Factors affecting sustainable infrastructure delivery in South Africa - a case of Gauteng province

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Abstract. Infrastructure plays a crucial role in the economic growth and development of any country; therefore, it is important to ensure adequate investments for the delivery of infrastructure services. This paper assessed factors affecting the development of sustainable infrastructure in South Africa. The identified factors can be utilised by government as reference to enhance the delivery of sustainable infrastructure.

To achieve the objective of the study, Quantitative data was collected. The study used a sample size of 57 out of the 65 questionnaires (a response rate of 87.7%) which were answered by professionals in the built environment viz. Architects, Property Developers, Quantity Surveyors, Engineers, Construction and Project Managers. The data collected was then analysed and interpreted using IBM Statistical Package for Social Science (SPSS) computer software to provide mean item scores, standard deviations and Cronbach’s alpha. Given the explored factors which affect the delivery of sustainable infrastructure, the results have established that due to developers habit of building to maximise profit only, not for end-users’ comfort and the initial high cost required to develop sustainable infrastructure were the major factors that affect the delivery of sustainable infrastructure. It is recommended that the government develop clear, stable and credible policies that will attract investors who will be committed to inject financial resources into infrastructure development and alter the existing building regulations to complement the sustainable development goals.

1. Introduction

Sustainability revolution is taking place and it will require the built environment, especially construction industry, to find solutions to living in rapidly urbanizing areas and cities. The way building materials are used and how construction is conducted shall change to keep up with the new era, therefore creative thinking is required in order for people to survive and thrive on planet earth for much longer and the construction industry has a major role to play [1]. Yan, Wang, Quan, Wu & Zhao [2] define sustainable development as a development approach that satisfies the needs of our day-to-day lives, and the well-being of the future generation. According to Yan et al. [2], Sustainable Development strive to balance the needs of this and the upcoming generation as well as regional and global needs, nature and development, and competence and equality.

Gauteng is the smallest province in South Africa, covering about 15% of the country’s total land area however, it population is greater than that of all the provinces in the country as one-fourth of the South Africa’s population is based in Gauteng [3]. World Population Review [4] stated, “The City of Johannesburg needs a plan for a population growth of about 66% in the next 30 years, which includes plans to improve access to clean water, energy and the management of waste and sanitation. Johannesburg is projected to grow to 6.5 million by 2040.”
The Minister of Human Settlement Lindiwe Sisulu in Pettersson [5] mentioned that South Africa is need of solutions to plan and manage rapidly growing population and urbanization related challenges that the country is facing. The Minister stated that, “The real challenges faced by urbanization, when its positive aspects are recognized, are sustainable in the social, economic and environmental dimensions. Sustainable urban planning and development is necessary to eliminate the causes of segregation and exclusion and support the social, spatial and economic transformation of cities and towns.” The minister further added that if proper measures are not followed during development stage cities suffer the consequences [5]. The projected rapid growth of population in the Gauteng province in the next 30 years should be the main drive for the government to implement systems that will mitigate factors affecting sustainable infrastructure delivery in the province. Achieving that, the government will not only be able to accommodate the large number of individuals who are moving into the province but will also be building sustainable societies with decent facilities and access to economic opportunities [4].

In the past two decades, substantial amount of construction work have been undertaken close the gap between the demand for infrastructure services associated and the rapidly growing population, improvements in the technological, communication and digital systems. However, the lack of monetary valuation studies and scarcity of investments towards sustainable infrastructure has made it very challenging for the province to deliver sustainable infrastructure [6]. Through sustainable infrastructure development, the design and construction phases are exploited to improve energy efficiency as well as indoor environmental quality, increase the use of renewable resources and reduce waste. These practices can be used to improve the sustainability of the existing infrastructure until the required technologies are available [7].

2. Literature review
Sustainability is a wide-ranging concept that has become a major concern in the built environment, sustainability allows human beings to have an enhanced comfort and health, improved social, economic and environmental conditions, and it improve overall quality of life. Meadowcroft [8] and Asdrubali [9] define Sustainable Development (SD) as a development approach that satisfies the needs of day-to-day lives, and the well-being of the future generation.

There issues of accelerating sustainable development, eliminating poverty and climate change are growing in importance and have become inextricably linked. Poverty reduction, economic growth, and environmental sustainability can be tackled successfully through infrastructure [10]. According to Shazmin, Sipan and Sapri [11] sustainable development can improve the way the building uses the resources, concurrently reduces the impact of the building on human health as well as on the environment during the existence of the infrastructure through improved design, development, maintenance and disposal of the building.

According to Gauteng Provincial Government [6] there are no sufficient investment and commitment to sustainable infra-structure development from both public and private sectors. More infrastructure, precisely sustainable infrastructure, is required in order for the provincial government to be able to meet consumption demands of the rapidly growing population. The development banks need to invest more in infrastructure development in order to assist in building improved infrastructure [10]. Infrastructure development has a massive impact in improving the standard of living in developing countries however due to lack of financing the much-needed projects do not become a success [12]. It is not a secret that the public sector is the largest investor in infrastructure development. How-ever, the projects funded by the government lack vision and planning due to weak regulatory frameworks and limited local capacity, most of those projects does not succeed [12]. Levy [12] suggested that less developed countries formulate policies and regulations that will attract foreign investors to finance mega infrastructure projects. A study conducted by Abi-ad, Fuceri and Topalova [13] found that when the investments in the infrastructure development are increased the Gross Domestic Product (GDP) of the country can improve as well as its economy’s productive capacity. If the GDP in investment spending increases by 1% the level of output will go up by 0.4% in one year. The investment in infrastructure development could generate income and pay for itself if it is done correctly. A number of projects are not completed over anticipated period, they usually take longer. In most cases it is the government that changes policies during the construction and operating phases of the project e.g. change in pricing rules of electricity or
water. Investors do not like to rely on rules that apply to a certain investment or investment technique [10].

Ghanen [14] established that the population growth, especially in developing countries, has a negative impact on achieving sustainable development due to an existing inverse relationship between the population and the environment and its impact on sustainable development, using a multi-equation model in Egypt. According to Ghanen [14] findings when a population increases by 1% the carbon dioxide (CO₂) emissions goes up by 2.4%, when CO₂ emissions increases by 1% the deaths caused by air pollution goes up by 2.5% and the poor health that is caused by air pollution reduces labour productivity by 1.58%. Ghanen [14] further noted that even though population growth has an indirect negative impact on decreasing labour productivity, it still affects economic growth and delays the state from delivering sustainable development. In addition, Guney [15] assessed the population growth and its impact on chances for achieving sustainable development in developed and developing countries, the variables have established that population growth has a negative impact and a positive impact in developing and developed nations, respectively.

The delivery of sustainable infrastructure requires a government to produce clear, stable and credible set of policies and initiatives in the field of sustainable construction [16]. In addition, government should stimulate organisations in the built environment that will proactively support and monitor sustainable development and set their own targets, rather than only complying with the government policies and legislation [16].

The number of sustainable infrastructure development has been slightly increasing in South Africa since the formation of the Green Building Council of South Africa (GBCSA) in 2007, almost 200 buildings have been awarded Green Star SA certification and over 7 000 professionals have undertaken GBCSA training [17]. However, the adoption of sustainable infrastructure development is still increasing steadily, the studies locally and internationally has revealed that one of the reasons that there is a low progress is the perception that the initial cost of sustainable development ranges between 15% and 25% higher than the initial cost of traditional construction [17]. Likewise, the study of Mustapha [18] revealed that one of the factors that hinder the progress of sustainable infrastructure development in South Africa is the ideology that the development of sustainable buildings is too costly. The lack of information about sustainable development benefits to the clients, and that developers build to enhance profits only not the end users’ comfort affects sustainable infrastructure delivery in South Africa [18].

3. Research methodology

The research methodology adopted to collect, analyse and interpret data was carefully selected in the best way that will fulfil the purpose and the objective of the study. The data for this study was collected in the Gauteng province, mainly in the City of Johannesburg as the population is well represented in the city and quantitative approach was used to conduct the study. The closed-ended format questionnaires were distributed to respondents who are professionals in the built environment, the respondents completed the questionnaires using a 5 point Likert scale to rate their extent of agreement or disagreement with the variables that are stipulated in the questionnaires. The data collected was then analysed and interpreted using IBM Statistical Package for Social Science (SPSS) computer software to provide mean item scores, standard deviations and Cronbach’s alpha.

The non-probability sampling was employed to select the sample for the study, using purposive sampling. The sample size of 65 respondents who are based in the Gauteng province were approached to form part of the study, however only 57 of the 65 completed and returned questionnaires (a response rate of 87.7%). The respondents for the study were Architects, Property Developers, Quantity Surveyors, Engineers, Construction and Project Managers as well as professionals in the built environment who are working for the various Development Agencies in the Gauteng province viz. Johannesburg Development Agency (JDA), Johannesburg Housing Company (JOSHCO) and Johannesburg Road Agency (JRA).
4. Findings and discussions

4.1 General information and results
The findings that were drawn clearly showed that 40% of the respondents that formed part of the study had national diploma as the highest educational qualification, 34% had bachelor’s degree, 22% had honour's degree, 10% had master’s degree, and 4% had higher certificate and 4% doctorate. Thirty percent of the respondents were Quantity Surveyors, 19% were Engineers, the Architects and Construction Project Managers were represented by 18% of the 57 respondents, 11% were Construction Managers and 5% were other professionals like Facilities Managers, Architectural Technologists and Land Surveyors. The findings extracted from the questionnaires indicated that 32% of the 57 professionals that took part of the study had more than 12 years of experience in the construction industry, 26% had between 4-6 years of experience, professionals who had between 1-3 years, 7-9 years and 10-12 years of experience were represented by 14% of the 57 respondents each. The findings further revealed that 61% of the respondents that took part in the study were employed in the private sector and 39% were employed in the public sector. While the findings for the respondent’s previous involvement in the sustainable infrastructure projects show that 32 of the respondents had previously been involved in the sustainable projects, which is 56% and 25 were not, which is 44%. Out of the 32 respondents that have been involved in the sustainable infrastructure projects before 34% have been involved in five projects and more, while the respondents who were involved in one project and two projects before each had 22%. Sixteen percent of the respondents had been involved in three projects before and 6% of the respondents had been involved in four projects. While the 34% of the respondents noted that, the sustainable infrastructure projects that they were involved in were located in Gauteng, and 16% in KwaZulu-Natal and 13% outside South Africa. Free State and Mpumalanga had 9% of the respondents each, 6% of the respondents indicated that the projects that they were involved in were located in the Western Cape. Eastern Cape, Northern Cape and North West had 3% each. These results give a clear indication that the respondents had a sufficient working experience and the adequate academic qualifications to understand matters concerning the delivery of sustainable development in the built environment. Therefore, the response received from these respondents can be deemed reliable based on the results obtained.

| Table 1. Factors influencing sustainable infrastructure development in South Africa |
|-------------------------------------------------|-------------------------------|-----------------|----------|
| Factors influencing sustainable development      | Standard deviation | Mean item score | Ranking |
| Developers build to maximise profit only, not for users’ comfort | 0.909              | 4.32            | 1        |
| High construction cost                           | 1.067              | 4.07            | 2        |
| Lack of investment                               | 1.306              | 3.84            | 3        |
| Resistance to change from current practice       | 1.093              | 3.81            | 4        |
| Inadequate project development capacity          | 1.142              | 3.35            | 5        |
| Population growth                                | 1.295              | 3.30            | 6        |
| Policy uncertainty                               | 1.195              | 3.23            | 7        |
| Lack of public awareness                         | 1.203              | 3.02            | 8        |
| Scarcity of high-efficiency products suppliers   | 1.136              | 2.82            | 9        |
| Clients lack of knowledge on sustainable development | 1.481              | 2.81            | 10       |
The findings were in partial agreement with the study of Mustapha [18]. The study showed that clients lack of knowledge about SD, developers build to enhance profits only and does not take into consideration the end-users’ comfort as well as the scarcity of high–efficiency products suppliers in South Africa are some of the factors affecting sustainable infrastructure delivery in South Africa. The findings revealed the clients’ lack of knowledge about SD and scarcity of high-efficiency products are not likely to affect the delivery of sustainable infrastructure. However, the findings strongly agreed with the study that developer’s habit to build to maximise profit only and not consider users’ comfort and the belief ideology that the high construction cost to develop sustainable buildings are very likely to affect the delivery of sustain-able infrastructure. In addition, the study of Guney [15] was in total agreement with the findings that population growth does affect the delivery of the sustainable infrastructure, Guney [15] revealed that population growth has a negative impact and a positive impact in developing and developed nations, respectively. Likewise, the study of [10] and the findings were in consensus that lack of investment has a very high level of influence in the delivery of the sustainable infrastructure; as Bhattacharya et al. [10] stated in the study that infrastructure require a sufficient investment.

5. Conclusion and recommendations
The factors influencing sustainable development in the Gauteng province were discovered through the literature review that was compiled, the following are those factors in their descending order: Developers build to maximise profit only, not for users’ comfort; high construction cost; lack of investment; resistance to change from current practice and inadequate project development capacity. Furthermore, population growth; policy uncertainty; lack of public awareness; scarcity of high-efficiency products suppliers and clients lack of knowledge on sustainable development were other factors influencing sustainable development that were revealed by the literature. The findings that were discovered during the analyses of the data that was acquired from the questionnaires completed by the respondents was comparable with the literature review that was drawn from the different historical studies, they were able to assess possible factors affecting sustainable infra-structure delivery in South Africa. The identified factors can be used by the provincial government as an appropriate reference to deliver sustainable infrastructure at larger scale, which will help improve the quality of life in communities, not only socially but also by being environmental friendly and make a positive contribution to the economy.

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