AN INVESTIGATION OF THE SUSTAINABILITY OF STEEL CONSTRUCTION TECHNOLOGIES IN MOBILE TELECOMMUNICATION INDUSTRY IN KENYA

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ABSTRACT

The growth in Mobile Telecommunication sector has been rapid to the extent that by the end of 2011, there were 6 billion mobile subscriptions worldwide; an equivalent of 87% of the world's population. The rapid growth in the sector has caused GSM service providers to constantly roll out radio base stations in order to meet their capacity and coverage demands. Steel is the most commonly used material in the construction of the antenna support structures. The study evaluated the degree of sustainability of steel construction technologies in base stations. Sustainability is a systemic concept, relating to the continuity of economic, social, institutional and environmental aspects of human society. It is about reducing negative environmental impacts, enhancing social aspects and improving economic efficiency throughout a project's life cycle. This paper focused on all aspects of sustainability of steel construction technologies in the mobile sector in Kenya with specific focus on Safaricom Ltd.

A quantitative descriptive method was used, where Questionnaires were administered to 67 subjects in various sub-sectors of Telecommunication industry as: Project managers, Engineers, Environmental Experts, Suppliers, Civil work contractors, Site supervisors and Acquisition Experts, who formed the target population. Both descriptive and inferential statistics were used to analyze the data. Results of the study revealed that all the respondents have heard about sustainability but only about 37% have good, 58% have average and 5% have poor knowledge on sustainability. More than 50% of respondents recorded very high to high degree levels on

economic, environmental and social sustainability of steel construction technologies in GSM sector. Findings indicate that there is high degree of sustainability of steel construction technologies in Kenya due to its cost effectiveness, low recyclability index and respondents have average knowledge on sustainability indicators. There is need for specialized training on sustainability to raise the knowledge and to promote its applications in the industry. The study recommends use of sustainable steel construction technologies because it enhances economic productivity and reduces environmental pollution in the sector.

Keywords: *Sustainability of Steel Construction Technologies in Mobile Telecommunication Industry*

Introduction

From a global perspective, GSM networks had over 50 million subscriber base in Europe alone during the first seven years, compared to fixed networks which took nearly 50 years to acquire the same number of subscribers worldwide, and about 15 years for the Internet to attract 50 million users worldwide (Bout et al., 2000). According to the International Telecommunication Union (2011), there are 6 billion mobile phone users worldwide today. The African continent so far outpaces the rest of the world in average annual growth of mobile phone subscriptions. The International Telecommunication Union indicates that from 1999 through to 2004, Africans signed up for cell phones at a far greater rate than Asians and nearly three times as fast as Americans, with most of that growth being in the sub- Saharan region. Key barrier to this growth has been the slow pace at which most African governments fail to enact legal frameworks and tax regimes that promote the development and growth of this sector.

In Kenya**,** reluctance to let go government institutions that actively transact the business, for instance, Telkom Kenya whose growth in the telecommunications industry had stagnated for a long time. This is because; opportunities were lost through lack of impetus to grow. After liberalization in 1999, the new players Safaricom Ltd in which Telkom Kenya partnered with

Vodafone Group PLC and KenCell Communications Ltd, now Airtel managed to roll out and provide service that has succeeded in reaching beyond their expectations. According to London-based Tele-Geography Research on launching its service in 1999, Safaricom expected to have 3 million subscribers by 2020 yet only in six years (2005), there were more than 4.6 million wireless subscribers in Kenya, split between the two carriers.

Furthermore, research on sustainability of construction materials and technologies in mobile communications industry would also greatly benefit in future from being commissioned jointly by the relevant government regulatory bodies rather than on an individual basis. This is due to the fact that, construction is a major consumer of non-renewable resources and a massive producer of waste, and the operation of constructed facilities is responsible for emissions of carbon dioxide. Thus, this industry faces the challenge of delivering economic structures that maintain or enhance quality of life, while at the same time reducing the impact of the social, economic and environmental burdens which it places on the society (The Green Guide to Specifications 2004).

Notably, the construction process includes; civil works related elements such as foundations and the delivery to site and assembling of the steel towers, the shelters, the generating sets, the power elements, air-conditioning, the earthing processes, and the radio equipment up to integration and the final commissioning. All these phases could span from one month to one year, depending on the logistic arrangement utilized by the operator. The processes described above are mandatory for initial deployment of telecom services anywhere, but when the technology has attained some level of maturity in any market, it becomes a very ineffective approach for any new operator entering the market, both in terms of cost, security, logistics, and time to market.

In the case of buildings the inability to adapt and upgrade buildings can compromise occupant comfort, energy efficiency and in commercial buildings reduce the productivity of workers. Therefore, re-using and recycling construction products and materials have a significant contribution to make towards achieving sustainable development, as it reduces waste and saves primary resources. On the other hand in the case of steel construction technology, the designer can maximize the potential for re-using steel structures by using bolted connections in preference to welded joints, using standard connection details, bolt size and spacing of holes, ensuring easy access to connections and using long span constructions to offer maximum possibility of re-use by cutting the beam to a new length. Re-use sometimes demands that structures can be extended vertically to create more usable space and make them economically viable. This can be achieved by roof-top extensions and generally using lightweight construction of steel to ensure that the existing structure is not overloaded.

In the case of mobile communication towers which are the chief consumer of steel in the sector, production of repeatable modular units is very efficient for height flexibility. The key benefit of modular towers is that it can be dismantled easily and re-used elsewhere hence maintaining asset value after use. In addition, post construction benefits of sustainable steel construction technologies include energy-efficient structure envelopes, flexibility in long-term use, non-combustibility and corrosion free and shrinkage, ease of extension and adaptation, and ultimately, refurbishment, recycling and re-use. Generally, sustainability is about reducing negative environmental impacts, enhancing social aspects and improving economic efficiency. Thus, this study focused on all the three aspects of sustainability as far as the steel construction technologies are applicable in the mobile communications sector in Kenya.

Statement of the Problem

The mobile sector operates in a volatile business environment because of the political anxieties, competition from new entries, globalization and technological advancements. Communications Commission of Kenya prepares regulations and guidelines for siting of communications base stations, towers, masts and safe use of mobile telephones in Kenya. For sustainability of steel, they have to look at engineered steel that takes fewer raw materials, but gives the required strength, (Watuka and Aligula, 2002). For instance, Mabati Roling Mills (MRM) in conjunction with Falmek of South Africa has developed trussed components which are light weight but strong compared to traditional construction. Also, sustainable construction requires good design which is made in the initial stage of the project development. This means that sustainable construction technologies should consider the embodied energy, operational energy, efficiency, transport, raw materials and water, emissions, recycling, re-use and land use. As such, sustainable design of structures can be reached by specifying steel as well as the life-time of the structure, a scenario that would benefit the mobile industries which needs structures that are durable since they aim to stay longer in the market.

Majority of the largest mobile telecommunication service providers have made steps towards addressing sustainability, Kearney (2009). However, most of these sustainability strategies are aimed at leveraging mobile technology to make progress on reducing its carbon emissions and through innovation develop services that enable more efficient and effective healthcare; access to basic financial services to mobile payment solutions, and machine-to-machine applications that can bring substantial carbon and energy cost savings during mobile site operations. None of these efforts have focused on the sustainability of steel construction technologies in current use in the construction of mobile communication sites.

Objectives of the Study

General Objective

The broad objective of the study was to investigate the Sustainability of Steel Construction Technologies in Mobile Telecommunication Industry in Kenya.

Specific Objectives

i. To explore the extent of sustainability of steel construction technologies in the mobile telecommunication industry in Kenya with specific focus on Safaricom.

ii. To identify factors influencing the use of sustainable steel construction technologies in the mobile communication industry in Kenya with specific focus on Safaricom base station sites.

iii. Formulate evaluation criteria to measure sustainability of steel construction technologies in the Mobile Communications Industry in Kenya.

Literature Review

The discovery of steel which is the most predominant material in the manufacture of towers used in the mobile base stations today was made possible in industrial quantities by the Bessemer process of 1856. Ashby (2009) classifies steel as a quasi-sustainable material. The structural steel framing, art and function can come together in limitless ways to offer new solutions and opportunities. The advanced steel technology has unfolded exciting design opportunities hence, the designers are able to expand their artistic expression and design spectacular structure.

Products are thought to have specific perceived characteristics that contribute to their success or failure. Product characteristics include good value (financial), quality, meet decision maker's needs, unique features or solve problems other products do not, visible benefits, safe, efficient,

satisfying to use, durable and serviceable (Cagan & Vogel, 2002). These characteristics are thought to provide value to the concerned product. The six components that contribute to value include emotion (sensuality, power, and sense of adventure), aesthetic (visual, tactile, and auditory), product identity (personality, sense of impact, and social), ergonomics (ease of use, safety, and comfort), core technology (enabling and reliable), and quality (durability) (Cagan & Vogel 2002). Since, a sustainable product must give as much satisfaction as possible to the user to be successful in the market (Ljungberg, 2007); a sustainable product should incorporate all these values in its production.

Construction on the other side as defined in Du Plessis et al (2002) refers to the broad process/mechanism for the realization of human settlements and the creation of infrastructure that supports development. This includes the extraction and beneficiation of raw materials, the manufacturing of construction materials and components, the construction project cycle from feasibility to deconstruction, and the management and operation of the built environment." Irurah (2001) provided interpretation of construction at four levels: as site activity, as the comprehensive project cycle, as everything related to the business of construction, and as the broader process of human settlement creation.

Empirical Review

Technological Advancements

All steel systems used in construction are highly produced as industrialized components by modern manufacturing processes. Wells (2005) asserts that, these systems are highly pre-fabricated, minimize on-site process and impact beneficially on sustainability of construction. Design by the Computer Aided Design increase efficiency, reduce waste and improve quality and accuracy. Material use is minimized by the high: strength ratio of steel components. The

factory conditions are safe and warm providing high quality environment for the workers, Bout et al (2000). Components of steel are delivered in time to the construction site and installed rapidly by crane or other equipment. This lowers the cost in site management for instance, since no personnel may be employed to watch over the materials. It also reduces storage resulting in a more productive construction process and shorter construction programmes in comparison to site-intensive building.

Cost

Construction cost is related to use of materials, labor, specialist components, equipments and machinery. Cost is influenced by time related factors. Steel construction achieves high levels of productivity and therefore labor cost is reduced on the construction site in comparison to site based construction. Speed of construction and safety is increased by the higher levels of pre-fabrication implicit in steel-intensive construction systems. The cost of the steel framework is typically only 12-15% of the as-built of the building and therefore, it is the influence of the choice of structure on the other building components and speed of installation. Life cycle costing shows that the operational costs can be more than the construction cost over 50 year life. The operational benefits of steel are due to energy savings, low maintenance and flexibility (Wells 2005).

Materials

Construction is one of the major users of materials and resources. It is important to minimize their use and to maximize recyclability. In steel construction this is achieved effectively; typical lightweight steel framed house uses only 40-45 kg steel per m^3. Lightweight steel construction reduces material use by up to 30% in brick clad houses which are equalized to 54% in the GSM industries in construction of BTS, (Jim, 2010). A light steel framework is protected by

lightweight materials like plasterboard and mineral wool insulation. The physical weight and use of materials is much less than in more traditional construction. The recyclability and demountabilty of steel contributes to sustainability in the construction industries.

Data Analysis/Findings

Sustainability of Steel Construction Technologies in Kenya

Figure 4.34 shows the results as follows; strongly agree 68.42%, agree 26.32% and don't know 5.26%. Majority of the respondents agreed that a steel construction technology in Kenya is sustainable. Only 5.26% were not sure of steel sustainability.

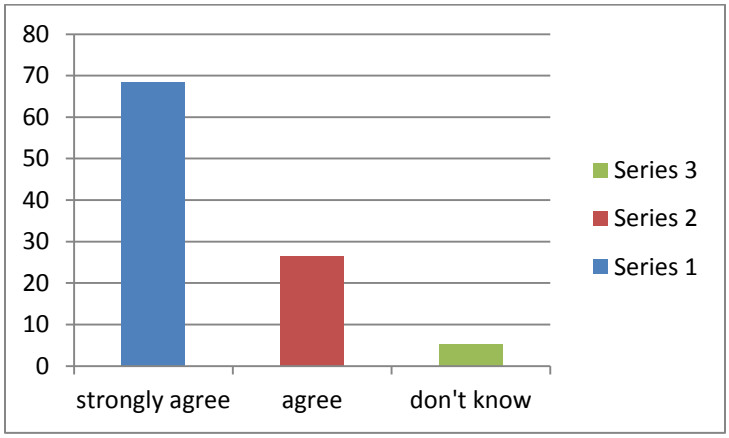

Figure 4.34 Sustainability of Steel Construction Technologies

Source (Field data 2013)

Benefits of Steel Construction Technologies in Mobile Industry in Kenya

According to figure 4.35, above, 57.89 % of the respondents strongly agreed, and 42.11% agreed. This means that, there was more focus largely on the reduction of energy, materials and resources consumption to a more acceptable level (Gibbered, 2003).

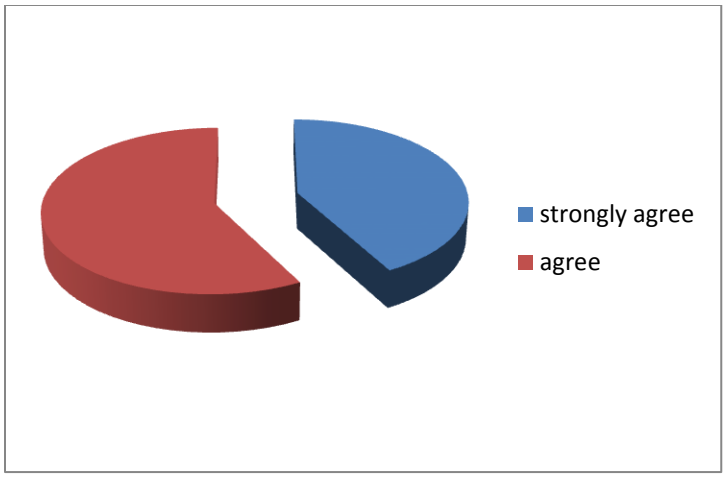

Figure 4.35 Benefits of Steel Construction Technologies

Source (Field data 2013)

Contribution in Advancement of Steel Construction Technologies

Highly fabricated steel

As shown in figure 4.36 below, 78.95% of the respondents answered yes while 15.79% answered no. Only 5.26% (Mobile Operator) were not aware if steel construction technologies contributed to highly fabricated steel.

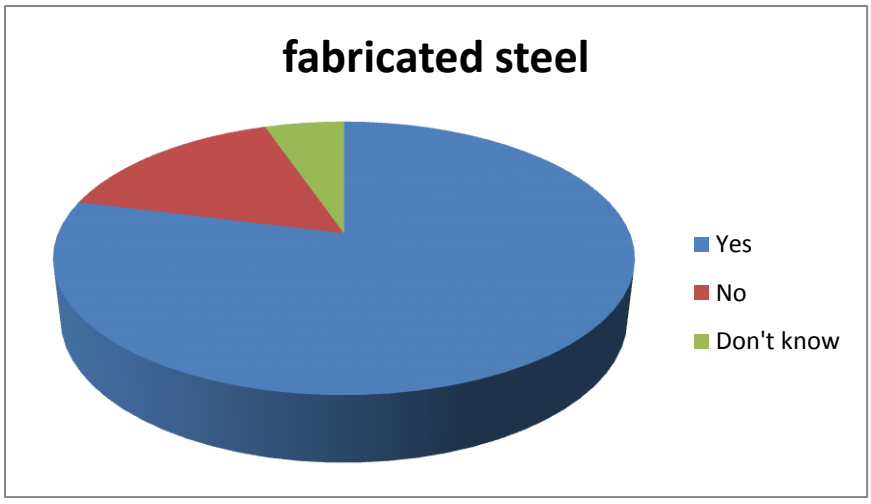

Figure 4.36 Fabricated steel

Source (Field data 2013)

Minimal Site Process

As shown in figure 4.37, 94.74% of the respondents answered yes while 5.26% did not know about minimal site process, he was the employee for the mobile operator. The higher percentage of the respondents asserted Howard (2000) who posited that construction activity like minimal site process was considered as sustainable construction.

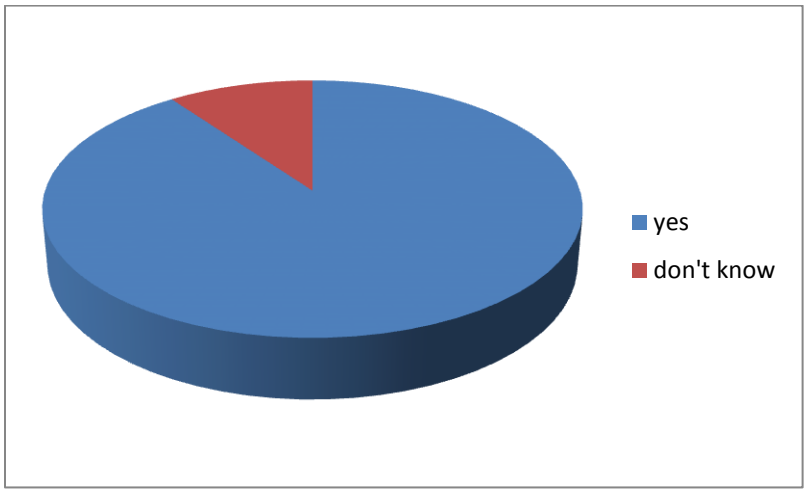

Figure 4.37 Minimal Site Process

Source (Field data 2013)

Reduced Wastage

As shown in figure 4.38 below, 94.74% of the respondents answered yes while 5.26% did not know (employee of the mobile operator). This response echoes Jim (2010) who indicated that there was ease of extension, adoption recycling and re-use of steel technologies thus minimizing waste.

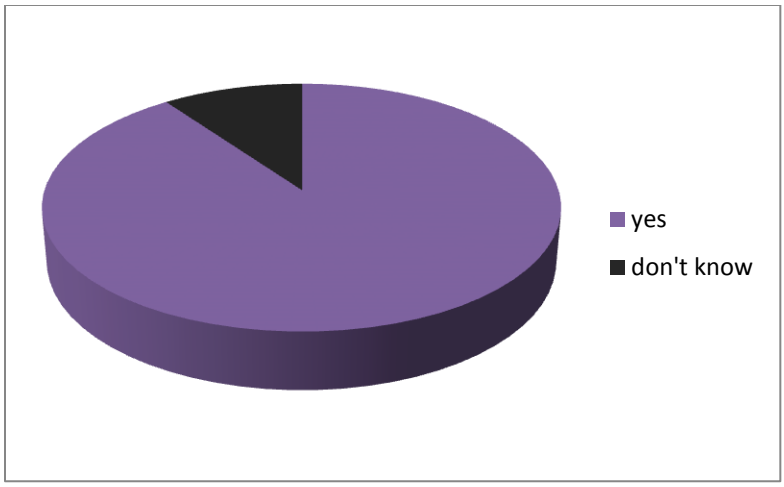

Figure 4.38 Reduced Wastage

Source (Field data 2013)

Improved Quality

Figure 4.39 shows the results as follows; 89.47% of the respondent's answered yes, while 5.26% answered No. Only 5.26% (employee of mobile operator) were not aware if steel contributes to improved quality. These results align with Singh (2007) who noted that socially there was excellent acoustic insulation which was achieved using lightweight heating costs.

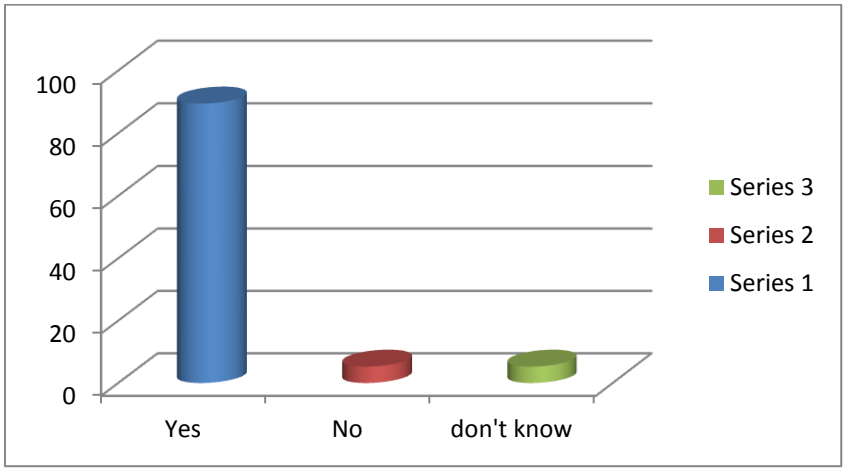

Figure 4.39 showing improved quality

Source (Field data 2013)

Improved Accuracy.

As shown in figure 4.40 below, 89.47% of the respondents answered yes, 5.26% answered No and 5.26% did not know. The response given by majority of the respondents (89.47%) asserts Wells (2005) who stated that design by the Computer Aided Design increase efficiency and improve quality and accuracy.

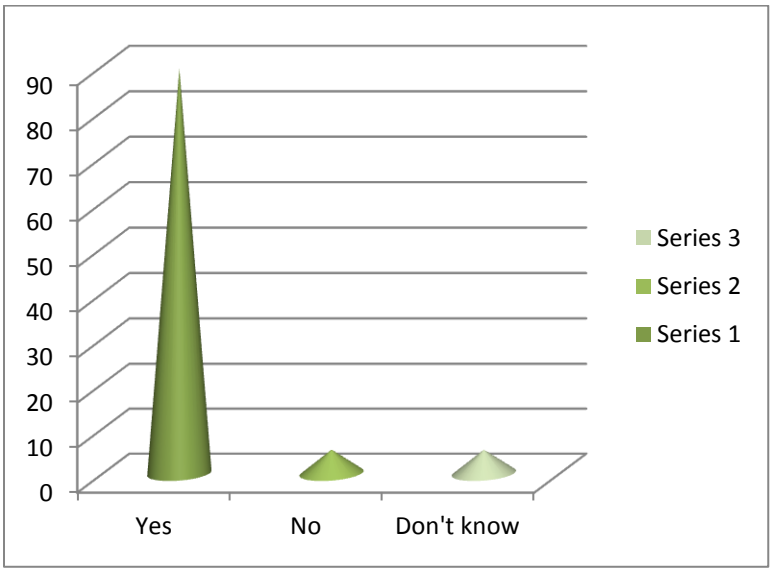

Figure 4.40 Improved Accuracy

Source (Field data 2013)

Reduced storage space

The results in figure 4.41 shows that 78.94% of the respondents answered yes while 15.79% answered no and 5.26% did not know. The respondents who answered No included 2 contractors and one consultant while the one who did not know was a mobile operator. The response given by the higher percentage (78.94%) aligns with Bout et al (2000) who said minimal on-site construction reduces storage resulting in a more productive construction process.

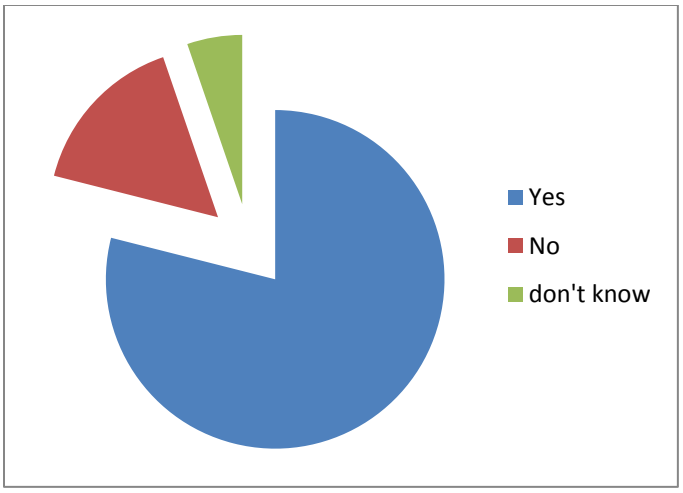

Figure 4.41 Reduced Storage Space

Source (Field data 2013)

Programme Predictability

As shown in figure 4.42 below, 89.47% of the respondents agreed that it reduced risk of delays while 10.53% did not agree these included one contractor and one consultant. According to Bout et al (2000) components of steel are delivered in time to the construction site and installed rapidly by crane or other equipment.

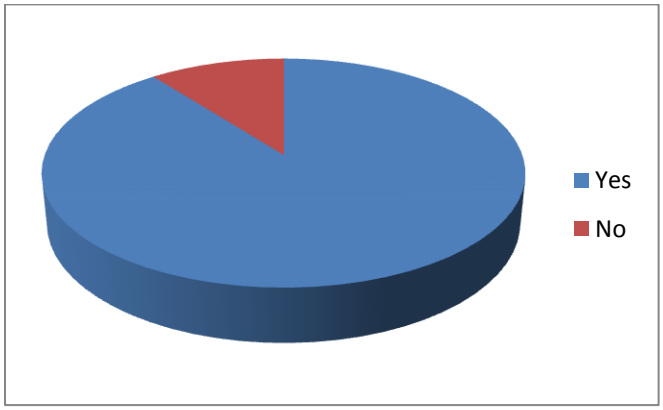

Figure 4.42 Programme Predictability

Source (Field data 2013)

Flexibility in Long-term use and Re-use

All the respondents agreed with this statement therefore acknowledging that steel had flexibility in long term use and re-use.

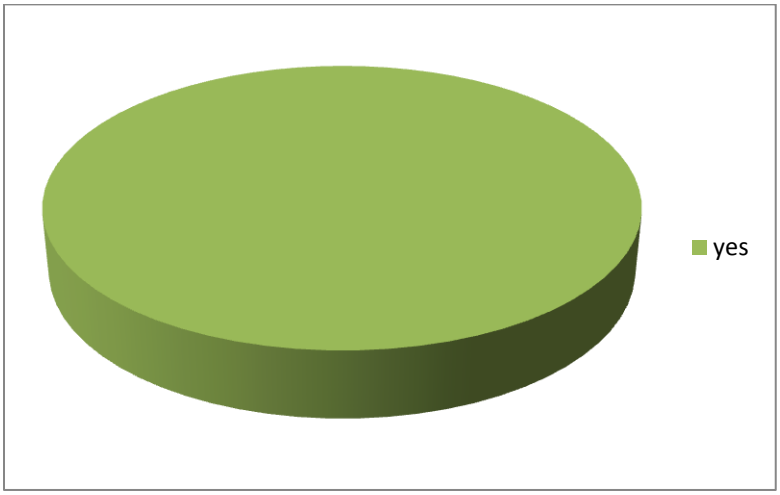

Figure 4.43 Flexibility in Long-term use and Re-use

Source (Field data 2013)

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