions that would result in quantitative and qualitative differences in the comparability and mobility of built environment qualifications. The study finds that it is hardly likely that students will graduate with directly comparable qualifications since the tertiary institutions have different course content with different credit values taught by different staff in different facilities.

The report finds that several external factors influence the comparability as well, including SAQA principles and guidelines, accreditation (national and international), university rankings and perceptions of different HE institutions. With regard to mobility, the report finds that it is highly unlikely that a student at a University of Technology (UoT) will be able to continue the course of study at a university seamlessly.

QUALITATIVE SURVEY
The qualitative survey involved in-depth interviews with ‘experts’ in the various BEP disciplines. Collecting and collating the responses, the report finds the following:

• Young entrants are being attracted to BEPs as a result of the current construction ‘boom’ in South Africa and there are many more applications for BE programmes than places available. Remuneration prospects and personal status as a professional were the dominant career choice drivers. The findings show that gender played a more influential role in career choice than race. The findings show that cost of study and access to tertiary institutions were significant drivers. Generally, respondents believe that these trends will continue for the next five years.

• All the respondents perceive a difference between universities and UoTs, and believe the difference is one of emphasis, i.e. universities pursue conceptual thinking and innovation while UoTs pursue execution. Respondents believe that historically white universities (HWUs) have better facilities and staff and therefore the value of the qualification is better than that of historically black universities (HBUs). The findings suggest that employers are more likely to be influenced by the specific tertiary institution of the graduate than by the race or gender of the graduate. The findings show a general expectation that these trends will continue for the next five years.

• The findings show that generally all BE programmes are aligned with the requirements of the various categories of registration, although some exceptions were found. The findings also reveal consensus among respondents on a ‘disconnection’ between curricula content and the skills required by the BEPs.

• Most respondents are highly critical of the contribution of CETA to the ongoing education and training needs of BEPs. The findings show conflicting views with regard to the value and contribution of RPL.

• The findings show that generally students are not aware of the various professions constituting the BEP in South Africa.

• The findings show that generally graduates are not very aware of the need for professional registration, but where they are the majority of graduates intend registering and entering into the BEP. The findings show that in general registration processes are not very user-friendly and that they can discourage registration in some circumstances. The findings concur with the findings of the sub-study that access to internships, mentors and mentor programmes can be problematic, and can discourage and/or delay registration. Respondents indicated that generally race and gender were not significant influences in career choices within the BEP. The findings show that there may be cases where impediments exist with regard to persons registering in the lower categories of registration. Most respondents believe that the current candidate registration trends will continue for the next five years.

• The findings show that while some respondents believe the low number of black entrants into the BEP has to do with a lack of transformation within the BEP, the majority of respondents believe it to be a consequence of the poor quality of schooling at primary and secondary level. Most respondents believe that this trend will continue for the next five years.

• Most respondents believe that South Africa is experiencing a net loss of BEP skills due to emigration, although the report could not quantify the extent of that loss. With regard to national migration trends the findings show that in general this is not believed to exercise a negative impact on the BEPs, although the trend does impact on those areas experiencing an outward flow of BEP skills. Most respondents believe that these migration trends will continue for the next five years.

• The findings show that the BEPs constitute an ageing skills pool, and that respondents believe that the major impact has to do with a loss of experienced people and a lost opportunity for skills transfer. Most respondents believe that these migration trends will continue for the next five years.

• The majority of the respondents believe that targeted procurement is achieving its aims although respondents believe there are unintended consequences, such as skewed salaries, job-hopping and the establishing of black-owned practices without the necessary practice experience.

• With regard to HIV and AIDS and BEPs most respondents do not believe it to be significant among BEPs. The findings could show no empirical evidence to verify this.

QUANTITATIVE SURVEY
With regard to the quantitative survey, data sourced from the statutory councils and national statistics indicate that there are about 50 000 BEPs in South Africa, of which about 35 000 are
registered and 15,000 unregistered. Assuming current employment growth rates within the BEPs, the survey predicts that this number will grow to about 60,000 (40,000 and 20,000 respectively) by 2011. The findings show that the race equity profile of the BEP is low, but finds a significant increase in the proportion of black professionals – from 9% of all registered professionals in 2002 to 21% in 2007. With regard to gender equity, the findings show that the overall proportion of women in the BEP to be low, at less than 10%. The findings show a great deal of unevenness between BEP disciplines, ranging from 4% for engineering to 20% in architecture. The findings reveal that the growth rate of BEP university graduates (8%) exceeds the estimated growth rate of BEP employment (2.5%) and thus concludes that:

- There are more BEP students graduating than currently being employed.
- The central discourse on BEP skills should shift from the quantitative to the qualitative, particularly with regard to low-level and high-level skills and employability.

In conclusion, it may be said that significant blockages exist along the skills-supply pipeline at the primary and secondary school level. Although blockages can be found at candidate registration level, these are not impacting significantly on the total BEP supply pool.

CONCLUDING COMMENTS
The study as a whole finds that there is a quality-deficit with regard to BE qualifications, specifically from an employability perspective, that the deficit is wider at the lower levels of registration, and that its causes are located in the drive to increase student numbers in BEP programmes, the decreasing number of skilled staff, and the poor level of schooling that many of the students have, especially black students. The study notes that South Africa’s modern economy, and the infrastructure needed to support it, requires an integrated education and skills development platform spanning formal schooling, vocational training and sector-specific skills augmentation, supplemented by in-job training.

Government measures to enhance skills development have been unsuccessful at BEP level. This is mainly due to the skills development procedures being unaligned to the particular circumstances of the BEP (CETA training agreements and training material aimed at NQF 1). Government measures at broadening the skills base of graduates to include scarce and critical skills in terms of the NQF have been unsuccessful at the BEP level. All the expert interviews indicated a mismatch between the skills set required by industry and those provided by tertiary institutions. In addition, the study indicates that the elements of portability and mobility desired by the NQF are not manifesting.

It is unrealistic for employers to see training provision solely as the domain of public agencies. Equally, public training agencies have a responsibility to act positively and avoid being labelled as ineffective and inflexible. It is necessary that employers and public agencies coordinate their approach to skills development and play to their respective strengths. (Excerpt from the Built Environment Professional Skills Supply-Side Audit 2007: Summary of Studies 1-6 and Recommendations, prepared by the CSIR Built Environment, Pretoria, January 2008)
1. Submission of manuscripts

Authors should submit their papers electronically to hauptt@cput.ac.za or mayc@cput.ac.za provided that the paper is attached as a separate file using the recommended MS Word software format. All electronic submissions containing viruses will be deleted without opening them.

Manuscripts must be submitted in English and must be original, unpublished work not under consideration for publication elsewhere. It will be assumed that authors will keep a copy of their manuscript. Manuscripts are not returned to the author(s).

Manuscripts are blind peer reviewed by acknowledged experts. Revisions may be required before a decision is made to accept or reject the paper. If an author is uncertain about whether a paper is suitable for publication in JOC, it is acceptable to submit a synopsis first.

2. 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.

3. Preparation of the manuscript

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

Layout: The manuscript must be in English, typed and double-spaced 10pt type on one side of A4 paper only, with a 4cm margin on the left-hand side. All other margins are to be 3cm. 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 five 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 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 emphasise 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.