Journal of Construction Project management and Innovation

Volume 3 Number 1 May, 2013

ISSN 2223-7852

ABOUT JCPMI

The **Journal of Construction Project Management and Innovation** is published bi-annually (twice per year) through the Centre of Construction Management and Leadership Development (CCMLD) by Sabinet Online - SA ePublications.

Journal of Construction Project Management and Innovation is an open access journal that publish all sorts of researches on Construction project management; Project management; Design and construction management processes; Housing and infrastructure development; Stakeholder management; Project planning and project impact assessments; Design and implementation of labour-intensive projects; Procurement management; Management of construction companies; Industry development; Knowledge management in construction; Empowerment of women; Innovation; Project financing; Current and emerging infrastructure issues in developing countries etc. as well as other issues. The goal of JCPMI is to broaden the knowledge of construction professionals and academicians by promoting free access and providing valuable insight to construction-related information, research and ideas. JCPMI is a bi-annual publication and all articles are peer-reviewed.

Submission of Manuscript

Submit manuscripts as e-mail attachment to the Editorial Office at: aigclinton@gmail.com, caigbavboa@uj.ac.za, didibhukut@uj.ac.za. A manuscript number will be mailed to the corresponding author shortly after submission.

For all other correspondence that cannot be sent by e-mail, please contact the editorial office (aigclinton@gmail.com, caigbavboa@uj.ac.za, didibhukut@uj.ac.za).

The Journal of Construction Project Management and Innovation will only accept manuscripts submitted as e-mail attachments. Please read the Instructions for Authors before submitting your manuscript. The manuscript files should be given the last name of the first author.

Editor

Prof. Wellington Didibhuku Thwala
Department of Construction Management and Quantity Surveying,
Faculty of Engineering and the Built Environment,
University of Johannesburg,
South Africa.

Editorial Assistance

Clinton Aigbavboa
Department of Construction Management and Quantity Surveying,
Faculty of Engineering and the Built Environment,
University of Johannesburg,
South Africa.

Editorial Board

Instructions for Author

Electronic submission of manuscripts is strongly encouraged, provided that the text, tables, and figures are included in a single Microsoft Word file (preferably in Arial font).

The **cover letter** should include the corresponding author's full address and telephone/fax numbers and should be in an e-mail message sent to the Editor, with the file, whose name should begin with the first author's surname, as an attachment.

Article Types
Three types of manuscripts may be submitted:

Regular Articles
All portions of the manuscript must be typed 1.5 spacing and all pages numbered starting from the title page. The font size must be 12.

Regular articles: These should describe new and carefully confirmed findings, and experimental procedures should be given in sufficient detail for others to verify the work. The length of a full paper should be the minimum required to describe and interpret the work clearly. The length of a full paper should be between 4000 – 7000 words. .
Review Process

Short Communications: A Short Communication is suitable for recording the results of complete small investigations or giving details of new models or hypotheses, innovative methods, techniques or apparatus. The style of main sections need not conform to that of full-length papers. Short communications are 2 to 4 printed pages (about 6 to 12 manuscript pages) in length.

Reviews: Submissions of reviews and perspectives covering topics of current interest are welcome and encouraged. Reviews should be concise and no longer than 4-6 printed pages (about 12 to 18 manuscript pages). Reviews are also peer-reviewed.

Review Process
All manuscripts are reviewed by an editor and members of the Editorial Board or qualified outside reviewers. Authors cannot nominate reviewers. Only reviewers randomly selected from our database with specialization in the subject area will be contacted to evaluate the manuscripts. The process will be blind review. Decisions will be made as rapidly as possible, and the journal strives to return reviewers' comments to authors as fast as possible. The editorial board will re-review manuscripts that are accepted pending revision. It is the goal of the JCPMI to publish manuscripts within the shortest possible time after submission.

Regular articles

All portions of the manuscript must be typed double spaced and all pages numbered starting from the title page.

The Title should be a brief phrase describing the contents of the paper. The Title Page should include the authors' full names and affiliations, the name of the corresponding author
along with phone, fax and E-mail information. Present addresses of authors should appear as a footnote.

The **Abstract** should be informative and completely self-explanatory briefly present the topic, state the scope of the experiments, indicate significant data, and point out major findings and conclusions. The Abstract should be 100 to 300 words in length. Complete sentences, active verbs, and the third person should be used, and the abstract should be written in the past tense. Standard nomenclature should be used and abbreviations should be avoided. No literature should be cited. Following the abstract, about 3 to 10 key words that will provide indexing references should be listed.

A list of non-standard **Abbreviations** should be added.
In general, non-standard abbreviations should be used only when the full term is very long and used often. Each abbreviation should be spelled out and introduced in parentheses the first time it is used in the text.

The Introduction should provide a clear statement of the problem, the relevant literature on the subject, and the proposed approach or solution. It should be understandable to colleagues from a broad range of scientific disciplines.

Materials and methods should be complete enough to allow experiments to be reproduced. However, only truly new procedures should be described in detail; previously published procedures should be cited, and important modifications of published procedures should be mentioned briefly. Capitalize trade names and include the manufacturer's name and address. Subheadings should be used. Methods in general use need not be described in detail.

Results should be presented with clarity and precision. The results should be written in the past tense when describing findings in the authors' experiments. Previously published findings should be written in the present tense. Results should be explained, but largely without referring to the literature. Discussion, speculation and detailed interpretation of data should not be included in the Results but should be put into the Discussion section

The Discussion should interpret the findings in view of the results obtained in this and in past studies on this topic. State the conclusions in a few sentences at the end of the paper. The Results and Discussion sections can include subheadings, and when appropriate, both sections can be combined.

The Acknowledgments of people, grants, funds, etc. should be brief.

Tables should be kept to a minimum and be designed to be as simple as possible. Tables are to be typed double- spaced throughout, including headings and footnotes. Each table should be on a separate page, numbered consecutively in Arabic numerals and supplied with a heading and a legend. Tables should be self-explanatory without reference to the text. The details of the methods used in the experiments should preferably be described in the legend instead of in the text. The same data should not be presented in both table and graph form or repeated in the text.

Figure legends should be typed in numerical order on a separate sheet. Graphics should be prepared using applications capable of generating high resolution GIF, TIFF, JPEG or Powerpoint before pasting in the Microsoft Word manuscript file. Tables should be prepared in Microsoft Word. Use Arabic numerals to designate figures and upper case letters for their parts (Figure 1). Begin each legend with a title and include sufficient description so that the figure is understandable without reading the text of the manuscript. Information given in legends should not be repeated in the text.

References: In the text, a reference identified by means of an author‘s name should be followed by the date of the reference in parentheses. When there are more than two authors, only the first author‘s name should be mentioned, followed by ’et al‘. In the event that an author cited has had two or more works published during the same year, the reference, both in the text and in the reference list, should be identified by a lower case letter like ’a‘ and ’b‘ after the date to distinguish the works.

Examples:

Aigbavboa (2012), Aigbavboa et al. (2012), (Thwala, 2000), (Aigbavboa and Thwala, 2012), (Aigbavboa, 2008; Lesito, 2007a, b;

Aigbavboa, 2010, 2011), (Thwala et al., 2001)

References should be listed at the end of the paper in alphabetical order. Articles in preparation or articles submitted for publication, unpublished observations, personal communications, etc. should not be included in the reference list but should only be mentioned in the article text (e.g., A. Kingori, University of Nairobi, Kenya, personal communication). Journal names are abbreviated according to Chemical Abstracts. Authors are fully responsible for the accuracy of the references.

Examples:

Aigbavboa CO (2010). Residential satisfaction in low-income housing: a South Africa perspective. Journal of Construction Project Management and Innovation. 1(2): 14 – 20.

Aigbavboa CO, Lesito K (2012). ICT benefit in South Africa Construction Journal of Construction Project Management and Innovation. 2(2): 75 – 81.

Short Communications

Short Communications are limited to a maximum of two figures and one table. They should present a complete study that is more limited in scope than is found in full-length papers. The items of manuscript preparation listed above apply to Short Communications with the following differences: (1) Abstracts are limited to 300 words; (2) instead of a separate Materials and Methods section, experimental procedures may be incorporated into Figure Legends and Table footnotes; (3) Results and Discussion should be combined into a single section.

Proofs and Reprints: Electronic proofs will be sent (e- mail attachment) to the corresponding author as a PDF file. Page proofs are considered to be the final version of the manuscript. With the exception of typographical or minor clerical errors, no changes will be made in the manuscript at the proof stage.

Fees and Charges

No fee is paid for the publication of article in JCPMI. Author's submissions are only required to meet the peer review process.

Submission of a manuscript implies: that the work described has not been published before (except in the form of an abstract or as part of a published lecture, or thesis) that it is not under consideration for publication elsewhere; that if and when the manuscript is accepted for publication, the authors agree to automatic transfer of the copyright to the publisher.

Disclaimer of Warranties

In no event shall the management of the Journal of Construction Project Management and Innovation be liable for any special, incidental, indirect, or consequential damages of any kind arising out of or in connection with the use of the articles or other material derived from the JCPMI, whether or not advised of the possibility of damage, and on any theory of liability.

This publication is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Descriptions of, or references to, products or publications does not imply endorsement of that product or publication. While every effort is made by JCPMI management to see that no inaccurate or misleading data, opinion or statements appear in this publication, they wish to make it clear that the data and opinions appearing in the articles and advertisements herein are the responsibility of the contributor or advertiser concerned. JCPMI management makes no warranty of any kind, either express or implied, regarding the quality, accuracy, availability, or validity of the data or information in this publication or of any other publication to which it may be linked.

Table of Contents: Volume 3 Number 1 May, 2013

ARTICLES

Research Articles

Human capital theory: implications for the Ghanaian construction industry development **464**
Fugar, F.D.K., Ashiboe-Mensah, N.A. and Adinyira, E.

Conceptual models for assessing adversarial business relationship and improvement of engineering and design service delivery (EDSD) in Ghana **479**
Orgen, N. D., Ahadzie, K., Ayarkwa, J, and Badu, E

A perspective on causes of material waste in the city of Tshwane building industry **498**
Okorafor, C and Mwanaumo, E

Illegal appendages to residential buildings in Kumasi, Ghana – a case study of North Suntreso **511**
Adinyira, E and Anokye, P

Benefits derived by district assemblies from their project consultants **530**
Ayarkwa, J., Baiden, B. K., Osei-Asibey, D. and Sabah, C. B. S.

Understanding complexity within energy infrastructure delivery systems in developing countries: adopting a viable systems approach **543**
Awuzie, B. O and Mcdermott, P

Investment methodology in planning and development of infrastructure: an unbalanced growth approach **560**
Ojuri, B. O

Conceptualizing the liveable African City **573**
Lawanson, T., Salau, T and Yadua, O.

Apoptosis in city systems: a biomimetic approach to city regeneration **589**
Ajadi, S.

Journal of Construction Project Management and Innovation Vol. 3 (1): 464-479, 2013
ISSN 2223-7852

HUMAN CAPITAL THEORY: IMPLICATIONS FOR THE GHANAIAN CONSTRUCTION INDUSTRY DEVELOPMENT

Fugar, F.D.K[1], Ashiboe-Mensah, N.A[2] and Adinyira, E[3]

[1 2 3]Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
Email: fdkfugar.cap@knust.edu.gh; naaadjeleyashiboe@yahoo.co.uk; adinyira.feds@knust.edu.gh.

Abstract
The purpose of this study is to identify from the literature the effect of human capital development on growth, profitability and competitive success of organisations and to argue that the development of the Ghanaian construction industry, its capacity to remain pivotal to the nation's economic growth and the ability to become globally competitive are directly linked to investment in the development of its human capital. This theoretical paper reviewed the literature to identify empirical evidences of the correlation between human capital development and organisational success and profitability. The findings reveal that investment in education has positive correlation with high performance of other industry categories. The research has also revealed some criticisms of the theory of human capital development and provided insights into the barriers to human capital development within the construction industry in developing countries such as Ghana. The paper presents empirical evidence of the benefits that accrue to organisations that invest in human capital development and provides a training and development model that could serve as a framework for training and developing employees within the Ghanaian construction industry.

Keywords: Human capital development, Ghanaian construction industry, Firm performance

INTRODUCTION

The construction industry in Ghana, like in every other country, is pivotal to the economic welfare of the country. It is a major industry for generating or creating new wealth and value to meet other economic and social goals in the country (Ahiaga-Dagbui, et al., 2011). Compared with other industries, the Ghanaian Construction industry is low-tech and labour intensive. Consequently, the long term sustainability of the industry's significant role in the socio-economic development of the country is contingent upon the development of its human capital bearing in mind some of the human-related problems that has bedeviled the industry over the years; low productivity, low quality workmanship, low level of technical and

managerial competence, and time and cost overruns (Westring, G, 1977; Ofori, G. 2001; World Bank, 2003; Ahiaga-Dagbui, et al., 2011).

Human capital has been generally accepted as the most valuable asset of nations and organisations. It is the core capability within firms and an important variable that determines an organisation's competitive success and profitability in today's market place. Fisher et al. (2003) state that organisations require a number of things to be effective but the factor that is most likely to provide potential competitive advantage is human resources and how these resources are managed. Besides its significance to a firm's success, human capital is a key to an individual's employability and earning capacity.

As already stated, the economic prosperity of the construction industry is closely tied to its human capital because it is labour-intensive. Thus, the effective delivery of construction projects depends on the quality of personnel at the professional, technical, supervisory and worker levels at all stages from project inception through design and implementation to completion. It is important therefore, to train, develop and retain quality work force capable of and committed to the success of the industry. Paradoxically, it is in this industry that there is a "wide spread of ignorance of good practice in this area" (Loosemore et al., 2003).

Globalisation, technological change, market complexity and the growing number of competitors in all industries have put high premium on human capital development because it is a critical part of organisation's competitive capability. Marimuthu et al. 2009 and Fisher et al. 2003 emphasise that production technology, financing and marketing can all be copied by other competitors but the strategy that is harder to copy is the unique ways an organisation optimises its workforce through comprehensive human capital development towards the realisation of organisational goals, long term survival and sustainability. Pfeffer, (1998) also states that organisational success is not based on conventional factors such company size, a unique image, the right market niche, dominant market share, being in the right industry, and so forth, but on how employees are treated (cited in Fisher et al. 2003).

Indeed, in an environment of constant change and fierce competition, human capital development is a veritable and inevitable route to developing ideas for reconfiguration, innovation, quality and continuous improvement, as well as other critical variables necessary to succeed in the business world. The construction industry in the last two decades has seen tremendous changes in construction technology, procurement practices, IT, legislation and above all client demands (Loosemore et al., 2003). For that reason, it is important that effective policies and strategies are developed to promote superior human capacity development and management within the Ghanaian construction industry to cope with these changes and in order to remain relevant. This theoretical paper discusses issues of human capital development and advocates the potential positive association between human capital development and the growth of the construction industry by linking human capital development with high performance in other industry categories.

THE HUMAN CAPITAL THEORY

Bohlander et al. (2001) define human capital as "knowledge, skills, and capabilities of individuals that have economic value to an organization." The Organisation for Economic Cooperation and Development (OECD, 2001) describes human capital as "the knowledge, skills, competencies, and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being." Dess and Pickens (1999) also define human capital as "capabilities, knowledge, skills, and experience, all of them embodied in and inseparable from the individual."

This paper focuses on human capital as the knowledge, skills, competencies, experience and attributes that individuals have which contribute to the achievement of organisational goals and enhance individual value in the market place. Thus, human capital development is any activity which increases the quality of the employee. Training is a primary mechanism by which human capital is developed. Marimuthu et al. (2009) describe it as the knowledge and training required and undergone by an employee that increases the individual's capabilities in performing activities of economic values.

The theory of human capital was proposed by Schultz (1961) and developed by the Nobel prize-winning economist Gary S. Becker in his seminal work on the economics of employer-provided training (1962, 1964). Human capital theory advocates that education or training imparts useful knowledge and skills to workers which in turn increase their productivity and incomes (Becker, 1964). Becker distinguishes between specific human capital and general human capital. Specific human capital includes expertise acquired through education and training which is specific to a particular firm (firm-specific or context-specific skills). General human capital (general skills), on the other hand, is knowledge gained through education and training which is valuable across board (e.g., reading and writing).

Becker views human capital as similar to "physical means of production", e.g., factories and machines: one can invest in human capital (via education, training, medical treatment) and one's outputs depend partly on the rate of return on the human capital one owns. Thus, human capital is a means of production, into which additional investment yields additional output.

A number of authors have criticised the human capital theory for being too simplistic in its analysis of employee productivity and have argued that education alone cannot lead to organisational productivity but must be complemented by other variables. Levin and Kelley (1994) have pointed out that economists and other social scientists have overestimated the payoffs from increased education and ignored complimentary inputs such as, training, contract terms, and management practices which must exist for education to improve productivity. According to Thurow (1975), productivity is largely characteristic of jobs rather than of workers; employers use education credentials to select workers because better-educated workers can be trained for specific jobs more quickly and at a lower cost than their less-educated peers. Spence (1973) also posits that education may simply be a market signal of the potential productivity of a worker since there is hardly any other way for firms to determine the productive attributes of a worker. Notwithstanding these criticisms, “Becker’s human capital theory has been resilient and still remains the principal theoretical construct that is used for understanding human capital investment, both from the perspective of the individual and the firm” (Bassi &McMurrer, 2006).

POTENTIAL PAYOFFS OF HUMAN CAPITAL DEVELOPMENT

The following are some benefits of human capital development:

- Results in high and effective performance (Beardwell and Holden, 1997 cited in Loosemore et al., 2003);
- Provides competitive advantage in emerging knowledge economy (Lengnick-Hall and Lengnick-Hall, 2003);
- Prepares employees for promotion and managerial succession (Grobler et al., 2002);
- Fosters a continual learning culture and stimulates the reinventing of organisations in a highly competitive and turbulent environment (Martocchio and Baldwin, 1997 cited in Fisher et al., 2003);
- Updates or gives new skills to front-line as well as managerial employees in order to keep them from obsolescence in the face of constant technological innovations and the global competitive pressure (Grobler et al., 2002);
- Enhances loyalty and retention of top-quality staff (Candy and Miller, 2000; Elsdon & Iyer, 1999, cited in Fisher et al., 2003);
- Increases the problem-solving abilities and the creative thinking of managers to handle the multifaceted problems of organisations (Fisher et al., 2003);
- Satisfies personal growth needs of employees (Grobler et al., 2003); and
- Manifests corporate commitment to employees who may, as a result, feel valued by their employers (Sisson and Storey, 2000 cited in Loosemore, et al., 2003).

EVIDENCE OF THE EFFECTS OF HUMAN CAPITAL DEVELOPMENT AND FIRM'S PRODUCTIVITY

Hansson et al. (2003 cited in Bassi & McMurrer, 2006), conducted an extensive review of the literature to identify the impact of investment on human capital development at the firm level in European countries and concluded that "increasingly, studies provide evidence that training generates substantial gains for employers. The most compelling evidence is presented in several recent papers connecting training investment with changes in productivity, profitability, and stock market performance." Another review of literature by Tamkin et al. (2004 cited in Bassi & McMurrer, 2006) which focused primarily on firms in United Kingdom has concluded as follows:

- "The evidence is that the benefits to the firm exceed the wage costs paid back to the individual;
- High performing firms employ better educated people than low performers;
- Better educated workforces are associated with higher productivity and other organisational outcomes;
- Matched plant research has suggested skills are an important component of the skills gap with competitor nations;
- Higher levels of training are associated with positive business benefits in several studies but not all;
- There is mixed evidence regarding the kinds of training and their link to business outcomes;
- Evidence suggests consistent trainers achieve greater returns."

What is more, Hansson (2005) analyses data on about 6,000 private sector organisations in 26 countries (primarily in Europe, but including a small number of non-European countries) and concludes that "staff turnover (mobility) does not appear to be a decisive factor in explaining the provision of training on a national or company level though it is to some extent associated with profitability. However, the single most important factor associated with profitability is how much is invested in training (intensity), suggesting that the economic benefits of training outweigh the cost of staff turnover" (cited in Bassi & McMurrer, 2006)

A number of studies in the US (Low and Kalafut, 2002; Pfau and Kay, 2002, Buckingham and Coffman, 1999) conclude that the best human capital practices are directly related to firm's present and future performance, high financial performance, employee retention, customer satisfaction, and productivity. Certainly, there is a growing body of evidence in the literature that human capital development can play an important role in improving firms' financial performance, productivity and other key operational outcomes.

BARRIERS TO HUMAN CAPITAL DEVELOPMENT WITHIN THE GHANAIAN CONSTRUCTION INDUSTRY

Despite the acclaimed contribution of human capital development to organisational growth and profitability, most Ghanaian construction companies do not take advantage of it due to certain barriers:

Lack of central development and regulatory agency

Currently, there is no central agency with legislative backbone to promote and enforce the advancement of skills, experience and professionalism in the Ghanaian construction industry. There is no compulsion on firms and contractors to undertake continual development of their employees. This has partly led to the poor performance on projects in areas such cost, quality and productivity. A high percentage of construction projects undertaken in Ghana overshoot the cost and time limits set by the parties (Ofori 2003; & Erkelens et al., 2008). It is in this regard that calls for a Construction Development Board for Ghana is relevant and urgent, following successful examples in other countries: the National Construction Council (NCC) of Tanzania, the Building Construction Authority (BCA) of Singapore and the Construction Development Boards (CIDB) of Malaysia and South Africa.

Lack of financial resources

The myriad of problems facing Ghanaian contractors and consultants is vividly captured in a road-sector report. Among these problems are inability to secure working capital, perennial problem of arrears in payments and low level of consultancy fees (Government of the Republic of Ghana 2000). This situation makes it almost impossible for contractors to embark on human capital development and prevents the development of technical support for consultancy firms in Ghana. Notwithstanding the financial problems and having regard to the immense benefit of human capital development to be accrued to the industry, creative approaches to training and development could be adopted to minimise cost and time. On-the-job training, for example, even though has its short comings may be one of such approaches to reduce cost and time.

Lack of appreciation of the role of human capital in organizational performance

Some managers do not appreciate the importance of human capital development as the means for reinventing organizations to be competitive and proactive in a highly competitive and ever-changing economic environment. In such organisations, human capital development is hardly ever incorporated into their strategy and structure. This has partly contributed to the non-viability and non-competitiveness of such domestic enterprises.

Cost of human capital development

Besides being one of the most important human resource management functions, Human capital development is also one of the most expensive (Fisher et al., 2003). It involves investment of time and financial resources with long-term benefits. Most owners of construction firms are more interested in immediate benefits than long-term returns. Thus, such enterprises are not normally inclined to invest in human capital development. Furthermore, insufficient and erratic flow of jobs coupled with irregular payment for work done by construction clients has exacerbated the reluctance of construction firms in Ghana to invest in human capital development.

Macho-nature and low-tech of the industry

The Ghanaian construction industry, like others in developing countries, is labour intensive and many of the activities on construction projects are physical in nature and cannot be effectively learned in the classroom. This has contributed to the less value placed on formal training or education by some managers (Loosemore et al., 2003).

Slowness to change

The construction the industry is slow to change; old construction techniques and materials are still been used thus making human capital development seemingly inconsequential; For example, in 2007, PMC Global Incorporated of the USA started the production of pozzolana cement to reduce the cost and perennial shortages in cement supplies in Ghana.

Pozzolana cement is the product of 30 years of extensive research by the Building and Road Research Institute (BRRI) of the Council for Scientific and Industrial Research. However, because of low patronage, the company was reported to be on the brink of folding up (Business, 2011). This is just one example of how slow the Ghanaian construction industry is in adopting innovation. Consequently, little opportunity or incentive is available to train employees in new technologies and processes.

High employee mobility

High mobility of construction employees is a major disincentive for training and development. Trained employees are easily poached by other companies through the use of attractive remunerations and other benefits. Thus, no employer is willing to train employees who become easy 'preys' for their competitors. It is unattractive for contractors to train employees because with a better incentive a contractor can attract trained personnel from other companies. The consequence of this, according to Loosemore et al., 2003, is a training stalemate. Furthermore, these itinerant employees fail to cultivate any loyalty to their companies thus further negating the need to provide training to staff. Paradoxically, many research studies have concluded that one of the ways to reduce mobility is by training the employees. Because training engenders commitment of employees and committed employees remain in the organisations for longer periods (Brum, n.d).

Low level of education

Most Ghanaian construction site employees have low level of education. Studies in the industry especially in the area of job satisfaction and motivation have revealed a relatively high percentage of employees whose educational level is not above Junior High School or its equivalent. Indeed, some artisans were found not to have had any formal education (Fugar and Salam, 2007; Adjei, 2009; Oduro-Owusu, 2010). As a result, any human capital development strategy must include general skill training, such as, reading and writing. But it is unlikely that employers would be willing to invest their training budgets in general training which may not have direct impact to their current jobs.

Fragmentation of the industry

The Ghanaian construction industry is made up of small firms which lack financial capacity. This dominant characteristic is a barrier to human capital development.

CURRENT IMPERATIVES FOR HUMAN CAPITAL DEVELOPMENT WITHIN THE GHANAIAN CONSTRUCTION INDUSTRY

The current economic environment makes human capital development in the Ghanaian construction industry a matter that must be given a serious thought if the industry must survive. The following are some of the compelling imperatives:

Globalisation

Contractors and consultants are currently facing competition from foreign firms who have greater experience and resources (Ofori n.d). Thus, it is becoming increasingly important to develop an internationally competitive industry that will be able to undertake construction projects of any size at home and abroad and ensure that clients receive value for money. It must be an industry that is conscious of the environment in the execution of construction projects. This can happen if Ghanaian construction practitioners acquire appropriate knowledge and skills through effective and continuous human capital development.

Increased use of latest IT technologies for pacing up work

This century has seen overwhelming changes in technologies. Internationally, there is evidence that the construction industry is gradually integrating information and communication technology (ICT) applications into the industry's business processes. ICT is used in coordinating stake holders, online procurement, customer relationship management, and for improved efficiency. Practitioners in the Ghanaian construction must acquire knowledge in these technologies and be proficient in their application. The use of ICT will in no small way address some of the current weaknesses of the Ghanaian construction industry which often result in cost and time overruns, and operational and quality deficiencies.

Increasing clients' demands for quality, speed and cost efficiency

Today's clients are exacting in their demand for quality, speed and value for money. This requires a complete paradigm shift to a positive quality and performance oriented culture. Training is fundamental in bringing about organisation-wide cultural transformation (Fisher et al., 2003). Training is needed for developing commitment to total quality management within the Ghanaian construction industry.

Health and safety issues on construction sites

Construction has been one of the most hazardous industries as measured by the number of fatalities. Efforts have been made in most countries to reduce accidents on construction sites. However, statistics indicate that construction industry accidents continue to rise in Ghana (Boakye-Nimo et al., 2010). This poor performance of the Ghanaian construction industry with regard to the safety of its employees has raised the importance of training in occupational health and safety in the construction sector.

Emergent black gold economy

Ghana's economy has been given a positive boost with the discovery of oil in commercial quantities. The World bank reported in 2011 that Ghana was the fastest growing economy in the world, recording a single digit inflation of 8.5 per cent, and a decline in interest rates to the lowest level in four decades (The Ghanaian Times, 2012) A wide range of opportunities exist for the construction industry if the oil sector becomes well developed. Characteristic of most oil rich countries, multi billion cedi infrastructural development projects including onshore and off shore pipelines and other facilities will be undertaken as is the case in Nigeria (Jagun, 2006). Such gigantic construction projects will require knowledge of new technologies and new management and leadership skills. This economic era will also see public-private partnerships playing a major role (Ofori n.d). Thus, the construction industry must acquire the skills necessary to take advantage of the enormous opportunities to be offered by emerging oil economy.

MODEL FOR HUMAN CAPITAL DEVELOPMENT

Figure 1 illustrates a training and development model consisting of seven steps. The major phases of human capital development are: (1) development of staff training and development policy (2) regular assessment of training and development needs (3) development of training/development objectives (4) instructional design (5) validation (6) implementation (7) evaluation.

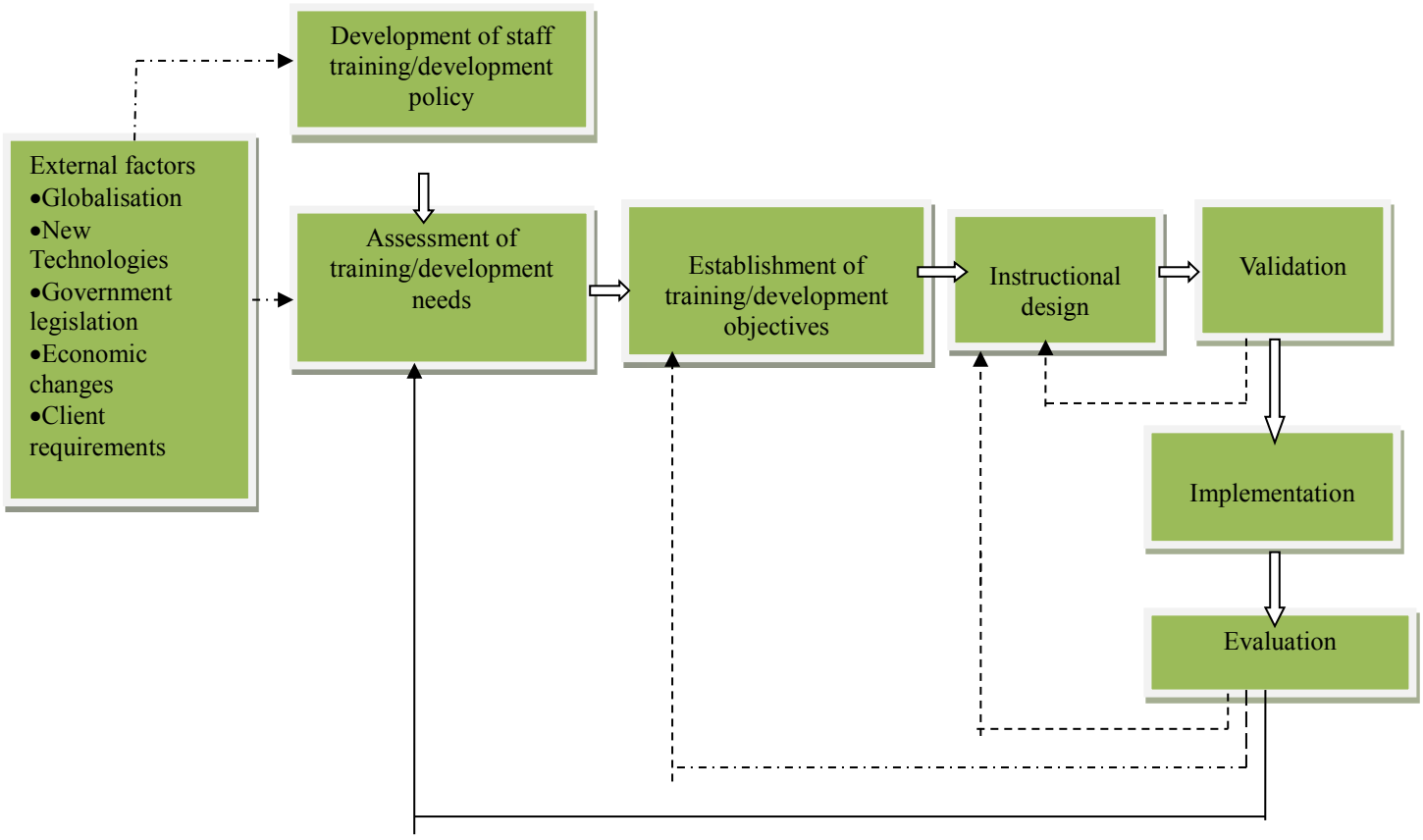


Figure1 Training and development model (Source: Authors)

Development of staff training/development policy

The policy must link objectives of the organisation to the nature of training to be provided. It must be flexible enough to allow for regular revision to accommodate changes brought about by changes in the technological, economic, legal and social environments which will require that employees acquire new knowledge, skills and abilities. According to Loosemore et al. (2003) an effective training policy must possess the following qualities:

- "Should identify a hierarchy of skills and knowledge requirements for the organisation to enable it prioritise its training needs
- Must not only define the training needs of individuals, teams and larger workgroups, but must also show how the provision of these skills will contribute towards meeting the organisation's objectives.
- Should reflect individual, group and organisational training priorities, linking them together in a complementary manner."

Assessment of training/development needs

This must identify in a systematic manner the specific training activities an organisation requires to achieve its objectives. It must answer the following basic questions (Byars and Rue, 2004):

- What skills/knowledge will employees need for the organisation to stay competitive over the next five years?
- What problems does the organisation have that can be solved through training?

Establishment of training/development objectives

After training needs have been determined, objectives must be established for meeting those needs. These must be specific, measurable knowledge and performance objectives (Dessler, 2000).

Instructional design

This involves the compilation and production of the actual content of the training programme. Included are workbooks, exercises and activities

Validation

It is the step in which the training programme is pre-tested on a small representative audience to ensure that it will be able to achieve the training and development objectives

Implementation

Several training techniques or methods are available but the decision regarding which to use must take into account the characteristics of the workers (e.g., age, educational level, etc).

Evaluation

This is a follow-up step to assess the programme's success or failure.

CONCLUSIONS AND IMPLICATIONS

The purpose of this study is to identify from the literature the effect of human capital development on growth, profitability and competitiveness of organisations and to argue that the development of the Ghanaian construction industry, its capacity to remain pivotal to the nation's economic growth and the ability to become internationally competitive are incontrovertibly linked to investment in the development of its human capital. The extant literature on human capital development reveals reasonably strong correlation between human capital development and firms' financial performance and other significant operational outcomes. The Ghanaian construction industry like those in many developing countries has problems with cost, quality and productivity. Construction products are unsatisfactory in terms of their maintainability and durability. Overcoming these problems will require a strategic and deliberate investment in various aspects of human capital development. Indeed, there are many barriers to overcome but current challenges and new imperatives brought about by globalisation, information technology and a dramatic growth of the Ghanaian economy owing to the oil find, make it necessary for the industry practitioners to update their knowledge from time to time through a well planned and executed human development policy. The establishment of a central agency with the legal backing to, among other things, set standards for training and facilitate training in the construction industry will go a long way to minimise the poor perception of the Ghanaian construction industry and enhance its capability and capacity as a mainstay of the socio-economic development of the country .

REFERENCES

Ahiaga-Dagbui, D.D., Fugar, F.D.K, McCarter, W.J. and Adinyira, E.,. 'Potential risks to international joint ventures in developing economies: the Ghanaian construction industry , In Uwakweh B.O. (Ed.) Procs of the CIBW 107 Conference 1-3 November, 2011 Hanoi –Vietnam, pp. 191-195.

Bassi, L.J and McMurrer, D.P (2006) Employers' perspectives on human capital development and management. Organization for Economic Co-operation and Development (OECD).

Beardwell, I. and Holden, L. (eds) (1977). Human resource management: A contemporary perspective, Pitman, London.

Becker, G. (1964). Human Capital. Columbia University Press. New York

Becker, G. (1962). "Investment in human capital: A theoretical analysis." Journal of Political Economy. 70: 9-49.

Brum S., (n.d.) What impact does training have on employee commitment and employee turnover? http://www.uri.edu/research/lrc/research/papers/Brum-Commitment.pdf accessed on 26 January 2013

Buckingham, M. and Coffman, C. (1999). First, Break All the Rules: What the World's Greatest Managers Do Differently. Simon & Schuster

Business 2011, '**Pozzolana cement factory to be shut down', 27 July viewed 31 January2013,**http://business.thinkghana.com/pages/industry/201107/55232.php

Byars, L. and Rue, L.W. (2004). Human resource management. (7th edition). McGraw Hill, New York.

Bohlander, G., Snell, S.A., and Sherman, A. (2001). Managing human resource. (12th edition). South-Western College Publishing, Cincinnati, OH

Brandon, P S (1990) Quantity Surveying Techniques: New Directions, BSP Professional Books, Oxford

Cardy, R.L. and Miller, J.S. (2000) "A customer-based appraisal to managing two R's. Human Resource News, Fall 2000,pp. 10-11

Dess, G.G., and Pickens, J.C. (1999). Beyond productivity: How leading companies achieve superior by leveraging their human capital. American Management Association, New York.

Dessler, G. (2000). Human resource management (8th edition). Prentice Hall, New Jersey

Elsdon, R. and Iyer, S. (1999)"Creating value and enhancing retention through employee development: The sun Microsystems experience," Human Resource Planning, Vol. 22 (2), pp. 39-47.

Erkelens, P.A. and Egmond-de Wilde De Ligny E.L.C.van (2008). Hungarian Electronic Journal of Sciences, ARC – 081 226-B1-1/6.

Fisher, C.D, Schoenfeldt, L.F. and Shaw J.B. (2003). Human resource management (5th edition). Houghton Mifflin Co., New York.

Government of the Republic of Ghana (2000) Highway Network Master Plan, 2001-2020: Draft Final Report, Executive Summary, Accra.

Grobler, P., Warnich, S., Carrell, M.R., Elbert, N.F. and Hatfield, R.D. (2002). Human Resource Management in South Africa. (2nd Edition). Thomson, Australia.

Jagun, J. (2006). "New opportunities for quantity surveyors in the Nigerian's economic environment." Proceedings of the 22nd Biennial conference of the Nigerian Institute of Quantity Surveyors22-25th November, 2006, Calabar, Nigeria

Lengnick-Hall, M.L. and Lengnick-Hall, C.A. (2003). Human Resource Management in the Knowledge Economy, Berrett-Koehler Publishers, Inc, San Francisco.

Leveson, R (1996) Can Professionals be Multi-skilled? People Management, Vol. 2 No. 17, August.

Levin, H. M. and Kelley, C. (1994). Can education do it along? Economics of Education Review 13 (2), 97-108.

Low J and Kalafut, P.C. (2002) "Invisible advantage: How intangibles" are driving business performance. Perseus publishing.

Loosemore, M., Dainty, A. and Lingard, H. (2003) Human resource management in construction projects: Strategic and operational approaches. Spon Press, New York.

Marimuthu, M., Arokiasamy, L., and Ismail, M. (2009). "Human capital development and its impact on firm performance: Evidence from developmental economics." The Journal of International Social Research, Volume 2/8.

Martocchio, J.J and Baldwin, T.T. (1997). "The evolution of strategic organisational training." Research in Personnel and Human Resources Management, Vol. 15, pp- 1-46.

Mingle, E (2012) 'IMF Commends Ghana's Economic Progress', The Ghanaian Times, 9 March 2012, viewed 26 January 2013, http://newtimes.com.gh/story/imf-commends-ghana-s-economic-progress.

Nimo-Boakye, A. Akomah B.B., Fugar, and F.D.K. (2010). "Ensuring the health and safety of Ghanaian construction workers by decentralised government agencies: An exploratory study". Proceedings of 2nd West African Built Environment Research (WABER) Conference July 27-28, Accra, Ghana.

Ofori, G. (2001) Challenges facing the construction industries of Southern Africa. Paper presented at the Regional Seminar on "Developing the Construction Industries of Southern Africa", Pretoria, South Africa, 23-25 April.

Ofori, G. (n.d.) Developing the Construction Industry in Ghana: the case for a central agency. http://www.buildingcontractorsgh.com/Developing%20the%20Construction%20Industry%20in%20Ghana.pdf accessed on 26 January 2013.

Organization for Economic Co-operation and Development (OECD) (2001). The Well- Being of Nations: The Role of Human and Social Capital. Paris: OECD.

Pfau, B. and Ira, K. (2002). The Human Capital Edge. McGraw-Hill.

Pfeffer, J. (1998), "The Human Equation: building profits by putting people first", Boston: Harvard Business School Press.

Prokesch, S E (1997) Unleashing the Power of Learning: An Interview with British Petroleum's John

Tamkin, P., Giles, L., Campbell, M. and Hillage, J. (2004). Skills Pay: The contribution of skills tobusiness success. Institute for Employment Studies.

Thurow. L. (1975). Generating inequality. Basic Books, Inc, New York.

Sisson, K. and Storey, J. (2000). The realities of human resource management: Managing the employment relationship, Open University Press, Birmingham.

Spence, M. (1973). Job market signalling. Quarterly Journal of Economics 87(3) 355-375

Westring, G (1977), Ghana Public Procurement Reform, An Audit Report prepared for the World, Bank, Stockholm: Advokatfirman Cederquist KB.

Journal of Construction Project Management and Innovation Vol. 3 (1): 480-497, 2013
ISSN 2223-7852

CONCEPTUAL MODELS FOR ASSESSING ADVERSARIAL BUSINESS RELATIONSHIP AND IMPROVEMENT OF ENGINEERING AND DESIGN SERVICE DELIVERY (EDSD) IN GHANA

N. K. Orgen[1], D.K. Ahadzie[2], J. Ayarkwa[3], E Badu[4]

[1 2 3 4]Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
Email: nenyio@yahoo.co.uk, divinedka10@yahoo.com, ayarkwajosh@yahoo.com, edwardbadu@yahoo.com

Abstract
Cordial, harmonious business relationship and collaborative business culture that are essential tools for improvement of construction supply chains and networks seem to have eluded Engineering and Design Service Delivery (EDSD) activities despite several years of useful interventions. The aim of this paper was to develop models: to show current EDSD business relationship problems with the view of improving the EDSD activities. The modeling development followed action oriented system theory, system thinking and rethinking. The way of dealing with construction issues in the traditional procurement system in Ghana have been revealed to be adversarial. These offered specific background to demonstrate why the action oriented system theory; system thinking and rethinking were useful in Supply Chain Relationship Management (SCRM) improvement modeling. Further, SCRM improvement modeling is to provide indicative illustration model to overcome the business relationship problems, which have impeded the improvement and continuous improvement of EDSD activities in the past. The desk based search of literature as well helped to develop the models through induction and deduction inferences. These processes were robust attempts pursued based on action oriented system theory, system thinking and rethinking, and relevant literature concepts. Also two separate models for the improvement of the EDSD activities were developed, using performance feedbacks, traditional non adversarial methods/review and innovative information exchange among EDSD practitioners and between them and contractors. One model produced three-stage improvement approach and the other comprising five maturity categorization regions for determination of nine levels of EDSD improvement assessment and continuous improvement in current procurement practice in Ghana.

Keywords: Engineering and design service delivery, Relationship improvement, Supply chain relationship management, Action oriented/System theory/thinking/rethinking,

INTRODUCTION

In a global perspective, evidence of cordial, harmonious construction business relationship and collaborative business culture as essential tools in business improvement processes are shown in many useful construction interventions. Such interventions include alliancing (Yeung et al., 2007), partnering (Bresnen and Marshall, 2002; Naoum, 2003; Wong and Cheung, 2004; Bresnen, 2007; Alderman and Ivory, 2007; Kadefors et al. 2007) and integration of teams (Baiden et al., 2006); which were meant to strengthen, sharpen and shape the tools of collaborative business culture in the time past. These were also to achieve cordial, harmonious business relationship in collaborative culture. Besides, such cordial, harmonious business relationship discourages harsh or adversarial relationship driven by discords, disputes and conflicts (DDC) through preventive or reductive procedures (Orgen et al., 2011; 2012a). These intervention procedures have forged many collaborative, non adversarial and harmonious business processes in most developed and some developing construction industries in the world. However, Engineering Design Service Delivery (EDSD) in developing countries like Ghana keep on working in non collaborative, harsh and adversarial business relationship conditions (Anvuur and Kumaraswamy , 2006; Laryea, 2010; Orgen et al., 2011). Despite all efforts in the past towards achievement of cordial, harmonious business relationship, collaborative business and non adversarial business culture still eludes the EDSD actors. Thus preventing business relationship improvement as an effective and efficient tools, which employ critical relationship improvement factors such as trust (Kadefors, 2004; Meng, 2010), alignment of objectives, problem solving, communication (Meng, 2010) to improve the EDSD activities. Non collaborative working and adversarial business relationship culture cause construction procurement routes and processes to suffer from poor working practices and experiences (Laryea, 2010; Orgen et al., 2012a, 2012b).These then block useful performance feedbacks, traditional non adversarial methods/review and innovative information for the improvement of the EDSD activities (Orgen et al., 2012a). Also the denial of vital information causes EDSD actors on the supply chain of information flow (SCIf) to experience difficulties in communication paving ways for harsh and non collaborative business relationship. It then makes long-term improvement and continuous improvement of EDSD activities extremely difficult leading to delay, poor quality

projects, increase cost, and waste in the construction project delivery (Liiker and Choi, 2006; Orgen et al., 2011; 2012a).

Based on these insights, there is a quest for a robust improvement in collaborative business relationship culture for the improvement of EDSD activities. For that matter, the sole purpose pursued in this construction transformational is seeking to achieve quality, diversity, assessable improvement and continuous improvement in Engineering Design Service Delivery (EDSD) activities as projected through the study (Orgen et al., 2011; 2012a; 2012b). Therefore, the paper was organized to consider first, literature review on the current attitudinal behavioural culture of the EDSD actors that makes improvement of the EDSD extremely difficult. This was followed by theories and concepts that are used in the modeling of an improvement assessment model for the EDSD activities Also, a discussion of a 3-stage improvement model for the improvement of EDSD activities followed before the conclusion was presented.

BRIEF OVERVIEW OF THE CULTURAL AND PROCUREMENT IDENTITY

Construction industries in both developed and developing economies suffer from fragmentation, mistrust, more self-interested, unhealthy competitive behaviour and adversarial business relationship culture. (Bresnen and Marshall, 2002; Pryke, 2009; Orgen et al., 2011, 2012a). These situation of discords, disputes and conflicts (DDC) in construction culture greatly contribute to poor project performance (Bresnen and Marshall, 2002; Naoum, 2003; Baiden et al. 2006; Bresnen, 2007; Pryke, 2009; Orgen et al., 2011, 2012a). Ghanaian construction industrial situation is not in anyway different. In some cases the construction business situation is worse, harsh, adversarial and exacerbated by unstable inflation trends coupled with budgetary deficits (Anvuur and Kumaraswamy, 2006; Laryea, 2010; Orgen et al. 2011). These unfavourable situations make construction businesses, especially indigenous firms or companies; find it extremely difficult in being creditworthy to clients and financial institutions (Laryea, 2010). This have not only contributed to lost of both local and foreign contracts, but also have affected immensely the local expertise and EDSD ability to develop a united collaborative working front for large construction ventures. Obviously there is lack of proper collaborative business relationship front or forum to champion exchange of free flow of performance feedbacks, traditional non adversarial methods/review and innovative

information for the improvement of the EDSD activities for large scale business performance (Orgen et al., 2011, 2012a).

The non collaborative and adversarial cultural burden is shouldered by two identifiable contracting groups: the registered and unregistered contractors. The registered contractors are duly registered by the Ministry of Water Resources, Works and Housing (MWRWH) and with Registrar General's Department under Act 179 (1963) of the companies' registration code (Amoah et al., 2011). According to Amoah et al. (2011), the classification of the contractors depend on a number of issues such as plant and equipment holding, financial standing, previous performance and technical expertise. Using this information as a guide MWRWH have categorized Ghanaian construction works under letter D and K for general building works and civil works respectively. In this respect, MWRWH have subdivided the contractors into four categories D1, D2, D3, D4 for building contractors and K1, K2, K3, K4 for civil works contractors. Out of these groupings have emerged large scale (big firms) contractors in class D1/D2 and K1/K2 and also small scale (small firms) contractors with class D3/D4 and K3/K4 currently representing over 95% of contractors operating in the country (Amoah et al., 2011). The unregistered contractors are the groups/types of contractors who do not have their name in the Ministry's classification register and cannot tender for government contracts.

The procurement method commonly used for all government funded contracts in Ghana is the traditional procurement, which seems to be very popular with both public and private clients, consultants and contractors in the Ghanaian construction industry. Traditional procurement system led by Project Manager is recently introduced by the government through the Public Procurement Authority (PPA) (Ahadzie et. al., 2012) and it is intended to reform old age harsh and adversarial procurement system (Anvuur and Kumaraswamy, 2006; Laryea, 2010; Orgen et al., 2011, 2012), which has been in use. In the later method the lead consultant is supposed to be Project Manager (PM) who has acquired project management skills and have capacity to manage projects. The PM has not been empowered enough to control and improve project performance. Also, throughout the procurement processes the critical

business relationship improvement factors such trust, communication, alignment of objectives; problem solving and others are not vigorously pursued.

MULTI-THEORY DEVELOPMENT

Action oriented system theory, system thinking and rethinking are the combined theories used as a path that guides theorizing, explanations, discussions and spell the end of the research in developing the two models and associated discussions in this paper (Seymour et al, 1997; Harriss, 1998; Jugdev, 2004). The supply chain relationship management captured the inputs of critical relationship improvement factors ie trust (Kadefors, 2004; Meng, 2010). These indicative illustration models with the critical business relationship improvement factors are to improve construction works procurement by overcoming the adversarial business relationship problems. Such problems results in discords, disputes and conflicts (DDC) encountered on the supply chain of information flow (SCIf) in the EDSD activities (Anvuur and Kumaraswamy, 2006; Laryea, 2010; Orgen et al. 2011; 2012a; 2012b). The business relationship improvement modeling is hinged on integrated supply chain relationship management (SCRM). The focus is specifically to overcome DDC in the common works procurements in Ghana, and to improve EDSD activities of traditional method and the current project manager led traditional method with project manager as lead consultant as introduced in the Public Procurement Act, 2003 (Act 663).

THEORY OF ACTION (TA)

Relevant aspect of the Theory of Action (TA) required in this paper includes the efforts of Tuomela (1991); Seebass, (2008) and Coleman and Ostrom (2009), indicating that TA is intention driven. This consist of both < I-intention of an action, weaker than the other, we-intention > which is explained further that the separate action of an individual is not comparable to the joint action of individuals in a group. The joint goal depending on' We thinking' or effort of the We-intention for example to assess EDSD improvement or to improve EDSD activities by making SCIf efficient and effective are concerned with act-relational intentions produce full blown stronger 'We-sense' (shared intention for increase benefits of win-win-win situation). For the EDSD activities involving all EDSD actors is by far stronger (due to aggregate active power of the group) than the I- intention producing weaker 'I-sense' involving a single person ie an architect's or QS sub-SCIf product like design or bill of quantities for EDSD activity.

SYSTEM THEORY (ST)

Another theory useful for the theorization is the System Theory (ST) which is an interdisciplinary theory about every system in nature, in society and in many scientific domains as well as a framework with which can be used to investigate phenomena from a holistic approach (Mele, et. al., 2010). A system from multidisciplinary point of view is defined as an entity, which is a coherent whole with perceived boundary around it in order to distinguish internal and external elements such as clients, sub-contractors and construction supplies activities outside the EDSD entities Mele, et al., 2010;Ng, Maull and Yip, 2009. It also identifies input and output connected to and emerging from the entity. On this basis, Mele, et. al. (2010) stated that ST is a theoretical perspective that analyzes a phenomenon seen as a whole ie EDSD activity and not as simply the sum of elementary parts; like the individual professional SCIf works (DDC sub-SCIfs) or separate works of project manager, architect, quantity surveyor, structural engineer, services engineer and contractor' works from his outfit. For that matter, depending on this latest definition the focus of the ST will be on the EDSD activity's interactions, business relationships between the EDSD parts or works of individual professions constituting the SCIf (sub-SCIfs) works.

CLOSED/OPENED SYSTEMS AND SYSTEM THINKING/RETHINKING

A system is collection of interrelated parts which form some whole (Cole and Kelly, 2011). A closed system is that which does not interact with its environment the supra-systems and the sub-systems (Cole and Kelly, 2011) A system can be closed or opened. If a system is closed that no materials enter or leave it, then it implies that there will be no inputs and outputs, (ISN, 2009). A closed system therefore does not interact with its environment the supra-systems and the sub-systems. It is easy to turn from open system to close system but not vice versa (ISN, 2009). This is the basic reasons why the EDSD, models and concepts to change EDSD activities from partially or closed system as it seems evident with DDC sub SCIf call for a series of actions. To change to a more opened or freely opened system seems complicated as shown in model 1. On the other hand, according to Barile (2006, 2008) a system is opened when it allows inflow and outflow of materials to change its compositions

or components. That is the system interacts with supra-systems and sub-systems for actual transformation.

This refer to the study of how actions by a system cause changes in behaviour that are understood by the system itself in terms of feedback, allowing the adaptation of the system to new conditions (Mele, et. al., 2010). Supra-system is better organized as function which influences the system. The EDSD sub-systems are the works of individual professions constituting sub-SCIfs that make up the SCIf works which needs to be directed and managed by the system in order to contribute to SCIf's finality (Mele, et. al., 2010). This draws into the research another important aspect of the ST, which is system thinking contributing to the indicative illustration of EDSD activity modeling for EDSD system's finality. System thinking comes from the shift in attention from the part to the whole (Checkland, 1997; Weinbeng, 2001; Jackson, 2003, cited in Mele, et. al., 2010). It occurs in a way that the integrated and interacting situation of a phenomena reveal properties of single parts as Project Manager (PM), Architect (Arc) Quantity Survoyer (QS), Service Engineer (Ser Eng), Structural/civil Engineer (St Eng) and Geotechnical Engineer (Geo-tech. Eng) (distinctly as 'I's or be in absolute union, which by the activities of system elements ie sub-SCIfs or EDSD actors) work are rationally connected (Mele, et. al., 2010). The core problem of system thinking revolves around causation and reductionism (Pickel, 2007). Moreover, system method of thinking assists companies or firms to become learning organization (Mele, et. al., 2010). In this respect, some aspects of the rethinking system theory (RST) cannot be overlooked. This is in order to constitute a robust multi-theory for the theorization, discussions of EDSD activities and construct models for the assessment of EDSD improvement and improvement of the EDSD activities, grounded in systemic paradigm as systemic thinking called 'systemism'(Pickel, 2007).

RETHINKING SYSTEM THEORY (RST)

The idealist concepts of holism and reductionism are accepted in these new wider thoughts as real and causally efficacious in multi-theory building ((Pickel, 2007). They are taken as integral part of the rethinking process where each system takes all other systems as its environment, an ontological position that allows greater flexibility in the conceptualization of

systems, than that based on the part to whole distinction (Pickel, 2004, 2007). In this regard a system cannot be defined only by the set of elements and their relations to an environment. There is the need for the inclusion of the actual processes that make the system a system, which in the complex real-world is the self-organisation.

JCPMI Vol. 3 (1): 480 - 497, 2013

According to the research of Bunge (2004) 'systemism' is like holism the difference is that it encourage analysis of wholes into their constituents and as a results is never in harmony with intuitionist epistemology inherent in holism. Therefore, the EDSD practitioners and contractor should be treated as the producers of any social whole ie EDSD activities. In this regard, what then is a system? Pickel (2007) defined system as a complex object whose parts or components are held together by bonds of some kind. These bonds are logical in the case of a conceptual system, such as a theory; in concrete systems they are materials such as SCIf documentations for constructing projects.

RESEARCH METHODS

The research methods used were desk based study, an extensive review of relevant literature (Fellows and Liu, 2003). In the research, the descriptive approach where questions which seek to find why performance feedbacks, traditional non adversarial methods/review and innovative information for improvement of the EDSD system are difficult to flow, manage and apply freely among the EDSD actors were asked(Naoum, 2004). The review of the literature covered multi-theories which explained and provided strong conceptual content and basis for the model 1 & 2. These methods also helped reveal the relevance of the integrated supply chain relationship management (SCRM) in the construction of the models in terms of the three information elements and attitudinal behavioural attributes used. The information gathered also helped to indicate and illustrate how EDSD improvement assessment can be carried out using model 1 and how to use model 2 for improvement and continuous improvement of the EDSD system finality. Also the system theory, systemic thinking and rethinking showed how preservation and sustainability of free flow of feedbacks, traditional non-adversarial methods/review and innovative information through business relationship improvement to improve EDSD activities can be achieved.

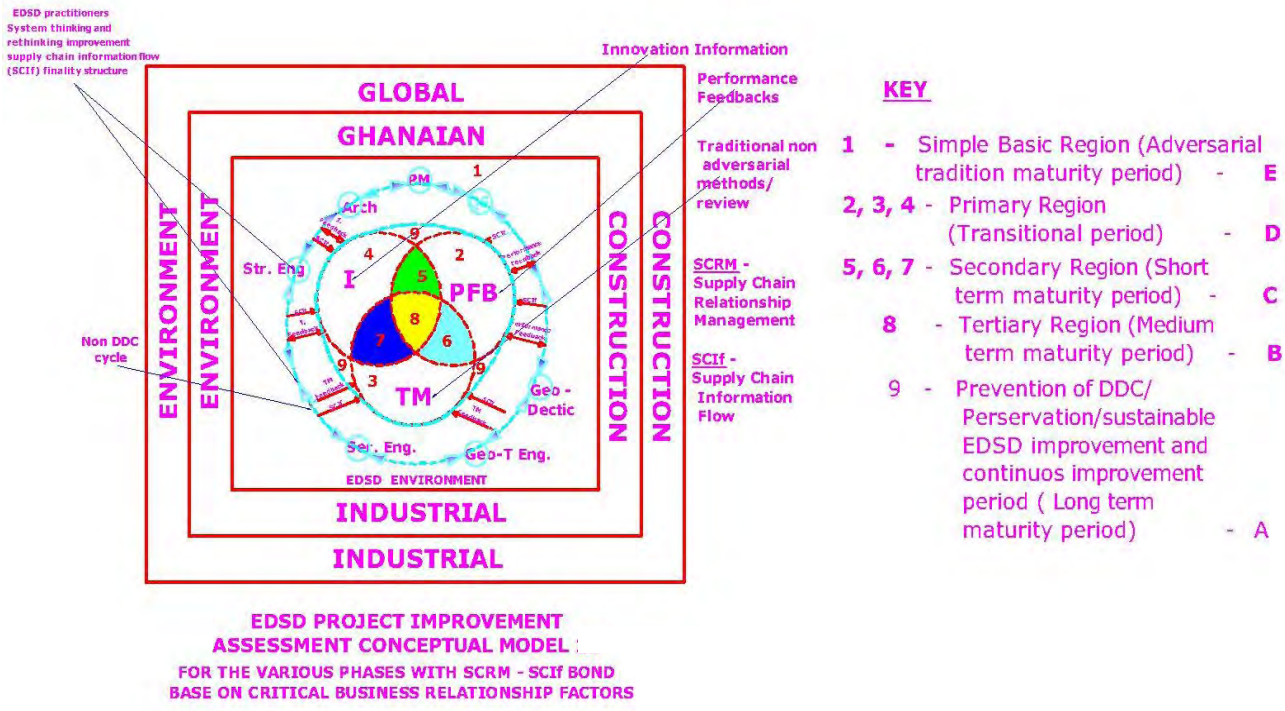
DISCUSSIONS OF THE MODELING

Input and Output processes and procedures for the EDSD improvement assessment model are relevant to determine the extent of EDSD improvement in terms of the information constructs before any action. The strong arguments presented are the conditions or preconditions that demand chain of actions that makes inputs and output in EDSD systems necessary.

For instance, it is identified with much evidence that non collaborative working and adversarial business relationship caused by DDC exist among the sub-SCIfs (ie separate products from individual professions of the EDSD entity) and also between them and the contractor's organisation (sub-EDSD actors) as a EDSD sub-system. The EDSD activities are taken as a system whole which its improvement is dependent on proper and effective interaction of the sub-SCIfs systems. The degree of permeability of the EDSD system boundaries and the sub-SCIf boundaries are very important for exchange free flow (in and out) of performance feedbacks, traditional non adversarial method/review and innovative information is to make the SCIf whole effective and efficient cycle as in model 1 This proper and effective interaction is possible through the active power of the EDSD actors (comprising sub-SCIfs systems and the contractor as EDSD sub-system) as well as the facilitator's work of promoting and motivating the use of business relationship improvement (BRI) factors. It is on this business relationship improvement (BRI) that sub-SCIfs and the entire EDSD entity dependents to achieve free flow of exchange and sharing of performance feedbacks, traditional non adversarial methods/review and innovative information shown in model 1 This kind of information exchange and sharing is to make SCIf on which the EDSD activities depend effective and efficient for the improvement of EDSD activities as a system whole shown in model 1 and in the 3- stage conceptual model 2. Therefore, the key issues for the modeling of EDSD entity as a system whole are the need to draw or have inputs from the environment. This is in effect to take all other systems and sub-systems for instance clients, sub-contractors, supplies, other contractors, and other EDSD actors in the Global and Ghanaian environments and draw from to make up the sub-SCIfs, by so doing constitute an effective and efficient SCIf shown in model 1. The SCIf is the bond playing a central role in the mechanism that make the EDSD entity work as a system (Pickel, 2007). Therefore, improving SCIf through the active power of the EDSD actors in promoting and motivating the use of critical (BRI) factors by the facilitator is essential in full blown achievement of a joint goal of the EDSD system. The focus of this theorization is to achieve a finality of

improvement in the EDSD activities open system as developed in indicative illustration model 1. To improve the EDSD entity, individual practitioners (PM, ARC, QS, St Eng., Ser Eng., Geo-tech.) thinking should be a paradigm shift from parts such as sub-SCIfs products of professions towards interactions that assist the system whole finality.

In this sense, the parts (sub-SCIfs) are to be composed through interaction into system whole of SCIf cycle as shown in the model 1. It is essential that all the EDSD actors in the model 1 contribute to achieve effective and efficient bond which is formed through proper interaction and exchange of information.



Model 1

Therefore, in the EDSD assessment conceptual model 1 the supra systems and sub-systems in the Global and Ghanaian construction environment are rationally and strongly connected to the EDSD system and should be in single union of non DDC cycle of SCIf bond. System rethinking expresses that exchanging and sharing of SCIf cycle information by the EDSD practitioners with contractor is a bond playing a central role in a mechanism that makes EDSD system a system (Pickel, 2007). Mechanisms central processes in realizing the

systems, so projecting the processes as 'systemism' in system rethinking should vigorously be pursued. The functioning of the processes in rethinking is dependent on the following: SCIf bond as in model 1 big circle.

EDSD component ie are the EDSD practitioners on the circle and contractor/its organization that can be mobile depending on his situation, EDSD structure the architecture ie the autonomous sub-SCIfs (EDSD actors) with the lead EDSD practitioner as procurement head, and EDSD environments ie Global and Ghanaian environment indicated in model 1. The SCIf bond is the mechanism that works the system, EDSD structure, EDSD component and EDSD environment. Action in the EDSD system should work as processes of a mechanism of a system whole of EDSD practitioners and contractor in hybrid procurement system to improve EDSD activities as in the 3- stage conceptual model 2. Then there will be no more room for reductionism of parts such as DDC sub-SCIfs to cause professional, non collaborative working and adversarial attitudinal behaviours.

MODEL 1 EDSD IMPROVEMENT ASSESSMENT MODEL

The EDSD improvement assessment model consists of five regions: simple base (baseline), primary, secondary, tertiary and improvement and continuous improvement regions. The simple base region is traditionally non collaborative, harsh and adversarial in nature, has one level (level1) where there is little or no exchange or sharing of performance feedbacks, traditional non adversarial methods/review and innovative information to improve SCIf and EDSD system whole as in model 1. Also, model 1 has eight other levels within the remaining four regions. These can be used alongside the level 1 in the simple base region (traditional adversarial period) to determine in terms of exchange or sharing of performance feedbacks, traditional non adversarial methods/review and innovative information where a particular construction company or firm will be placed. The EDSD practitioners' ability in terms of exchange or sharing information elements eg, Performance feedbacks will also be determined. It will then offer useful premises to investigate and assess why there is/are improvement or no improvement based on the flow of information from SCIf cycle of EDSD practitioners to contractor/organization and vice versa. Besides, based on the following facts of the model 2 construction firms or companies can in field survey be

assessed of the level of improvement conducted based on the performance feedbacks, traditional non adversarial method/review and innovative information used.

Indeed, model 1 offer indicative illustrative assessment dimension prior to the usage of 3-stage EDSD improvement conceptual model 2 Further, primary region (transitional period) of three open subsystems levels 2, 3, 4, each offers one piece of improvement information only. The secondary region (short-term period) also of three open subsystems levels 5, 6, 7, each offers two pieces of improvement information only. Furthermore, model 1 presents a tertiary region (medium-term period) of only one open subsystem level 8, which offers three pieces of improvement information only. Finally, improvement and continuous improvement region (long-term period) embraces all the open subsystems of the primary, secondary and tertiary as level 9, contribute to the system whole finality. This is exclusively essential for the preservation, stability and substance of improvement and continuous improvement in the long-term and prevention DDC through effective used of the critical business relationship improvement factors. In each of these nine levels there is at least an exchange and share of one of the following information: performance feedbacks, traditional non adversarial methods/review and innovative information from bond SCIf cycle of the mechanisms which make the system a system. The effectiveness and efficiency of the SCIf cycle is based on the voluntary relinquishment of some autonomy for a hybrid procurement through business relationship improvement to achieve proper and effective EDSD actors' interaction and exchange of information to the improve EDSD system whole finality.

Stage 1 Improvement in Business Relationship and Information Generation

The stage 1 of the EDSD improvement conceptual model is constructed with a focus on business relationship improvement (BRI) for the generation of information. The preconditions or conditions that necessitated this chain of actions are that in the EDSD system whole, under the traditional or recent PM led traditional procurement method the EDSD practitioners (sub-EDSD actors) and contractor (sub-EDSD actors) have autonomy to practise their professions. However, people dislike being controlled and thus engage in conflict to avoid being controlled as it is with EDSD actors Collins, 1975; Orgen et al,

2012a). Each consulting EDSD practitioner wishes to keep his autonomy and monopoly of his profession. These conditions encourage DDC among EDSD actors where artificial closed system of sub-SCIfs with DDC is produced giving rise to the non collaborative and adversarial business relationship syndrome.

Also the EDSD practitioners' autonomy in producing sub-SCIfs seems to have strong linkage with the procurement method used. For that matter, the encouragement of BRI call for a hybrid procurement method which will allow or encourage BRI to flourish properly among EDSD actors to voluntarily relinquish some of their autonomy and monopoly for the useful development of BRI based on critical relationship improvement factors ie trust, problem solving, alignment of objective and others as in model 2. Also there will be proper flourishing of BRI which will foster promotion and motivation of the active power of EDSD actors to plan and achieve a full blown joint business goal coupled with We-intentions for the success of the EDSD system whole. Further the facilitators workshops, for a, seminars and meetings through brainstorming will produce proper interaction and free flow of performance feedbacks, traditional non adversarial and innovative information. This information then will flow to the information processing stage 2 developing towards an open system of thinking and rethinking as in the conceptual model 2 to achieve effective and efficient SCIf bond to improve EDSD system whole finality.

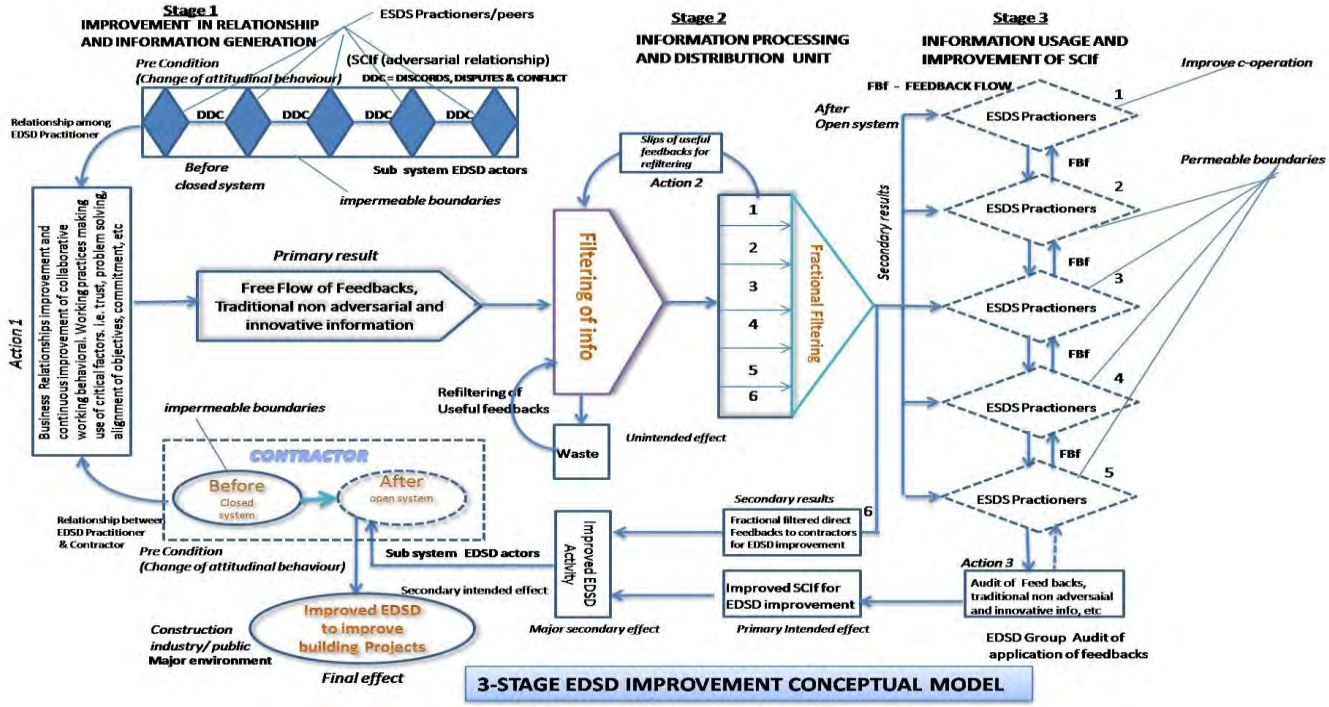
Stage 2- Information Processing and Distribution of the conceptual model

The stage 2 of the conceptual model 2 is developed for information processing and distribution, which greatly involve the EDSD mechanism and processes in which the SCIf bond works to make EDSD system a system. The improvement of the EDSD systemic (systemism), demands that the information processing should involve all information from all systems and sub-systems within the EDSD entity and those that form the external global and Ghanaian environments as indicated in model 2 for filtration and fractional filtering before distribution. Proper filtration will sieve and deal with all element and issues that will prevent full development of the supply chain relationship management such as; DDC prone issues, non critical business relationship factors and general elements or issues which fans non collaborative and adversarial relationship which block improvement of the EDSD system.

These filtration and fractional filtration will make use of the feedback sheets for optimum success (Orgen et al, 2012a).. Details of fractional filtration concerning grouping of information into two categories should be; inline with respective professions.

The type of information i.e. performance feedbacks, traditional non adversarial method/review and innovative, which are based on the EDSD structure and components numbering in stage 2 and recycling of information which seems irrelevant during processing or difficult to interpret or group or classify as waste. Indeed such wastage need special reasoning, experience and tactfulness through thinking and rethinking of the processes to make boundaries of the sub-SCIf and SCIf permeable systems to allow re-filtration of managing the waste to obtained maximum effective and efficient use of the interaction and information flow before application or absorption.

Three-stage EDSD Improvement Model



Model 2

Stage 3:- Improvement of SCIf for the Improvement of EDSD system

For the construction of the final stage of the 3-stage conceptual model, the finality of model is based on action oriented system theory, thinking and rethinking which drew its developmental strength from EDSD We-intention, We-goal or joint goal.

Besides it involves opened system of permeable boundaries of EDSD practitioners and contractor's/organisation contributing to an effective and efficient SCIf in processes of the mechanism, structure, components and environments in which SCIf develops into required finality. The results of an effective and efficient SCIf optimum or finality level comes through proper interaction, effective exchange and free sharing of fractionally filtered performance feedbacks, traditional non adversarial and innovative information abstracted from EDSD feedbacks sheets. This information are applied and absorbed in two separate channels, direct to the contractor after fractional filtration and through the SCIf after absorption of the applied information and auditing. Also the application and adoption of the information arise on the basis that a hybrid procurement approach, with full application of relationship management concepts should be encouraged with optimum relaxation of EDSD actors' professional autonomy. It is in the light of these issues that the improvement of EDSD entity activities will directly improve EDSD projects. It should further be noted that the improvement of the EDSD will effectively occur after a controlled EDSD actors' audit of the total quality output of the systemic (systemism) information used in the development of the SCIf as in model 2. On the basis of this multi-theory reasoning the EDSD improvement are bound to succeed and thrive.

CONCLUSION

It is evidence that non collaborative working and harsh or adversarial issues exist among the EDSD actors (EDSD practitioners and contractor/organization). These situations hamper business relationship improvement among EDSD actors and affect the effective and efficient performance of the Traditional procurement system led by Project Managers. Business relationship improvement (BRI) will be proper and effective among EDSD actors through exchange and share of performance feedbacks, traditional non adversarial methods review and innovative information. The BRI is partly dependent on voluntary relinquishing of some professional autonomy of EDSD actors to adopt free exchange and share of performance

feedbacks, traditional non adversarial methods review and innovative information to make SCIf effective and efficient for the improvement of the EDSD activities. It is the proper development of these BRI issues that will break and prevent continuous occurrence of business failure and overturn all justification for DDC sub-SCIf (sub or fragmented documentations).

EDSD entity finality obviously lacks continuous integrated supply chain relationship management of business relationship to develop strong, effective and efficient SCIf bond to cause any systemic (systemism) function to occur. The multi-theories of action oriented system theory, thinking and rethinking offer tools that have proved effective in the construction of relationship of direct and inverse proportions. These conditions led to development of EDSD improvement assessment model 1, which could be used to find the improvement status of construction organisations. The improvement status based on the three information elements: feedbacks, traditional non adversarial methods/review and innovative information by adopting the 3-stage improvement conceptual model 2 for their improvement could be applied effectively for continuous improvement of the EDSD system. Then if model 2 is properly used, it will yield cohesiveness of indigenous EDSD and contracting works for project success. Indeed, there is an urgent need to develop business relationship improvement in a hybrid procurement system for Ghana.

REFERENCES

Ahadzie , D.K., Kissi, E. and Adjei-Kumi, T. (2012) The Status of Project Management Practices in the Ghanaian Construction Industry. In: Badu E, Dinye R, Ahadzie D, Owusu-Manu D (Eds) Procs 1st International Conference on Infrastructure Development in Africa (ICIDA), March 22-24, 2012, Kumasi, Ghana. pp. 116.

Anvuur, A. and Kumaraswamy, M. (2006) Taking Forward Public Procurement Reforms in Ghana CIB W107 Construction in Developing Economies International Symposium, "Construction in Developing Economies: New Issues and Challenges" January 18th – 20th –Santiago Chile

Amoah, P., Ahadzie, D.K. and Ayirebi, D, (2011) The Factors Affecting Construction Performance in Ghana: The Perspective of Small-Scale Building Contractors, The Ghana Surveyor Vol.4, No 1, 2011, Accra, Ghana. pp. 41 – 48.

Baiden,B.K.,Price,A.D.F. and Dainty A.R.J. (2006) The extent of team integration within construction projects. International Journal of Project Management, 24, pp. 13-23..

Bresnen, M. and Marshall, N. (2002) The engineering or evolution of co-operation? A tale of

two partnering projects, International Journal of Project Management, 20, pp. 497 505.
Bresnen, M. (2007) Deconstructing partnering in project-based organization: Seven pillars, seven paradoxes and seven deadly sins. International Journal of Project Management, 25, pp. 365-374
Coleman, E. and Ostrom, E. (2009) Experimental Contributions to Collective Action Theory, Florida State University, Department of Political Science, Bellany 543, Tallahasse, Fl 32306-2180
Cole, G.A. and Kelly, P. (2011) Management: Theory and Practice, Published under Book Power 7th Ed. Printed in Singapore.

Collins, R. (1975) Conflict Sociology, in lecture 8: Analytic conflict Theory. University of Pennsylvania, Pennsylvania, U.S.A. pp. 38-43.
Fellows, R. and Liu, A. (2003) Research Methods for construction, Osney Mead Oxford OX2 0El, UK, Blackwell: Blackwell Science Ltd. Publishing company pp. 98.
Jones, M. (2006) Putting Action into Socio-technical Systems Theory-a proposed analysis of the Australian film Industry using START, Transformational Tool for the 21st Century, School of Management and Marketing, University of Wollongong, Australia. pp. 64-74.
Kadefors, A., Bjorlingson E. and Karlsson A. (2007) Procuring service innovations: Contractor selection for partnering projects. International Journal of Project Management, 25, pp. 375 – 385.
Kadefors, A. (2004) Trust in project relationships – inside the black box. International Journal of Project Management 22, 2004, pp.175-182.
Harriss, C. (1998) Why research without theory is not research A reply to Seymour, Crook and Rooke Construction Management and Economics (1998) 16, School of Construction & Building Science, University of Western Sydney, Quakers, Hill, NSW 2763, Australia. pp. 113-116.
Humphries, A. S. and Wilding, R. (2004) Long Term Collaborative Business Relationships: The Impact of Trust and C3 Behaviour, Journal of Marketing Management, Vol. 20, No, 9 -10 (November 2004) pp. 1107-1122.
Laryea, S. (2010) Challenges and opportunities facing contractors in Ghana. West Africa Built Environment Research (WABER) Conference, 27th -28th July 2010, Accra, Ghana. pp. 215 – 226.
Liker, J. K. and Choi, T.Y. (2006) Building Deep Supplier Relationships Harvard Business Review on
Supply Chain Management, Harvard Business School Publishing Corporation, USA. pp.23-47.
Mele, C. Pels, J. Polese, F. (2010) A Brief Review of Systems Theories and Their Managerial Applications, Journal of Service Science 2(1/2), © 2010 SSG, Italy. pp. 126 -135.
Meng, X. (2010) Assessment framework for construction supply chain relationships: Development and evaluation, International Journal of Project Management, 28, pp. 695-707.
Naoum, S.G. (2004) Dissertation Research and Writing for Construction Students, Oxford OX2 9DP 200 Wheeler Road, Burlington, MA 01803: Elsevier Ltd. pp. 46-50
non Bertalanffy, L. (1950) An Outline of General System Theory, The British Journal for the Philosophy of Science, Vol. No. 2 pp. 134 -165.

Orgen, N.K., Ahadzie, D.K., Ayarkwa, J. and Badu, E. (2011). An integrated Relationship and Supply Chain Management Framework for Improving Engineering and Design Service Delivery to Building Contractors in Ghana In: largea, S.,Leiringer, R., and Hughes, W. (Eds) Procs West Africa Built Environment Research (WABER) Conference, 19 -21 July 2011, Accra, Ghana. pp. 119-129.

Orgen, N.K., Ahadzie, D.K., Ayarkwa, J. and Badu, E. (2012a) Adversarial Relationship in Construction Engineering Design Service Delivery: Discords, Disputes and Conflicts. In 1st International Conference on Infrastructure Development in Africa (ICIDA - 2012), 22nd -24th \March, 2012, Kumasi, Ghana.

Orgen, N.K., Ahadzie, D.K., Ayarkwa, J. and Badu, E. (2012b). An integrated Supply Chain Relationship Management Conceptual framework for improving Engineering and Design Service Delivery (EDSD) to Building Contractors in Ghana. In: largea, S., Agyepong,S.A., Leiringer, R., and Hughes, W. (Eds) Procs 4th West Africa Built Environment Research (WABER) Conference, 24 -26 July 2012, Abuja, Nigeria, pp.1189-1204..

Goddard, J. (2009) A Brief History of Management Theory, The Leading Edge Forum, Rethinking Management and Employee Engagement, Britain.

Patton, W. and McMahon, M. (2006) The System Theory framework of Career Development and Counseling: Connecting Theory and Practice, International journal for the Advancement of Counseling 26(2): pp. 153-166.

Pickel, A. (2007) Rethinking systems theory: A programmatic Introduction, Philosophy of the Social Science 37: 391, published by Sage. Trent University. pp. 391-407.

Public Procurement Act, 2003, Act 663, Ghana Government, Accra.

Pryke. S. (2009) Construction Supply chain Management Concepts and Case Studies, Oxford UK, Blackwell publishing Ltd. pp. 2-46.

Bunge , M. (2004) How does it work? The Search for Explanatory Mechanism, Philosophy of the Social Science 34,2, pp. 182 -210.

Schout, A. and Vanhoonacker, S. (2003) Towards a Contingency Theory on The Presidency Revisiting Nice, European Institute of Public Administration – EIPA Conference, Nashville, University Maastricht, Open University, Maastricht. Journal Publication Outline, List of Sociologist

Steen, J. (2010) Actor-network theory and the dilemma of the resource concept in strategic management, Scandinavian Journal of Management, 26, UQ, Business School, University of Queensland, Brisbane, Queensland 4072, Australia. pp. 324-331.

Seymour, D., Crook, D. and Rooke, J. (1997) The role of theory in construction management a call for Debate Construction Management and Economics 15, School of Civil Engineering, University of Birmingham, Edgbaston, Birmingham, B15 2TT, UK. pp. 117 -119.

Seebass, G. (2008) Analytical Action Theory as a Conceptual Basis of Social Science, published in Social Action on comments on Raimo Tuomela's paper of 'Social Action' URL: http://www.ub.uni-konstanz.de/kops/volltexte/2008/4605,

Reided, 1965, pp 129-137. Glass: Examining Theory Development in Project Management with the Resource-Based View Lens Project Management Journal by the Project Management Institute vol. 35,No 3, Athabasca University, 8311- 11 street SW Calgary, Alberta, Canada T2V 1N7. pp. l5-26.

Tuomela, R. (1991) The Social Dimension of Action Theory, Department of Philosophy, University of Helsinki Unioninkatu 40 B 00170 HELSINKI 17, Finlandia. pp. 145-158 .

Yeung , J. F.Y. Chan, A.P.C. and Chan, D. W. M. (2007) The definition of alliancing in construction as a Wittgenstein family-resemblance concept. International Journal of Project Management, 25, pp. 219 -231

Journal of Construction Project Management and Innovation Vol. 3 (1): 498-510, 2013
ISSN 2223-7852

EVALUATION OF WASTE MANAGEMENT STRATEGIES ADOPTED IN TSHWANE BUILDING INDUSTRY

Okorafor Chikezirim[1] and Erastus Mwanaumo[2]

[1 2] Tshwane University of Technology, Pretoria, South Africa
Email: kezirim042@yahoo.com, mwanaumoem@tut.ac.za

Abstract
The minimisation and disposal of construction wastes has become one of the most construction and environmental issues in recent years. The disposal of waste can have a significant impact on the environment as total volume of available landfill is decreasing and cost associated in its disposal are quite enormous. Primary data were obtained using structured questionnaire, interviews and site visits. The questionnaire was also designed in line with the method to cover various factors that lead to wastages on construction sites, waste control measures, existence of waste management plan in contractual process and remedies to the problem. The findings indicate that waste of materials in the building industry is fairly high and that a large variability in waste incidence is found across different projects. The study established that the strategies adopted in minimising material wastes in the City of Tshwane building industry were good but evidence on site reveal to the contrary.

Keywords: Waste, Management Strategies, Waste Management Plan, Internal Company Waste Plan

INTRODUCTION

Construction industry is the most significant sector on a global scale with respect to its economic, technological, and environmental impact (Georgios et al., 2010). Its rapid growth over the last decade has resulted in an enormous increase of construction and demolition waste. Therefore, the need of appropriate waste management strategies has arisen to contribute to the environmental sustainability.

Dealing with waste is one of the most difficult environmental problems faced by many nations. For instance, while countries such as Belgium, Holland and Denmark recycle 80-90% of their construction waste (Symonds et al.,1999), Israel recycle only about 20% and most of the rest is dumped in legal and illegal land filling sites (Amnon and Hadassa, 2010).

The reasons provided for illegal dumping include a shortage of legal land filling sites, long transportation distances to land fill sites and high tipping fees. Further, lack of enforcement measures as well as lack of knowledge on recycling options for different waste materials has been identified as the underlining causes of illegal dumping (Ammon and Hadassa, 2010).
Thwala et al. (2004) posit that South African construction industry has a reputation of low productivity compared to other sectors of the economy such as manufacturing. However, waste of material in the industry is fairly high and that a large variability in waste incidence is found across different project (Thwala et al., 2004). Most of this waste can be avoided by implementing inexpensive preventive measures. This study therefore was undertaken to explore and evaluate the waste management strategies adopted in the City of Tshwane.

LITERATURE REVIEW

Although waste minimization is defined as one of the key factors for achieving sustainability, the relative significance of construction waste sources and a comprehensive waste assessment system have yet to be developed (Ekanayake and Ofori, 2000). Implementing any successful waste minimization strategy during project execution requires the assessment of waste. Waste minimization has to be embedded as one of the project objectives that lead to sustainability (Ekanayake and Ofori, 2000).

Studies at the Building Research Establishment (BRE) in the 1970's cited by (Ekanayake and Ofori, 2000) established that waste levels were not necessarily related to the type of construction or the building company but to the site and the people engaged in the particular project. According to Henry et al (2009), the construction sector represents one of the most dynamic and complex industrial developments the world over. Therefore, construction activities in the context of the South African economy cannot be treated with laxity.

Ilesanmi (1996) posited that the cost of materials accounted for 50 to 60% of the total cost of construction of any project, while Skoyles (2000) came out with the most recent information that cost of material alone in the building construction project is 55 to 65%. To reduce cost of construction projects, an optimum material control on site should be therefore adopted.

As noted by CSIR, (2004) the industry is underachieving in amongst others, quality and efficiency and that the industry needs to radically improve the practice through which it delivers its project. Improvement to the process will require construction professionals to review their current practices.

CONSTRUCTION WASTE

The construction sector generates enormous amounts of waste by consuming natural resources (Poon, 2007). Waste in the industry include such delays as time, cost, lack of safety, rework, unnecessary transportation journeys, long distances, improper choice or management of programme or equipments and poor constructability (Lee, et al.,1999). Shen et al., (2004) stated that construction wastes are in the form of building debris, rubble. earth, concrete, steel, timber and mixed site clearance materials arising from various construction activities for example, excavation, demolition, pavement work, and refurbishment. Gavilan and Bernold (1994) produced a framework which recognises that construction waste comes from six sources including design, procurement, materials handling and operation, residual and other sources.

The study of Pinto and Aopayan, (1994) reported that Brazil's construction industry waste is accounted as 20-30 percent of material weight on construction site. Research by Bossink and Brouwers (1996) found that construction waste is 1-10 percent of each building materials weight purchased depending on the material type. Their research examined the construction waste from the application of a range of building materials and classified the waste source by the nature and the technology of using materials into stone tablets, piles, concrete, sand-lime bricks and elements, roof tiles, mortar, packing and other small fractions of metal and wood.

The study in the UK conducted by BRS (1981) cited by Yang and Mitchell(2010) dealt with waste for specific materials on 230 different constructions sites and identified that actual waste is consistently higher than the number estimated for all the materials examined. The research highlights that new purchases to replace wasted materials, rework to correct mistake, delay and handling of generated waste caused heavy financial losses to the contractor (Ekanayake and Offori, 2000).

Thus the development of innovative approaches to managing construction waste is an important issue to improve profitability and the effectiveness of construction project management.

METHODS OF WASTE MANAGEMENT

Various researches have attempted to create waste management programmes, plan, methods of minimisation of waste on construction projects and sites. According to CIRIA (1995) it is initially through design that waste minimisation, reuse and recycling of construction materials can be encouraged and promoted. Design has taken a leading role in controlling and handling materials waste on construction sites (Shen et al., 2004). Shen and Tam (2002) suggested that the method of management of construction waste should be part of project management functions and involve employee's participation. The design stage of construction project was playing a central role to minimise waste generated lately on building sites and material wasted. Formoso et al. (1999) developed a method of controlling waste on building sites. The method focused on the control procedures as part of project management on a routine basis. It shows components of waste management on building sites. The tools used were to collect the information of construction activities to establish the pattern of usage of building products and materials on site so that the construction and building waste could be reduced by applying improved and more precise management procedures. Mills et al. (2001) proposed that to provide a cost-effective and successful waste management plan, the project management is required to:

- Asses the project materials
- Standardise alternative waste disposal
- Calculate the economic effect of available disposal method,

WASTE MANAGEMENT STRATEGIES

The construction Industry Research and information Association (CIRIA) attempted to address waste management by organising research which concentrates on the use of the advanced technologies to deal with construction waste on site in the UK construction industry

(CIRIA 1993). Shen et al. (2004) applied a mapping approach to management of waste on construction sites.

The mapping approach named as Waste Management Mapping Model (WMMM) integrates the good operations embodied in the existing systems and tools, and provides an alternative tool to aiding in planning, controlling and managing waste on site. Mc Grath (2001) developed a waste minimisation system named Site Methodology to Audit and Target Waste (SMARTWaste) to classify and appraise waste arising on a construction site. The purpose of the system is to improve material recovery for reuse and to reduce waste generated on sites.

Begum et al. (2007) developed a tool called Waste Minimisation Factors (WMF) which is to identify major influential factors of waste generation in projects. The waste minimisation system examines two aspects of the waste management: source reduction and recycling materials. Source reduction emphasises on products, material input, good practice of operation, and technologies. Recycling focuses on use / reuse and reclamation. Bertram, et al (2002) further applied materials flow analysis system to establish the budget for the European waste management which takes a leading role in managing and controlling the waste crossing European countries. Other system such as waste management planning system (McDonald and Smithers, 1998), ready mixed concrete waste management(Sealey and Jill, 2001), integrated waste management (Bossink and Brouwers, 1996) look at different reasoning, factors which are directly linked to waste generation and reduction.

RESEARCH METHODOLOGY

The scope of coverage of this work was limited to construction companies in the City of Tshwane (CoT) in South Africa to evaluate the waste management strategies adopted. The restriction to the city was informed by the fact that there is little or no research done on material waste management strategies within the province as a whole in which CoT falls. For this research purposes a simple random method was used from the study population of construction firms in CoT.

Different methods to evaluate waste generated during construction process have been used by different researchers. For instance, Bossink and Brouwers (1996) used brainstorming technique, while Serpell and Labra (2003) used the interview method.

In the study of Poon et al. (2004) on construction waste management in Hong Kong public housing projects; there was the use of questionnaire that covered a wide range of topics concerning waste minimisation; regular visits to know the scope of work done where waste were generated by using a checklist of information and the quantities of waste estimated by visual inspection tape (that is volume) measurements and truck load records.

In this study therefore, primary data were obtained using structured questionnaire, interviews and site visits. Questionnaires were designed to get information about personal data of the respondents to depict their profile that may let them have experience on issues relating to waste management and control in construction process. The questionnaire was also designed in line with the method adopted by Poon et al. (2004), but also made to cover various factors that lead to wastages on construction sites, waste control measures, existence of waste management plan in contractual process and remedies to the problem. One hundred (100) structured questionnaire were administered to the practitioners in the industry involved in construction process. The views of the respondents were assess by using likert scale to measure the waste management strategies and a total of forty-four (44) questionnaire were returned and found useful which amounts to a return rate of 44%.

Interviews were conducted among construction professionals namely Client, Architects, Engineer, Quantity surveyors, Project manager and Contractor by covering issues related to the order of site activities, waste generation rate, waste management strategies and likely suggestions to avoid and minimise waste. The data collected were analysed with the use of mean percentage.

FINDINGS AND DISCUSSIONS

Table 1 indicates that the majority of respondents were project managers (34%), followed by contractors (25%) and Quantity surveyors (23%). It is worth mentioning though that in number, five (5) of the quantity surveyors were working for contracting companies even

though they indicated their profession as quantity surveyors bringing the number of contractor respondents to 16 and could reduce the number of quantity surveyors to five. The percentage of responses from clients and engineers was 7% for each and 4% for the architects.

Of the 25% contractor respondents, 2% were registered in grade 5 of the Construction Industry Development Board (CIDB) and 9% were registered in grade 6. Larger categories of grades 7, 8 and 9 had more respondents to the questionnaire of 14% and 11% respectively.

Table 1: Distribution of professionals who responded to the questionnaire

Professionals	Numbers	Percentage (%)
Client	3	7.0
Architect	2	4.0
Engineers	3	7.0
Quantity Surveyors	10	23.0
Project manager	15	34.0
Contractor	11	25.0

Further, Table 2 indicates that majority of respondents have over five years working experience in construction industry. 32% had less than 5 years experience and 36% had over 15 years of working experience in construction industry made up of 23% 15 to 20 years and 13% with working experience greater than 21.

Table2: The years of experience of respondents within construction industry

Years of experience	Frequency	Percentage (%)
0<5	14	32.0
5<10	7	16.0
10<15	7	16.0
15<20	10	23.0
>20	6	13.0

Waste Management Strategies

The results in Table 3 suggest that the majority of respondents have a waste management goal. This is seen in the 43% of the respondents indicating that they always have a waste management goal and 27% sometimes have the waste management goal, while 27% were unsure. Only 5% indicated that they rarely have a waste management goal with another five percent indicating that they never have waste management goal. However, despite about 70%

suggesting they either always or sometimes have a waste management goal, evidence on site reveal to the contrary.

Further, 25% of the respondents indicated that they always implement good material abstracting, while 30% sometimes implement good material abstracting.

Few respondents (2% rated rarely and 5% rated never) do not implement good material abstracting while 38% were unsure. It is evident from the results that only minority of the respondents do not implement good material abstracting on their site. It could be that they may not appreciate the benefits accrued to it or they lack the will power to implement that and the resultant effect would be high waste generation rate on the sites as suggested by various scholars (Poon et al 2004).

In table 3, 27% of the respondents indicated that they always analyse site waste to be generated before purchasing materials while 25% sometimes analyse site waste to be generated before purchasing. Twenty three percent and 14% of the respondents rated not sure and rarely respectively while 11% never analyse site waste to be generated before purchasing materials. It is evident that only minority of the respondents do not analyse site waste to be generated before purchasing. Their inability to do so could be attributed to lack of awareness that such strategies could lead to reduction of waste as suggested by Macdonald and Smithers (1998.)

With regards to training of labour in usage of materials, 27% of the respondents specified that's they are always trained to use material use optimally while 25% of the respondents only suggested that they are sometimes trained. Fewer respondents (14% indicated rarely and 11% suggested never) do not train their workers on material usage while 23% are not sure. However, despite about 52% suggesting they, either always or sometimes, train their workers on optimum material usage, evidence on site reveal that workers still could not understand how one can use materials optimally. Respondents also attributed failure to manage waste to their inability to organise waste management meetings with their project site personnel. For instance, 25% of the respondents indicated that they never organise waste management meetings with 11% of the respondents unsure and 22% indicating rarely organise waste management meetings. Only 21% of the respondents always do and 21% of the respondents

sometimes organise waste management meetings. This implies that those respondents that do not organise waste management meeting will inevitably have high waste generation rate as posited by suggested by Poon et al. (2004). Workers will not know how to management waste because they never were informed in any meeting in the first place. Further, about 50% of the respondents (represented by 27% and 23%), either always or sometimes, issue guideline for hazardous waste management.

Another 50% were either unsure or rarely or never issued guidelines for hazardous waste management. In addition, 18% of the respondents always segregate non-hazardous waste and 23% sometimes do, while 37% were unsure. 11% of respondents indicated that they rarely segregate non-hazardous waste with another 11% they never segregate non hazardous waste. Evidently, only minority of the respondents do not segregate non hazardous waste, but in a situation where construction waste could not be prevented and recovered, they need to be stored in an appropriate manner and kept under control (Tulay and Nilay, 2006).

Table 3: Waste management Strategies adopted by construction firms on site

Waste Management Strategy	Always	Sometimes	Not sure	Rarely	Never
The firm has a waste management goal.	43%	27%	25%	5%	5%
Implementation of good materials abstracting	25%	30%	38%	2%	5%
Analysing site waste to be generated before purchasing	25%	20%	25%	16%	14%
Good training of workers on optimum material usage	27%	25%	23%	14%	11%
Organising waste management meetings	21%	21%	11%	22%	25%
Issuing (implementing) guidelines for hazardous waste management	27%	23%	30%	9%	11%
Preparing a list of each waste material to be salvaged used and recycled	20%	14%	30%	20%	16%
Set waste reduction targets	22%	21%	27%	21%	9%
Non-hazardous waste segregation	18%	23%	37%	11%	11%
On site re-use of waste material	23%	47%	18%	7%	5%
Provide easy access for delivery vehicles	45%	25%	23%	2%	5%
Appropriate storage of material	45%	23%	21%	11%	0%
Off-site re-use of waste material	16%	18%	44%	11%	11%
Recycle waste material	20%	25%	23%	7%	25%

Where the strategy to salvage waste materials and recycle them, 20% of the respondents indicated that they always prepare a list of each material to be salvaged, used and recycled and 14% sometimes do that. A slight majority either rarely or never (20% and 16% respectively) prepare a list of each waste material to be salvaged, used and recycled. Thirty 30% were unsure.

A further 21% indicated that they rarely set waste reduction targets and 9% indicating they never do, while only 22% of the respondents always set waste reduction targets and 21% sometimes do with 27% sure of the practice. However, with 23% of the respondents suggesting they always re-use waste material and 47% sometimes re-use waste material, it should have been clear that a similar proportion of respondents should have known how to salvage, used and recycle material. This however is not the case with the findings. It is evident from the result that only minority of the respondents of the respondents do not set waste management targets. It could be that they lack the will power or they are not aware that such strategies could lead to waste reduction (Lawal and Wahab, 2011). The results in Table 3 also suggest that a greater percentage don't re–use waste material off site, due to factors beyond the scope of this work but however it should be promoted on site and off site because that leads to sustainability (Ekanayake and Ofori, 2000).

Easy access for delivery vehicles was identified by the majority as one strategy that minimises waste. About 45% of the respondents indicating that they always provide easy access and 25% sometimes do. This strategy would minimal waste associated with it such as long distance to off load materials which would expose it to breakages, pilfers and other waste associated with transporting and lack of easy access to site. The results are further supported by the similar number of responded (45%) suggesting that appropriate storage of their material is important to their waste management. It could be that they do consider it worthwhile and the resultant effect will be minimal waste generation rate on site (Wahab and Lawal, 2011).

Internal Company Waste Management Strategies

To establish whether individual companies do have internal waste management strategies Table 4 indicates that only 45% of the respondents agreed to having the internal company waste management and thus incorporate waste management plan as one of the document in tendering process. A further 47% suggested that they know that waste indices could assist them to determine the amount of waste that could be generated on site and therefore do have them as an internal company strategy. A very significant percentage of respondents however recognised the need to set out waste management goals for their employees within the firm. This is seen in 57% of the respondents agreeing that they do set out waste management goals to their staff.

Table 4: Internal company waste management strategies

Question on internal company waste management strategies	YES	NO
Does your company incorporate waste management plans as one of the documents in tendering process?	45%	55%
Does your company know that waste indices could assist them to determine the amount of waste that could be generated on site	47%	53%
Does your company set out waste management goal or guidelines to its staff?	57%	43%
Are you aware of the increase on material waste on the construction environment?	41%	59%
Do you have a full time material controller on your site?	32%	68%

According to Macdonald and Smithers (1998), waste management plan list is required to be produced by contractors while bidding for projects to show how wastes generated would be handled. They argue that such practice leads to sustainability of environment. It is also worthy noting that incorporation of waste management goal or guidelines aims at helping the project manager to anticipate the quantities of waste that will be produced in order to establish awareness of the management and to reduce waste generation during all stages of the construction project. This is not just good practice, but could save the firm from experiencing lost costs from waste materials. Further introduction of material controller is a new practice and so they don't know the benefit of having such for most of them. However, majority of the respondents have appreciably good waste management strategies, but evidence on site reveal to the contrary it can be likened to the fact that attitude of the people in construction towards waste are generally negative as posited by Kulantunga et al, (2006).

CONCLUSION

Authors (2012) indicate that waste of materials are fairly high and that a large variability in waste incidence is found across different projects and it is with the background that the researchers aim to explore and evaluate the waste management strategies adopted in the industry.

It can be concluded that in the City of Tshwane, organising waste management meetings as a waste management strategy is not practiced. Other strategies such as recycling of waste materials, preparing a list of each waste material to be salvaged, used and recycled, analysing site waste to be generated before purchasing materials with the view to monitor usage and manage waste as well as off-site reuse of waste materials are not used regularly as waste management strategies.

The reasons could be that majority of firms as the evidence suggests do not have internal company policies that deal with waste management. The missing policies were identified as having internal company waste management policy, failure to incorporate waste management plan as one of the document in tendering process, use of waste indices to determine the amount of waste that could be generated on site and the need to set out waste management goals for their staff members within the firm.

REFERENCES

Amnon, K and Hadasa, B. (2010) A Novel Methodology To Estimate The Evolution of Construction Waste in Construction Sites.

Begum, R. A., Siwar, C., Pereira, J.J and Jaafar, A.H (2007) Implementation of Waste Manage ement in the Construction Industry of Malaysia; Resource conservation and Recycling Vol.51,pp 190 – 202.

Bertram, M., Graedel, T.E., Rechberger, H and Spatari, S. (2002) The contemporary European Copper cycle: Waste management Subsystem; Ecological Economics, Vol. 42.

Bossink, B.A.G. and Brouwers, H.J.H. (1996) Construction Waste: Quantification and Source Evaluation, Journal of Construction Engineering and management, Vol. 122.

CIRIA (1993) Waste management: The Duty of Care, Construction Industry Environmental Forum, UK.

CIRIA (1995) Waste Minimisation and Recycling in Construction, A Review, Special Publication.

CSIR, (2004) A Review of the South African Construction Industry. The Built Environment Professions Report. Online http//www.buildnet.co.za

Ekanayake,L.L and Ofori, G (2000). Construction Material Waste Source Evaluation, Proceedings of the 2nd South African conference on Sustainable Development In the Built Environment, Pretoria South Africa.

Formoso, C.T., Isatto,E.L and Hirota, E.H (1999) Method for Waste Control In the Building Industry; Proceedings IGLC -7, 26 – 28 July 1999, University of California, Berkeley, CA, USA.

Gavilan, R.M and Bernold, L.E. (1994). Sources Evaluation of Solid Waste in Building Construction. Journal of Construction Engineering and Management, Vol 120.

Henry, A., Jackson, A.M, Bengt H (2009). Organisational effectiveness of Ugandan building Firms as viewed by Craftsman, Journal for Civil Engineers and Management.

Georgios, B.,Charisios, A.,Christos, V.,Nicolas, M. And Sokratis, T. (2010). Assesing Multiple Criteria for the Optimal location of a Construction and Demolition Waste Management Facility.Building andEnvironment Vol 45(2010)2317-2326.

Ilesanmi, O (1996) Material Management as a Tool for Enhancing Productivity on Selected Building Construction Sites in Nigeria. Unpublished.

Lee, S. H., Diekamann, J.E., Songer, A.D. and Brown, H (1999) Identifying Waste ApplicationOf Construction Process Analysis, Proceedings IGLC – 7, 26-28 August 1999, University of California, Berkeley, Ca, USA pp 63-72.

Mc Donald, B. And Smithers, M. (1998) Implementing A Waste Management Plan During The Construction Phase of a Project: A case Study; Construction Management And Economics, Vol.16,pp 71-78

Mc Mrath, C. (2001) Waste Minimisation in Practice; Resource, Conservation and Recyclin Vol.32, pp 227-238

Mills, T.H, Showalter, E., and Jarman, D. (2001) A cost Effective Waste Management Plan Cost Engineering, Vol .41 No 3. Pp 35-43

Pinto, P.T and Aopayan, v (1994) Construction Waste As Raw Materials For Low Cost Construction Project, Sustainable Construction, Proceedings of First Conference Of CIBT G16, Florida, pp 335-342

Poon, C.S. (2007) Management of Construction and Demolition Waste, Waste Management, Vol. 27,pp 159-160.

Sealey, B.J., Philips, P.S and Hill, G.J. (2001) Waste Management issues for the UK Ready Mixed Concrete industry, Resource Conservation and Recycling, Vol.32 p 321-331.

Shen, L.Y., Tam, V.W.Y, Tam, C.M and Drew, D. (2004) Mapping Approach For Examing Waste Management on Construction Sites, Journal of Construction Engineering and Management, July/August, pp 472-481

Skoyles, E.R (2000).Material Control to avoid Waste, Building Research Establishment Digest London, UK.,3 (259): 1-8

Symonds, ARGUS, COWI and PRC Bouwcentrum, (1999). Construction and Demolition Waste Management Practices and their Economic impacts. Report to DG xi European Commision. Department of the Environment Transport and the Regions, HMSO, London.

Tulay, E. And Nilay C. (2006)A study conducted to reduce construction waste generation in Turkey.Building and Environment 42(2007)1667-1674.

Yang, J. And Mitchell, D. (2007). Approaches to waste Materials Management in Construction Projects.Available online

Journal of Construction Project Management and Innovation Vol. 3 (1): 511-529, 2013
ISSN 2223-7852

ILLEGAL APPENDAGES TO RESIDENTIAL BUILDINGS IN KUMASI, GHANA – A CASE STUDY OF NORTH SUNTRESO

E. Adinyira[1] and P. Anokye[2]

[1 2] Kwame Nkrumah University of Science and Technology, Ghana
Email: eadinyira.feds@knust.edu.gh

Abstract
Global estimates suggest that much of the anticipated growth in the world will occur in the developing world of which Ghana is no exception. As at 1985, it was estimated that if Kumasi could achieve a room occupancy rate of three, then its housing stock should at least double at the time. This evident inadequacy of urban space particularly for housing development and the continuous population growth in Kumasi has fuelled the proliferation of illegal appendages to residential buildings at an alarming rate. Illegal appendages, have been an aspect of the after construction process that have been ignored by many the world over. This paper examines the extent of this occurrence, its causes and effects on the health and safety (H&S) of inhabitants of the area as well as on the physical planning of the area and the value of such properties. A questionnaire survey approach coupled with physical inspection was adopted for the study. Data from the survey was largely analyzed using descriptive statistics. The study confirmed 'population growth', 'inadequate space', 'commercialisation of facilities' and 'inadequate knowledge of the Building Regulations' as the major causes of this phenomenon. Findings from the study points to 'effect on the value of such properties', 'effect on spatial planning', 'effect on indoor conditions such as lighting and ventilation' and 'structural effects' as the most significant effects of such additions to buildings. This paper provides the much needed insight into the problem and makes recommendations to include in the formulation of effective building safety policies for such urban areas.

Keywords: Health and Safety, Illegal Appendages, Physical Planning, Property Values, Residential Buildings, Ghana

INTRODUCTION

Residential buildings do not exist in isolation, but they represent various levels of action and interaction between people and their surroundings. On one hand, they can be expressions of creative impulse and on the other, simple statements of functional need (Watt, 1999).

In whichever form, buildings exist as physical structures which serve as shelter for man, his properties and activities. In performing these functions according to the general perception of what constitutes housing, emphasis is as well be placed on dimensions such as adequate privacy; adequate space; adequate ventilation and lighting.

Throughout history, man has built to keep out the elements, and create a general living space for comfort and privacy. As a fundamental need, it must not only protect man against inclement weather, but must be safe in terms of structural stability and durability. Safety can also be perceived as per the definition of the World Health Organization (WHO, 1998) as "a state in which hazards and conditions leading to physical, psychological or material harm are controlled in order to preserve the health and well-being of individuals and the community." With reference to this definition, the assertion that building safety "offers occupants freedom from hazards or risk" (Al – Hamoud and Khan, 2004) is insufficient. Building safety affects, not only the occupants, but also passers-by and the general public (Ho et al., 2008).

Illegal appendages, have been an aspect of the after construction process that have been ignored by many the world over and Ghana is no exception. Illegal appendages can be defined as after construction without prior approval and consent from recognized authorities or institutions. These structures are normally attached to the external faces of the main buildings, which deface the external envelope, posing threat not only to occupant but also to passersby. External building works which are normally done without obtaining permission from the right authorities are responsible for serious building related accidents in residential buildings. They obstruct passage ways in times of fire outbreak and other emergency rescue operations. As part of the post-independence government's effort at addressing the housing shortage that plagued the large cities at the time, the State Housing Corporation was mandated to develop 35 housing estates between 1950s and 1960s. Kumasi happened to be one of the most populated cities in Ghana at the time. As at 1970, North Suntreso had been developed with as many as 424 houses constructed. During the early days of the estate, it was occupied mainly by the elite in the area. The place was therefore serene and well kept. The estate was originally made up of single room and two bedroom houses with the utility areas separated from the main building.

A steady increase in the population over the years however has compelled families to make several extensions and additions to the original structures in order to accommodate the ever expanding families. These actions of occupants have contributed largely to the menace of illegal appendages in the area. This paper examines the extent of this occurrence, its causes and effects on the H&S of inhabitants of the area as well as on the physical planning of the area and the value of such properties. It provides much needed insight into the problem and makes recommendations to include in the formulation of effective building safety policies for such urban areas.

APPENDAGES TO RESIDENTIAL BUILDINGS

An appendage in the broadest sense is an additional or subsidiary part existing on, or added to, something which can generally still function if the appendage has never existed or is later provided or grown, or will still perform a primary function if the appendage is removed. Inferring from this definition an appendage to a building could be any after construction additions that extend a main building. These building works together with the main building forms the building envelope. The incorporation of appendages to apartment buildings is a matter of necessity, correction, and convenience. They can be authorized or not and could be safe or otherwise depending on how structurally safe they are or how adequately they are constructed.

In general housing literature, appendages that stems from necessity and convenience are mostly alterations and extensions. An after construction addition that results in internal changes to the layout of the structure without increasing the overall net floor area except for the inclusion of the balcony, repositioning of doors or removal of internal wall is referred to as an alteration. Extensions on the other hand involve the built addition that adds at least a room or more to the number of rooms thus increasing the net floor area. Since most of these changes occur after the building plans have been vetted and approval granted for construction in line with established health and safety considerations, such changes might not conform to these standards. Section 186 of the National Buildings Regulations (L. I. 1630) for instance defines the terms “building” and “building works” broadly to include almost any form of

building construction. Section 7 of the National Buildings Regulations further specifies that no construction of building works can be commenced without the prior approval of building plans and consent for commencement of the building works from the District Planning Authority. Any building works contravening this stipulation is regarded as unauthorised or illegal building works, unless exempted under Section 4 of the National Buildings Regulations. Building works which can be carried out without prior approval and consent from the District Planning Authority (L.I. 1630) include military buildings such as Ports (airports, sea ports and inland water ports), security buildings, mining buildings and Government buildings.

Lai and Ho (2001) categorized Unauthorised Building Works into three broad types in functional terms:

1. Type 1: advertisement sign boards projecting from external walls or resting on roof tops and satellite discs for television and mobile phones.
2. Type 2: improvised measures to enhance the amenities of property, such as canopies above windows, flower racks.
3. Type 3: structures to create space for human habitation.

Appendages can be constructed in many different areas, such as the building façade, internal or external common areas and the rooftop. Common Unauthorised Building Works found in buildings in could be summarized as follows:

1. Cages, canopies, metal flower racks and any projection from the external walls of a building;
2. Canopies and structures that project over government land, pavements, or lanes;
3. Structures on rooftops, flat roofs, yards, or light wells;
4. Metal supporting frames for air-conditioning plants and cooling towers;
5. Alterations to means of escape;
6. Subdivision of approved units in multi-storey residential and industrial buildings; and
7. Unauthorized changes of use which may or may not include illegal structures.

Proliferation and Causes of Illegal Appendages

Unauthorised building work has been a common phenomenon in many cities of the world. In 2000, there were about 800,000 unauthorised building works existing in the 60,000 blocks of

private buildings in Hong Kong, and an estimated 10,000 new unauthorised building works undertaken every year (Lai and Ho, 2001).

In the Ghanaian context, especially in the case of North Suntreso despite the increase in the population size, the number of rooms available has not kept pace with the growth rate. Medium to large scale extensions have been made to original housing units. About 38 percent of the 120 buildings surveyed in 1992 had 3 to 6 additional rooms added on to the original buildings (Owusu and Martha, 1992). The socio economic changes in the lives of the owners and the quest to cater for the needs of the family members as well as other factors such as stability of residence or tenure security, ownership of the dwelling unit, adequacy of space around the original house, opportunity to rent and attitude of local authority influenced the number of additional rooms and facilities added to the original housing units. Generally, the incidence and perpetual existence and occupation of unauthorised appendages are often blamed on the indiscipline of both owners and tenants.

The existence of obsolete, duplicative and contradictory provisions in planning laws have themselves made it very difficult for individuals who flout planning regulations to be sanctioned. Even in cases where action is taken against offenders, the sanctions are not punitive enough due to some contradictory provisions in these pieces of legislations such as the prescription of varied sanctions for the same offence. Until the promulgation of the Local Government Act, 1993 (Act 462) the Town and Country Planning ordinance [CAP 84] made provisions that governed planning in Ghana. The Town and Country Planning Department was also charged with the mandate of enforcing most if not all the provisions in the law through a centralized system of planning. Making the District Planning Authority the highest authority in the district under a decentralized system without synchronizing the provisions in the new Act ultimately reduced the once powerful department to an advisory unit.

The provision under section 63 of the Local Government Act is adhered to by Metropolitan Municipal and District Assemblies. However, the provision made by the drafter of the LI 1630 which gives implied approval three months from the date an application is made for building permit has obviously made the enforcement of planning and building regulation very

difficult. This partly explains the rise in illegal appendages in many districts in Ghana especially in urban areas.

In the back of this come the problems of logistical and capacity gap that have characterized most Building Inspectorate Divisions of most Metropolitan, Municipal and District Assemblies.

North Suntreso as a suburb is an extremely small area with a high population growth rate. With the passage of time, the increase in population and the resultant increase in household size played a key role in encouraging the development of building appendages. According to KMA the area has a gross population density of 100 persons per hectare on the average (KMA, 2006). This has made it one of the densely populated areas in the city and compares well with many high density areas in Ghana. In the quest to relieve the pressures due to scarce resources, appendages in the form of additional rooms have been constructed on most buildings (Acquaah-Harrison, 2004). Limited resources on the part of local authorities have meant that most of these unconsented building works have gone unchecked (Owusu and Martha, 1992). The obvious conclusion that can be drawn from this is that ineffectiveness in the implementation of planning legislations and development control measures, population growth, scarcity of land, high enforcement cost, poor building management, delay in the issuance of development and building permits, dissatisfaction with architectural designs, and ambiguities in the planning and building ordinances are the major causes of illegal appendages to residential buildings (Hong Kong Government, 2005; Lai and Ho, 2001; Lai and Chan, 2004; Lai and Ho, 2000; KMA, 2006; Acquaah-Harrison, 2004; Owusu and Martha, 1992).

Effects of illegal Appendages

The danger that illegal building works poses in densely populated cities like Hong Kong and Kumasi is numerous. They create a whole range of spatial environmental and socio economic problems in the city centres. Spatially, conflicting land uses occur with a lot of unauthorised buildings works, for instance a reservation of land meant for a road or market converted into a residential unit create vehicular and human conflict. Lai and Ho (2001) address four

implications of the existence of unauthorised building works as; loading implications or structural soundness, visual and aesthetics implication, lighting and ventilation, and fire risk implications. Unauthorised building works may impose additional loading to buildings.

JCPMI Vol. 3 (1): 511 - 529, 2013

Any failure or collapse of building structures (authorized or otherwise) due to illegal alteration or addition may lead to fatal accidents. Such illegal structures may not be visually consistent with the original design and appearance of the building. The visual and aesthetics aspects of the building are thus negatively affected causing unpleasant effects in the entire neighbourhood. For a building to be appropriate for living, lighting and ventilation are two important considerations. However, unauthorised building works which project from the external walls such as canopies and hanging iron cages may block natural lighting and ventilation.

It is particularly relevant in office and residential buildings in which certain areas of prescribed windows have to be provided to habitable rooms (Lai and Ho, 2000). Some of the unauthorised building works may also obstruct the means of escape during fire outbreaks making fire fighting and rescue even more difficult. With such places, you find fire-fighters and ambulances having enormous difficulties in performing their duties. Also service providers such as water, electricity and telecommunication companies find it very difficult if not impossible to extend their services to areas with a lot of these unauthorised appendages.

METHOD OF STUDY

With the aim of aligning the pursuit of the set objectives with the practical considerations and limitations of the study, a questionnaire survey approach coupled with physical inspection was adopted. Questionnaires were administered to residents of the study area to elicit their views on the issues identified and presented in the research objectives. Building Inspection forms were completed during the physical inspection of the buildings in order to ascertain the presence and state of the appendages included in the study. Data collected included; type of unauthorised appendages on the buildings surveyed, number of unauthorised appendages that exist on the buildings surveyed, number of units in the building, building age, property size, number of storeys that a building consisted of, the mode of acquisition of the properties, the

perception of the occupants as to the causes and effects of the unauthorised appendages to the buildings, among others.

Since the study focused only on externally-erected unauthorised appendages to residential buildings, eleven groups of such appendages obtained from literature as commonly found in residential buildings were extracted as follows: metal cages, light weight canopy, solid canopy, drying rack, air condition support frame, advertisement signs, flower pots, wooden cages, television poles, satellite dish, solid extensions.

During the inspection of buildings, the total number of appendages constructed on the external face of each building was counted. Although each type of the appendage may be different in size, material and location, they were treated as the same in this research. They were assumed to have the same extent of influence on the H&S of the buildings for simplicity. For example, a metal cage embracing the balcony of a unit was counted as one unit of appendage, while an air-conditioning frame will also be counted as one unit of appendage, although their coverage and size are different. The total number of each category of unauthorised appendage on a particular building was however recorded. The questionnaire used for the survey part of this study consisted of 13 questions categorised into 4 themes: identification, basic characteristics, causes and effects of illegal appendages. The first section of the questionnaire was aimed at establishing the source of the data and it included data on the region and name of the community as well as the house numbers of the houses that were selected for the survey. This was done in order to provide sufficient information on the exact location of the study area and the study units. The second section dealt with the demographic profile of the respondents in the study area, including the name, age, gender, their positions in the house and whether they were owners or tenants as well as the number of years they have lived in the house under consideration. This information was crucial for the understanding of the knowledge base of the respondents regarding the activities in the house. The last two sections had respondents rank their perception of the causes and effects of illegal appendages to residential buildings on a Likert rating scale of 1 to 4 with 1 = ‘Not Important’, 2 =

'Slightly Important', 3 = 'Important', and 4 = 'Very Important'. This 4 point scale was chosen to prevent respondents from providing neutral answers.

The most appropriate unit of analysis for this study was identified as housing units within the locality of North Suntreso.

With the 2010 National Population and Housing Census not published as at the time of the study, a total of 842 housing units from 2000 National Population and Housing Census was adopted for the study. Applying the Kish Formula for sample size determination (Kish, 1965), a sample size of 100 housing units was chosen for this population. The 100 houses were randomly selected and a face-to face approach to administering questionnaires adopted. Data from the survey was largely analyzed using descriptive statistics. This helped to provide simple summaries and measures in the form of percentages, central tendencies (mean and standard deviation), and frequency distributions. Mean score is a central tendency that shows the average estimate of a distribution of values. This was used in analysing the data on the perceived causes and effects of illegal appendages to residential building. The mean score of each variable was calculated using the formula:

$$\text{MS} = \left[\frac{\sum(f\ x\ s)}{N}\right],$$

where MS is the mean score, f is the frequency of the responses to each rating (1 – 4), sis the score given to each variable by the respondents (ranges from 1 to 4) and Nis the total number of responses concerning that factor.

RESULTS AND DISCUSSIONS

Description of the study area

North Suntreso is located at the centre of Kumasi the capital city of Ashanti region of Ghana. The study area shares boundaries to the south with South Suntreso, to the North with Adowato, to the East with Bantama and to the West with Sofoline, which are all in the Kumasi Metropolitan of the Ashanti Region. North Suntreso is one of the rapidly developing areas in the Kumasi Metropolitan Assembly. The 2000 Population and Housing Census conducted by the Ghana Statistical Service gives the total population of the area to be 10,127

up from the 1984 population census figure of 8,066 representing a percentage increase of approximately 25.55%.The community consists of both the formal and informal economic sectors. The formal sector is characterized by cooperative ownership, small and large scale production. The informal sector consists of small workshops and enterprises producing goods and services with complicated distribution and communication networks at their disposal.

The service and trade sector consist of mainly banking institutions, restaurants, small market establishment, traditional caterers (chop bars), guest houses, retail and whole sale shops.

Primary production which entails urban agriculture is very rear partly due to the scarce availability of farming land. Although many people in North Suntreso are engaged in a form of employment, be it private or public sector, the residents still have a low standard of living resulting from low income levels. Available facilities as per the 2000 Population and Housing Census include a post office, telephone facilities, traditional health facilities, and a hospital. Others are clinics, primary schools, junior high schools and senior high schools. The population census under consideration puts the housing stock of North Suntreso at a total of 842 with the total households being 2,096. The housing census gives the average household size to be 4.8 people per house.

Characteristics of the Occupants of the Buildings Surveyed

It is always important to have a fair idea of the respondents who answered a questionnaire in order to situate the responses within context. With respect to gender, it was realised that majority (60.0%) of the respondents were female. This perhaps could be attributed to the nature of the traditional Ghanaian society, where females are the ones who usually stay at home and takes care of the activities of the household whilst the men go to work to provide for the family or go visiting friends. Table 1 shows a mean average age of the respondents of 49.6 years and average length of stay in the study areas of 28.6 years. These points to largely a mature group of respondents with the ability to provide reliable information on the questions asked. Also 57.6% of the respondents indicated they were the heads of their household, whilst 42.4% of the respondents were only members of their household. On ownership and mode of acquisition, the results indicated that there were more owners than tenants. 60% of the owners indicated they inherited the property, 7% said they bought the

houses from the State Housing Corporation, while 6% indicated purchasing the houses from other parties other than the State Housing Corporation. However, 25% of the respondents chose not to answer the question.

Table1: Age of Respondent and Number of Years lived in the study area

Variables	Mean	Minimum	Maximum	Standard Deviation
Age of Respondent	49.63	13	94	19.316
Years lived in the House	28.56	1	61	18.298

Physical Characteristics of the Buildings

Based on the results of the analysis carried out on the data gathered, it was realised that although the original houses sold to the owners of the estate houses were all of standard sizes, the additions and modifications to the buildings had resulted in varying sizes of buildings now identified in the area. The mean size of the houses surveyed as shown in Table 2 is 99.45 m2 with a minimum and maximum size of 23 m2 and 468 m2 respectively. The original houses built by the State Housing Corporation were all single storey one or two bedroom houses with a hall. The utilities areas were located some metres from the main accommodation. There was however some few two storey houses that were also provided to some middle class households. Results from the survey shows that 96% of the houses surveyed were single storey residential houses, whilst 4% of them were two Storey houses. The North Suntreso housing stocks were all constructed in the year 1953.

Table 2: Size and Number of Units in Buildings

Characteristics	Maximum	Mean	Minimum	Standard Deviation
Size of the Buildings (m2)	468	99.45	23	70.86
Number of Units (Rooms) in a House	13	4.20	2	1.92

Illegal Appendages Identified In the Survey

Solid extensions were the dominant appendages in the houses surveyed. This appendage was found in 97% of all the houses surveyed. Light weight canopy was the next dominant appendage found in 57.6% of the houses surveyed, followed by television poles found in 56.6% and metal cages had an almost 50.3% of the houses surveyed. Table 3 summarizes the statistics by the type of the unauthorised appendages that were observed in the residential buildings that were surveyed in North Suntreso.

With a maximum number of 10, metal cage is the most prevalent appendage observed in any single building in North Suntreso. Solid canopy, advertisement sign, wooden cage, air condition support frame were the least prevalent appendages observed in a single building.

Table 3: Number of illegal appendages by type

Type of Appendage		**Frequency**	**Valid Percent**	**Maximum Number observed in a single building**
Metal Cage	Present	50	50.5	10
	Not Present	49	49.5	
	Present	57	57.6	8
	Not Present	42	42.4	
Solid Canopy	Present	10	10.1	2
	Not Present	89	89.9	
Drying Rack	Present	23	23.2	3
	Not Present	76	76.8	
Air Condition Support Frame	Present	2	2.0	2
	Not Present	97	98.0	
Advertisement Sign	Present	3	3.0	2
	Not Present	96	97.0	
Flower Pots	Present	2	2.0	3
	Not Present	97	98.0	
Wooden Cage	Present	3	3.0	2
	Not Present	96	97.0	
Television Pole	Present	56	56.6	6
	Not Present	43	43.4	
DSTV Dish	Present	13	13.1	3
	Not Present	85	85.9	
Solid Extensions	Present	96	97.0	5
	Not Present	3	3.0	

Causes of illegal Appendages to residential buildings

Table 4 shows the ranking of the perceptions of respondents on the causes of the unauthorised appendages to residential buildings.

Table 4: Ranking of Causes by households

Variables	Mean	Standard Deviation	Rank
Population Growth	3.38	0.696	1
Inadequate Space	2.55	0.913	2
inadequate Amenities	2.11	0.978	3
Inadequate of developing land	2.04	0.731	4
Poor building management	2.04	0.957	5
Difficulties in obtaining permits	1.78	0.828	6
Commercialisation of facilities	1.71	1.020	7
Inadequate knowledge of the building regulations	1.67	0.706	8

Population Growth

Most of the respondents agreed that the most significant cause of the proliferation of Unauthorised Appendages to residential building is population growth. With a Mean Score of 3.38, population growth was the highest ranked cause proposed by the residents of North Suntreso. The influence of population growth on the proliferation of Unauthorised Appendages to residential buildings can be seen from the work of Owusu and Martha, (1992) where it was explicitly states that despite the increase in the population size in Kumasi, the number of rooms available has not kept pace with the growth rate. They go on further to state that "about 38 percent of 120 of the number of buildings surveyed in 1992 have 3 to 6 additional rooms" built without appropriate approval.

Inadequate Space

It is not surprising that the next important cause of the proliferation of this phenomenon of unauthorised appendages agreed on by the respondents is Inadequate Space (MS = 2.55). This cause can easily be linked with population growth and the increase in the size of individual households as it is the lack of space for the expanding population that causes the erection of the unauthorised appendages in the first place. Lai and Ho (2001) reinforced this

idea that the existence of unauthorised structures reveals the inadequate supply of space in urban land in Hong Kong.

Commercialisation of Facilities

Respondents to this survey perceived 'commercialisation of the facilities' (MS = 2.55) as one of the least important influencing factors when it comes to proliferation of illegal appendages to residential buildings. This however contrasts with the personal observation of the authors as during the site inspection, it was observed that most of the solid extensions that were attached to the original buildings were bedrooms that were let out to tenants. Li (2003) reinforces this view in this work by stating that "as Unauthorised Appendages to buildings are economic goods which may generate services and additional space for property owners, owners will continue building Unauthorised structures until reaching the point that the marginal cost of production equals to the marginal revenue generated by that particular unit of Unauthorised Appendages".

Lack of Knowledge of the Building Regulations

The respondents indicated that lack of knowledge of the building regulations is the least important cause of the proliferation of the unauthorised construction of Appendages to residential buildings. This was evident with a Mean Score of 1.67 which ranks 8th among the causes that were outlined in question 12 of the questionnaire that was administered. This is because as earlier explained in relation to the existing planning laws, even if these individuals had knowledge on building and planning regulations, the lack of incentives for compliance will still have not made a difference.

Effects of illegal Appendages to Residential Buildings

Table 5 shows the mean score, standard deviation and respective ranks for the various effects of illegal appendages to residential buildings. These effects are grouped into two categories namely effects on the occupants and effects on the building fabric.

Table 5: Ranking the Effects of Illegal Appendages

EFFECT OF APPENDAGE	MEAN SCORE	STANDARD DEVIATION	RANK
On Building			
They deface the building	3.12	0.954	1st
They disturb the structural stability of the building	1.96	0.676	2nd
They devalue the building	1.55	0.736	3rd
On Occupants			
Impedes access by the fire service in times of fire outbreak	3.51	0.805	1st
Poses health hazards by blocking ventilation access	3.09	0.991	2nd
Causes injury to occupants	2.34	1.048	3rd
Impede access of service providers	2.07	0.981	4th
Causes injury to passers – by	1.75	0.736	5th
Social costs: e.g. legal actions	1.27	0.490	6th

Effects on the Building

The proliferation of unauthorised appendages to residential buildings often defaces the buildings unto which they are attached. A number of studies have shown that these illegal structures which may not be visually consistent with the original design and appearance of the building, may also negatively affect the visual and aesthetics aspects of the building they attached to and could lead to some devaluing of such buildings. In addition to the unpleasant visual effects they have the propensity to devalue these properties. The increase in rooms in the case of alteration and extensions without a corresponding increase in service reduce these neighbourhoods to slums. This is mostly the case since access and supply of water and sanitation services might not necessarily increase. Even though some of these appendages like solid extensions and light weight canopies are actually constructed for some economic benefit, they in the long term turn to run rundown the value of these properties this time due to the overcrowding that have come to be associated with the development of such appendages.

Effects on the Occupants

Unauthorised Appendages often puts the approved planning scheme of these areas into disarray. The reasons are that it defies the very principles, which form the basis of planning. Planning seeks to achieve among other things health and safety, convenience, economy just to cite a few.

JCPMI Vol. 3 (1): 511 - 529, 2013

Application of health and safety considerations are seen in the regulations such as those that restricts height, use and density through zoning; prevents development from occurring in hazardous locations; putting in place systems for the prevention of accidents. Developed without regards to planning regulations, most illegal appendages ignore zoning regulation such as the setbacks that helps ensure that density zoning is respected.

Again, other enforcement measures such as the FAR and impervious area ratios are all not respected. Having disregarded these standards, occupants of such buildings and their neighbourhoods pay the cost. One of the highly rated effects of the problem of Unauthorised Appendages to residential buildings is serious health risk posed by blockage of natural ventilation into such buildings. For a building to be appropriate for living lighting and ventilation are two important considerations and everything must be done to ensure adequate amount of these. Apart from this, the paving of every space especially in the case of extension has the tendency to reduce percolation of runoffs a potential reason for the floods in such communities.

Convenience as a planning principle primarily seeks to ensure that there is ease of movement and that obstacle to movement are prevented and curtailed. In a bid to achieving this, planning distinguishes between public and private spaces that serve this purpose. Public spaces such as road reservations and public open spaces are defined as distinct from private spaces. Without regard for setbacks that defines the reservation between the building line and the boundary line, appendages tend to encroach on reserved public spaces. Such unauthorised Appendages to residential building could impede access to such buildings especially to the fire department during occasions of fire outbreaks and other emergency and rescue operations thus defeating the convenience principle. The issue of Unauthorised

Appendages impeding the path of fire fighters cannot be taken for granted as Fire-fighters and ambulances may find it difficult to locate places being engulfed by fire in case of outbreak and could result in the needless loss of lives. Unauthorized building works causes structural weakness in building. This situation in turn results in structural failures that cause injury to occupants.

CONCLUSION AND RECOMMENDATIONS

Incidents involving falling objects from the external walls of buildings especially in crowded areas have become quite rampant of late and is indicative of a hazard to society. This study provides preliminary results and insights into the issue within residential areas. The findings presented in this paper are the results of case study of this contemporary phenomenon in North Suntreso, a community that was planned in Kumasi the capital city of the Ashanti region of Ghana. The findings provide an understanding into the extent of the problem as well as the factors that contributed to the proliferation of the problem. A key import of this study is the understanding of what unauthorised appendages do to both the occupants of the buildings and the building fabric itself. In line with the findings and conclusion, the following are some recommendations made based on the identified causes of the problems.

As established by literature, most of the low and middle income estates developed did not factor into the designs the housing preferences of the will be occupant and how they will like their internal spaces organised thus making is necessary that the designs be modified once ownership changes. In the case of North Suntreso, the decision to provide communal facilities to a significant extent deprived the households of their privacy needs. It is thus recommended that in view of the importance of adequate privacy or private spaces in housing development, future housing development especially for the low and middle income households must be preceded by a needs assessment study. The design of the housing must also avoid the creation of shared facilities since they usually create conflict hence a recipe for the development of appendages. Planning controls are for the collective good of society, they set the standard that help address competing claims by private interest thus reducing negative and unpleasant effects in space. For planning to be effective however, there must certainly be

in existence a good and effective legal and regulatory framework. As earlier discussed, such frameworks have been weak in Ghana for varied reasons. Curbing the incidence of illegal appendages development requires that conflicting provisions in the law are reconciled, obsolete provision and laws amended and repealed and duplicative provisions harmonized. The resources required for the effective implementation of the laws must also be provided.

Regarding the problem of inadequate knowledge of planning laws and regulation and the difficulty in the permit acquisition process, the following recommendations might be useful. Almost all MMDAs have the outfit of National Commission on Civic Education. Although their mandate is not directly to educate on the citizens on planning laws and regulations, given the relevance of the issue and the health and safety implications of violation of planning regulation, the unit can include this in their programme by engaging competent planners. It has also been established that the laws are not as punitive as they supposed to be. Thus weighting the cost of compliance against non-compliance, it makes economic sense to break the laws regarding permit acquisition. Relaxing the process and speeding up the permitting process is an effective way of engendering willing compliance on the part of will be developers. There can be the possibility where the strategy for housing low and middle income borders on incremental expansion and development of their plots, either to accommodate potential increase in household sizeor developing for commercial purposes. Under such as circumstance the designs must incorporate such possibilities and come clear on the incremental development process and approach. The benefit of such consideration is that it will help address the situation where illegal appendages encroach on public space reserved for access and mobility within the given urban space.

As urbanisation occurs in our towns and cities, planning authorities must keep pace with the trend and understand the implications it has for developable space and housing in general and introduce policies and regulations that increase land supply through land intensification. For instance planning can lead the market by identifying potential redevelopment and extension areas, change zoning regulations in those areas to conform to changing space needs of society as well as adjust the floor area ratios in line with the prevailing needs. This will facilitate

monitoring of such development and quick identification of illegal appendages before they become full blown.

REFERENCES

Acquaah-Harrison R. (2004), "Housing and urban development in Ghana: with special reference to low income housing", United Nations Human Settlement Programme.

Al-homoud, M, S and Khan, M.M(2004) Assessing safety measures in the residential buildings in Saudi Arabia. Building research information, 32(4), 300-305.

Ho, D.C.W., Leung, H.F., Wong, S.K., Cheung, A.K.C., Lau, S.S.Y., Wong, W.S., Lung, P.Y. and Chau, K.W. (2004), Assessing the health and hygiene performance of apartment buildings, Facilities, Vol. 22 Nos 3/4, pp. 58-69.

Kish, L. (1965) Survey Sampling. New York: John Wiley and Sons. Inc.

Kumasi metropolitan assembly (2006), Housing characteristics in the Kumasi metropolis, 2006.

Lai, L.W.C. and Ho, D.C.W. (2001), Unauthorised structures in high-rise high-density environment, Property Management, Vol. 19 No. 2, pp. 112-23.

Lai, L.W.C. and Chan, P.Y.L. (2004), The formation of owners' corporations in Hong Kong's Private housing estates, Property Management, Vol. 22 No. 1, pp. 55-68.

Lai, L.W.C. and Ho, D.C.W. (2000), unauthorised structures in high-rise high-density environment: the case of Hong Kong.

Li, S.K. (2003) Why Unauthorised building Works? An Econometric Inquiry, Unpublished B.Sc. (Surveying) Dissertation, Department of Real Estate and Construction, Hong Kong: The University of Hong Kong.

MLGRD (2010) Draft National Urban Policy, Ministry of Local Government and Rural Development, Accra.

Owusu S.E. and Martha M. A. (1992), Housing supply for low income urban dwellers through transformation: Case Study of Suntreso. Department of housing and planning research. KNUST, Ghana

Republic of Ghana, National Building Regulations (LI 1630) Accra, Ghana Publishing Corporation.

Watt D, (1999), Building Pathology: Principles and Practice. Blackwell Publication,United Kingdom.

World Health Organization (1989) Health principles of housing, World Health Organization, Geneva. pg. 14

World health organization (1998) Safety and Safety Promotion: Conceptual and Operational Aspects, World Health Organization, Quebec

Journal of Construction Project Management and Innovation Vol. 3 (1): 530-542, 2013
ISSN 2223-7852

BENEFITS DERIVED BY DISTRICT ASSEMBLIES FROM THEIR PROJECT CONSULTANTS

J. Ayarkwa[1]. B.K. Baiden[2], D. Osei-Asibey[3] and C.B.S. Sabah[4]

[1 2 3 4]Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
Email: ayarkwajosh@yahoo.com; bkbaiden.cap@knust.edu.gh; coocarl@yahoo.com; occads@yahoo.com

Abstract
Many of the problems in construction at the local level can be traced to consultants who supervise projects on behalf of local government agencies. Consultants therefore need to be evaluated regularly to ensure that they are delivering the expected benefits to their clients. This study seeks to assess the benefits District Assemblies (DAs) in Ghana derive from their consultants who supervise projects funded through the District Assemblies' Common Fund. The study involved a postal survey of 80 DAs and identified the expected benefits the DAs would like to attain through the services of their consultants and the perceived actual benefits they had received. The one-way analysis of variance (ANOVA) (p=0.05) was used to determine the significance of the differences between the expected and the actual benefits. The findings revealed that, of the documented benefits DAs would expect to receive from the professional services rendered by their consultants, increasing accuracy of project budget estimation, saving cost, minimizing risk through improved tender documents, promoting better communication with clients, and meeting clients' deadline were considered important benefits by the DAs. There were significant differences between the expected benefits and the level of benefits achieved from consultants. The actual benefits were generally lower than that expected by the DAs. The paper is of value to local government agencies wishing to obtain greater benefits from their project consultants, and consultants wishing to realize their weaknesses for continual improvement.

Keywords: District Assemblies, consultants, benefits, Ghana

INTRODUCTION

District Assemblies (DAs) in Ghana initiate and execute programmes and projects for the development of basic infrastructure in their respective local government jurisdiction. These Assemblies often lack the capacity to supervise their development projects, and rely significantly on external consultants. To ensure continued delivery on their roles to the benefit of their clients, the external consultants would also require regular evaluation.

This is because as the business environment, according to Ng (2005), becomes more competitive, the success of a consultant becomes more dependent on the provision of expected quality of professional service to preserve the interests of the client at different stages of a project. Goetsh & Davis (2002) and Murphy (2002) also concluded that the release of ISO 9000 QMS has placed more emphasis on customer satisfaction and continuous improvement. This "satisfaction", as defined in study by Hill et al (2002), can be measured by comparing the difference between what is expected and what is actually received, and clients' satisfaction with the performance of a consultant when the quality of service provided exceeds or at least meets their expectation. Ng (2005) re-echoed that continuous improvement can only be realized if consultants are aware of their weaknesses or deficiencies and make corresponding adjustments to satisfy the expectations of their clients. In this paper, the benefits that DAs in Ghana would expect from their project consultants are identified and compared with the actual benefits they had gained.

LITERATURE REVIEW

Concept, composition and functions of DAs in Ghana

The concept of Local Governance in Ghana dates back to 1850s when the Colonial Government issued the Municipal Ordinance to cover Cape Coast and its environs (Osei-Asibey, 2005). This centralized system of governance continued until the introduction of the Local Government Act (ACT 54) in 1961 which was expected to fully decentralise governance in Ghana, but was not implemented. The implementation of decentralisation governance was achieved in Ghana in 1988 when the Provisional National Defence Council (PNDC) Law 207 was passed. This law was further strengthened by the Local Government Act, 1993 (ACT 462) which established the DAs in the Fourth Republic of Ghana repealing previous laws (Botchway, 2000).

As of June 2011, there were 170 Metropolitan, Municipal and District Assemblies across Ghana. Section 162 of Act 462, defined "District Assemblies" to include Municipal and Metropolitan Assemblies whiles "District Chief Executives" included Metropolitan and Municipal Chief Executives. This study adopts this definition of District Assemblies to include Metropolitan and Municipal Assemblies.

The 1992 Constitution of the Republic of Ghana provides in article 242 that a DA shall consist of one person elected from each local government electoral area within the district, the member or members of parliament for the constituencies that fall within the area of authority of the DA, the District Chief Executive of the District and other members not more than thirty percent of all the members of the DA appointed by the President.

District Assemblies are composed of at least 11 decentralized departments which include Education, Youth and Sports Department; Social Welfare and Community Development Department, Works Department, Physical Planning Department, Finance Department, Natural Resource Conservation Department, Central Administration, Trade and Industry, Disaster Prevention Department, Health Department and Department of Agriculture (Osei-Asibey, 2005). The DA is the highest political and administrative body in the district with legislative and executive functions. Sections 10 of Act 462 (1993) list functions of the District Assemblies to include the following:

- To initiate programme for the development of basic infrastructure and provide municipal works and service in the district;
- To promote and encourage other persons or bodies to undertake projects under approved development plans and;
- To monitor the execution of projects under approved development plans and assess and evaluate their impact on the people's development in the local, district and national economy.

In line with the DA's mandate of developing its area, projects are identified or proposed by the DA, local communities or government. Projects are either executed by the Works Department of the DAs or by agents of the DAs (contractors and consultants) depending on the size, cost, duration of the project, manpower and skill required (Botchway, 2000).

The District Assemblies Common Fund

The District Assemblies' Common Fund (DACF) was created by Section 252 of the 1992 Constitution of Ghana. The DACF Act, (ACT 455) was enacted in 1993 to allocate not less than 5% of the total revenue of the nation to the DAs for development (Osei-Asibey, 2005).

The DACF is the most important source of funding for DAs and covers between 80 - 90% of a DA's annual expenditure (Banful, 2009). Currently, the percentage of the total government revenue to be allocated to the DAs is 7.5%. While there are broad regulatory guidelines, DAs are free to use the funds as they wish if the intended use is in their budgets furnished to the DACF Administrator prior to disbursements (Banful, 2009).

The DACF has provided finance for development in health and sanitation, education, potable water, residential and office accommodation, rehabilitation of roads and provision of community centre facilities (Osei-Asibey, 2005). The fund, according to a World Bank report (2004) on the DACF has become a suitable mechanism for providing resources to the Districts for the provision of basic infrastructure in education, health and water which hitherto have been neglected. However, erratic payment by government and large number of competing needs have put a lot of pressure on the Common Fund. Additionally, the near absence of technically competent and experienced staff in the district, utilization and management of Common Fund projects has been beset with problems (Osei-Asibey, 2005).

RESEARCH METHODOLOGY

At the time of the study, there were 170 Metropolitan, Municipal and District Assemblies in Ghana (www.ghanaweb.com). A sample size of 80 DAs from the total population of 170 DAs, representing 47%, was selected for the study. According to Bartlett et al. (2001), the minimum sample size for a population of 200 is 74, indicating the adequacy of the sample size of 80 for the study. Regions of Ghana were considered as strata from which District Assemblies were selected. This was done to ensure that views of DAs from all ten regions of Ghana were included in the study. Eight DAs were selected from each region of Ghana using the mixed sampling technique. For each region, systematic sampling was used to select the sample used in the survey. To select the sample, a sampling fraction was calculated for each region by dividing the sampling frame by the sample size to give a value which is rounded to the next whole number n. The first sample was randomly chosen within the first n samples in the sampling frame after which every nth sample was chosen until the desired sample size was achieved.

This sample was used for the study on the assumption that there exists a link between the characteristic of the sample and the population, allowing a series of referrals to be made within a circle of acquaintances (Berg, 1988).

A questionnaire survey involving closed-ended questions was considered suitable for this study.The questionnaire consisted of two sections. The first section involved the profile of the DAs. The second section assessed the benefits derived by clients from their project consultants. Caldwell and Hagan (1994) stated that ISO 9000-based QMS could improve the service quality of the firm, and hence the client's satisfaction, market share, revenue as well as workers' morale. ISO 9000QMS certification guarantees benefits to both client and consultants. Potential benefits expected to be derived by clients from their project consultants and also benefits of implementing ISO 9000QMS identified from relevant literature (Chan & Tam, 2000; Tang & Kam, 1999; Ahmed & Kangari, 1995), were listed out forofficials of the selected DAs to score their importance to the DAs. The officials were also asked to indicate how well their consultants have helped their DAs achieve the stated benefits on a five-point Likert scale (with 1 being the lowest and 5 being the highest level of benefit). Projects funded through the District Assemblies' Common Fund were chosen as the basis of the study because they provided a common platform with similar characteristic for all Assemblies. This therefore minimized the effects of other factors in the study. Out of the 80 questionnaires administered, 43responsive ones were received, giving a response rate of 53%. With the data analysis, the first part of the questionnaires involving the profile of the DAs was analyzed using percentages. The second part of the questionnaire was analyzed by comparing the mean values of the expected benefits and the actual benefits.The mean values were obtained by the following formula:

$\mu = \frac{\sum_{i=1}^{5} i.f_i}{\sum_{i=1}^{5} f_i}$ (Begum et al., 2006),

where, f isthe frequency of score i for the factor concerned. In this study, a mean value of 3.0 is considered as significant.

Client's satisfaction can be portrayed by comparing the mean values of the expected and actual benefits (Ng, 2005).

In order to adequately confirm whether there exists a significant difference between the means, one-way analysis of variance (ANOVA) was used to determine whether there was a disparity in the sample means of the expected and actual benefits.

FINDINGS AND DISCUSSION

Profile of Respondents

District Assemblies in Ghana have been in existence for varying periods. Indeed, some DAs have been in existence longer than others. It was considered important to know the period of existence of DAs who took part in the study (Figure 1). This was used as an indicator of how long they have dealt with consultants.

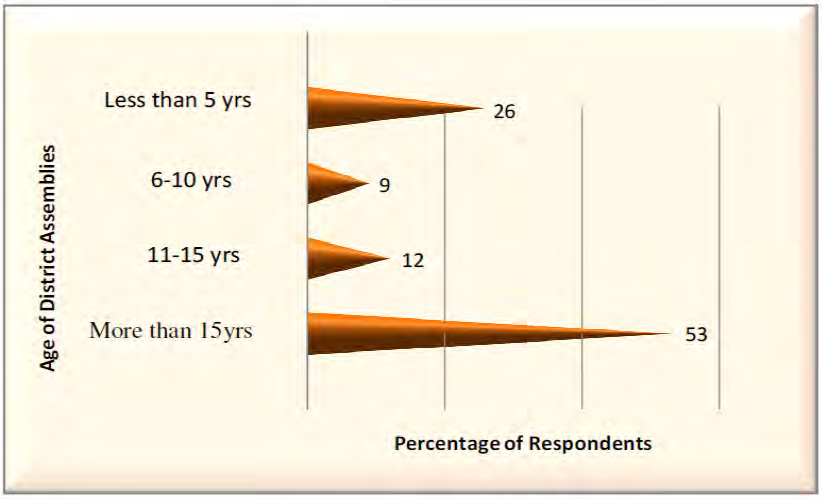


Figure 1. Period of existence of District Assemblies

The results show that 26% of DAs in the study had existed for less than 5 years. However 74% of the DAs surveyed had existed for over five years. Thus majority of respondents have existed for over five years, a period long enough to give reliable information about the performance of consultants.

Designation of Respondents

The questionnaires were completed by individuals working in the Assemblies on behalf of the DAs.

It was considered necessary to know the designation of the respondents who actually completed the questionnaire because a wide array of staff work in the DAs, some of whom are better placed to provide accurate information on projects than others. Figure 2 shows the designation of individuals who completed the questionnaire.

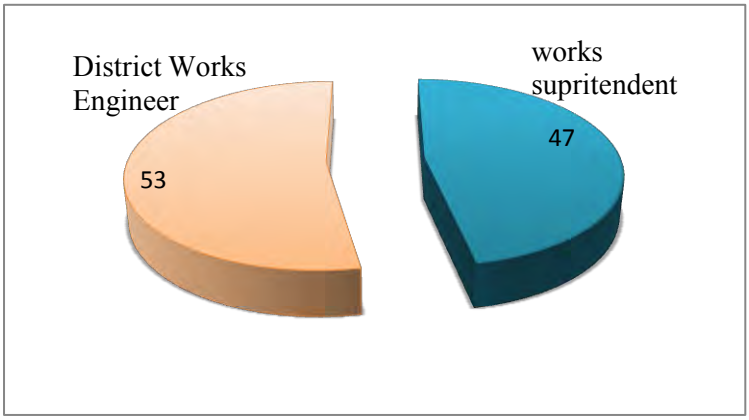


Fig 2 Designation of Respondents

From Fig. 2, fifty three percent (53%) and 47% of the questionnaires were completed by District Works Engineers and Works Superintendents respectively. Indeed, these are officials in the Districts directly involved in construction works and by extension those who work directly with consultants at the District Level. Respondents who completed the questionnaires were in good positions to provide reliable and accurate information on consultants' performance.

Experience of Respondents

In addition to the designation of the individual respondents, it was considered important to determine the length of time the respondents had been involved in project management. It is widely accepted that officials gain more experience in a field as their length of service increases. Table 1 gives the years of experience of the individual respondents.

Table 1 Experience of Respondents

Respondents years of experience	No of respondents	% of respondents
Less than 5 years	6	14
6-10 years	6	14
11-15 years	22	51
More than 15 years	9	21
Total	43	100

Over 75% of the respondents have over five years working experience in Construction Management at the District level, hence are very likely to have the knowledge, skills and judgment to be able to differentiate between expected and actual benefits from the DAs project consultants.

Engagement of Consultants by District Assemblies

The use of consultants by DAs on their projects is done for a myriad of reasons. Figure 3 shows the reasons for engagement of consultants. DAs surveyed were of the view that consultants were engaged mainly because DAs did not have the required expertise for supervision of projects. Other significant reasons were heavy work load and the high cost and complexity of certain projects. Indeed, this is significant because some of the DAs that took part in the study did not have the capacity to carry out supervision of all construction works within their Districts which span over large geographical areas.

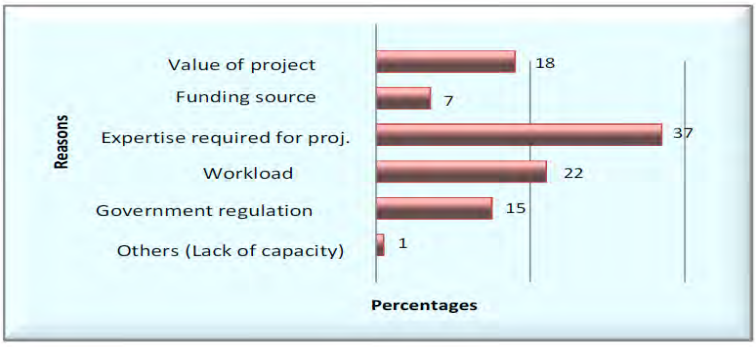


Figure 3 Reasons for engagement of consultants

Benefits derived by District Assemblies from consultants

The study assessed the respondents' views on the benefits derived by DAs from their project consultants. A summary of mean scores of expected and actual benefits from DAs' consultants is presented in Table 2. Mean scores of all the potential benefits evaluated are greater than 3.0, indicating that they are all important to the DAs. The most important benefits derived by DAs include increasing accuracy of project budget estimation, saving cost, minimizing risk through improved tender documents, promoting better communication with clients, and meeting client's deadline (Table 2).

Table 2 Summary of Mean Scores of Expected and Actual Benefits of ISO 9000 QMS Implementation

Code	Benefits	Mean expected score	Standard Deviation	Rank	Mean actual Score	Standard Deviation	Rank
B1	Enhancing organization's quality image	3.86	1.02	10th	2.67	1.62	12th
B2	Improving quality of engineering design	3.70	1.03	11th	3.19	1.04	5th
B3	Improving quality of engineering study recommendation	3.44	1.08	12th	2.84	1.29	11th
B4	Promoting better communication with client	4.16	0.79	4th	3.00	1.24	9th
B5	Saving cost	4.40	0.66	2nd	3.37	0.91	3rd
B6	Increasing accuracy of project budget estimation	4.60	0.46	1st	2.98	1.26	10th
B7	Increasing reliability of project program	4.10	0.81	6th	3.49	0.86	2nd
B8	Meeting client's deadline	4.13	0.80	5th	3.30	0.95	4th
B9	Reduced time for responding to queries and complaints	3.95	0.86	7th	3.60	0.68	1st
B10	Improve the management of sub consultants	3.93	0.95	8th	3.02	1.22	8th
B11	Minimizing risk through improved tender documents	4.19	0.68	3rd	3.14	1.13	6th
B12	Achieve continuous improvements	3.91	1.01	9th	3.14	1.15	7th

The first four actual benefits achieved by DAs from their project consultants were ranked as increasing reliability of project program, reduced time for responding to queries and complaints, saving cost, and meeting client's deadline (Table 2).

The results presented in Table 2 and the graphical illustration of mean scores of the expected and actual benefits (Figure 4) shows that means scores of the expected benefits are higher than those of the actual benefits for all the benefits evaluated. Thus, the benefits derived from consultants are lower than the DAs' expectations.

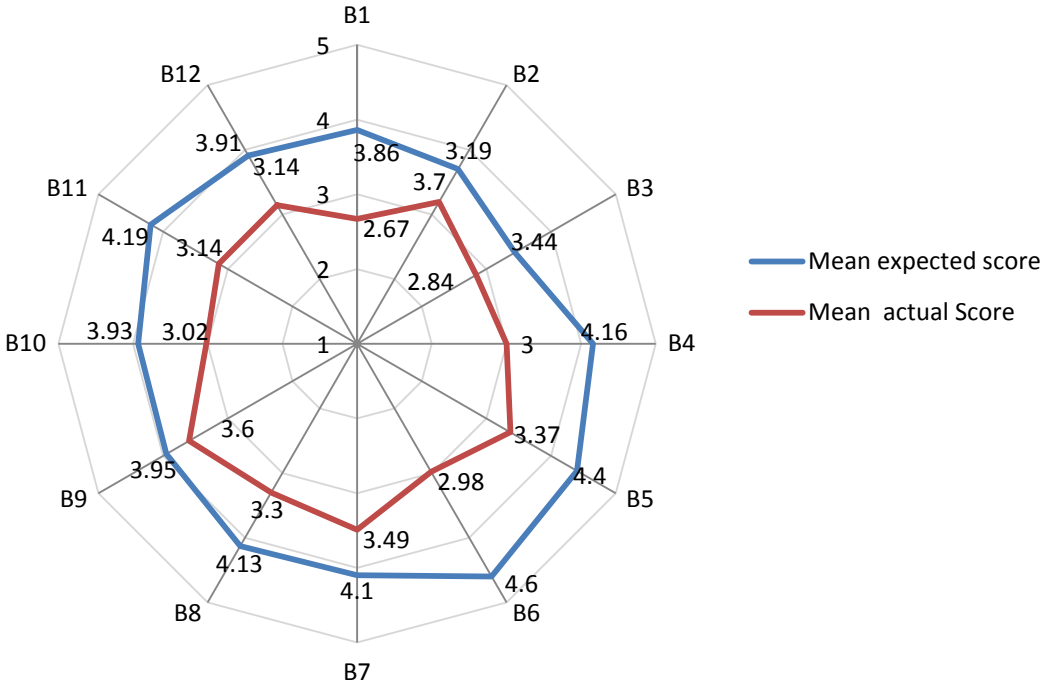


Figure 1. Comparison of mean scores of expected and actual Benefits

Analysis of Variances

The one-way ANOVA was used to test whether there were statistically significant differences between the expected benefits and actual benefits. The results of the analysis are presented in the ANOVA table (Table 3).

Table 3 Analysis of variance for differences between the expected and actual benefits

Benefit of ISO 9000 QMS implementation	SS	df	MS	F	P-value	F crit	Ranking
Enhancing organizations quality image	30.244	1	30.244	34.053	9.8E-08	3.955	7th
Improving quality of engineering design	5.628	1	5.628	6.255	0.01433	3.955	2nd
Improving quality of engineering study recommendation	7.860	1	7.860	6.706	0.01133	3.955	3rd
Promoting better communication with client	29.070	1	29.070	48.974	5.9E-10	3.955	11th
Saving cost	22.512	1	22.512	34.808	7.4E-08	3.955	8th
Increasing accuracy of project budget estimation	56.977	1	56.977	121.919	4.9E-18	3.955	12th
Increasing reliability of project program	14.244	1	14.244	24.020	4.6E-06	3.955	6th
Meeting client's deadline	22.512	1	22.512	44.481	2.6E-09	3.955	9th
Reduced time for responding to queries and complaints	2.616	1	2.616	4.211	0.04327	3.955	1st
Improve the management of sub consultants	17.686	1	17.686	18.624	4.3E-05	3.955	4th
Minimizing risk through improved tender documents	23.547	1	23.547	47.461	9.6E-10	3.955	10th
Achieve continuous improvements	12.663	1	12.663	19.413	3.1E-05	3.955	5th

Statistical difference between two sets of data can be determined by comparing the P-values generated from the analysis of the variances. At 5%, p-values less than 0.05 imply a difference in the data and p-values greater than 0.05 imply no difference. From Table 3, all the p-values are less than 0.05 indicating that there are significant differences between all the data sets. The expected benefits are statistically different from the actual benefits for each benefit evaluated. By referring to the F-ratios, the benefits that exhibited the greatest difference or similarity can be identified. A large F-ratio implies a large difference whiles a small F-ratio implies a small difference. Very large F-ratios, indicating very large differences, were recorded for the following benefits: increasing accuracy of project budget estimation, minimizing risk through improved tender documents, promoting better communication with client, and meeting client's deadline.

The largest F ratio of 121 was in the benefit "increasing accuracy of project budget estimation" meaning it was the benefits that had the widest gap between the actual and expected benefits. This may be so because of the very high budgets overruns incurred by the DAs. Consultants do not help DAs much in executing their projects within budget. Thus consultants have to improve

on their project budget estimation.

Other benefits like "meeting client's deadline", "minimizing risk through improved tender documents" and "promoting better communication with client" had high F-ratios of 44.46, 47.46 and 48.974 respectively, also suggesting that consultants need to take a critical look at issues with meeting deadlines, minimizing risks on behalf of DAs and improving communication with the DAs. The benefits with the least F-ratios were "reduced time for responding to queries and complaints" and "improved quality of their designs" with ratios of 4.21 and 6.25 respectively. These were the only benefits where the expectations were close to the actual benefits.

Conclusions

The results of the study show that of the potential benefits from DAs consultants, increasing accuracy of project budget estimation, saving cost, minimizing risk through improved tender documents, promoting better communication with clients, and meeting clients' deadline were considered important by the DAs.

At 5% level of significance, there were significant differences between the expected benefits and the actual benefits the DAs derived from their consultants. For consultants to meet their clients expectation and clients also achieve enhanced benefits from their consultants, it is recommended that DAs include consultant's evaluation in their contracts with their consultants. District Assemblies should also evaluate their consultants on all projects to provide much needed feedback for the consultants to be able to examine their deficiencies for continual improvement and guaranteed benefits to the DAs. Consultants are recommended to seek regular feedbacks from the DAs and review their service quality on those deficient aspects.

References

Ahmed, S.M. & Kangari, R. (1995), 'Analysis of client satisfaction factors in construction industry', Journal of Management in Engineering, ASCE, Vol. 11, No (2), pp. 36-44.

Banful A. B. (2009), 'Do Institutions limit Clientelism? A study of the District Assemblies Common Fund in Ghana'. International Food Policy Research Institute.

Bartlett J., Kotrlik, J. & Higgings, C. (2001), 'Organisation Research, Determining appropriate sample size in survey research', Information Technology Learning and Performance

Journal, Vol 19, pp 43-49.
Berg, S. (1988), 'Snowball sampling', In Encyclopaedia of Statistical Sciences, vol. 8 (Kotz S. and Johnson N.L. eds), pp. 529–532.

Botchway, E. (2000), 'The assessment of the role of and impact of Human resource base of the District Assemblies for effective utilisation of the District Assemblies common fund'. Un-published MSC thesis. KNUST, Ghana.
Caldwell, J.A. & Hagen, T.D. (1994), 'Engineering consultants implement TQM'. Quality Progress, Vol. 27 No (1), pp. 57-63.
Chan, A.P.C. & Tam, C.M. (2000), 'Factors affecting the quality of building projects in Hong Kong', International Journal of Quality and Reliability Management, Vol. 17 No. (4/5), pp. 423-451.
Chow Lai Kit, S. & Ng, T. (2007),'A fuzzy gap analysis model for evaluating the performance of engineering consultants', Automation in construction, Vol 16, pp 425-435
Cooley, M.S. (1994), 'Selecting the right consultants'. HR Magazine Vol. 39, No. (8):100–3
District Assemblies Act (1993), 'Act 462 of Parliament of Ghana'.
District Assemblies Common Fund Act (1993), 'Act 455 of Parliament of Ghana'.
Federation Internationale Des Ingenieurs Conseils (FIDIC) (1997). Quality-based selection for the procurement of consulting services. Lausanne, Switzerland.
Goetsch, D.L. & Davis, S.B. (2002), 'Understanding and Implementing ISO 9000: 2000', 2nd ed., Prentice-Hall, Upper Saddle River, NJ.
Hill, N. Self, B. & Roche, G. (2002), 'Customer Satisfaction Measurement for ISO 9000:2000', Butterworth-Heinemann, Oxford.
Murphy, R.J. (2002), 'Implementing an ISO 9000: 2000 Based Quality Management System: Including Safety and Environmental Considerations, ABS Consulting Press, Rockville, MD.
Ng, S.T. (2005), 'Performance of engineering consultants in ISO 9000-based quality management systems implementation Engineering', Construction and Architectural Management Vol. 12, No. (6), pp. 519-532.
Osei-Asibey, D. (2005),'Implementation of total quality management for District Assemblies Common fund projects at the Atwima District Assembly- pre contract stage'. Unpublished MSc thesis, KNUST.
Tang, S.L. & Kam, C.W. (1999), 'A survey of ISO 9001 implementation in engineering consultancies in Hong Kong', International Journal of Quality and Reliability Management, Vol. 16, No. (6), pp.
562-574.
World Bank report (2004), 'Presentation on the Tracking of Ghana's District Assemblies Common Fund Video Conference': April 14, 2004

Journal of Construction Project Management and Innovation Vol. 3 (1): 543-559, 2013
ISSN 2223-7852

UNDERSTANDING COMPLEXITY WITHIN ENERGY INFRASTRUCTURE DELIVERY SYSTEMS IN DEVELOPING COUNTRIES: ADOPTING A VIABLE SYSTEMS APPROACH

B.O. Awuzie[1] and P. McDermott[2]

[1 2] University of Salford, Salford, UK
Email: b.o.awuzie@edu.salford.ac.uk and p.mcdermott@salford.ac.uk

Abstract
Infrastructure delivery systems involve high complexity. This stems from numerous factors: a diverse range of skilled professionals, diverse cultural affiliations, incomplete contracts and complex contractual relationships among stakeholders, government policies, finance and regulatory issues, and high levels of asset specificity. The degree of complexity is enhanced in projects requiring high levels of specialization. Energy infrastructure projects can be described as possessing a relatively high degree of complexity. The ability to understand and manage such complexity directly affects project performance. Previous studies into the failure of most of these projects have traced project failures to several factors such as corruption, lack of transparency in the procurement process, lack of proper regulatory frameworks, and lack of political willpower. Surprisingly, few studies have attempted to spearhead a concise understanding of the inherent complexities in delivery systems. This paper attempts to contribute to the literature on project delivery process and its inherent complexities. This study proposes a viable systems model approach to understanding complexities in energy infrastructure delivery systems in developing countries. This is based upon the premise that a system must be understood properly to enable effective diagnosis. It argues that whereas the aforementioned factors adversely affect the performance of the infrastructure projects, a better understanding of the delivery process would allow for timely and appropriate solutions to be proffered. The viable systems model is premised on the concept of systems thinking and cybernetics-science of communication and control. It has proven effective in diagnosing organizations. It is hoped that this study, which forms part of an on-going PhD study, would elicit further discourse in the application of the viable systems model in diagnosing and re-designing infrastructure delivery systems within the energy sector of developing economies.

Keywords: Infrastructure Delivery Systems, Project Complexity, Viable Systems Model, Developing Countries

INTRODUCTION

The process of delivering infrastructure projects involves a high degree of complexity. Various factors such as the presence of diverse professionals and trades, the application of state of the art technology, multicultural nature of the project environment, incomplete contracts and several contractual relationships are prevalent within infrastructure project environments (Van Marrewijk et al., 2008). These factors contribute to the high degrees of complexity experienced in such projects. This degree of complexity is further enhanced in projects requiring high levels of specialization such as energy infrastructure (Baccarini, 1996, Gidado, 1996, Wood and Ashton, 2010 Vidal et al., 2007). Usually labelled megaprojects, Van Marrewijk et al. (2008) defines them as multibillion dollar mega infrastructure projects, commissioned by governments and delivered by private enterprise; and characterised as uncertain, complex, politically-sensitive and involving a large number of stakeholders. Flyvbjerg et al. (2003) have attributed the causes of megaproject failure to the following causes: lack of realism in initial cost estimates, motivated by vested interests; underestimation of length and cost of delays; very low contingencies; not enough consideration being given to changes in project specifications and design; fluctuations in exchange rates between currencies and price changes are grossly undervalued; environmental demands, expropriation costs and safety are grossly undermined. Megaprojects are also characterised by conflict, uncertainty and poor cooperation between partners (Van Marrewijk et al., 2008). They posit that project design and project cultures play a dominant role in determining how managers and partners cooperate to a greater or lesser extent.

Other studies looking specifically into the causes of project failure in developing economies particularly in Africa, have identified the following causes as leading to the failure of projects of similar magnitude: corruption, lack of transparency in the procurement process, lack of proper regulatory frameworks, lack of trust between project stakeholders and poor communication channels within the delivery systems ((Okonjo-Iweala and Osafo-Kwaako, 2007, Diallo and Thuillier, 2005). Arguably, these aforementioned factors result from ineffective management of complexity by project managers. This has led to the huge energy infrastructure deficit in developing countries hence reducing productivity levels directly and economic growth within those countries indirectly.

Wood and Ashton (2010) and Van Marrewijk et al. (2008) maintain that the level of complexity and the ability to manage such complexity significantly affects project performance.

Developing countries have witnessed slow economic growth despite being blessed with vast amounts of natural resources (Dessy, 2007). Inadequate energy infrastructure has contributed immensely to this slow growth. Many African nations, particularly Nigeria, have adopted intensive measures to develop their energy infrastructure to spearhead a return to productivity and economic growth. The adoption of Public-Private Partnerships is one of the major avenues being exploited by the Nigerian government to develop its energy infrastructure. This paper posits that unless a viable model, capable of ensuring an enhanced understanding and subsequent management of complexities, is developed for the delivery of energy infrastructure in developing countries, the current failed and abandoned project phenomena beleaguering such countries would continue to persist. Surprisingly, despite evidence that poor or inadequate management of project complexities affects project performance (Wood and Ashton, 2010), literature barely exists within the field of construction management on the management of project complexity in infrastructure projects in developing economies. Baccarini (1996) laments the absence of abundant literature treating project complexity from the project management perspective. Wood and Ashton (2010) whilst agreeing with Baccarini, attempt to assist with a front end based identification of factors of complexity in projects with the aim of developing a medium through which the attendant complexities can be managed for better project outcomes. Having discovered this gap in literature, this study, which forms part of a PhD research, seeks to make a case for the adoption of the viable systems approach as a guide to understanding the inherent complexities in the delivery of energy infrastructure in developing countries. It is hoped that given a proper understanding of these project complexities, project managers and project stakeholders would be able to successfully manage them and attain the desired project outcomes.

To achieve its objective, this paper reviews literature on the concept of complexity, highlighting the types of complexities encountered in projects and the factors responsible for such complexities.

It appraises the current state of energy infrastructure in Nigeria, highlighting as it were, the negative impact of energy infrastructure stock deficit on economic growth and measures being taken by government to remedy the situation. Next, infrastructure delivery systems are understudied from a complex systems perspective. A discourse on the concept of viable systems approach ensues. A case is then subsequently made for the application of the Viable Systems Model in understanding complexity within infrastructure delivery systems. This paper, part of an on-going study focusing on the attainment of a viable means of delivering infrastructure to the oil and gas industry, after a synthesis of literature concludes with the notion that the VSM remains a more robust approach to understanding complexity within the delivery process and subsequent design of such processes for project success.

WHAT IS COMPLEXITY?

The concept of complexity is one which has continually defied any universal definition ((Wood and Ashton, 2010, Mitchell, 2009). They agree that word complexity connotes different things to different people. Mitchell (2009) posits that in the absence of any definite science of complexity, various sciences of complexity could be said to exist. She notes that this has made the development of a universally accepted definition of the term 'complexity' impossible. Relying on the work of Seth Lloyd on how to measure complexity, published in 2001, Mitchell (2009) maintains that complexity can be defined on the basis of three distinct criteria namely: size, entropy, algorithmic information context, logical depth, thermodynamic depth, statistics, fractal dimensions and the degree of hierarchy. Within the realm of infrastructure delivery, defining complexity according the degree of hierarchies, size, and information processing capacity might be seen as apposite. Mason (2007:10) defines complexity as the measure of heterogeneity or diversity in internal and environmental factors such as departments, customers, suppliers, socio-politics and technology. Baccarini (1996:201-202) highlights two different dictionary definitions of the term 'complexity' which can be likened to projects.

He maintains that complexity could be used to describe endeavours which are (a) consisting of many varied interrelated parts, and (b) complicated, involved, intricate.

These definitions proffered in the dictionary and cited by Baccarini (1996) seems an apt way of describing the endeavour of delivering energy infrastructure. An energy infrastructure delivery system could be described as having several varied interrelated parts consisting of several tasks, professionals and non-linear sequences which must all be co-ordinated effectively to attain a specified goal. The prevalence of varied stakeholder interests, application of cutting edge technology, and huge expenditure incurred by the project sponsors makes the process a complicated, involved and one fraught with intricacies. Hence, Baccarini (1996:202) defines project complexity as "consisting of many varied interrelated parts". Furthermore, he stated that it can be operationalised in terms of differentiation and interdependency. Caution should be exercised in comparing project complexity to project size and the levels of uncertainty as the concept of project complexity is entirely different.

Types of complexity encountered in infrastructure projects

Gidado (1996) identifies two perspectives of project complexity within the construction industry; the managerial and the operative/technological perspectives. Similarly Baccarini (1996) highlights the existence of two perspectives to complexity within the project environment: organisational and technological complexity perspectives. Whereas Baccarini advises researchers and project mangers alike to be explicit on the perspective of complexity they are interested in, it is appreciable to note that both perspectives are applicable to energy infrastructure projects. Whereas organisational complexity bothers on the existence of varied differentiated parts of the infrastructure delivery system, by differentiation, technological complexity is concerned with the variety of some aspects of a given task and by interdependency, comprising of all the interdependencies between tasks, within a network of tasks, across teams and multi-stakeholders (Baccarini, 1996).

Factors Causing Complexity in Infrastructure Projects

Wood and Ashton (2010) identified a total of forty-six factors leading to increased complexity in projects. They grouped these factors under five themes namely: Organisational factors (people involved/relationships); Operational and technological factors; Planning and management factors; Environmental factors; and uncertainty factors respectively. For a full rendition of the forty-six causal factors, see Wood and Ashton (2010).

These factors are responsible for the increasing degrees of complexity within project environments especially megaprojects and if not properly managed, capable of undermining their performance.

Baccarini (1996:201) emphasizes the significance of understanding project complexity by project managers, stating that project complexity was capable of: determining planning, co-ordination and control requirements; hindering clear identification of project goals; playing a central role in choosing an appropriate project organisational form from a league of alternatives; influencing the selection of project inputs such as the expertise and experience requirements of specialist tradesmen and professionals; being applied as a principal criteria in selecting a suitable project procurement arrangement for a particular project; affecting the project objectives of time, cost and quality especially given that the higher the project complexity the greater the time and cost. Thus the significance of project complexity to project success or otherwise cannot be underestimated, hence the compelling need to allow for a thorough understanding of the inherent complexities in an infrastructure delivery system. Although project complexity is only but one dimension of attaining project success (Baccarini, 1996), it still poses a huge threat to the successful delivery of energy infrastructure in developing countries especially Nigeria. The absence of a universally acceptable way of enabling an understanding of complexity such as is experienced within infrastructure projects becomes a major hindrance to effective and efficient planning and subsequent management of such projects.

This study becomes imperative as it seeks to propose an approach to understanding complexity in infrastructure projects within the energy sector thus leading to project tailored project management strategies for these projects, especially within the comity of developing countries. This is due to the fact that the authors have argued severally elsewhere, (Awuzie and McDermott, 2012), that the main reason for poor delivery of viable infrastructure in developing countries stems from the organisational arrangements and the poor management of the interrelationships between the various parties to a delivery process.

They argue that most of the organisational strategies and the management modes adopted for such activity do not take cognisance of critical issues like culture, normative values and effects of social capital on the project environment. This view is supported by Van Marrewijk et al. (2008) given their perception of construction project environments as being socially constructed wherein social actors (project participants) develop a more or less stable working environment for themselves with consequently greater or lesser cooperation between themselves. Hence, they lament that whereas these contractual provisions seek to address all the existing interests which are at stake in complex megaprojects such as energy infrastructure, they do not fully capture the complexity of the multiple, fragmented subcultures at work in a project culture.

Bertelsen (2003) argues that the incomplete understanding of the construction process by its various stakeholders has been the cause of the declining performance of delivered products despite improvements on the engineering perspectives. Having studied several megaprojects, Van Marrewijk et al. (2008) discover that the managerial rationalities within the projects are limited in understanding their own complex project realities which are themselves bound by limits imposed by overall governance structures and strategies.

STATE OF ENERGY INFRASTRUCTURE IN DEVELOPING COUNTRIES-THE NIGERIAN CASE

The significance of energy in our contemporary society can never be overemphasized. According to UNIDO (2010), the world's prosperity rests on its ability to maintain a guaranteed supply of energy for production and industrialization purposes. Given that energy remains a very crucial input in production processes, most developing countries have been unable to harness energy from diverse sources due to the lack of energy infrastructure. This deficit in infrastructure has rather led to a decline in productivity levels in these countries, thus reducing their competitiveness.

Several studies have highlighted the relationship between energy infrastructure stock availability and investments and the economic growth in countries, see (Agénor and Moreno-Dodson, 2006, Foster, 2008, Agenor, 2009). For instance, the Spanish power generation capacity equals the entire power generation capacity of the entire sub-Saharan Africa- a region comprising of a total of forty-nine (49) nations (UNIDO, 2010), despite the fact that this region plays host to large mineral reserves necessary for energy generation. Nigeria belongs to this sub-Saharan Africa community. The country still imports most of all its petroleum products and is grappling with incessant power shortages, thus frustrating industrialization and undermining productivity levels. In a recent study carried out by Foster and Pushak as part of a world bank sponsored initiative, they successfully catalogued the current state of Nigerian infrastructure ranging from telecommunications to power and energy, from transportation through to water projects (Foster and Pushak, 2011). A proper picture of the state of Nigeria's infrastructure stock can be obtained in Foster and Pushak (2011). The energy infrastructure is presently being procured by the Federal government through its MDAs and their private sector partners. In the last decade, the Nigerian government initiated several energy infrastructure projects including the construction of oil and gas pipelines. In order not to allow these projects to fail like their predecessors, it becomes pertinent to develop ways of tackling the complexities which have haunted the success of previous projects. This is the aim of this paper.

INFRASTRUCTURE DELIVERY SYSTEMS AS COMPLEX SYSTEMS

Infrastructure delivery systems can be described as complex systems. Previous studies have shown that the failure of most infrastructure projects has resulted from the inability of the project management personnel to understand the process of delivering infrastructure projects as a complex venture (Bertelsen, 2003). He states that the failure of project management has resulted from its tendency to treat projects as ordered and linear activities as against what it actually is, a complex and dynamic, non-linear phenomena. As a system's complexity increases, the ability to understand and process information for planning and predictions become more difficult, hence problematic in adapting to its external environment (Mason, 2007, Rhee, 2000). This scenario is not new to the energy infrastructure delivery process.

Systems theory tells us that complex systems are deterministic in nature and evolve through a phase of instability, which eventually reaches another threshold where a new relationship is established between its internal and external environments and itself. This external environment comprises of elements such as: competition; the economy; socio-cultural-demographic factors; political-legal-government aspects; technology; and the natural environment (Beeson & Davis 2000:183). An organisation such as an infrastructure delivery system as a complex system, ultimately learns from its environment and changes its internal structures and procedures accordingly thus changing the behaviour of the individual elements (Sherif 2006:77; Paraskevas 2006:901). Mason (2007:13) admits that an understanding of the dynamics and behaviour of an organisation can only be effectively done by managers who understand these complex interactions. The infrastructure delivery system is no different as only an understanding of the inherent complex interactions can guarantee better delivery and subsequently successful performance.

Bertelsen (2003) agrees that the construction process is a complex system. He states that construction projects are managed by engineers and advised by economists, professionals who derive their knowledge from the understanding of our world and its living systems, which is fundamentally aged more than 300 years old. He states that a new understanding of life, living systems, and by that the understanding of social systems such as organisations, societies, and, indeed even Mother Nature and the Universe in general has gained more and more foothold in science. He maintains that the complex systems theory had come to stay insisting that the Newtonian systems theory applicable to the construction process (linearity) exists only in theory and thus is not capable of bringing about change due to the sort of mess which the real world connotes. We agree with Bertelsen's views on contemporary project management practice as it concerns linearity of work process and organisation.

VIABLE SYSTEMS MODEL

The evolution of the Viable Systems Model (VSM) can be traced to systems theory and cybernetics. Espejo (1994) insists that system thinking entails a comprehension of how parts interact with each other to form a whole through a self-organizing process.

Polese et al. (2009) restate that the concept of system thinking refocuses attention from the part to the whole, suggesting that the individual qualities of the parts become vague whereas their relationship with other parts becomes important. This theory is based on the postulation that every system is made up of subsystems and that the conglomeration of these systems leads to a whole (Checkland, 1981). The inherent individual characteristics of these subsystems diffuse into the system leading to a generic characteristic of the whole and not a summation of the characteristics of the individual subsystems making up the parent system (Checkland, 1981).

The VSM was derived from this concept of wholes, drawn from the biological sciences, the human nervous system particularly by Stafford Beer in 1971(Leonard, 2000). Espejo and Bendek (2011) assert that the VSM enables observers to see beyond formal institutions, the existence of the social organizations where they can interact and participate in the decision making process. They highlight the powerful nature of the law of variety postulated by Ashby, which is a relational platform catering for how we relate with our situations in changing times and upon which Beer's VSM is premised. The VSM is dependent upon the concepts of complexity and recursivity (Espejo and Gill, 1997). Given the nature of complexity, the mere fact that cybernetic principles are focused on the management of complexities in organizations makes the VSM an attractive tool for anyone trying to manage complexities within an organization. The principle of recursivity acknowledges the existence of subsystems within every whole and is premised on the fact that each subsystem does possess self-regulatory and self-organizing traits and that this process continues until the last single cell available thus making them effective absorbers of the inherent complexities which might arise out of the systems interaction with its external environment (Espejo and Gill, 1997). Leonard (2000:711) posits that the recursive characteristic of the VSM ensures that "each independent viable system is embedded in other more comprehensive systems". She opines that this recursive nature of the VSM enables policies, goals, and modes to be investigated and evaluated for improvement purposes. It is not a new idea having been employed as a conceptual tool for appraising organizations, redesigning them and rendering the much needed support for change management within organizations (Brocklesby and Cummings, 1996, Espejo and Gill, 1997).

The VSM is not a widely applied phenomenon within the realm of management due to the perceived difficulty in coming to terms with its operability and the fact that they run contrary to the grounded norms of organizational thinking (Espejo and Gill, 1997). Brocklesby and Cummings (1996) argue that the VSM remains a tool for the anticipation, planning, and implementing of large scale organizational change. To be viable, organizations must possess the ability to improve upon their existing processes and procedures to satisfy the stakeholders/customers/clients, and also adapt to the ever dynamic operating environment and this is what the VSM tries to achieve.

Under a VSM approach, the control points are spread throughout the whole system thus allowing for the effective manifestation of the self-organizing capabilities of the subsystems and their efficient utilization within the system of the whole. It is widely believed that this decentralization of control engenders efficiency (Jackson, 1988).

The VSM is structured in such a manner that it has five subsystems, all of which are self-regulatory and self-organizing in line with recursivity. These five subsystems have been identified as comprising of the following, namely; (a) Policy-This is the last function of a VSM. It is responsible for the policy making duties of the organization. Its major functions include the provision of overall clarity and purpose for the organizational unit and to prepare a concrete and tenable design for organizational efficiency. (b) Intelligence- This functions as a connection between the VSM and the external environment. Whilst it is responsible for the projection of the organization's image and message to the external environment, it is also responsible for the obtaining information from the external environment. It is future focussed but maintains a communication loop with the control subsystem to complement the control function on areas such as maintaining the definition, adjustments and implementation of the unit's identity. (c) Control and Monitoring*- This subsystem serves as a channel through which resources are negotiated and the issuance of direct line management takes place. The monitoring function is also domiciled within this subsystem serving as a corroboration agent to the control function so as to ensure accountability. (d) Co-ordination- These are the systems put in place within a VSM to co-ordinate the interactions between the support functions and between the autonomous units.

(e)Implementation- This system is responsible directly for the production or provision of services to the customer/clients (Devine, 2005, Brocklesby and Cummings, 1996, Espejo and Gill, 1997, Jackson, 1988).

DISCUSSION

Understanding Organisational Complexity – the Viable Systems Model

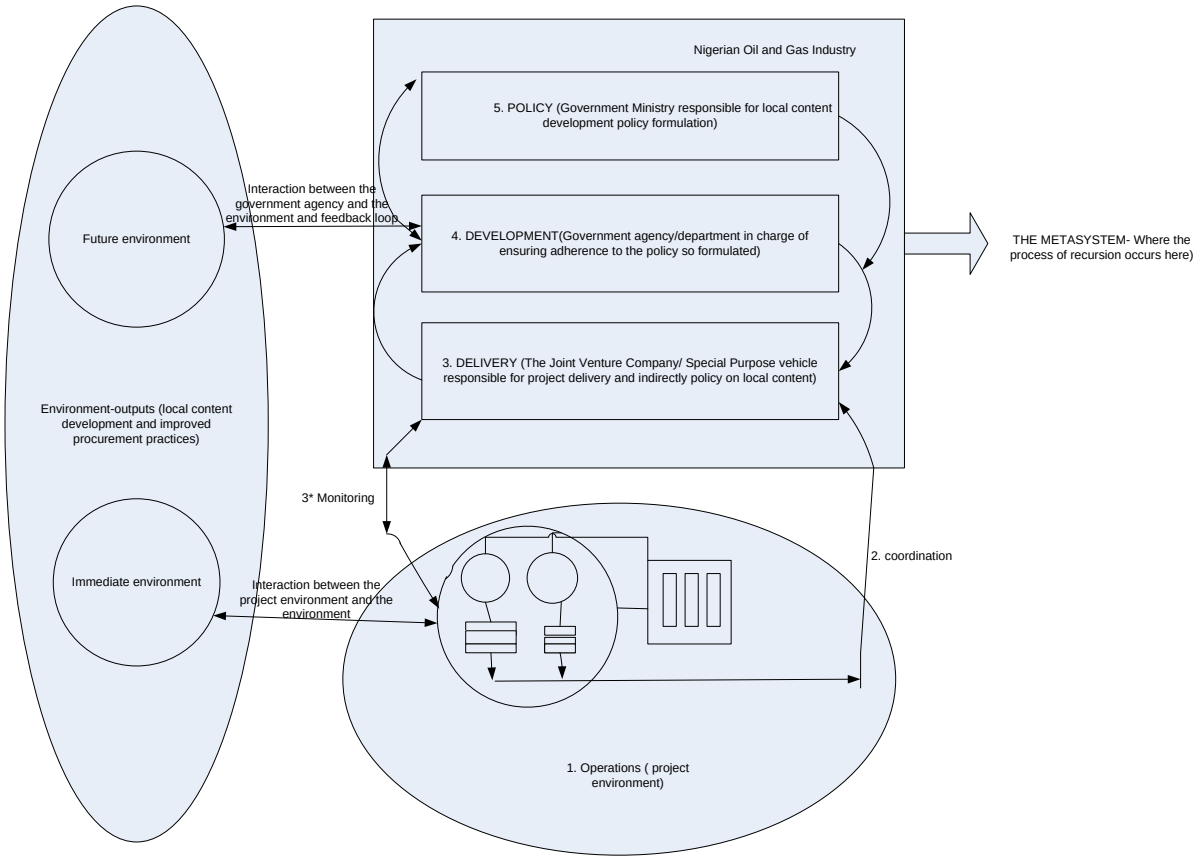
We make a case for the adoption of the VSM in enhancing an understanding of complexity in infrastructure projects. Schwaninger (2006) asserts that the VSM provides a formal apparatus for dealing with complex systems of all kinds and is therefore being adopted increasingly in many fields of inquiry. It has also grown to become recognised as a new language that allows synergetic interaction between different disciplines, thus increasing the possibility of innovative, trans-disciplinary solutions to complex issues. He describes organisational cybernetics as the application of the science of control and communication in complex systems and maintains that it furnishes the structure –theoretic underpinning for humanistic postulates such as autonomy, meaningful work, and human self-realization (Schwaninger 2001: 208). He states that from a cybernetic stance, organisational intelligence should enable an organisation to: adapt to changing situations; influence and shape its environmental milieu; if necessary, find a new playing field or to reconfigure itself anew with its environment; to make contributions to the larger wholes into which it is embedded (209).

That the infrastructure delivery process consists of immense organisational complexity is not new knowledge. The poor management of organisational complexity on the performance of the project is widespread knowledge and has been deduced as being the reason for the failure and incessant abandonment of several energy infrastructures in developing countries. The main issue with the management of complexity remains the development of a methodology that would enable effective understanding of the type and degree of organisational complexity affecting the projects. Organisational complexity can only be managed for optimal benefits only if they are better understood at the early stages of the project (Wood & Ashton, 2010).

The VSM offers a platform for enabling this understanding. It has been proven as giving social systems the capability to deal with dynamic complexity along with all the related organisational and even ethical challenges (Schwaninger, 2001). He posits that the propositions behind the VSM can be summarized as follows: an enterprise is viable if and only if it disposes of a set of management functions with a specific set of interrelationships, identified and formalized in the model. Although several approaches have been applied in the management of complexity in project organisations, they have failed to yield any result as they have only led to optimization in one single dimension leaving the complex organisational issue unsolved (Schwaninger, 2001, Bertelsen, 2003). In lending his support to the VSM, Schwaninger(2001:212) maintains that "the result of an organisational process cannot be better than the model on which the management of that process is based, except by chance". He adds that systems and complexity models can offer more promising avenues from which organisational leaders can appreciate and address complex organisational dilemmas. The VSM models the organisation as a set of interrelationships and allows for the application of several modes of management and governance approaches. It recognises the delivery process as a social system, constructed by the participants (Van Marrewijk et al., 2008). It brings the issues relating to organisational complexity to the fore thus allowing the project manager and other stakeholders to know what they are required to do to reduce the uncertainty associated with increasing complexity.

In using the viable systems approach to understand energy infrastructure delivery, the energy infrastructure delivery process is likened to an organization. Within the model, the government ministry-in charge of policy formulation- being situated at the strategic level, alongside the agency or department responsible for the implementation of policy. This agency oversees the formation of SPV/JV for the purpose of executing the proposed infrastructure development. It plays an administrative role, ensuring that the SPV/JV abides by the tenets required to attain the policy goals behind such an investment. The ministry, its agency and the SPV are situated within the meta-system section of the Viable Systems Model (VSM) responsible for coordinating, auditing, supervision, and monitoring functions. Beneath this aspect of the VSM is the implementation section which consists of the project environment proper where the actual delivery activity occurs.

This would enable an understanding of what it entails to plan and manage an energy infrastructure project. The impact of the project on its host environment can also be evaluated with ease and improved upon. The VSM also enables organisational change within the delivery chain allowing for effective and efficient coordination, monitoring and control. Given its project organisation specific nature, the VSM allows for project peculiarities to be taken into consideration thus allowing for the application of relative strategies for optimisation of the work processes and the interrelationships between the several participants within the project environment.



The energy infrastructure delivery system viewed through a Viable Systems Model prism (Adapted from Beer's Viable System Model)

This part, theoretically, impacts directly upon the external environment, delivering policy objectives behind the investment to that environment.

CONCLUSION AND FUTURE RESEARCH

This article set out to make a case for the adoption of the viable systems approach for studying organisational complexity within energy infrastructure delivery systems in developing countries. It discussed the concept of complexity, especially as it concerned projects and its impact on project performance. A typology of project complexity was also highlighted. An identification of factors responsible for the increasing complexity within projects was also mentioned. An extensive review of literature on the viable systems approach ensued after a narration of the state of energy infrastructure in developing countries. Nigeria was adopted as a typical case of a developing country and its huge energy infrastructure deficit was highlighted through a synthesis of literature. The essence of effective front-end complexity understanding and management was buttressed and the need for a methodology for understanding this phenomenon was stated.

Summarily, after having carried out an extensive synthesis of literature on the core issues of this paper, we conclude by making a case for the adoption of the viable systems approach as an effective mode for understanding the inherent complexities in the delivery of energy infrastructure in developing countries. This study is part of an on-going PhD which proposes to utilize the VSM to diagnose the current infrastructure delivery system case studies in a developing country-Nigeria, and to redesign the delivery system for optimal viability.

ACKNOWLEDGEMENT

The corresponding author wishes to express his gratitude to the Nigerian Petroleum Technology Development Fund (PTDF) for sponsoring the Doctorate Programme for which this paper is an integral part.

REFERENCES

Agenor, P. R. 2009. Infrastructure investment and maintenance expenditure: Optimal allocation rules in a growing economy. Journal of Public Economic Theory, 11, 233-250.

Agenor, P. R. & Moreno-Dodson, B. 2006. Public infrastructure and growth: new channels and policy implications. Available at SSRN 2005043.

Awuzie, B. O. & McDermott, P. 2012. Using a Systems Viability Approach to Investigate The Social And Economic Impact Of Energy Infrastructure Investments On Local Construction Supply Chain Development-A Case Of Nigeria's Niger Delta Region. In: JAVERNICK-WILL, A. & MAHALINGAM, A. (eds.) Engineering Project Organisation Society Conference. Rheden, Netherlands.

Baccarini, D. 1996. The concept of Project Complexity-a review. International Journal of Project Management, 14, 4.

Beeson, I. & Davis, C. 2000. Emergence and accomplishment in organizational change. Journal of Organizational Change Management, 13, 178-189.

Bertelsen, S. 2003. Complexity- Construction in a new perspective. IGLC-11. Blacksburg: International Group for Lean Construction.

Brocklesby, J. & Cummings, S. 1996. Designing a Viable Organization Structure. Long Range Planning, 29, 9.

Checkland, P. B. 1981. Rethinking a systems approach. Journal of Applied Systems Analysis, 8, 117-131.

Dessy, S. 2007. Client power, citizen participation, institutions and services delivery: Theory and Evidence with special emphasis on Africa. AERC Project on Institutions and Service Delivery. http://aercafrica. org/documents/isd_workingpapers/DessyS_ClientPowerCitizenParticipationISD. pdf.

Devine, S. 2005. The viable systems model applied to a national system of innovation to inform policy development. Systemic Practice and Action Research, 18, 491-517.

Diallo, A. & Thullier, D. 2005. The success of international development projects, trust and communication: an African perspective. International Journal of Project Management, 23, 237-252.

Espejo, R. 1994. What is systemic thinking? System Dynamics Review, 10, 14.

Espejo, R. & Bendek, Z. M. 2011. An argument for active citizenship and organisational transparency. Kybernetes, 40, 477-493.

Espejo, R. & Gill, A. 1997. The Viable System Model as a framework for understanding organizations. Phrontis Limited & SYNCHO Limited.

Flyvberg, B., S., M. K. & Buhl, S. L. 2003. How common and how large are cost overruns in transport infrastructure projects? Transport Reviews, 23, 71-88.

Foster, V. 2008. Overhauling the engine of growth: infrastructure in Africa. Africa Infrastructure Country Diagnostic.

Foster, V. & Pushak, N. 2011. Nigeria's infrastructure: a continental perspective. World Bank Policy Research Working Paper Series, Vol.

Gidado, K. 1996. Project complexity: The focal point of construction production planning. Construction Management & Economics, 14, 213-225.

Jackson, M. C. 1988. An appreciation of Stafford Beer's 'Viable System'viewpoint on managerial practice. Journal of Management Studies, 25, 557-573.

Leonard, A. 2000. The viable system model and knowledge management. Kybernetes, 29, 710-715.

Mason, R. B. 2007. The external environment's effect on management and strategy: a complexity theory approach. Management Decision, 45, 10-28.

Mitchell, M. 2009. Complexity: a guided tour, Oxford University Press, USA.

Okonjo-Iweala, N. & Osafo-Kwaako, P. 2007. Nigeria's economic reforms: Progress and challenges. Policy Research Series. Washington: World Bank.

Paraskevas, A. 2006. Crisis management or crisis response system?: A complexity science approach to organizational crises. Management Decision, 44, 892-907.

Polese, F., Giuseppe, R. & Carrubbo, L. 2009. The contribute of Viable System Approach in directing and managing inter-firm relationships. Annual Euromed Conference [Online].

Rhee, Y. P. 2000. Complex systems approach to the study of politics. Systems research and behavioral science, 17, 487-491.

Schwaninger, M. 2001. Intelligent organizations: an integrative framework. Systems research and behavioral science, 18, 137-158.

Schwaninger, M. 2006. Theories of Viability: a Comparison Systems Research and Behavioural Science 23, 11.

Sherif, K. 2006. An adaptive strategy for managing knowledge in organizations. Journal of Knowledge Management, 10, 72-80.

UNIDO 2010. Energy Infrastructure and Industrial Development. In: ISAKSSON, A. (ed.) Research and Statistics Branch Working Paper 12/2009. Vienna: United Nations Industrial Development Organisation.

Van Marrewijk, A., Clegg, S. R., Pitsis, T. S. & Veenswijk, M. 2008. Managing public–private megaprojects: paradoxes, complexity, and project design. International Journal of Project Management, 26, 591-600.

Vidal, L., Marle, F. & Bocquet, J. Modelling project complexity. 2007.

Wood, H. L. & Ashton, P. 2010. Modelling project complexity. In: EGBU, C. (ed.) Proceedings 26th Annual ARCOM Conference. Leeds, UK: Association of Researchers in Construction Management.

Journal of Construction Project Management and Innovation Vol. 3 (1): 560-572, 2013
ISSN 2223-7852

INVESTMENT METHODOLOGY IN PLANNING AND DEVELOPMENT OF INFRASTRUCTURE: AN UNBALANCED GROWTH APPROACH

Omoleye B. Ojuri

Federal University of Technology, Akure, Ondo State, Nigeria
Email: leyerem@yahoo.com

Abstract
The economic as well as efficient use of scarce resources is one of the challenges in developing countries. This paper aims at providing an investment methodology to infrastructure planning and development agencies. To achieve the goal, the paper specifically analyses the unbalanced growth concept in prioritizing investment in infrastructure development. It further examines in detail the investment policies in infrastructure development in Sri-Lanka. Based on that, this paper carried out an extensive survey of the literature pertaining to available social infrastructure and the social status of Nigerian Niger Delta (ND) region. In looking for broad correlations, this paper sets aside a crucial issue - given that investment capital is scarce and living standards are low, what should get priority in terms of investment between consumption and productive activities? The study employed. An adaptation of photovoice methodology is used to collect primary data on the status of infrastructure facilities in the ND. The methodology is adopted to identify scope not captured through quantitative measures. The methodology combines photography with grassroots social action through interviews. The sample size is based on purposive sampling technique because the methodology requires adults that can participate in interview survey and handle instruments to be used for data collection. Based on that, fifty seven participants were first selected and subdivided into eight groups. The findings establish that social overhead capital (SOC) investments are more beneficial than direct productive activities (DPA) during early phase of infrastructural development and thus be given priority because the provision of SOC is relevant to addressing the appalling state of living of the people of the Nigerian ND region and thus improve the region's human capacity. The paper concludes that the measure of self-reliance of poor people is a strong indicator of the long-term poverty reduction impact of infrastructure development. Policy recommendations and specific actionable targets are suggested.

Keywords: Unbalanced growth, Social overhead capital, Infrastructural planning and development

INTRODUCTION

Analysis of Strategy of unbalanced growth

According to the theory propounded by Albert O. Hirschman, no developing country has sufficient endowment of resources as to enable it invest simultaneously in all sectors of the economy in order to achieve balanced growth (Jain & Ohri, 2007). Consequently, for this chronic scarcity of resources to be economically as well as efficiently utilized, a deliberate strategy of unbalancing the economy should be adopted and be included in the planning policies. The theory stresses investment in strategic sectors rather than in all sectors simultaneously. The other sectors would automatically develop through linkages effect (Jain & Ohri, 2007). Hirschman maintains that strategic sectors of the economy should get priority in terms of investment. Growth of these sectors will open new channels of growth in other sectors of the economy through externalities and complementaries (Jain & Ohri, 2007). For example, externalities in the sense that, the growth of industry A will generate the growth of industry B and C, while growth of output of A may generate the demands for the products of B and C. These are technical complementaries which stimulate growth of related industries, following the strategy of unbalanced growth.

Hirschman classifies investments into two parts namely SOC and DPA. SOC is termed as those basic devices without which primary, secondary and tertiary activities cannot function. This calls for expenditure on projects like roads, electricity, health care centres, water supply, schools and communications. On the other side, DPA are those activities which are a consequence of some investment, add to the flow of final goods and services. Investment in industry, plant, equipment is deemed as belonging to DPA (Jain & Ohri, 2007). As mentioned above, both SOC and DPA cannot be taken up simultaneously in less developed countries owing to the general lack of resources. Investment in SOC is advocated not because of its direct effect on final output, but because it permits and in fact invites DPA to come in. 'Some SOC investment is required as a prerequisite for DPA investment' (Familoni, 2008).

SOC can thus be seen from a variety of viewpoints that relates to productive capital, meaning that, capital that functions to indirectly enhance the production capacity of productive capital. This is in contrast with productive capital, which has an inherent direct production capacity.

Also SOC can be functions which although are essential to the health of the society, which are unlikely to be supplied in sufficient quantity by the market mechanism because of characteristics such as collective consumability of non-excludability. However, for the purpose of this study, SOC are the sectors that are essential to the health of the people, form foundation for industrial activities and act as an impulse to induce spontaneous private investment, consequently foster economic growth in the region. Furthermore, the author analyses this theory to draw the attention of infrastructure planners to investment priorities in early phase infrastructure development. Due to the fact that the provision of SOC is relevant to addressing the deplorable state of living of the people and can stimulate their potentials for sustainable livelihood. The author illustrates in the next section development path via provision of excess SOC.

In Figure 2.1, the path of development is demonstrated, using the strategy of unbalanced growth. The X-axis of the diagram shows investment cost in socially productive activities, while the Y-axis shows investment cost in direct productive activities. AA, BB and CC are equi-product curves, indicating various combinations of SOC and DPA corresponding to a given level of output or national income. The higher the curve, the greater is the level of output. In this sequence, if investment is first made in SOC, the economy will follow DEGHK as its course of development. Increase in investment of SOC from D to E will induce greater investment in DPA unto point F because infrastructure like transportation, electricity among others will become cheap and are now made available. Investment in DPA increases until balance is restored at G, in other words, the economy would be in state of equilibrium at point G. However, G is located at high equi product point BB. This implies increase in level of output in the economy. A further increase in investment in SOC up to point H would further induce investment in DPA from point G to J. This induces further investment in DPA until equilibrium is reached at point K on a higher iso-product curve CC indicating a higher level of output.

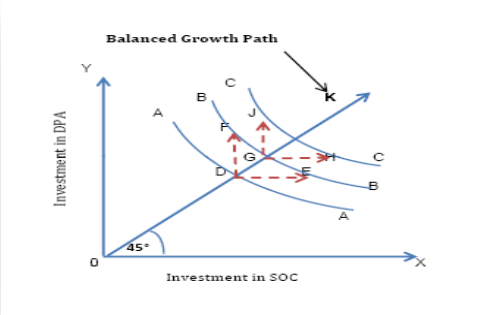


Figure. 2.1: Development Via Excess Capacity Of Soc
(Source: Jain & Ohri, 2007)

ANALYSIS OF INFRASTRUCTURE POLICIES

This section of the paper analyses the policy options and possible reform measures available to ensure that infrastructure planning and development manifest in the well-being of the people. To avoid likely problems, the author looks at other country' experiences in dealing with this issue.

Lessons from Sri Lanka

Sri Lanka may be worth looking at to illustrate how to achieve a suitable allocation of resources in infrastructure development. Sri Lanka has had a strong preference for investment in social infrastructure under its socialist economic system (Akatsuka & Tsuneaki, 1999). Economic infrastructure has been rather neglected, and as a result, the economy as a whole has seen little rise in productivity. This biased preference resulted in slow GDP growth, while the recurring budget for support of the social has risen (Akatsuka & Tsuneaki, 1999). Sri Lanka is far ahead her South Asian neighbours in the accomplishment of human development goals having her human development index as 0.751 (United Nations Children's Fund, 2012). In Table 2.1 life expectancy at birth is 76 years and 70 years for female and male respectively, this is close to the estimated lifespan in the developed countries. The literacy rate of 87% as indicated in Table 2.1 is high relative to her counterparts in the developing countries.

There is low mortality rates of 20 deaths per 1000 births as indicated in Table 2.1 and the steadily declining population growth, reflect the country's progress in the sphere of social development. Although, in the case of Sri Lanka, there are pros and cons, the lesson learnt is that the preferential investment in SOC has improved the social indicators such as life expectancy, literacy rate and infant mortality rate. The country is ranked as one of the highest in Asia in this respect. Meanwhile, on the other hand, the country has experienced very little rise in GDP

Table 2.1: Some social indicators of Sri Lanka

Case study	Life Expectancy F/M	Education Index	Literacy rate F/M	Infant mortality/1000	Accessibility to electricity	Accessibility to safe drinking water	Mortality rate un der 5 /1000 F/M
Sri Lanka	76(F)/ 70(M)	0.84	87%/ 93%	20	75% of population	89% of population	17/24

(Sources: United Nations Children's Fund, 2012 & Andrew, 2012)

INFRASTRUCTURE AND THE NIGERIAN NIGER DELTA

The lack of modern infrastructure is a major challenge to Nigeria's economic development and constitutes a major impediment to the achievement of the Millennium Development Goals (MDGs) (United Nations Development Programme, 2006). The positive relationship between infrastructure and economic growth is well-known, and requires little further elaboration. Ironically, however, the links between infrastructure and human development are often less recognized and are not enunciated in terms relevant to policy. Infrastructure provides people with services that they need and want. Access to water, sanitation, electricity, telephones, computers and transport make immeasurable difference in people's lives. The absence of some of the most basic infrastructure services often translates into absence of human development (Directorate of Institutional Finance & Sanket, 2007). Broadly, infrastructure impacts on human development in two ways: first, it supports the processes of growth on which much of poverty reduction depends; and second, it helps the poor access basic services which can improve their lives and income opportunities. At its best, infrastructure can draw poverty reduction, service provision, and growth into a reinforcing virtuous cycle (Directorate of Institutional Finance & Sanket, 2007).

Safe and convenient water supplies save time and arrest the spread of a range of serious disease such as diarrhea, a leading cause of infant mortality and malnutrition. Infrastructure lowers costs, enlarges markets, and facilitates trade. Electricity powers, health and education services and boosts the productivity of small businesses. Road networks provide links to global and local markets.

Roads, water and electricity are also essential to addressing the non-income elements of poverty, as reflected in the Millennium Development Goals, including access to education and health care, gender equality and environmental sustainability (Michael, 2007). Infrastructure also has an important impact on human development and poverty through growth. It is also an intermediate input into production. Without power and water, all but the most basic production would grind to a halt. It raises the productivity of factors of production— by generating the power that allows factories to mechanize, by allowing workers to get to work quicker, or by providing the networks through which information health can pass electronically. Infrastructure connects goods to markets, workers to industry, people to services, and the poor in rural areas to urban centres. Infrastructure lowers costs, enlarges markets, and facilitates trade. Infrastructure has a human development impact on the activities through which people earn their living. It contributes to the health and education that people need to fill jobs, or create them. It may seem intuitive that the ability of people to earn a living is increased when transport, information, power, and water are readily available (Directorate of Institutional Finance & Sanket, 2007). Health is one of the major determinants of labour productivity and efficiency. The impact of health services may be similarly affected by the ability of the poor to access facilities.

Even though human capital is only one factor of many that drives development and associated economic growth, it is an important factor for the development process for a developing country like Nigeria. The productive capacity of a country is related to the level of human capital, explaining why human capital formation must be considered of great importance in the future. Human capital is an important factor for the wealth of a nation due to its influence on the overall production of the country.

Technological progress can provide more efficient production-methods like machines and computers, but skilled labor is necessary to manage and develop them as well as to improve the quality and productivity of the existing labor. The Human Development Index (HDI) provides a measure of human capital development in three dimensions: income, health, and education.

The formation of Nigeria's human capital is therefore of great importance in the coming years if Nigeria wants to be competitive in the future. Table 3.1 below summarizes the Human development index (HDI) score; a measure of well-being encompassing the longevity of life, knowledge and a decent standard of living, remains at a low value of 0.564 points on a 1.0-point scale in the ND region.

Table 3.1: Some social indicators of Niger Delta Region of Ondo state

Case study	Life Expectancy F/M	Education Index	GDP Index	Infant mortality/1000	Accessibility to electricity	Accessibility to afe drinking water	Mortality rate under 5 /1000 F&M
Rural area in Ondo state NDR	47.9/(F) 46.8/(M)	0.575	0.512	120	34% of population	31% of population	206

(Source: Paul & Shonali, 2008)

The level of poverty in the region is manifested clearly in inadequate social infrastructure services. This has worsened people's access to fundamental basic social amenities such as, safe drinking water, sanitation, health, family welfare, rural electrification, rural schooling and training institutions, as well as suitable housing fit for human habitation. The supply of water and electricity is undependable. Teachers and health care providers have become demoralized to the point where some health centers and public schools have simply been abandoned. Social services in the form of education, health and recreation and physical infrastructure such as roads, electricity, water, sewers are poor everywhere (United Nations Development Programme, 2006). Stated more directly, infrastructure underdevelopment is the poverty signpost of the Nigerian ND region.

The infrastructural needs of the ND region are enormous and contentious; from rural roads, railways and harbours to irrigation systems, telecommunications, clean water, sanitation, energy and such basic social infrastructure as health, education, banking and commercial services. Given that investment capital is scarce and living standards are low, what should be the balance between consumption and investment? Should priority be given to public works or productive activities, these two sectors are referred to as SOC and DPA. This concern necessitated this write-up. The core physical infrastructure and infrastructure services addressed in this paper – namely roads, electricity, health care centres, water supply, schools and communications are foundational for Nigeria's future, not only for economic growth, but for achieving virtually all of the goals of a poverty-oriented approach to development. While infrastructure contributes to economic growth, this paper identifies greater importance of infrastructure to the input of human development. The Nigerian government-sponsored development agency established with the sole mandate of fostering rapid development in the Niger Delta region of Nigeria is called Niger Delta Development Commission (NDDC). The NDDC launched the Niger Delta Regional Development Master Plan that focuses on two goals: poverty alleviation and economic growth in the region (Niger Delta Development Commission, 2006). This paper aims to provide an investment methodology to the management of NDDC during early phase of infrastructure planning and development in the ND region, with a view of improving human capacity in the region.

RESEARCH METHODOLOGY

The paper concentrates on Ilepete community; one of the communities in the ND region. The area became the author's choice because the concentration in this community tends to give a better data and results compared to scanty data from other communities in the ND region. More importantly, because there is a government agency responsible for infrastructure development of the ND region. Moreover, the paper attempted questions that included; can consensus building contribute usefully to infrastructure planning? what priority do ND people give to SOC and DPA? can photovoice be used as a method for eliciting community people's preference as regards SOC and DPA? To examine the study questions, it was necessary to apply the concept to a real infrastructure planning process that necessitated the use of a case study approach.

A qualitative method such as semi-structured interview was used to gain in-depth understanding of the participants and therefore was considered appropriate for elicitng preference between SOC and DPA, which is necessary for effective infrastructure planning.

An adaptation of photovoice methodology was employed in this paper. It is an innovative and engaging method of primary data collection. Participants take photographs of community concerns about agreed themes. The methodology combined photography with grassroots social action. It is mostly used in the field of community development, public health, and education (Claudia, 2008). The method allows researchers and policy makers to understand fully and identify the scope of the case study not captured through quantitative measures (Claudia, 2008). The sample size was based on purposive sampling technique because the methodology required adults to handle cameras that were used for the data collection and to participate in the interview survey. The paper specified between the age bracket of twenty to sixty years for participants which was established through a pilot questionnaire survey. Based on that, fifty seven participants were first selected and subdivided into eight groups. They were asked to take photographs in the community that describe the following themes; their living standards, specifically to cover availability and accessibility to; health care services, education, transportation, electricity and water supply including housing. The photos were copied onto a compact disc for coding and analysis. All photos were given a code according to the visual themes described by the participants.The paper's methodology further adapts that of (Claudia, 2008) in that, photographs taken by the participants were used to conduct the semi structured interview in order to identify interests and opinions. The purpose of the semi structured interview was both explanatory and exploratory. The interview sought information and opinions about infrastructure development and the planning processes.

FINDINGS AND DISCUSSION

The data used was collected from both primary and secondary sources. The extensive survey of the literature pertaining to the ND region indicates the deplorable state of social infrastructure in the region.

The findings from the photovoice methodology revealed the deplorable state of infrastructure facilities and abysmal social status of the ND people; this corroborates the findings of (United Nations Development Programme, 2006) and (Paul & Shonali 2008). The findings of the photovoice interview analyses indicate that the available social infrastructures in the ND region are inadequate, unavailable and poor quality, from water to telecommunication. The participants' photos from photos 4.1 to 4.5 below indicate that housing can generally be described as being in a poor state. Health and educational facilities are in shabby conditions while electricity supply and portable water supply facilities are not available in some rural areas in the region. The photovoice interview also revealed that one primary school serves every two settlements which is about 14 square kilometres while one secondary school serves every seven settlements which is about 55 square kilometres.

Photo 4.1: A structure for habitation in the rural area of Ondo state NDR

Photo 4.2: One of the Methods of Waste Disposal in the rural area of Ondo state NDR

Photo 4.3: Some rural people queuing up for medical outreach in Rural Area of Ondo state NDR

Photo 4.4 A typical primary school classroom in in Rural Area of Ondo state NDR

Photo 4.5 Basic river transport, but may cost N1,200 (US$10) per trip from the village to the nearest town

The photos 4.1 to 4.5 reflected that the majority of communities living in isolated areas lack the most basic modern medical care. Furthermore, across the ND region, nearly all school facilities are in a state of extreme disrepair requiring major rehabilitation. The secondary school system has been seriously afflicted by shortages of quality teachers; a regional pattern that is becoming increasingly acute due in large part to discordance between investments in infrastructure outside a well – coordinated planning process; revealing the immense challenge to development and provision of social amenities for sustainable livelihoods.

CONCLUSION AND FURTHER RESEARCH

The holistic investment methodology demonstrated in this paper emphasizes the positive relationships between infrastructure and human development which are often less recognized.The importance of a consensus building approach has proven well to improve infrastructure planning especially during its developmental stage. The unbalanced growth concept analysed in this paper purposely to indicate investment priority in infrastructure planning is necessary for scarce resources to be economically as well as efficiently utilized. Also, not only to break out of underdevelopment, but more importantly to be on the path of sustained growth. SOC is being argued over direct productive activities (DPA), for the purpose of creating an appealing and a healthy society in Ilepete community; one of the communities in Nigerian ND region as the main priority and prerequisite before embarking on direct productive activities (DPA) projects in the region. The availability of SOC like water supply, primary and reproductive health and basic education facilities, electrification would stimulate both domestic and foreign investments in projects like skill acquisition centers, manufacturing industries and railway transportation among others. The provision of some SOC is indeed a pre-requisite for investment in DPA. However, the author would like to indicate that the paper did not highlight the order of priority of the identified social overhead capital projects during developmental stage; this important area needs further research.

RECOMMENDATION

By a way of recommendation, the author is of the viewpoint that the provision of these SOC should be provided by the government or public enterprises due to the fact that infrastructure is not generally suitable for private investment because of the magnitude of capital requirement, the long gestation period and the high risks involved. Furthermore, the profit-seeking objective of private enterprises may not suit the multifaceted nature of infrastructure. However, exclusion of private enterprises may not be absolutely realistic in this case study, in case of inclusion of private investment in the provision of SOC in the ND region, certain regulations should be put in place to protect the public welfare. The paper's concept is recommended for Local/Regional Governments, State Governments as well as National and International donors.

ACKNOWLEDGEMENTS

The author acknowledges the supervisor, Prof. Tatshuiko Ikeda of Infrastructure Management Department, Yokohama National University in Japan. Also, the author appreciates the Joint Japan World Bank Graduate Scholarship Program (JJWBGSP) for sponsoring the Master's degree programme in Japan.

REFERENCES

Andrew M., (2012), Social Conditions of Sri Lanka, viewed 21 January 2013, <https://sites.google.com/a/tcd.ie/sri-lanka/home>

Akatsuka, Y., & Tsuneaki, Y., (1999), 'Systems for Infrastructure Development, Japan's Experience', Tokyo: Japan International Cooperation Publishing Co., Ltd.

Claudia, L.B. (2008), 'Integrating Values and Interests in Water Planning using a Consensus-building Approach', Unpublished PhD thesis, Brisbane: University of Queensland.

Directorate of Institutional Finance and Sanket (2007), 'Infrastructure and Human Development in Madhya Pradesh', Madhya Pradesh: Oxford University Press.

Familoni, D. K., (2008), 'The role of economic and social infrastructure in economic development: A global view, viewed 30 December 2012, <http://www.academia.edu/1566979/THE_ROLE_OF_ECONOMIC_AND_SOCIAL_INFRASTRUCTURE_IN_ECONOMIC_DEVELOPMENT_A_GLOBAL_VIEW_>

Jain, T. R., & Ohri, V.K., (2007), 'Development Economics', New Delhi: VK Publications.

Micheal, R.T., (2007), 'Beating Africa's Poverty by investing in Africa's Agriculture', The Partnership to cut hunger and Poverty in Africa, Washington D.C., pp.1-20.

Paul, F., & Shonali S., (2008), Niger Delta Social and Conflict Analysis, Washington D.C.: The World Bank.

United Nations Children's Fund, (2012), Sri Lanka Briefing sheet, water, sanitation and Hygiene, United Nations Children's Fund.

United Nations Development Programme, (2006), 'Niger Delta Human Development Report', Abuja: United Nations Development Programme.

Journal of Construction Project Management and Innovation Vol. 3 (1): 573-588, 2013
ISSN 2223-7852

CONCEPTUALIZING THE LIVEABLE AFRICAN CITY

Taibat Lawanson[1], Taofiki Salau[2], and Omoayena Yadua[3]

[1 2 3] University of Lagos, Akoka, Lagos, Nigeria
Email: tolawanson@gmail.com, salauti@gmail.com, yaduaomoh@yahoo.com

Abstract
This paper attempts to conceptualize the liveable African City using indices of liveability as advanced by Africans. The concepts of City Liveability and the City as a living system are used as the theoretical underpinnings to the study. A purposive online questionnaire survey of 453 Africans, living both in Africa and the Diaspora was conducted to elicit their perspectives on what they consider the most important indices for a Liveable African City. The data was disaggregated on locational basis. This was done to determine whether ones location i.e. living at home or in the Diaspora contributes significantly to one's opinion on the identified issues. Issues investigated include governance, safety and security, culture and global identity, environmental indices and infrastructure. Furthermore, the inherent contradictions between western and African concepts of liveability were examined. The study revealed that 67% of all respondents consider governance to be the most important determinant of city liveability. Cultural heritage and city image were considered the least important indices of urban liveability. In determining the choice of where to live, 82.2% of respondents consider quality of life, while few differentials existed based on location, safety and security, particularly violent crime and the threat of terror were considered extremely important by respondents living in the Diaspora. The study concludes by recommending the application of broad based urban management strategies combined with good urban governance mechanisms to improve city liveability across the continent.

Keywords: Liveability, Liveable city, Africa, Governance, Poverty, Quality of life

INTRODUCTION

Partners for Liveable Communities (2002) define liveability as the sum of the factors that add up to a community's quality of life including the built and natural environments, economic prosperity, social stability and equity, educational opportunity, and cultural, entertainment and recreation possibilities.

According to the City of Vancouver (2003), Liveability refers to an urban system that contributes to the physical, social and mental well being and personal development of all its inhabitants. It is about delightful and desirable urban spaces that offer and reflect cultural and sacred enrichment.

The Economist Intelligence Unit (2012) defines the concept of liveability as an assessment of which locations around the world provide the best or the worst living conditions. However, assessment rankings are largely subjective. Quality of life might refer to a citizen's satisfaction with residential environments, traffic, crime rate, employment opportunities, or the amount of open space (Myers, 1988). Alternatively, the phrase might refer to less tangible qualities such as freedom of expression and social justice (Land, 1996). According to Ling, Hamilton and Thomas (2007), liveability for some people is intrinsically tied to physical amenities such as parks and green space, while for others to cultural offerings, career opportunities, economic dynamism, or some degree of reasonable safety within which to raise a family. This paper therefore considers the perceptions of Africans with regards to urban liveability in Africa.

Various liveability rankings exist and the most popular are the Mercer Quality of Living Survey and the Economist Intelligence Unit (EIU) Global Liveability Report. The Economists Ranking is based on a survey of 140 cities in which every city is assigned a rating of relative comfort for over 30 qualitative and quantitative factors across five broad categories: stability; healthcare; culture and environment; education; and infrastructure. Mercer 2011 survey evaluates local living conditions in 220 cities according to 39 factors, grouped into 10 categories namely Political and social environment, Economic environment, Socio-cultural environment, Health, Schools and education (standard and availability of international schools, Public services and Recreation, Consumer , Housing and Natural environment. Some rankings include humidity and comfort level of international travellers and expatriate workers as well as availability of international schools and night life (EIU, 2012).

Mercer conducts the surveys to help governments and multi-national companies compensate employees fairly when placing them on international assignments and uses New York City as a benchmark while the Economists surveys have been criticised as being anglocentric (New York Times, 2010).

In the 2011 Mercer Quality of Living Survey, only three African cities namely; Port Louis in Mauritius, Cape Town and Johannesburg in South Africa fall into the top 100 liveable cities, while there are 18 African cities in the bottom 25. The Economists 2012 Liveability Report ranks Lagos 138th of the 140 cities ahead from the rear to other African Countries like Nairobi, (124), Lusaka, (126), Dakar,(129), Abidjan, (131) Douala,(133) and Harare (137). African cities score poorly on these rankings that are obviously skewed towards western concepts of what is pleasant and acceptable urban living. They do not take into consideration the differences in culture and environment of the various cities considered and also the concept of the City as a Living System which responds to both internal and external change as are synonymous to that of living organisms.

According to Ling, Hamilton and Thomas (2007), crucial to the well-being of communities is their resilience, their stability and their future. These need to be defined and continually refined by each community embedded in a dynamic planning process. Castellati (1997) opines that 'Liveability means we experience ourselves as real persons in the city'. Southworth(2007) also considers liveability as a concept to be a determinant of how well the city works for her inhabitants. Hence the raison d'être of this study is to answer the following questions - What issues are at the core of the African concept of liveability? What are the most important indices necessary for achieving urban liveability from an African perspective? Does being resident in Africa or abroad present any significant difference of opinion?

THE CITY AS A LIVING ORGANISM

The Twenty First Century city is made up of complex systems that are analogous to living organisms.

Literature reveals that the evolution of city structure has undergone various transitions to a situation where cities have all the sub-systems that are needed by living organisms (Mitchelle, 2007; Hanczyc, 2011; Lakhina, 2011; Gershenson, 2011 and Weinstock, 2011).

The concept of the City as a Living Organism serves as a powerful conceptual framework for the Liveability debate. It enables the examination of different critical components from the liveable city standpoint and at the same time focuses attention on the interdependence of these components in the quest to achieve holistic development of the urban system. According to Cools (1997), the city must be seen as a living organism in which balance must be maintained in order to function properly. Timmer and Seymoar (2006), in designing a Liveable Vancouver, compare the city to the living organism and according to them, the brain and nervous system refer to the governance structures, the heart refers to the city spirit and place identifiers, the different organs are the residential, industrial, open spaces and other hubs while the circulatory systems refer to the transportation routes and nodes and infrastructure networks as shown in Table 1.

Table 1: The Liveable City as a Living Organism

Liveable City Metaphor	**Components**	**Description**
The brain and nervous system	Governance and Participation Monitoring, Measuring, Learning	A liveable city engages the active involvement of a diversity of citizens in visioning, planning, implementing and monitoring regional plans and place-based solutions to challenges. The monitoring capability of a liveable city is equivalent to the nervous system in a living organism. A liveable city develops the capability to measure progress towards its goals, to encourage experimentation and test new ideas, to learn from experience, to adapt strategies in order to take into account dynamic circumstances and shifting priorities, and to quickly respond to opportunities and challenges.
The heart	Common Values, a Sense of Identity and Place	A liveable city contains an active public realm for reflecting the essence of itself, for creating and reinforcing a common identity, for dialogue about common values, for remembering history, for celebration and festivals, and for socialization of children and young people.
The organs	Complete Communities, Vital Downtown Core, Industrial Clusters, Green Space	A liveable city contains complete communities with mixed-use and affordable housing close to shopping, employment, cultural centres and pedestrian-friendly transportation networks; a vital downtown core with public spaces and economic activity; industrial clusters with shared infrastructure; and green space including agricultural lands and parks.
The circulatory	Natural Resource	A liveable city is connected through the flow of resources that

system	Flows, Green Corridors, Energy Grids, Communication, Transportation	sustain its activities including water, materials, sewage, and waste; through access to energy resources; through green corridors for biodiversity habitat and recreation; through access to the communication systems including information and communication technologies; through a transportation network that prioritizes walking, public transportation and efficient movement of goods.

(Source: Timmer & Seymoar, 2006)

Similar to the concept of Liveability is that of Sustainability, though according to Evans (2002)0 and Girardet (2004) liveability and sustainability are intimately connected, but are not the same. According to Idrus et al, (2008), the liveable city as a healthy, safe, economically growing, and socially, culturally and politically vibrant entity within its green ambience captures the essence of a sustainable city. A Sustainable city enables all its citizens to meet their own needs and to enhance their well being without degrading the natural world or the lives of other people, now or in the future (Habitat Agenda, 1996).

In comparing the liveable and sustainable city concepts, Douglass et al. (2004) maintain that a liveable city concept is more human centred as against the sustainable city which seeks to protect the environment. This can be interpreted to mean that the liveable city focuses on quality of life while the sustainable city focuses on quality of environment. Other studies on city liveability include those of McGee 1971; Salzano, 1997; Casellati 1997; Girardet, 1999; Leung 2004; Eastaway & Stoa, 2004; Abdul Aziz and Hadi (2007), Idrus, Shah and Mohamed, (2007) and Oktay (2012).

This study disaggregates issues of liveability on the basis of the conceptual framework discussed and sees the city as a living organism which is dynamic and continually recreates itself for the benefit of her citizens.

METHODS

This study adopted a survey design. A purposive online questionnaire survey of 453 Africans, living both in Africa and the Diaspora was done to elicit their perspectives on what they consider the most important indices for a Liveable African City.

UN Habitat (2010) states that a healthy, well-educated population is a major asset for any city, and knowledge is a prerequisite for enhanced civic participation in the social, political and cultural spheres. As such the target population for the study were people with at least a university degree. This was done to narrow down the respondents' pool to only those with an understanding of issues of sustainability and liveability. Majority of the respondents are professionals working in built environment disciplines, financial and professional services, education and information technology.

Data was disaggregated on locational basis. This was done to determine whether one's location i.e. living on the African continent or in the Diaspora contributes significantly to one's opinion on the identified issues. Five point Likert scale was designed to enable respondents choose in order of importance those issues that are germane to their perceptions of city liveability. The variables were developed from the Conceptual Framework and delineated based on the metaphors for the liveable city. Issues investigated include governance representing the brain and nervous system of the city , safety and security as well as cultural identity and global relevance representing the heart of the city , environmental indices and infrastructure representing the organs and circulatory system of the city. Furthermore, qualitative analyses of the perceived contradictions between Western and African concepts of liveability were carried out.

Data was analysed with simple descriptive statistics and presented with tables and graphs. Chi square tests were also done to determine if significant differences exist between the opinion of respondents living on the continent and those in the diaspora.

FINDINGS AND DISCUSSION

Profile of Respondents

Four hundred and fifty three (453) respondents from 15 African countries were sampled. Countries of origin for the respondents include Burkina Faso, Cameroon, Egypt, Ethiopia, the Gambia, Ghana, Kenya, Mali, Namibia, Nigeria, Sierra Leone, South Africa, Tanzania, Uganda and Zambia. 71.6% are resident on the African continent while 28.4% are resident

abroad. Those living abroad are resident in Australia, Canada, England, France, Italy, Jordan, Malaysia, the Netherlands, Spain and United States of America.

Sixty four (64%) of respondents were male, while 36% were female. Age distribution of the respondents was between 16 and 34 (41.8%), 35 and 44 (30.7%), 45 and 54 (20.9%). About 6.7% of the respondents were older than 54years old. 32.4% of the respondents have a first degree, while 67.6% have higher degrees. Majority of the respondents are professionals working in built environment disciplines, financial and professional services, education and information technology.

Perceptions of City Liveability

When asked what they perceived as the most important indices of city liveability, 67% of respondents chose governace, while 18.7%, 8% and 5% considered infrastructure, safety and environmental sustainability respectively as being important. It was interesting to note that among those residing in Africa 65% consided governance while 71% of those resident broad considered this to be important.

To 82% of respondents, the quality of life is the most important issue when selecting where to live, followed by safety (8%) and cost of living (7.8%). Nearness to kin and environmental friendliness were negligible considerations. Quality of life in this context refers to the state of social wellbeing of an individual or group, either perceived or as identified by observable indicators (Pacione, 2005). Indicators include security, health, education, work and social ties as highlighted by Marans and Stimson, 2011. Among those resident in Africa, quality of life was the most important determinant of choice of where to live for 80%, while 10% considered safety to be most important compared to only 3% of those resident abroad. However, cost of living is a stronger determinant of choice of residence for those living abroad (9.3%) than for those on the continent (6.1%). This may be because of the stronger kin networks which offer support structures that are prevalent in the African cultural context.

For the respondent's resident in Africa, the issues that have the most impact on Africa's liveability ranking are poverty (73.2%), economy (8%), governance (6%), and corruption (5%). Other issues include migration, regional conflicts and population dynamics which have negligible impact. Infrastructure, which most African governments consider as essential indices of development, was considered important by less than 1% of all respondents. For those residing abroad, 76% of respondents consider poverty to be the single most important issue impacting on Africa's liveability rankings. The economy, governance and corruption only have negligible impact, with 7% each of the respondents considering them as having some impact on the liveability rankings of African cities.

Governance as a Determinant of Urban Liveability

The variables considered in this section were Democratic Governance structure, political stability, citizen participation and government accountability as well as pro-poor governance policies. Respondents were required to choose which they considered to be essential to African liveability in order of importance.

For both groups of respondents, the most important governance variables for achieving urban liveability in Africa are government accountability, political stability and citizen participation. The respondents living abroad had stronger opinions concerning these issues as more of them considered the variables to be extremely important. 29.8% of those living in Africa consider democratic governance to be extremely important, compared to 39.1% of those abroad. This disparity was also reflected in the opinions concerning Political stability (44.1% Africa - 59% Diaspora) and citizen participation (32.3% Africa - 48.4% Diaspora).

Government accountability was considered extremely important by 48% of both groups, while 27% of respondents in Africa and 29.8% of those abroad consider pro-poor governance policies to be extremely important for the achievement of urban liveability in Africa

The relationship between location of the respondents (whether within the African continent and in Diaspora) and their perceptions of governance variables is further corroborated by chi-square tests as shown in Table 2 below.

The table shows that there are significant differences in the perceptions of citizen participation, pro-poor governance and government accountability. Conversely, insignificant differences exist in democratic governance structures and political stability perceptions with significance level of 0.05. It can therefore be concluded that opinions concerning the importance of democratic governance structure and political stability are a function of location.

Table 2: Chi Square Test for Location and Governance Perceptions of Respondents

Variable	Chi Square Value	Degree of Freedom	Level of Significance	Comment
Democratic Governance Structure	10.021	4	.040	Not Significant
Political Stability	12.369	4	.015	Not Significant
Citizen Participation	5.864	4	.210	Significant
Pro Poor Governance Policies	3.214	4	.523	Significant
Government Accountability	6.049	4	.196	Significant

Safety and Security as Determinants of Urban Liveability

The issues discussed with regards to urban safety and security is the prevalence of petty and violent crime, terrorism threats, and the importance of an effective policing system. The issues considered most important in order of intensity for both groups are threat of violent crime, terror and presence of an effective policing system. While 59.6% of those in Africa considered the threat of violent crime to be extremely important, 79.7% of those in the Diaspora held the same opinion. The higher value reported for those in the Diaspora may be because of the growing incidents of xenophobia around the world (DisGiusto and Jolly, 2009; Crush and Ramachandran, 2009; . 42.2% of respondents in the diaspora consider tolerance of foreigners as being extremely important, compared to 26.1% of those living in Africa. The threat of terror being an index of urban liveability was considered extremely important by 53% of all respondents. 8% of those living in Africa do not see this as important while less than 1% of those living abroad share a similar sentiment. Among those living abroad, the threat of terror is considered a higher threat (56.2%) than petty crime (39.1%). An effective policing system is considered extremely important by 44.7% of respondents in Africa and 53.7% of respondents abroad.

The results of the Chi Square test are presented in Table 3 below. Significant differences exist with regards to location and perception of threat of terror, tolerance of foreigners and effective policing system at a significance level of 0.05. This shows that respondents' opinions concerning these issues are a function of location. The data confirms these as those living abroad tend to exhibit stronger opinions concerning the importance of the issue of security.

Table 3: Chi Square Test for Location and safety and Security Perceptions of Respondents

Variable	Chi Square Value	Degree of Freedom	Level of Significance	Comment
Threat of Petty Crime	11.298	4	.023	Not Significant
Threat of violent crime	10.467	4	.033	Not Significant
Threat of Terrorism	2.753	4	.600	Significant
Tolerance of Foreigners	7.601	4	.107	Significant
Effective Policing System	8.055	4	.858	Significant

Threat of petty crime and violent crime had insignificant values and this can be directly related to that of effective policing system which recorded a highly significant value of .858. the importance of an effective policing system makes the threat of crime negligible as these would be minimized significantly if the policing system is effective.

Environment and Infrastructure as Determinants of Urban Liveability

Respondents' opinions on how important the following variables are to urban liveability were examined. These include quality of housing, education, health care and public infrastructure, and quality of transport and telecommunication services. Environmental variables include susceptibility of the city to natural disasters and environmental hazards as well as the clemency of weather and respondents access to nature.

When asked what they considered the most important infrastructure in determining urban liveability, 67% of that resident in Africa considered quality of water and sanitation services, while75% of those living in the Diaspora considered same as shown in Figure 1 below. This was closely followed by quality of health (65.6%) and education facilities (60.93%) for those in the diaspora, while those on the African continent considered quality of health services (56.5%) and telecommunication facilities (50.1%) to be next in importance.

From the survey findings, 48.5% of respondents in Africa consider quality of educational facilities to be extremely important, while 54.68% of respondents in the diaspora consider the quality of telecommunication services to be a very important determinant of urban liveability.

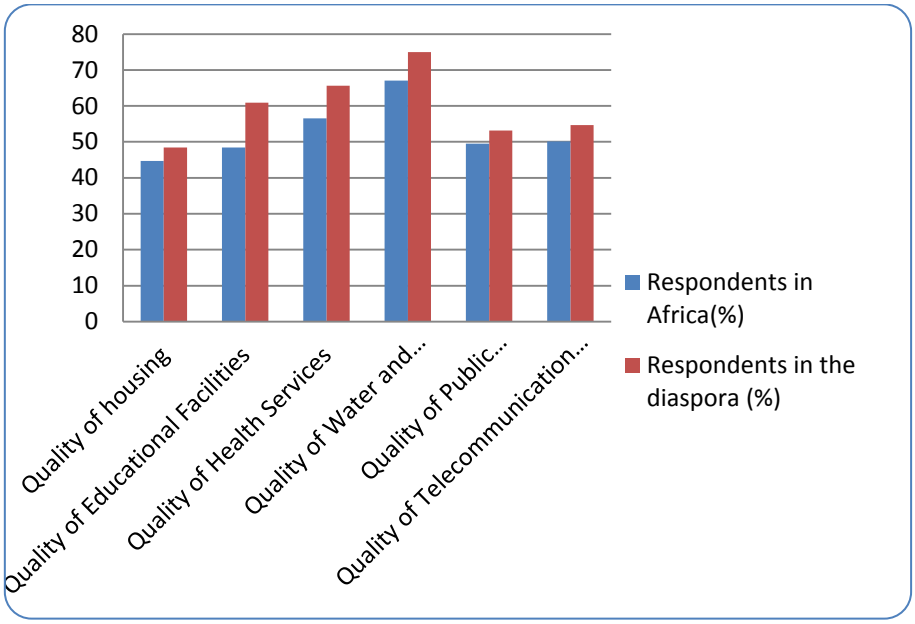


Figure 1: Respondents Perception of Quality of Infrastructure as Determinant of Urban Liveability

While 48.4% of respondents abroad and 44.72% of those in Africa consider quality of housing to be extremely important, 6.2% of respondents in Africa do not consider housing to be an important determinant of urban liveability. The quality of public transportation was also considered by 49% and 53% of Africans at home and abroad to be important in determining urban liveability.

Environmental variables also play an important part in the respondents' consideration of urban liveability. While 3% of respondents in Africa do not consider access to outdoor open spaces to be an important determinant of liveability, 29.8% do. 34.3% of those living in the Diaspora also share this opinion. Access to outdoor sports and recreation facilities is also considered important to 21% and 17% of respondents in Africa and abroad respectively. Significant chi square values were recorded for these variables as shown in Table 4 below.

Susceptibility of an area to natural disasters and extreme weather events were considered extremely important by 49% of all respondents. While susceptibility to natural disasters had an insignificant chi square value, threat of extreme weather event recorded a chi square value of 0.868. This may be because of the increasing frequency of storms, floods and other extreme weather events due to growing awareness of global warming and climate change.

Table 4: Chi Square Test for Location and Environmental Determinants of Liveability

Variable	Chi Square Value	Degree of Freedom	Level of Significance	Comment
Susceptibility to natural disasters	8.861	4	.065	Not Significant
Threat of extreme weather events	1.258	4	.868	Significant
Access to green spaces	1.629	4	.804	significant
Access to sports/ recreational facilities	1.730	4	.785	Significant
Family friendly urban facilities/ management	1.319	4	.858	Significant
Quality of housing facilities	6.344	4	.175	Significant
Quality of Educational Facilities	5.543	4	.236	Significant
Quality of Health Care Services	5.616	4	.230	Significant
Quality of Public Water and Sanitation Services	5.052	4	.282	Significant
Quality of Public transportation systems	3.653	4	.455	Significant
Quality of Telecommunication Services	7.444	4	.114	Significant

City Identity and Global Recognition and Determinants of Urban Liveability

The variables considered under this section are city identity and cultural heritage preservation, tolerance of foreigners and international travel linkages. Respondents held similar views on the average except for tolerance of foreigners which 42.2% of those living abroad considered extremely important compared to only 26% of respondents based in Africa. The importance of international financial linkage channels such as ease of money transfer were also highlighted by those in the diaspora (26.56%) compared to those in Africa (17.2%). Those living abroad prefer cities with international airports (29.6%), compared to those in Africa (26.7), albeit negligibly. For both groups of respondents, 25% considered religious freedoms to be important in their choice of preferred city.

African Perceptions of City Liveability

Though Africans' experience of poverty, lack of technological advancement, poor governance, corruption, poor service delivery, are common factors raised as the determining factors of city liveability in African city perception. Analysis of the responses shows that there exist some basic contradictions in the western and African perception of liveability of cities. Respondents cited cultural differences, differing spatial requirements, unequal household sizes, etc. Western concept of liveability appears more to be premised more on cities global relevance, the strength of institutional and democratic structures and freedom of choice. Africans view liveability however from the perspective of access to basic necessities of life and affordability, a perception formed from a long exposure to ineffective urban policies resulting in exclusion and slum development. African concept of liveability delves more on sustainability of life vis-a-vis access to basic necessities of life. Also while individuality and anonymity are preferred western city characteristics, Africans put greater value on good neighbourliness. Africans are communal, open and accommodating at the individual levels, western cities operate closed systems.

Some respondent's opinions of these contradictions are cited below:

- Western concepts of good urban form (urban modernism) do not fit well in Africa - in Africa I don't want to feel as if I am in any American city.
- The African concept of liveability is centred around community and interpersonal relationships while western concept is more geared towards individualism
- Africans are geared towards having a life that upholds culture and tradition whilst western country citizens regard technology and modernity
- I guess the current ideas in the West seem to conceive liveability more in global economic terms whereas in Africa (and perhaps Asia) the viewpoints lean more towards sociocultural wellbeing.

This survey has further revealed that concept of liveability in African perspective cannot be divorced from the realities of urban life in Africa as experienced by Africans both at home or the Diaspora.

Beyond the provision of social infrastructures, the African concept of liveability encourages the preservation of kinship and informal networks s opposed to the nucleated social structure of most western cultures.

The definition of a Liveable City from the standpoint of the respondents could be crystallized as follows:

- A liveable city is one that allows a citizen to thrive in all incomes, has equitable access to education, healthcare and housing as well as understand and utilize cultural differences to improve the quality of life for all citizens
- A liveable city is one that combines good infrastructures, good governance system, and feelings of oneness, standard security, job opportunities and a sense of belonging to an individual.
- A liveable city is one where you can have a reasonably easy access to all your daily requirements without having to forfeit your freedom or security.
- A liveable city is a place devoid of fear, and is secure, run by a relatively fair and just government with primary aim of people's welfare in mind.
- The city should have good governance through participatory processes, economic vibrancy, cultural and social diversity and equality.

CONCLUSION

This paper is a perception analysis on urban liveability . the study considered the opinions of people of African descent resiident in 13 african countreis and 10countries in the Diaspora. The study discovered that the most important indicex of urban liveability to those resident in Africa is governance, while for those resident abroad, the threat of violent attacks from terror. While both groups consider infrastructure to be an important index of urban liveability, religious freedoms, tolerance of foreigners and the preservation of cultural heritage were considered important. These issues are remarkably different from established Urban liveability rankings which are essentially an index of the most preferred locations for expatriates from developed countries, based on their cultural peculiarities. This research is an ongoing one. The next stage is to attempt a ranking schedule for African cities based on the major determinants highlighted.

REFERENCES

Abdul Aziz, N and Hadi, A (2007), 'Linking Urban Form to a Liveable City', Malaysian Journal of Environmental Management, Vol 8 (1) pp 101-122

Casselati, A. (1997). 'The Nature of Livability' in Lennard, SH et.al (eds). Making Cities Livable. International Making Cities Livable Conferences, California, USA: Godolier Press.

CitiesPLUS, (2003) A Sustainable Urban System: The Long-term Plan for Greater Vancouver. Vancouver, Canada

Cools, B. (1997) "The Future of the City" In Lennard, S. H., S von Ungern-Sternberg, H.L. Lennard, eds. Making Cities Livable. International Making Cities Livable Conferences. California, USA: Gondolier Press

Crush, J. and S. Ramachandran. (2009). "Xenophobia, International Migration, and Human Development." Human. Development Research Paper No. 47.

Douglass, M., Trung Q. L, Cameron K. L, Hao.T N, Pham. A. N, Thai N.D, & Yulinawati. H. (2004). The livability of mega-urban regions in Southeast Asia - Bangkok, Ho Chi Minh City, Jakarta and Manila compared. International Conference on The Growth Dynamics of Mega-Urban Regions in East and Southeast Asia, 24 - 25 June 2004, Singapore.

Eastaway, M.P. & Stoa, E. (2004). Dimensions of housing and urban sustainability, Journal of Housing and the Built Environment, Vol 19, pp1-5.

Economist Intelligence unit (2012) 'A Summary of the Liveability Ranking and Overview' www.eiu.com

Evans, P, ed. (2002). Livable Cities? Urban Struggles for Livelihood and Sustainability, California: University of California Press Ltd.

Gershenson, C. (2011).' Living in Living Cities', C3 Report 2011.09. http://arxiv.org/abs/1111.3659

Girardet, H. (1999). 'Creating Sustainable Cities', Devon, UK: Green Books for The Schumacher Society

Girardet, H. (2004). 'Cities people planet', liveable cities for a sustainable world. West Sussex, UK: John Wiley & Sons Ltd.

Hadi, A.S., S. Idrus, A.H.H. Shah and A.F. Mohamed, (2007). 'Shaping Livable Cities for Malaysia', In Modelling Local Sustainability: Developing a Conceptual Framework for Sustainable Development, Hadi, A.S., S. Idrus, A.H.H. Shah, A.F. Mohamed and N.M. Hamim (Eds.). LESTARI, Universiti Kebangsaan Malaysia, Bangi, pp: 11-18.

Hanczyc,M. (2011) 'The line between life and non-life', TED Videos, www.ted.com/talks/martin_hanczyc_the_line_between_life_a.

Hadi .I.S, Shah.A, Mohamed.A, (2008), 'Spatial Urban Metabolism For Livable City', In Proceedings Of Blueprints For Sustainable Infrastructure Conference. December 9-12, 2008. Auckland, New Zealand

Lakhina, (2011), 'Cities as living systems', The disaster library, http://www.disasterdiary.org/17/post/2011/11/cities-as-living-systems-by-shefali-j-lakhina.html

Land, K. (1996). 'Social indicators and the quality of life: Where do we stand in the mid-1990s?' SINET: Social Indicators Network News 45:5-8.

Leung, M.(2004), 'KCRC Linear City Research Project. Module 4.1: Precedents/International Examples', Final Report April 13, 2004

Ling,C, Hamiliton, J. and Thomas,K. (2007) What makes a city liveable? In http://crcresearch.org/case-studies/case-studies-sustainable-infrastructure/land-use-planning/what-makes-a-city-liveable

Marans.R. W and Stimson. R. J (Eds.) (2011), 'Investigating Quality of Urban Life: Theory, Methods and Empirical Research', Social Indicators Research Series, Volume 45, Springer, Dordrecht, pp. 453.

McGee, T. (1971) 'The Urbanization Process in The Third World' – Explorations in search of a Theory. 3rd edition. London: Bell & Hyman Limited

Mercer Human Resource Consulting (2011) 'Quality-of-Living Reports 2011' Information available: http://www.mercerhr.com

Mitchelle, (2007) 'Intelligent cities', Inaugural lecture of the UOC 2007-2008 Academic Year, uocpapers, e-journal of knowledge, iss. 5 (2007) | ISSN 1885-1541 http://uocpapers.uoc.edu

Myers, D. (1988). 'Building knowledge about quality of life for urban planning' Journal of the American Planning Association Vol 54, pp 347-358

New York Times (2010) 'The Best Place to Live?' New York Times May 27th 2010

Oktay, D. (2012)'Editorial: Quality of Life in Cities', Urban Design and Planning. Vol 165 (Issue DP 3)

Pacione M (2005) 'Urban Geography: a Global Perspective' Routledge Publishing and Co, New York, USA.

Partners for Livable Communities (2000) 'The Livable City: Revitalizing Urban Communities' New York: McGraw-Hill, Inc.

Salzano, E. (1997) 'Seven Aims for the Livable City' in Lennard, S. et.al (eds). Making Cities Livable. International Making Cities Livable Conferences, California: Godolier Press.

Southworth,M. (2007) 'Morphology of the Liveable City' , In: Urban Forms and Metropolitan Spaces April 2-3 2007, Roma, Università degli Studi di Roma Sapienza, Facoltà di Ingegneria, BERKELY .IT

Timmer, V. and Seymour, N. (2006), 'The Livable City'. The World Urban Forum 2006 – Vancouver Working Group Discussion Paper. International Centre for Sustainable Cities

United Nations Centre for Human Settlements (1996) 'Habitat Agenda- The Global Plan of Action' Adopted by the International Community at the Habitat II Conference in Istanbul, Turkey.

UN Habitat (2010) 'State of the World's Cities Report' 2010/2011', London: UNHABITAT

Weinstock, M. (2011), 'The Metabolism of the City: The Mathematics of Networks and Urban Surfaces' . Archit Design, Volume 81, Issue 4, pages 102–107 doi: 10.1002/ad.1275

Journal of Construction Project Management and Innovation Vol. 3 (1): 589-607, 2013
ISSN 2223-7852

APOPTOSIS IN CITY SYSTEMS: A BIOMIMETIC APPROACH TO CITY REGENERATION

Stephen Ajadi

College of Advanced and Professional Studies, Makurdi, Nigeria
Email: stephenajadi@gmail.com

Abstract
Over the past few years there have been a number of cases of large scale urban translocation, city division, and new formations of contemporary settlements in various parts of the world. An increase in the ubiquity of civil unrest around the world and mass uprisings are typical causes of these processes. This poses a serious threat to the efficacy of classical urban and architectural design strategies, and their motive. Since this is a new development which urban and architecture hardly anticipated, it is imperative to seek new ways to curb, manage or mitigate the proliferation of extemporaneous city mutations. The effort here is to employ chiefly the idea of biomimetics in an analytical juxtaposition of natural processes like apoptosis, pyknosis, karyorrhexis, and karyolysis with certain city processes and systems. The aim is to establish a new environmentally friendly motive for the disintegration and integration of settlements. Aided with streamlined programmatic principles, computational and algorithmic design, city systems are studied in an African context. The biomimetic approach to the study of city mutations is tailored to provide a design and management platform that attempts to predict and/or manage unanticipated shifts of settlements within city systems at various levels of urban and architectural schemes in West Africa, especially Nigeria.

Keywords: Apoptosis, Mutations, City Systems, Biomimetics, Settlements

INTRODUCTION

West African and in turn Nigerian landscape urbanism has reached a stage where one of the major problems facing planning and the proliferation of efficient and capable architectural design is the inability to effectively predict, recognise, compile, coordinate, and manage city systems.

One of a set of plausible reasons is the fact that city systems are being mutated at a more rapid rate than before. Societies prior to the independence period in Africa have been majorly rural (Alagbe, 2006). By the mid-20th century, most Africa countries began to gain independence from their colonial countries. This led to almost a quantum leap in the interface of the sociology and the economics of the countries (Alagbe, 2006). The rise of African cities was a major consequence. In the world today, the sporadic character of city systems remains almost the same while the scenarios continue to grow increasingly complex. New city systems are springing up in cities that do not have a planning and architecture platform that expects such developments. The extemporaneity of these systems makes the prediction and management of these city systems a tough task. As tough as the task seems; it is as well expedient. There is a strong imperative for the need to understand the extemporaneity of new city systems because their existence and activity increase the ambiguity of the African city.

There exists a highly inefficient state when planning and architecture cannot comprehensively describe into detail the behaviour of the city. If the behaviour of a system seems vague and unclear, then the improvement and maintenance of such a system will be more or less impossible. Knowing when and how to disintegrate or re-integrate a system or settlement becomes very difficult. This research has noticed that every city system has a cause; this cause can be another system which in turn exits by the effect or impact of another system. Increased migration flows have become a global trend (Castles 2009), for instance, intercity migration in West Africa is caused by certain city systems such as quality of education and employment while migration in and out of West African cities is due to (amongst many others) crisis migration issues, such as trafficking, international refugee flows and other irregular migration to Europe (Olsen, 2011). In the midst this current interplay and sporadic behaviour of city systems, one major factor that evokes the responsibility of the planner and the architect is the issue of housing. Housing is the frame work of settlements, because as the name implies, a settlement is a place where people settle. It is the nature of people to settle in shelter. The outlook of cities shows that a house is the modern paradigm of shelter. The research largely focuses on developing biomimetic strategies to predict, recognise, compile, coordinate, and manage city systems.

A set of city systems that are thought to be the most sporadic and volatile in Nigeria and some West African countries are analysed and studied. The primary developed strategy involves dissolving certain city settlements in a way that raises extremely little or no concerns about the economic, social strata, health and sustainability of the urban landscape. For this purpose a biomimetic methodology is also employed to produce a strategy by which a city can be 'put to death', decentralised or dissolved, by mimicking the micro but highly efficient process of apoptosis. Biomimicry can be applied to design in a number of levels (Biomimicry guild, 2007). They are as follows:

- Organism level (Mimicry of a specific organism)
- Behaviour level (Mimicry of how an organism behaves or relates to its larger context)
- Ecosystem level (Mimicry of an ecosystem)

The methodology engages biomimicry at the behaviour process mapping level, with this method, the process of apoptosis is super imposed on certain parameters of a dissolution strategy of city settlements. Paradoxically, the most important motive of the conclusive strategy is not to arrive at a final conclusive strategy, but make the strategy malleable and flexible to adapt to future developments in city systems.

CITY SYSTEMS

This research delineates city systems at two levels:

- The micro level: This is the level at which they are defined as definite or indefinite pattern or patterns of activity that progress through a city or a very similar settlement.
- The macro level: This is the level at which they are defined as definite or indefinite patterns of activity of a number of cities themselves through larger territories and regions. At the macro level, individual cities or group of cities become players or actors in the systemic process.

Just like the human body comprises of systems (e.g. digestive, reproductive, respiratory, e.tc.) the city also comprises of systems, but unlike the human body, the operation of city systems are largely difficult to fully define, and city systems often fade out and emerge with time as a city grows.

Examples of city systems include the movement of food, transportation of the working class, scarcity of fuel, variation of security, e.tc. With these examples it is logical to posit that the existence of some city systems largely depend the on the existence of other city systems, in other words, while some city systems are independent, some are dependent and inter connected. Some city systems may have a conspicuous character in terms of their presence and mostly in terms of their operation. Some other systems remain 'off -the-grid' and furtive. The characters of city systems also vary in terms of their stability and the formality of their proliferation, some city systems emerge gradually and eventually disappear gradually; some progress in a very predictable pattern (e.g. the transportation of working class) with little deviations while some are extremely Brownian in motion. This research has designated the term 'player' to describe the functional drivers of a city system. A typical system has a player or a set of players. This can be described as the factor that makes a system come to life. Players are like the verbs of a city system, that is, they induce the functioning of the system. For instance, when the transportation of the working class population of city is defined as a city system, a number of the major players that will animate such a system will include vehicles, roads, and the working class population. Tracking the behaviour and patterns of these players produce a better understanding of a city system.

SELECTED CITY SYSTEMS

This research is to try to investigate and identify processes and patterns of delineating city systems in Nigeria (while other city systems in West Africa may be similar). As a set of city systems are selected for consideration and evaluation in this research endeavour, the criteria and method for selection depends on the aim to grasp the urbanism of the Nigerian city in an efficiently holistic way. The selected systems contain players that affect a large array of other city systems across the country (see table 1 and 2)

MUTATIONS IN CITY SYSTEMS

A mutation in a city system can be defined as a break (either sudden or gradual) in the usual developmental process of a city and the operation and performance of its systems. With an understanding of city systems and their players, it is necessary to know how city systems change or mutate and the factors that affect or catalyze such changes.

One of the primary objectives of this research is to understand how systems affect each other. Systems change based on time and policies (Ajadi, 2012; Fletcher, 2009).

Time Induced Mutations

This can be described as a 'natural process' though it can also be argued that it is in no way linked to nature since it borders on human behaviour. It is a process that has an autopoietic character. History is a tool that allows the analysis of city systems from the stand point of time (Fletcher, 2009). Many changes on cities and their systems can be traced to time, e.g. natural disasters, over population and global warming. These systems in turn initiate a chain reaction leading to a wide array of mutation scenarios.

Policy Induced Mutations

This can further be dichotomised into formal policies and informal policies. Formal policies are results of an organized and accepted political management. These policies influence all human related city systems as they initiate laws that control and restrict human behaviour. Informal policies are policies that exist based on the reaction of the inhabitants of a settlement to time and formal policies. There are cases where such informal cases go against the formal policies and sometimes lead to civil unrest (Adagba et al., 2012; James, 2012). Developments that arise from informal policies are also effective in mutating city systems. A common character of informal policies is that they are often championed by a section of a settlement and are usually short lived, as they eventually submit to the formal policies. However there are some instances where the informal and formal policies come to a middle ground. Based on recent events around the world, some informal policies have been noticed to subdue and overpower the formal policies governing their settlements. Examples include the uprisings of African states like Libya, and Egypt, with drastic city system mutations taking place in cities like Cairo and Tripoli.

Table 1. Selected City Systems

City system	Primary players	Character/effects of mutation
Fluctuation of Urban Security	Politics, Religion, and Poverty	When the level of security in a city/settlement fluctuates, it triggers the activation of other city systems like emigration and immigration which are also primary systems to secondary systems like population shuffle, and transportation costs.

Table 2. Further selected City Systems

City system	Primary players	Character/effects of mutation
Flood as a Population Mixer	Weather, Climate, Land, and Housing	This is a very important city system in this region of Africa as it involves very environmentally influential players like storm surges and consequent flooding, changes in disease vectors, and drought. Many of these players have an implication that significantly exceeds the coast and sometimes threaten the already vitrified national economies.
The Housing System	Security, Food, Transportation, Income levels	Housing affects the absorption capabilities of cities during migration and emigration; this might lead to the implosion of people in an over-stretched housing system. This raises primarily, health and security concerns. In Nigeria for example, the inadequacies of housing are due to different combinations of reasons across the country (Ibidun, 2009). The cost and affordability of housing has also been proved to be a major reason for the inadequacy of housing in Nigeria (Ibidun, 2009; Alagbe, 2006).
Migrations of Critical Population Groups	Social class and economy standards	This system is also a dominant player in almost all other city systems as the climax of any shift in the central process of a city is often manifested as the movement of people. Research on West African migration has tended to focus on specific 'crisis migration' issues (Irit, 2001). However the migration of certain population groups irrespective of scenario should also be considered important. This is one of the most important determining factors to predict, and manage when re-planning an urban landscape as its effect is felt in areas of the urban fabric that include anthropology, sociology, economics, and demographic growth.
Food and Market Flow	Agriculture and Economy standards	Food is a major need of man; therefore its dynamics in the environment can strongly determine mass human behaviour as man naturally seeks a condition of cheap and affordable access to food. Access to food is largely characterized by a market, so market dynamics on the other hand is a system player that characterizes food availability as shown in figure 1.
Politics	Policies	In the course of urban and architectural planning, it is absolutely imperative that the planner and the architect must be at least a spectator of politics (Ajadi, 2012). Politics controls and ultimately determines the activity and outcome of almost all other city systems since it acts on policies which use the law as an induced tool for controlling the management of a whole system of settlement.
Death and Birth of Settlements	Most other City Systems	The death and birth of settlements are known to 'naturally' occur based on the developmental and morphological pace of the sociological environment in which they perform (Ajadi, 2012). Systems often responsible for such death are usually

		terminal systems like food, availability of shelter and security. Some systems trigger the malfunction of other systems which in turn lead to a birth or a death of a settlement.

(Source: Ajadi, 2012)

THE PROCESS OF APOPTOSIS

Apoptosis is the process of programmed cell death (PCD) that may occur in multicellular organisms (Raffray & Gerald, 1997). Biochemical events lead to characteristic cell change in morphology and eventually death (Green & Douglas, 2011). These changes include blebbing (scarring of the cell surface), cell shrinkage, nuclear fragmentation, chromatin condensation, and chromosomal DNA fragmentation. Research shows that between 50 and 70 billion cells die each day due to apoptosis in the average human adult (Karam & Jose, 2009). The process of apoptosis is controlled by a diverse range of cell signals, which may originate either extracellularly (via extrinsic inducers) or intracellularly (via intrinsic inducers) (Karam & Jose, 2009). Extracellular signals may include a range of inducers form hormones to growth factors. These signals may positively (activate) or negatively (repress) affect apoptosis. It must be noted that a cell initiates intracellular apoptotic signalling in response to a stress, which may bring about cell suicide. Enzymes activate the apoptosis process with each signal resulting in the activation of another enzyme or process that in turn is another signal until finally the cell dies or sometimes the process abruptly ends when the cell no longer needs to die (Karam & Jose, 2009). Whether by an intrinsic inducer or an extrinsic inducer the formal active process of apoptosis will be taken to begin with the production of caspases. This is triggered in the intrinsic pathway when cytochrome-c is released by the mitochondria which ultimately activate caspases (Green & Douglas, 2011). A cell undergoing apoptosis shows the following characteristic morphology (Santos et al., 2000):

- First stage involves cell shrinkage and rounding are shown because of the breakdown of the proteinaceous (protein component) cytoskeleton by caspases.
- The cytoplasm appears dense, and the organelles appear tightly packed.
- Condensation of Chromatin into compact sections against the nuclear envelope (membrane) in a process known as pyknosis.
- Nuclear membrane becomes discontinuous and the DNA inside it is fragmented in a process referred to as karyorrhexis.
- The cell membrane shows irregular buds known as blebs.

- As a result of the blebbing, the cell breaks apart into several vesicles called apoptotic bodies, which are then phagocytosed. (i.e. 'swallowed' by phagocytotic bodies, e.g. white blood cells)

Based on the process enumerated, it must be noted that most of the decisive stages of apoptosis originates from the nucleus which is 'centre' of the cell. The apoptotic bodies are picked up and engulfed by other cells called phagocytotic bodies.

THE PROCESS OF NECROSIS

Necrosis is a form of cell injury that results in the premature death of cells in living tissue (Proskuryakov, et al., 2003). Necrosis is caused by factors external to the cell or tissue, such as infection that result unregulated digestion of cell components. In contrast, apoptosis is a naturally occurring programmed and targeted cause of cellular death. While apoptosis often provides beneficial effects to the organism, necrosis is almost always detrimental and can be fatal (Kasper et al., 2001).The process of necrosis does not follow the signal transduction pathway that apoptosis does but rather various receptors are activated that result in the loss of the strength of the cell membrane and an uncontrolled release of products of cell death into the intracellular space (Proskuryakov, et al., 2003). In this scenario, nearby phagocytes are prevented from locating and engulfing the dead cells. This results in a build-up of dead tissue near the site of the cell death, which often calls for the removal of necrotic tissue surgically; this process is known as debridement. There are two broad pathways in which necrosis may occur in an organism (Raffray & Gerald, 1997).

Cell Death Pathway:

The cell death pathway initially involves oncosis, where swellings of the cells occur (Raffray & Gerald, 1997). The cell then proceeds to blebbing, and this is followed by pkynosis, in which nuclear shrinkage transpires (Raffray & Gerald, 1997). In the final step of this pathway the nucleus is dissolved into the cytoplasm, which is referred to as karyolysis (Raffray & Gerald, 1997).

Figure 1: Cell death pathway

(Source: Ajadi, 2012)

Secondary Necrosis Pathway:

This pathway occurs after apoptosis and budding (Raffray & Gerald, 1997). Cellular changes of necrosis occur in this secondary form of apoptosis; the nucleus breaks into fragments, this is called karyorrhexis (Raffray & Gerald, 1997).

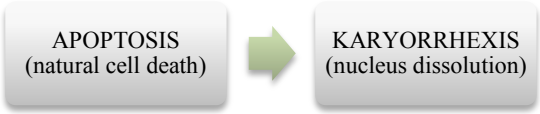


Figure 2: Secondary necrosis pathway

(Source: Ajadi, 2012)

RESEARCH METHODOLOGY

The aim is to apply the knowledge of city systems and their unique propensities for mutation to delineate and re-investigate the system of settlement integration and disintegration. This is done with an expectation of arriving at a method that will allow city systems and settlements to be integrated or disintegrated into the larger urban landscape with negligible or no negative impacts on the infrastructure, sociology, economics, health and security processes of the urban entity under consideration. The effort here is to employ chiefly the idea of biomimetics in an analytical juxtaposition and adaptation of the natural processes of apoptosis, with certain city processes and systems. Aided with streamlined programmatic principles, computational and algorithmic design, city systems are studied in an African context. The natural process of apoptosis is studied and super-imposed on a generic framework for disintegrating a settlement. This process is now combined with streamlined demographic algorithms to create a new idea that will drive further investigations of city system mutations and the integration and disintegration of settlements as a whole.

This method of investigation is adapted based on the identical characteristics of a cell and a settlement. Algorithmic and computational processes are also adopted to make the resulting outcome malleable and autopoietic, hermetic to a wide array of city system mutations that currently exist and that may arise in the future. It also helps in creating a system of parameters that will be very helpful in the advanced (computer aided) generative process of neighbourhood and city design, both from a planning and an architectural standpoint. The method employed seeks to create a platform for the proliferation of the idea of using biomimicry as a driving tool in investigating city system mutations, thereby effectively predicting, recognising, compiling, coordinating, and managing city systems.

THE BIOMIMETICS OF CITY INTEGRATION AND DISINTEGRATION

First of all, it will be helpful to understand the concept of biomimteics. Biomimetics or biomimcry is a scientific methodology that involves mimicking a natural process or phenomena and applying its benefits to other aspects of science and technology (Biomimicry guild, 2007). It can be basically put as the skillful plagerization of nature for the benefit of mankind. Here, a biomimetic apporach is employed to porvide a more sophisticated methodology of integrating and disintegrating a settlelement. The natural process of apoptosis and the bio-artificial process of necrosis are mimicked with an aim to establish an effective methodological platform for developing and co-ordinating urban startegies. The process of apoptosis is choosen becuase of its heirachial similarity with the city. The biological progression of complextiy can be convieneitly juxtaposed with the complexity progression of the settlements as seen in figure 3 below.

Figure 3: progression of complexity in cells and settlements

(Source: Ajadi, 2012)

As a cell is considered a settlement in this juxtapositive context, it will be helpful to delineate some key biomimteic interpretations of the cell with respect to a typical West African settlement. This creates a base for a streamlined specific vocabulary for the research methodology. Figure 6 illustrates primary interlinked nomenclatures for biomimetic comparism.

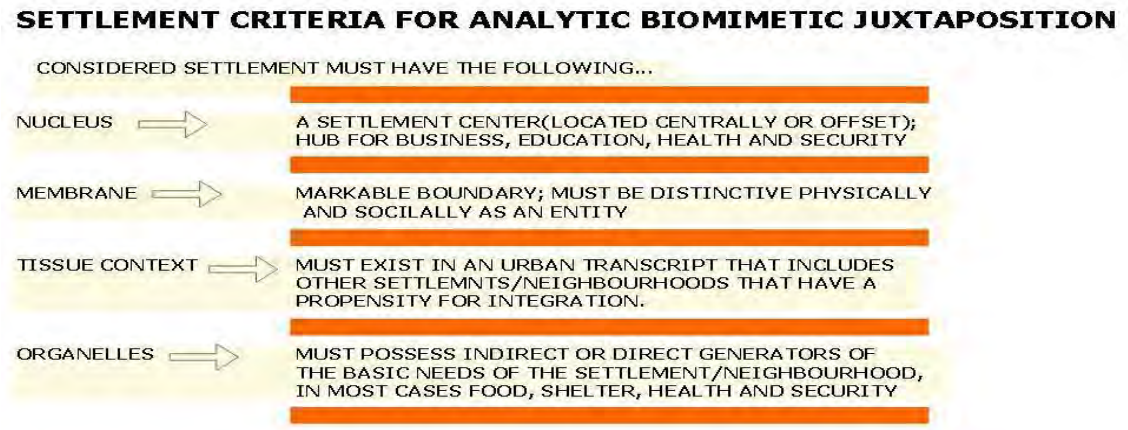


Figure 4: settlement criteria for analytic biomimetic juxtaposition

(Source: Ajadi, 2012)

AN APOPTOTIC SETTLEMENT DISINTEGRATION/INTEGRATION

Following the delineation of the natural process of apoptosis, an urban strategy is developed form the natural phenomena. This is done based on the interpretation of a series of processes that will now progress within the newly developed parameters and vocabulary of the biomimetic method. A biomimetic interpretation of the most essential strategies in this process is shown in Table 2. It is most imperative that the strategic framework is adapted to the dynamics of the city systems that are at play in the settlement region to be disintegrated. The process eventually leads to a grouping of the settlement into fragments or module sections. These sections should contain certain classes of people and city systems that are the needs of other settlements. For example a module section containing primary school teachers, primary schools, and paediatric clinics could be translocated to a settlement in need of more primary schools and health care.

Other factors to consider will be the family structure of the teachers as well as a keen look at the propensities for certain characteristics of the modules not to contradict certain city systems in the phagocytotic settlement e.g. religion and anthropological differences.

It is absolutely imperative that the urban strategy should be engaged based on a justified need for disintegration with respect to genuine extrinsic and intrinsic indicators of apoptosis; otherwise the process carried out may result in necrosis and ultimately a harmful shuffle of city systems.

Table 3.The Biomimetic Process of Apoptosis

	Biological Process	**Biomimetic Interpretation**
	Pre-Apoptotic Pathways	Pre-Disintegration Process
	Extrinsic Pathway:	External Initiator Process:
1	Some cytokines activate T-cells (Sun & Fink, 2007); FASL, (Fas lignand) a cytokine involved in cell death, TNF-related apoptosis inducing ligand (TRAIL), is also a cytokine that induces apoptosis.	Some external indicators justify an apoptotic disintegration of a settlement. Indicators may include, the master plan actualization, and city systems like security, land and housing, economic standards and politics.
2	The killer T-cell engages the cell to be disintegrated. A scenario with FASL involves death receptors clinging to it, connected to adaptor proteins that induce a recruitment of propase 8 that activates initiator caspase 8 which in turn activates effector caspase 3 (Sun & Fink, 2007).	External indicators are analyzed to establish a chain reaction comprising of strategic steps that importune the other steps. E.g. opening jobs in nearby settlements specifically for people in a selected settlement. A very safe psychological poise in the inhabitants of the settlement at this point should also be furtively initiated.
3	Caspase 3 cleaves other protein, the signal cascades within the cytoplasm.	The chain reaction strategy is allowed the benefit of a calculated time till demographic algorithms begin to indicate the willful emigration of people. If this is not achieved stage 2 should be reverted to.
	Intrinsic Pathway:	Internal Initiator Process:
4	Mitochondria releases cytochrome-c, Once cytochrome-c is released, it binds with Apoptotic protease activating factor - 1 (Apaf-1) and ATP, which then bind to pro-caspase-9 to create a protein complex known as an apoptosome. The apoptosome cleaves the pro-caspase to its active form of caspase-9, which in turn activates the effector caspase-3(Green & Douglas, 2011).	Respiration in a settlement is interpreted as the time based movement of people in and out of the settlement e.g. per day (Ajadi, 2010) People move in and out mainly to achieve means for their survival and hence the survival of the settlement. This process is adapted and re-engineered to establish a disintegration strategy that will lead to the result of stage 3. The strategy must be designed like a chain reaction sequence.
	APOPTOSIS PATHWAY	DISINTEGRATION PROCESS
5	Cell shrinkage due to the breakdown of the proteinaceous cytoskeleton by caspases. The cytoplasm appears dense, and the organelles appear tightly packed. Chromatin undergoes condensation into compact patches against the nuclear envelope in a process known as pyknosis (Santos et al., 2000).	All public branched parastatals begin to condense with respect to flexibility and priority; some exceptions may include police stations and some clinics. Settlement center condenses, expansion plans are gradually frozen. Scattered annexes are moved to nucleus cluster or out of the settlement.
6	The nucleus breaks into several discrete units due to the degradation of DNA .This is called karyorrhexis (Santos et al., 2000).	Gradual multiple dichotomization and fragmentation of sections of the settlement centre in order of dependence by the settlement. These fragments contain module

		sections of settlements comprising of different city system players and population classes. Neighbouring settlements are also analyzed and prepared for possible absorption of module sections.
7	The cell membrane shows irregular buds known as blebs. The cell breaks apart into several vesicles called apoptotic bodies, which are then phagocytosed (process called Phagocytosis) (Santos et al., 2000).	Module sections are gradually detached from parent settlement and grafted to new settlements (that will swallow them) according to their compatibilities and symbiotic factors.
		POST-DISINTEGRATION ANAYLSIS COMMENCES

(Source: Ajadi, 2012)

In order to more effectively track the behaviour of a number of city systems, some algorithms are theoretically developed with a bias for aiding in an easy indication of detecting extrinsic and intrinsic indicators that may justify the apoptosis of a settlement or a neighbourhood. Indicators depend on the master plan of the urban landscape and policies that are responsible for gradual or sudden shifts in certain urban behaviour including settlement dynamics.

Table 4. Delineation of parameters for intra-migration analyses

PARAMETER	NOTATION	NOTES
Original population	P_o	Original population of a settlement before shuffling.
New population	P_n	Momentary Population of a settlement after shuffling
Number of emigrants	N_e	Number of people(or life stock) moving out of settlement
Number of immigrants	N_i	Number of people(or life stock) moving into settlement
Original Working Class Population	W_o	Oringinal population of the working class population in a settlement before shuffling
New Working Class Population	W_n	Momentary Population of the working class population in a settlement after shuffling
Productive Emigration Index	P_{ei}	Difference between N_e and W_n
Productive Immigration Index	P_{ii}	Difference between N_i and W_n
Population Flux	$\sim P_x$	Relationship between P_o and P_n under a factor of 1.000

(Source: Ajadi, 2012)

Based on the above delineation, the momentary population of a settlement at any point in time after a population shuffle can be determined by:

Pn = Po - Ne + Ni ...(1) ; Pei and Pii values can be calculated as:

Pei = Ne - Wn ...(2); Pii = Ni - Wn ...(3)

Furthermore: ~Px = (Pn / Po) X 1.000; Net Emigration load: [(Ne - Wn)/(Po - Wn)]X 1.000 ...(4)

from ...(2) and ...(3) Ne =Pei + Wn ; Ni ==Pii + Wn therefore: Pn = Po - (Pei + Wn)+(Pii + Wn) ...(5)

~Px can also be expressed as: ~Px = [(Po + (Pei + Wn) +(Pii + Wn)) / Po] X 1.000 ...(6)

THE PATHOGENESIS OF FORCED SETTLEMENT DEMOLITION

This system can be likened to the bio-artificial process of necrosis. Unlike apoptosis, the necrotic process of eliminating a settlement destroys the settlement and makes it difficult or impossible for it to be absorbed by other settlements. Biomimetically, there is no is phagocytosis as the cell (settlement) is dissolved into the surrounding, that is,the institutional fragments of the settlement find no continuity in nearby (or other) settlements (see table 4 below).

Table 5. The Biomimetic Process of Necrosis

	BIOLOGICAL PROCESS	**BIOMIMETIC INTERPRETATION**
	Cell Death Pathway	Typical Elimination Process
1	Oncosis: swelling of the cell	The explosive growth of settlements is usually the signal indicator for urban necrosis. Most drastic measures are taken because of an explosion of population and housing.
2	Blebbing: Scarring/mutation of membrane	The boundaries of the settlement are demolished these are the regions of the neighbourhood or settlement that continue to grow. This is seen as an initial step in the process of demolition, areas showing this manifestation will most likely be scheduled for sudden (necrotic) demolition. The on-going demolition of Mpape in Abuja is a typical example.
3	Pyknosis: shrinkage of nucleus	This stage involves an almost irreversible process of demolishing or evicting the main sources of social survival in the settlement (banks, schools, markets, religious centres e.tc.) e.g. the demolition of Mpape in Abuja and the expulsion of commercial motorcycles in Lagos.
4	Karyolysis: dissolution of nucleus into the cytoplasm	Occurring simultaneously with stage 3, the nucleus of the settlement is dispersed within the collapsing settlement and outside it, thus bringing about a total elimination of the settlement. This often triggers a complex shuffle of city systems in detrimental ways.

(Source: Ajadi, 2012)

This makes it difficult to track the proliferation of people and city systems and hence it is difficult to predict the effects of the process. It must be stated here that demolition in the context of this research does not necessarily mean the 'felling' of houses and infrastructure but also the forced dispersal of people from their default place of abode. The death of settlements often occurs gradually and they are often due to changes in other urban systems. However, some West African cities (Nigeria in particular) have developed the habit of forcefully terminating and introducing settlements via a methodology so abrupt that it risks changing the very tempo of the urban development pace (Ajadi,2012).

Less than a decade ago, when a new leadership system took charge of the largest original black city in the world (Lagos state, in Nigeria), a rather radical and effective necrotic reformation of the megacity began (Ajadi, 2012). The aim of the new political system was to drastically reduce the population of one of the fastest growing cities in the world. His 'strategic' approach of clearing all overcrowded slums and sporadic clusters of people under the bridges seemed a great relief effort for the people of Lagos. However, Lagos for example has almost 70% of the population living in slum communities with population densities between790-1240 people per hectare (Ibidun, 2009). This effort caused a serious problem for the neighbouring south-western states. The policy importuned the sudden ejection of well over 1million people from Lagos into the nearby states. These people were the agents of the worst vices of the city (Ajadi, 2012): thieves, con-artists and the likes. Others were mainly poor people living deep below the poverty line. The unexpected arrival of these people in neighbouring states became a problem as none of the states affected were designed to suddenly handle such volume of such type of people. Therefore as the crime rates in Lagos plummeted drastically, those of Ogun, Oyo, Osun and Ekiti sky-rocketed (Ajadi, 2012). Such strategies still continue in Lagos till date with scheduled demolitions of mega-shanties like Makoko and the recent strategic expulsion of commercial bike riders form Lagos state. This move will surely decimate the transportation system of the city and at the same time increase security concerns for nearby cities, despite the uncertain propensity for it to make motorcycle transportation cheaper in other states. The on-going demolition of Mpape, an old sub-urban settlement in Abuja is also a typical example. The removal of vital settlement systems has already begun (blebbing and pyknosis in this case) in August 2012 as the main market has been demolished with just a notice of a month, and in a few weeks 10288 houses will also be removed in one of the many stages of demolition (Adetayo, 2012). Such necrotic strategies like these could only spell disaster in the long term because extemporaneously and forcefully demolishing most of the slums (or any settlement/neighbourhood) in a city with no phagocytotic settlements prepped up will only lead to a very complex shuffle of city systems; a scenario, that even most master plans do not seem to be ready for.

CONCLUSION

In conclusion, the sudden and forceful removal of settlements in any city is a detrimental strategy. Even if scenarios that require a sudden shutdown and disintegration of settlements arise (e.g. epidemics or war), it is still much safer to engage an apoptotic strategy in the disintegration and integration process. Unless the loss of lives is counted as an option, in any urban transcript, people are partly synonymous to energy; even though they can however be created, they cannot be destroyed, they can only be transformed from one form of living to another. This research continues, by considering the direct computational adaptation of this biomimetic strategy for ease of application by translating the framework of the strategy into a script that can be helpful in generating designs of neighbourhoods and settlements. Research shows that computational design on an algorithmic platform is very useful in simulating urban scenarios and generating design of easily deployable settlements. The research will proceed in trying to investigate the relationships of urban disintegration with a more complex juxtaposition with Apoptosis. This will be done by studying specifically, the complex signal transduction system in the natural process of apoptosis and finding out the levels of adaptability and translative propensities that exist within it. An ongoing research adaptation of the biomimetic strategy is being implemented in a proposed design for a semi vertical settlement with all the criteria for adaption. The design is generated with a bias for an easy apoptosis process if need (see Figure 5, 6 and 7- Appendix below). A far wider set of city systems will also be considered on a scenario case level. Scripting on software like Rhino and processing coupled with computer aided modelling on AutoCAD and Sketchup will also be employed to find out how to make the application of such a process more direct and user friendly. The framework can be written in script form and/or generatively adapted to a generative process of neighbourhoods and settlements. This will help African and other urban schemes to make more informed planning decisions regarding the birth and death of settlements in the future.

REFERENCES

Adagba O., Ugwu S.C., Eme, & Okechukwu I., (2012), 'Activities of Boko Haram and Insecurity Question in Nigeria', Arabian Journal of Business and Management Review, Vol. 1 (9), pp.77-99.

Adetayo O., (2012), ' Why 10,288 houses'll be demolished in Abuja –Minister' Online Punch

news; August 20. retrieved November 25, 2012 from: http://www.punchng.com/news/why-10288-housesll-be-demolished-in-abuja-minister/

Ajadi, B.S., (2010) 'From Here to There: High Speed Railway Station for Central Business District, Abuja' Undergraduate thesis of architecture, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.

Ajadi, B.S., (2012), 'Ghosts of the Primitives: The Predicament of X, Y, Z in Nigerian Architecture -1', Sun National Newspaper, April 1, Vol 6. (468), Lagos, Aba, Abuja, p.46.

Ajadi, B.S., (2012), 'Ghosts of the Primitives: The Predicament of X, Y, Z in Nigerian Architecture -2', Sun National Newspaper, April 8, Vol 6. (475), Lagos, Aba, Abuja, p.45.

Ajadi, B.S., (2012) 'Morphing the Rules: Advanced Adaptations of Mud in Nigerian Buildings' In: Editors, Laryea S., Agyepong S.A., Leiringer, R., and Huges, W., Conference Proceeding, 24-26 July 2012, Reading: WABER Conference, pp.163-175.

Alagbe O.A., (2006), 'Combating The Challenges Of Rise In Urban Slums In Cities In Developing World: A Case Study Of Lagos State', Lecture: International Conference On the Built Environment. Extracted October20, 2012 from: http://eprints.covenantuniversity.edu.ng/390/1/Combating_the_Challenges_of_Rise_in_Urban_Slums_in_Cities_in_Developing_World_A_Case_Study_of_Lagos_State.pdf

Biomimicry Guild, (2007), 'Innovation Inspired by Nature Work Book', USA: Biomimicry Guild Press.

Castles, S., (2009) 'The Age of Migration. International Population Movements in the Modern World', USA: Palgrave Macmillan.

Fletcher B. (1999), 'A History of Architecture', New Delhi: CBS publishers. pp 629-632, 712-715.

Green & Douglas, (2011), 'Means To an End.' New York: Cold Spring Harbor Laboratory Press.

Ibidun O.A.,(2009), 'Vulnerability of Poor Urban Coastal Communities to Climate Change in Lagos', Lecture: 5th Urban Research Symposium, Marseille. Extracted October20,2012from: http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1256566800920/adelekan.pdf

Irit S., (2001), ' Intraurban Housing Mobility in a Traditional West African City: Shelter or Business Decision?', Urban Studies Journal, Vol. 38 (3), pp.535-540.

James J.F., (2012), 'Confronting the Terrorism of Boko Haram in Nigeria', Florida: JSOU Press.

Karam, Jose A., (2009), 'Apoptosis in Carcinogenesis and Chemotherapy.' Netherlands: Springer.

Kasper D.L., Zaleznik D.F., (2001), 'Gas gangrene, antibiotic associated colitis, and other Clostridial infections.' In Braunwald E., Kasper D.L. et.al (Eds). Harrisons's Principles of Internal Medicine 15th ed., New York, McGraw Hill, pp. 922-927.

Olsen A.W., (2011), 'Reconsidering West African Migration Changing focus from European immigration to intra-regional flows', Denmark: Vesterkopi AS.

Proskuryakov, S. Y., Konoplyannikov, A. G., & Gabai, V. L., (2003), 'Necrosis: a specific form of programmed cell death?' Experimental Cell Research Vol 283, pp.1-16.

Raffray, M., & Gerald M. C., (1997), 'Apoptosis and necrosis in toxicology: A continuum or distinct modes of cell death?' Pharmacology & Therapeutics Vol 75, pp.153-177.

Santos A.S., Daugas E., Ravagnan L., et al., (2000), 'Two Distinct Pathways Leading to Nuclear Apoptosis'. Journal of Experimental Medicine Vol192 (4): 571–80.

Shelby D., (2009),'Data Mapping, Modeling and Experiential Simulation as information Management Tools in Urban System and Infrastructure Design' Zofnass Program for Infrastructure Sustainability, Report, pp.1-20.
Sun M, & Fink P.J., (2007), 'A new class of reverse signaling costimulators belongs to the TNF family'. J. Immunol. Vol 179 (7): pp.4307–4312.

Appendix – figures: 5, 6 and 7

Figure 5: Plan view of an ongoing neigbourhood Design (Source: Ajadi, 2012)

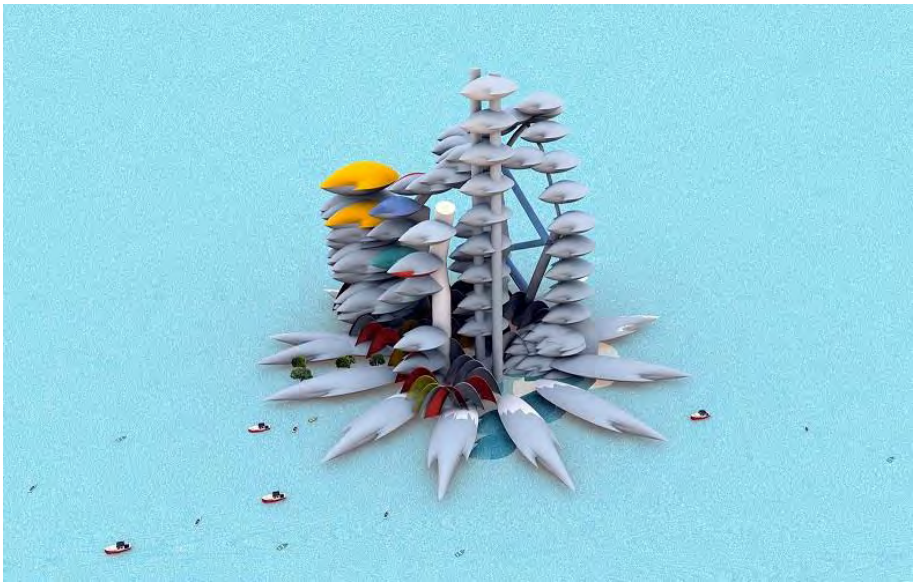


Figure 6: Offset sky view (Source: Ajadi, 2012)

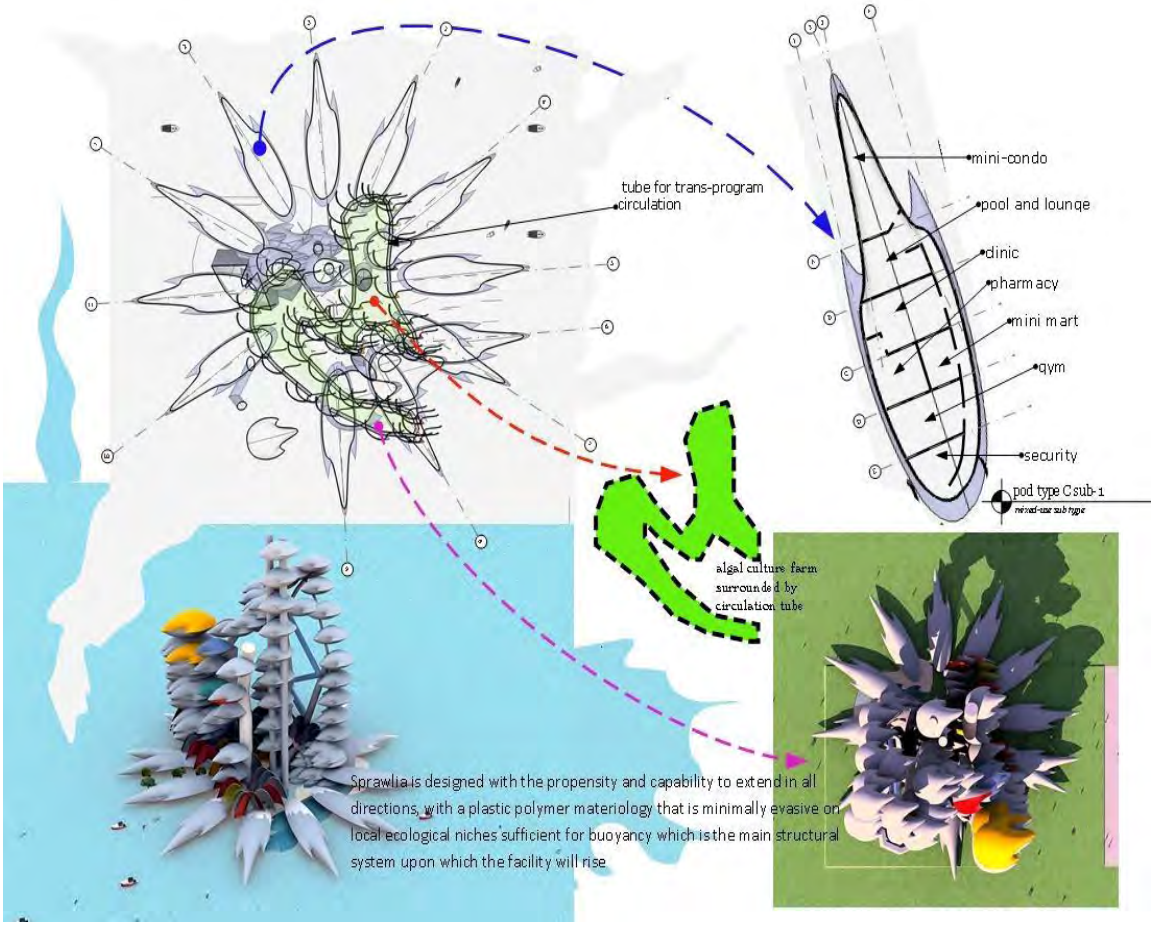


Figure 7: Vertical neighbourhood design showing a spatial strategy
(Source: Ajadi, 2012)