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Factors Influencing End–User Decision on the Purchase of Brands of Cement

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Abstract

Cement is one of the most essential construction materials used as a binder in mortar or concrete. This research determined factors influencing end–users' decisions to purchase cement brands. The objectives of the study were to identify prevailing cement brands in the study area and the purchase decision factors. This research sourced data through a questionnaire survey. Two hundred and three (203) questionnaires were administered to construction industry professionals randomly sampled from a list of active sites on Lafarge Cement Lagos Island (Simawa) and Mainland (Ikeja and Lekki – Ajah) Sales Excellence archive (as at March 2023), with one hundred and nineteen (119) returned (58.6% return rate). Findings revealed the most prevalent cement brand to be DanCem (AHP eigenvalue = 0.39). This is followed by the Lafarge brand – both Elephant Classic and Elephant Supaset cement (0.23). The most prominent factor influencing end–users' decision to purchase cement brand(s) is the company responsibility (Eigenvalue = 11.23), which explains 28.8% of the total Variance in the initial 39 itemised factors. The cement and cement properties follow this. However, the role of technical assistance was highlighted as germane to end-users' purchase decisions. The research also recommends further studies on the socio-ecological dimensions of cement for sustainable development and supply chain management.

Keywords: Cement, End-Users, Technical Assistance, Brand, Decision, Construction

1. Introduction

Cement is one of the most essential construction materials used as a binder in mortar or concrete. Its global production is estimated to reach 4.83 billion tons by 2030 (Miraki *et al.*, 2022). This production rate results in the consumption of about 1.5 tonnes of limestone and clay per ton of cement. There are twelve (12) registered cement manufacturing companies contributing a total of 58.9 MMT per year in Nigeria (Etim *et al.*, 2021). According to United Capital (2019), cement companies operating in Nigeria include: Dangote Cement Plc – DanCem (with a Nigerian installed capacity of 29.3 MMT), Lafarge Africa Plc (10.5 MMT), BUA Group (including CCNN) (8.0 MMT), Purechem Industries Limited (a cement company based in Ogun State with 900,000 MT). Dangote Cement is available in three grades: 32.5R, 42.5R, and 52.5R, with the 32.5R grade proposed for plastering, low-rise structures, and masonry. High-rise projects and big facilities can profit from the higher grades. All Dangote types of cement available in the market are Portland limestone cement. According to Lafarge's website, its premium cement brands include Elephant Classic, UNICEM, Ashaka, Elephant Supaset, and Powermax. The grade on the bag label is 32.5R, although the website does not disclose the exact strength rating of Elephant Classic and Unicem. Medium-strength concrete, suspended slabs, masonry (blocks, building, plastering, mortar), and reinforced concrete were all recommended. All Lafarge cement products offered in Nigeria's open markets also use Portland Limestone cement.

As a result of the increasing population, sustaining the availability of cement from a range of vendors throughout the federation is currently an issue for

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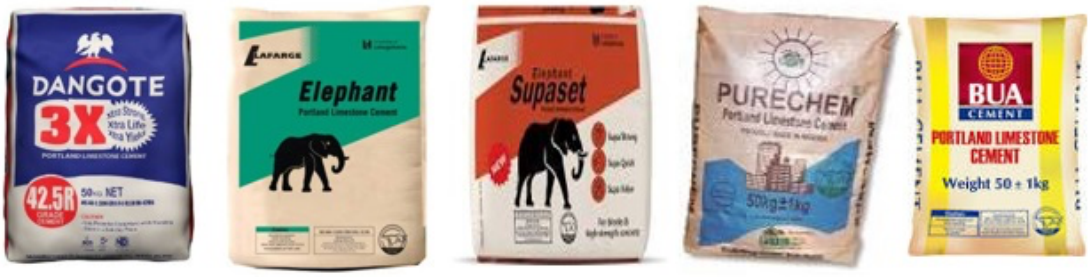

Figure 1: Cement Brands dominating the Lagos Island and Lagos Mainland Market

consideration, as this is affected by demand and supply imbalance, especially for residential purposes, which holds a higher demand compared to non-residential ones (Mojekwu *et al.*, 2013). Since its inception, between 1954 and 1967, the availability or supply of cement has been insufficient to meet the ever-increasing demand for cement because of its uniqueness as a binder for building components. Indeed, cement has different uses for homes, bridges, multi-storey structures, concrete works, stucco, and bricks (Kilani, 2021). As far as cement is concerned, attracting customers is mandatory (Kumar & Srivastava, 2022), yet end-users have specific expectations of branded cement in terms of quality, price, packaging, and promptness of delivery, among other factors. It is a common and desirable practice for end–users to compare the characteristics of competing alternatives before making a final decision (Balabanis & Siamagka, 2017). This is particularly true of construction and construction industry-related wares that operate by a whole different process of financing, marketing, and sales when compared to other manufacturing industries. (Han *et al.*, 2021). The authors reiterated that it may not be possible to directly prescribe results and findings in the manufacturing disciplines to the construction industry. Hence, discipline-specific studies are needed. While products such as hybrid electric vehicles and solar water heaters (Kumar et al., 2019) are relevant, results from such studies may not be directly entrenched in the construction industry (Han *et al.*, 2021). To this end, Dattaray (2017) examined factors that determine customer preference for cement brands. The study focused on dealers and retailers, rather than end–users. Chouhan *et al.* (2016) sampled end users, but a total of 42 responses were considered too small for conclusive judgment. Bonney *et al.* (2022) examined these same factors from a study population of 1000 private homeowners and construction/building companies within four major cities in Ghana. The study considered eight brands available in the Ghanaian cement market. The twelve factors (or attributes ranked), though central, are not exhaustive considering the myriad of factors influencing end–users' choice of cement brand. Sunmola *et al*. (2021)'s use of consumer trust as an explanatory variable for Dangote Cement brand communication is laudable, yet it is strictly a marketing perspective. Kalumikiza (2022) also examined factors influencing the brand of cement purchased as an objective of his study; sampling "key informants in the cement sector". The research, however, was narrowed down to pricing as a dominant factor. The author used only frequencies and percentages to analyse data. Furthermore, Ebitu (2014) examined the marketing strategies of United Cement and how they affect end–users' satisfaction in Calabar, while Nartey (2012) investigated Tema metropolis customers' perception of Dangote cement acceptability to determine clients' perception of product sturdiness, factors to consider before actual purchase, and management strategies for promoting sales. Both Ebitu (2014) and Nartey (2012), however, focused on only a brand of cement. Similarly, Maity (2014) opined that customers lack a basic understanding of the technical aspects of cement and so gather information from external sources. Thus, cement manufacturing companies are now engaging the services of architects, builders, and civil engineers to assist their sales team on these technical aspects and to solve problems faced by end users on-site while using cement. Services rendered by this team of professionals include education on safety precautions while working on site, giving out safety kits, assisting end-users with cement usage and applications, i.e., trial mixes (*Lafarge* Cement End-User Market Discovery Survey, 2022).

However, the literature has not emphasised the role of technical assistance or builders' input, nor has it explored the extent to which this has impacted the sales of cement companies. However, Ivanova and Smetanina's (2016) discussion on the target-oriented generation of awareness among customers and consumers; and commodity positioning resonates thoughts on this role together with specific tasks attributed to the role e.g. end-user discovery research survey, blockmakers' engagement on quality standards, end-user enlightenment on cement product differentiation and advantage of one brand over another, engaging

real estate and property development companies on the application of cementitious adhesives and related products etc. The researcher's definition of technical assistance is summed up thus. Further, there is a reference level of a dearth of education of end–users on cement products, and also a lack of positive feedback for the excellence of cement sold (Chang *et al.*, 2011).

There is also a lack of understanding of consumer behaviours in purchasing socio-ecological products, coupled with a dearth of knowledge on environmentally, socially, and economically sustainable products (Weniger *et al.*, 2023). The authors reported highly individualised sustainability-related criteria, varying from one consumer to another, from a review of the literature. Still, these and many more research studies on cement products have focused on marketing aspects, viz, price, and have neither delved into a compendium of factors nor examined the Builder's input (or the impact of building professionals' technical support) on sales of cement. Hence, this study identifies cement brands available in Lagos Island (Simawa) and Mainland (Ikeja and Lekki – Ajah) and examines factors influencing end–users' decision to purchase particular brand(s) of cement. There is a need to assess if end-users are prepared to accept cement products for cement companies to continue to operate.

The study identifies cement brands often used by respondent professionals on their sites and examines end-users' perceptions of cement brands' acceptability in relation to factors influencing the choice of a particular brand of cement. This direction, according to Weniger *et al.* (2023), is an initial evaluation of end-users' current state of knowledge and influences (i.e. motivations) for purchase decisions of building products that precede the possibility of determining consumer behaviour and communications on sustainable products. The research would help establish a rule of thumb for the number of persons likely to purchase each brand of cement regularly and periodically (i.e. market share), to prioritise end–users' factors for choosing cement brands and how to address their queries. This will boost the company's image and promote the product. Hence, this research seeks to proffer answers to some of these questions: what brand(s) of cement are available and commonly used on building sites in Lagos Island and Mainland; what are the factors influencing end-users' decision to purchase particular brand(s) of cement in the study area; how important is the factor of the role of technical assistance among factors influencing end – users' purchase decision. This is aimed at enhancing sales and cement product improvement.

2. Literature Review

2.1. Definition of cement

The Romans coined the term "cement" to describe masonry built of coarse aggregates and burnt limestone as a binder, similar to modern concrete. *Cementum* was the name given to a pneumatic binder made from volcanic ash and broken brick additions mixed with burning limestone (Wietek, 2021). It has been around for almost two thousand years and is arguably the most well-known building material (Ridi *et al.*, 2011). Cement is used in the production of building blocks and concrete. It is a low-value, bulk material. Portland cement grades 32.5 and 42.5 are sold in 50kg packets (or bags). Cement encompasses a wide range of compounds with adhesive and cohesive properties, which makes it capable of bonding materials such as mineral fragments into a compact whole.

On the other hand, cement is a term that is commonly used to describe adhesives that are used to keep stones, bricks, tiles, and other materials together and affix them to a base in the construction of buildings and other civil works (Akers, 2001). The majority of these adhesives are lime-based and best known as calcareous cement(s). When mixed with water, the particles of this form of finely powdered cement set into a hard mass. Setting and hardening are the consequences of hydration, i.e. the chemical reaction of cement components with water. Cement is one of the most widely used materials in the construction industry. In construction, the cement used can be characterised as being either hydraulic or non-hydraulic, depending upon the ability of the cement to be used in the presence of water (Edwards, 2005). Hydraulic cement is that which sets and hardens by chemical reaction with water and is capable of doing so underwater. The chemical reaction results in hydrates that are not very water-soluble and so are quite durable in water and safe from chemical attack. This allows setting in wet conditions or underwater and further protects the hardened material from chemical attack (e.g., Portland cement). Non-hydraulic cement will not set in wet conditions or underwater; instead, it sets as it dries and reacts with carbon dioxide in the air (Edwards, 2005). Some aggressive chemicals can attack it after setting.

2.2. Cement manufacturing process

The manufacturing process of cement involves mining, crushing, grinding of raw materials (principally limestone and clay), blending of raw meal, calcining the materials in a rotary kiln, cooling the resulting clinker, mixing the clinker with gypsum, milling, storing, bagging the finished cement and distribution (Kolawole, 2011). The raw materials for manufacturing cement can be divided into four basic components: lime (calcareous), silica (siliceous), alumina (argillaceous), and iron (ferriferous). Approximately 1450 kilograms (kg) of dry raw materials are required to produce one tonne (1000 kg) of cement. Approximately 35% of the

raw material weight is removed as carbon dioxide (CO_2) and water vapour. The introductory chemistry of the cement manufacturing process begins with the decomposition of clay minerals into SiO_2 and Al_2O_3, and the calcination of calcium carbonate ($CaCO_3$) at about 900 °C to leave calcium oxide (CaO, lime), liberating CO_2. This is followed by the clinkering process, in which the CaO reacts at high temperatures (typically 1450 °C) with silica, alumina, and ferrous oxide to form the silicates, aluminates, and ferrites of calcium. The resultant clinker is then milled together with gypsum and other additives to produce cement (Kolawole, 2011).

2.3. Carbon print impact on the cement-manufacturing environment

Nigeria's building sector is adjudged one of the major emitters of carbon dioxide in the country, owing to activities such as the use of heavy machinery and equipment such as bulldozers, excavators and cranes, burning of wood and charcoal on construction sites for cooking and heating, and cement manufacture. According to Liu et al. (2020), approximately 8% of the world's carbon dioxide emissions are exclusively attributable to the cement sector (Labaran, Musa, Mathur and Saini, 2024). This global scenario is explained by a quadratic fit between CO_2 emissions versus GDP per capita, with the prospect of a carbon footprint reduction in 2030. Hence, control measures to achieve this fit include lowering the clinker ratio, sustaining a good fuel mix (also the type of fuel), increasing the thermal substitution ratio (i.e. the use of alternative fuels, especially biomass through agricultural waste), energy-efficient kilns, carbon capture and storage systems (Kumari *et al.,* 2024).

Lafarge Cement reported a net CO_2 performance of 575kg/tonne in 2017 (-0.3% as against 2016). The report showed 151,786 and 127,300 tonnes of waste-derived resources in 2017 and 2016, respectively. Air emissions such as dust (i.e. particulate matter-PM), NO_x and SO_2 were at 244, 2817 and 1414 tonnes, showing a 22% reduction from 2016 numbers (Lafarge Africa Sustainability Report, 2017). These exact numbers for Dangote Cement read 38%, 42% and 14% decrease in PM, NO_x and SO_x absolute emissions per tonne of clinker in 2023 (Dangote Cement Plc Annual Report and Accounts, 2023). The leading cement-producing company boasts of a 184% increase in co-processed waste as an alternative fuel (446 Ktonnes in 2023 compared to 157 in 2022); while Lafarge reported increased use of geocycle model alternative fuels in kilns up to 45% of energy resource in Ewekoro 1 and 35% in Sagamu. Dangote Cement Plc also reported a net CO_2 of 13 kg/tonne from continuous emission monitors in scope one emission and 1.89 tonnes of waste recycled (Dangote Cement Plc Annual Report and Accounts, 2023). The company, being guided and regulated by the Global Cement and Concrete Association (GCCA), recorded an 11% improvement in sustainability training, a 2.2% reduction in CO_2 emissions (17.7 - 17.4 MMT), a 25% increase in social investment and tax payment of ₦166,129 million (this is compared to ₦150,766 million in 2022). According to Dangote Cement Plc Annual Report and Accounts (2023), total Corporate Social Responsibility (CSR) spending equals ₦2,355,586,868.43 in 43 projects and 6696 beneficiaries.

2.4. Types of cement

Types of cement include neat Portland Cement (PC) (yearly global output of around 3.8 million cubic meters); Portland Pozzolan Cement (PPC) (i.e. pozzolanic clinker ground with Portland cement; or fine pozzolan and used with gypsum or calcium sulphate) (Shaw, 2012); Rapid Hardening Cement (with higher lime content, higher C_3S content, and finer grinding, for quicker removal of formwork and to boost construction speed and save formwork costs); Quick setting cement (Shaw, 2012); Low Heat Cement (increased amount of C_2S and below 6% tricalcium aluminate (C_3A)) for mass concrete construction (Świtała et al., 2018); Sulphates Resisting Cement SRC (in canal linings, culverts, retaining walls, and siphons (Woodward, 2004); Blast Furnace Slag Cement (clinkers with around 60% slag); High Alumina Cement (A bauxite-lime mixture melted and mixed with clinker - 3.5 hours initial set time and 5 hours final setting time for concrete subjected to extreme temperatures, frost, or acidic action (Shaw, 2012); White Cement (Sumaila, 2014); Coloured cement (5 -10% mineral pigments and normal cement); Air Entraining Cement (Clinker plus air-entraining compounds such resins, glues, sodium salts of sulphates, and other indigenous air-entraining agents for improving workability and frost resistance in concrete that has a lower water-cement ratio) (Woodward, 2004); Expansive Cement for grouting Anchor bolts and prestressed concrete ducts are typically grouted using this cement (Shaw, 2012); Hydrographic Cement (composed up of water-repellent chemicals).

2.5. Properties of cement

To ensure a level of consistency between cement-producing plants, certain chemical and physical limits are placed on cement. A variety of standards and specifications define these chemical limits. For instance, Portland cement and blended hydraulic cement for concrete in the U.S. conform to the American Society for Testing and Materials (ASTM) C150 (Standard Specification for Portland Cement), C595 (Standard Specification for Blended Hydraulic Cement) or C1157 (Performance Specification for Hydraulic Cement).

The British types of cement conform primarily to the British/European Standard BS EN 197-1 and BS EN 197-5, which provides a test method that is necessary for the choice of cement, especially the type and/or

strength class to ensure durability depending on exposure class and type of construction.

2.6. Chemical composition of cement

Lime (CaO), silica (SiO_2), and alumina (Al_2O_3) are the three major oxide compositions responsible for influencing the various properties of cement. An increase in lime content beyond a particular value makes it difficult to combine completely with other compounds. Consequently, free time will exist in the clinker and will result in unsound cement. An increase in silica content at the expense of alumina and ferric oxide makes the cement difficult to fuse and form clinker (Kolawole, 2011). Other chemical composition in cement other than these principal oxides includes iron oxide (Fe_2O_3), magnesia (MgO), sulphur trioxide, soda/or potash ($Na_2O + K_2O$) (Akers, 2001).

2.7. Physical properties of cement

Physical properties of cement include fineness, soundness, consistency, setting time, compressive strength, the Heat of hydration, loss on ignition, specific gravity (or relative density), Bulk density, and chemical shrinkage, amongst others. Most of these physical tests are carried out using mortar or paste created from the cement. This testing confirms that cement can perform well in concrete; however, the performance of concrete in the field is determined by all of the concrete ingredients, their quantity, as well as the environment, and the handling and placing procedures used.

2.7.1. Fineness

The degree of hydrolysis, which is critical for the rate of strength gain, is controlled by the fineness or particle size of Portland cement. The greater the surface-to-volume ratio of a particle, the more surface area is available for water-cement interaction per unit volume. Cement particles are typically less than 45 microns in size, with an average particle size of approximately 15 microns. Surface area per unit mass is used to calculate fineness. The Wagner turbid meter test, the Blaine Air-permeability test, a 45-micrometre sieve, or an electronic particle size analyser can all be used to determine fineness (American Society for Testing and Materials, 2012).

2.7.2. Soundness

This is the tendency of a hardened cement paste to maintain its volume after it has set. Cement samples containing high quantities of hard charred free lime or magnesia are unsound. The autoclave expansion test is used to verify the cement's soundness (Richardson & Carrielies, 2012).

2.7.3. Consistency

The ability of a cement paste to flow is referred to as consistency. For evaluating cement specimens, regular consistency pastes must be created. When the lever of the Vicat instrument penetrates a paste by 10 mm, it is deemed to have a normal consistency (Richardson & Carrielies, 2012; Kolawole, 2011).

2.7.4. Setting Time

The curing period of cement is one of its most important properties since it dictates how much time the contractor has to lay and complete the concrete. The initial setting time refers to the amount of time it takes for the paste to lose its fluid or plastic properties once it is wet. The time it takes for the cement paste to reach a certain level of hardness to sustain a weight, on the other hand, is referred to as the final setting time. The Vicat device or the Gillmore needles are used to determine the setting time (Kolawole, 2011).

2.7.5. Compressive Strength

It is the most common strength test. A test specimen (40mm) is taken and subjected to a compressive load until failure. The loading sequence must be between 20 seconds and 80 seconds. Because cement strength varies over time, it is sometimes referred to as three-day, seven-day, or twenty-eight-day strength.

2.7.6. Heat of hydration

When water is added to cement, the reaction that takes place is called hydration. Hydration generates Heat, which can affect the quality of the cement and also be beneficial in maintaining curing temperature during cold weather. However, when heat generation is high, especially in large structures, it may cause undesired stress. The Heat of hydration is affected most by C_3S and C_3A present in cement, and also by water-cement ratio, fineness, and curing temperature. The Heat of hydration of Portland cement is calculated by determining the difference between the dry and the partially hydrated cement (obtained by comparing these at the 7th and 28th days). This is measured using a conduction calorimeter (Curuksu, 2018).

2.7.7. Loss on ignition

At temperatures ranging from 900 to 1000 °C (1650 to 1830 °F), a defined-weight cement sample is heated to a consistent weight. The weight loss of the pattern due to heating is then calculated. A significant loss in ignition indicates rehydration and carbonation. This could be a result of improper storage, degradation, or adulteration (more than 3 per cent) (Curuksu, 2018).

2.7.8. Specific gravity (relative density)

In concrete mix proportioning, specific gravity is usually necessary. The particle density of PC ranges from 3.1 to 3.25 megagrams per cubic meter (calculated by removing air between particles). OPC's relative density is considered to be 3.15. Le Chatelier's equipment is used to determine the density of cement (Curuksu, 2018).

2.7.9. Bulk density

By dividing the mass of cement particles and the air between them by the volume of the cement sample, the

Bulk density can be calculated. Ordinary Portland cement has a Bulk density of 830 kg/m^3 to 1650 kg/m^3. This test may be performed using two beakers with the same amount of cement. One beaker's cement is gently vibrated, leading to a volume decrease (Cooper & Schindler, 2011).

2.7.10. Chemical shrinkage

Chemical shrinkage measurement is another convenient way to track hydration kinetics. Because cement hydration products take up less space than the starting elements (cement and water), a moisturised cement paste will absorb water in direct proportion to its hydration level. Depercolation of the capillary porosity can significantly reduce the permeability of the cement paste, limiting its imbibition rate below that required to maintain saturation during the hydration process, except for low w/c ratio pastes (about 0.4). Using a coverage factor of 2, the highest extended error in the computed chemical shrinkage was initially slated to be 0.001mL/g of cement (Di Bella *et al.*, 2017)

2.8. Strength grades of cement

There are two primary cement grades, namely grade 32.5 and grade 42.5.

32.5 grade is a general-purpose cement suitable for all construction works. It has a low heat of hydration, which makes it suitable for plastering/rendering, block making, and concrete works. 32.5 grades of cement available in Nigeria's cement market are: Elephant Classic, Unicem, Ashaka Cement, Dangote, and Falcon (Sumaila, 2004).

42.5 grade has a high heat of hydration and is suitable for precast concrete, heavy concrete works, and block making. 42.5 grades of cement available in Nigeria's cement market are: Elephant Supaset, Powermax, Dangote 3X (i.e. DanCem), Blockmaster, and BUA. It is noteworthy that the designation N or R that follows the strength grade rating refers to the speed of strength development (i.e. Normal and Rapid, respectively). It indicates the speed at which a cement brand attains a large proportion of its strength rating after (say, three and a half days) when cured as appropriate.

2.9. Theoretical underpinning

The study identifies cement brands often used by respondent professionals on their sites. It examines end-users' perceptions of cement brands' acceptability in relation to factors influencing the choice of a particular brand of cement. This is to enhance sales and cement product improvement. Its theoretical underpinning includes the application of relationship quality dimensions (Hennig-Thurau & Klee, 1997) and the role of technical support to expose end-users to the functionality of cement products and enlightenment on cement product differentiation to manage sales outcomes outrightly. Hennig-Thurau and Klee (1997) conceptualised relationship quality to buoy assertions of a direct empirical association between satisfaction and core company goals or outcomes (e.g. customer retention and sales). This concept functions to reduce cost and uncertainties in the purchase of products, thereby building a higher confidence level in buyers and fulfilling other social needs, such as attractive packaging of cement and the brand name/image's implication for customers' identity, and even end-users' self-actualisation. Hennig–Thurau *et al.* (2002) stressed the general agreement that satisfaction, trust, and commitment to the relationship with the service firm or manufacturing company brand are key components of relationship quality. It is noteworthy that retaining a client costs a tenth of the cost of obtaining a new one (Sunmola *et al.*, 2021).

Customers' trust and consequent repeated buying potential have been used to explain cement brand communication; a binder for business and relationship (Sunmola et al., 2021). The researcher has observed this to be critical to cement business in a 5½ year site engagement. Relationship quality dimensions drive the cement business. It is a laudable approach to the question of what end-users stand to gain for identifying with a cement brand's range of products over time, because retailers are usually next to wholesalers in the event of reward programs from cement companies. The important place of end-users in the relationship quality framework needs to be prioritised.

2.10. Factors contributing to end users' decision to purchase particular brand(s) of cement

Factors contributing to end users' decision to purchase particular brand(s) of cement include quality (Uggla, 2006), price (Kalumikiza, 2022), influence by others (Maity, 2014), advertising (Aaker, 2008), packaging for product preservation, attractive packaging and complex branding impression to forestall counterfeiting and product differentiation (Kotler and Armstrong, 2013; Oliver, 2009), convenience or easy access i.e. availability (Lin and Chang, 2003) distribution channel i.e. local dealer and retailer, self – decision and influencer recommendation (Maity, 2014), after sales support services (Onu and Adegbola, 2018), brand awareness (Sunmola et al., 2021; Świtała et al., 2018), sales promotion (buy and win, spell and win etc.), end-of-year fringe benefits, premiums, coupon, temporary price discounts, letters to trade, proforma invoice and trade shows (Oliver, 2009), market conditions (natural market zone) (Sumaila, 2004), transportation and handling costs, proximity of wholesale or retail outlet to end – user's site (Shaw, 2012), and Corporate social responsibility (CSR) to enhance cement companies' image (Babalola, 2012). According to *Lafarge* Cement End User Market Discovery Survey (2022), factors contributing to end – users' choice include availability, price, strength, colour of cement, good finishing of building unit produced with cement, good workability, dries faster, provision of credit facility and flexible terms of

payment, brand name or image, proximity or nearness of cement outlet to end – users' jobsite, promptness of delivery, good working relationship between company's representative and buyer (or end – user), provision of technical support, reputation of supplier (or credit worthiness), value creation through provision of additional services such as estimating for materials and labour for building works, assisting retailers to deplete cement stock by sourcing more end – users' site and blockmaking jobsites, attendance in Blockmakers' Association Meetings to carry out cement trial mixes, carrying out cement and mortar trial mixes at renown Estates and Property Developers' office buildings and thus fostering partnership for increased sales and direct site sales initiative. Business ethics, full cement bags, addressing complaints (feedback) of end-users over time, strong presence of retail outlets, and brand dominating the target market at the moment, are other factors that emanated from the end–user market discovery (*Lafarge* Cement End-User Market Discovery Survey, 2022).

3. Research Methodology

The research utilised primary and secondary data. The research method summed up the study population, sample size, sampling technique, data analytical method, and discussion of results. The research examined factors influencing end–users' decision to purchase brand(s) of cement from information elicited from building construction professionals. A total of 203 copies of the questionnaire were randomly administered to end – users i.e. construction professionals conveniently sampled from a list of active sites on Lafarge Cement Lagos Island (Simawa) and Mainland (Ikeja and Lekki – Ajah) Sales Excellence archive (as at March 2023) with one hundred and nineteen (119) returned implying 58.6% return rate. The fraction of active sites for the three selected sales teams relative to the nine teams that make up the study area equals 203/648, i.e. a third of the total active sites. These three teams were conveniently sampled to cover the island and mainland of the study area. The questionnaire was divided into three sections: general information, including the respondent's demographics, professional inclination, and experience level in the construction industry. The second section comprises prevailing brand(s) of cement in Lagos Island and the Mainland cement market.

In contrast, the last section comprises factors influencing the choice of cement brand(s) in the study area. General information of respondents was designed as nominal and multiple-choice, and identification of prevailing brand(s) of cement was designed as a pairwise scale on the Analytical Hierarchy Process (AHP), with the five common brands noticeable in the market paired against themselves to have ten pairings (i.e. a 5x5 matrix). The AHP pairing scale rates 1,3,5,7 and 9. 1 representing equal importance i.e. a pair of measures compares (or competes) equally in importance; 3 representing moderate importance; 5 for high importance; 7 for very high importance and 9 means extreme importance i.e. for a pair of cement brand, one brand (on the left-hand side) is "extremely favoured" when compared to the brand on the right-hand side; as perceivably weighed by respondents. Thirty-nine factors influencing end–users' choice of cement brand(s) were ranked on a Likert scale of 1 – 5 in increasing level of importance; with 1 representing unimportant, 2 representing low importance, 3 representing substantial importance, 4 representing high importance, and 5 representing very high importance. The general information was analysed using frequencies and percentages, and the prevalent brands of cement were ranked using the AHP priority eigenvector. In contrast, cement purchase decision factors were analysed using the mean score and factor analysis to group the factors and determine the prevailing cement brand(s).

The essence of AHP is the decomposition of a decision problem, while the principal assumption is that the goal is attainable through the fulfilment of partial goals leading to the overall objective. All variant solutions submitted to analysis satisfy the expectations, but to various degrees. The extent to which a given decision variant fulfils the goal depends on the degree of fulfilment of the main criteria and adequately grouped partial criteria (Szafranko, 2017). A hierarchy model composed of several levels (e.g. 4) is constructed to evaluate alternative options. Then, all criteria on the same given level are pairwise compared against the goal for their importance and the values derived from comparisons are entered into a comparison or judgment matrix A. The number of compared pairs that make up the matrix depends on the number of defined criteria. The diagonal of the matrix is composed of values equal to one because it comprises comparisons of each criterion to itself (aij =1 for i=j). At the same time, components aji are the reverse of aij. Logically, all aij>0. Decision-making is achieved through three integrated stages in a logical sequence: development of a hierarchy model (determination of criteria), assessment of the criteria on a nine-point scoring scale and evaluation and ranking of the variants by assigning to them priorities, while also taking into consideration the vectors of partial criteria. The advantage of the AHP Scale is that it compares two decision elements (or criteria) at a time, thus making the decision maker more focused. Consequently, the accuracy and reliability of the response are improved. The AHP pairwise scale gives every compared element a match against every other element on the list, thus making the perception of respondents more accurate on a fundamental scale; unlike if the elements were to stand solely and rated in a relative importance index (Saaty, 2001; Ramoutar K. & Syan, 2009). The fundamental scale is a one-to-one mapping between the criteria (i.e. choices) available to the decision maker (Oladapo, 2011). In comparing

criterion A to criterion B, a decision maker may determine, using the scale, that A is highly favoured as paired with B and assign a relative value of 9 to A. This means that the relative value of B to A is 1/9. The judgments on pairs of criteria are presented by an n x n matrix, by adding relative values from all pairs across the total responses obtained.

Cement purchase decision factors were analysed using mean score rating and standard deviation according to equations (1) and (2).

$$\textbf{Mean Score } (\textbf{MS}) = \frac{\textbf{sum of all variables}}{\textbf{frequency of allvariables}} \quad \text{..... (1)}$$

$$Standard\ Deviation(SD) = \frac{\sqrt{\sum f(X-\bar{X})^2}}{\sum f} \quad \text{..... (2)}$$

4. Results and Discussion

4.1. Profiling

The profiles of the respondents and organisations were investigated based on the respondents' opinions and presented in Table 1 (Appendix 1).

4.2. Cement brands

Findings from Bonney *et al.* (2022) revealed that DanCem ranked 3/8 and 2/8 in consumer awareness and preference, respectively, in Ghana; while Dattaray (2017) reported stiff competition among prevalent brands in Cuttack and Bhubaneswar, with the Lafarge brand ranking low in preference when compared to local brands in India. According to Kalumikiza (2022) in Malawi, 43% of 33% not using the predominant brand (67% overall end-usage) use DanCem. Thus, ranking two out of seven (2/7) brands identified by the author, though with low numbers (14%).

4.3. Factors contributing to end–users' decision in cement purchase

Table 3: Total Variance Explained - Factors influencing end–users' decision to purchase cement

Total Variance Explained						
Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.232	28.801	28.801	4.408	11.302	11.302
2	3.232	8.287	37.088	4.061	10.413	21.715
3	2.451	6.284	43.373	3.906	10.015	31.731
4	2.033	5.214	48.586	3.668	9.405	41.135
5	1.534	3.933	52.519	2.981	7.645	48.780
6	1.504	3.856	56.376	2.962	7.596	56.376

The study factored thirty-nine (39) factors contributing to end–users' decision to cement purchase to reduce them to principal components. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy test carried out showed that the data collected were adequate for the analysis, and Barlett's test of sphericity (p = 0.000) was highly significant. The total Variance explained by the resulting six (6) factors extracted via principal component analysis with eigenvalues greater than 1.500 is shown in Table 3. By considering a cut-off point for the score loading with an absolute value greater than 0.400, the components and the corresponding critical factors loading are presented in Table 4 (Appendix 1). The extracted six (6) components explain approximately 56.4% of % variability in the original thirty (39) factors. The rotation sums of squared loadings revealed the percentage of variables accounted for by extracted components as listed in a uniformly distributed manner of 11.30%, 10.41%, 10.02%, 9.41%, 7.65%, and 7.60%.

Research findings support the position of the company's responsibilities; in carrying out timely market discovery surveys and promptly addressing

Table 2: Priority vector for the second (iteration) inconsistent matrix

		Eigenvalues	Rank
DanCem	2819.79	0.39	1
Classic	1647.76	0.23	2
Supaset	1616.77	0.23	2
BUA	712.06	0.10	4
Purechem	419.04	0.05	5
	7215.42	**1.00**	

feedback from the end–users of the cement product, extending fringe benefits to end–users (as they do retailers) at the end of each business year, partnering with research institutes and sponsoring research, periodic intervention programs for interlocking block and kerb-makers and concrete electric poll-makers. Weniger *et al.* (2023) corroborated findings by stating that companies need to reach out to consumers with comprehensive information, including information on the sustainability of products through the use of sustainability certificates and labels, among others. The authors also reported the need to reward positive buying and consuming behaviours or changes in consumer attitude based on how these behaviours influence sustainable living and the inclusion of sustainability-related criteria in a purchase decision. This view also defines company responsibilities. Mishra and Sharestha (2019) noted that non-availability of the desired brand (as an unpredictable factor) modifies the actual choice made by an end – user i.e. if cement is available (Mean = 4.28, Rank 3) - availability is a factor of cement and cement properties (cement strength (4.34, Rank 1), good workability (4.30, Rank 2), dries faster (4.08, Rank 5), weighty or full bags (4.03, Rank 7); features such as consistency, instant or fast drying, packaging, distribution and prompt delivery method (3.81, Rank 9) become predominant expectations from the end – users (Murugan & Ganapathi, 2012). In line with this, Ivanova and Smetanina (2016) noted the socio-ecological dimension of the cement industry. However, they reported Russian respondents who could not afford environmentally friendly houses (building materials) because of high prices. Besides, the authors affirmed that the environmental friendliness of construction/finishing materials is not among the values of the piloted respondents. Retail factors comprising good working relationship with the retailer (3.77, Rank 11) and reputation of retailer (3.76, Rank 12) are also held as store brand variables in impacting the choice of end–users (with twice the deviation from the least ranked to deviation from cement strength). Store familiarity, viz. Store image is an important determinant of the choice of end-users (Diallo *et al.*, 2013).

Furthermore, sales representatives and technical assistants selling directly to construction sites are an overlap between the retail factor and the technical assistance factor (3.71, Rank 14). This is in line with providing additional services for renowned Estates & Property Developers to boost sales (3.50, Rank 18) and the attendance of sales representatives and technical assistants in Blockmakers' Association Meetings to carry out cement and mortar trial mixes to attract customers (3.45, Rank 21). This aspect of technical support is a key focus of this research. It can also be captured in Ivanova and Smetanina's (2016) role involving the target-oriented generation of awareness among customers and consumers, and commodity positioning. This, according to the authors, will result in new methods and techniques for the distribution of construction products in the retail market as well as motivate end-users on the sociological dimension of these construction materials.

Household name/brand currently dominating the market ranked 10th (Mean=3.79). The gap between the dominance of the Dangote brand (as the major brand across the length and breadth of Nigeria between 2021 and 2024) and other major players in the Nigerian cement industry remains (Sunmola *et al.*, 2021). The authors found awareness, familiarity, and image (being elements of brand communications) to be predictors of customers' trust, with the brand image having the least positive coefficient of the three (Pitso, Ligaraba, and Chuchu, 2023). For the authors and marketing-wise, trust binds businesses and relationships in transactions. Digital advertisement, the use of celebrities in promoting brands, and creativity in packaging cement (as it relates to marketing) ranked 29, 39, and 37. This agrees with Bonney *et al.* (2022), Mishra and Sharestha (2019), and Pitso, Ligaraba, and Chuchu (2023), who reported that advertisement and sales promotion do not play a significant role in the end–users' preferences and cement purchase decisions. For both authors, respondents also downplayed the factor of price in purchase decisions. As shown in Table 3, the provision of credit facility of payment Rank 38), favourable and flexible terms of payment and doing business (Rank 35), and discounted or subsidised price (for focus or sensitive markets) (Rank 32); all of which are price concerns ranked least – in mean scores and initial eigenvalue of 1.53 compared to 11.23 for factor of company responsibility.

4.4. Summary of factors and corresponding mean score

The first component (factor with total initial eigenvalue of 11.23) is mainly correlated with Company responsibility. It comprises involvement in Corporate Social Responsibility (0.461), partnering with research institutes (such as Nigerian Building and Road Research Institute - NBRRI etc) (0.460), proforma invoice (0.539) and offering fringe benefits to end – users at the end of each business year; amongst others (0.657).

The second factor is correlated with cement properties (eigenvalue = 3.23). It comprises cement strength (0.721, Rank 1), good workability (0.563, Rank 2), availability (0.714, Rank 3), dries faster (0.675, Rank 5), full bags (0.604, Rank 7), amongst others.

The third factor is correlated with retailing (eigenvalue = 2.45). It comprises a good working relationship with the retailer (0.619, Rank 11), the reputation of the supplier (retailer) (0.484, Rank 12), proximity of retail outlet to site (0.672, Rank 12), Sales representative

(Technical Assistant) selling cement directly to site (0.459, Rank 14); amongst others.

The fourth factor is correlated with marketing (eigenvalue = 2.03). It comprises "household name/brand currently dominating the market (0.569, Rank 10) and company innovation on product differentiation (0.556, Rank 18). Results showed that use of celebrities (0.580, Rank 39), digital advertising (0.792, Rank 29), and creativity in the packaging of cement products do not contribute to end–users' decision–making, relative to other factors independently.

The fifth factor is correlated with price (eigenvalue = 1.53). However, the standard deviation of price as an independent factor (1.2233) is the fourth highest (>1.0000); in the group with provision of credit facility of payment (0.449, SD = 1.3433, Rank 38), use of celebrities (SD = 1.3268), discounted or subsidised price (0.489, SD = 1.3094, Rank 32). This indicates that the opinions of respondents are diverse and varied. Hence, there is no margin of agreement from respondents on price as a factor in cement purchase.
The sixth factor is correlated to technical assistance (eigenvalue = 1.50). It comprises a company identifying with renowned estate developers such as Adron Homes (0.608, Rank 19) and attendance of Technical Assistants in the Blockmaker's Association meeting (0.602, Rank 21).

4.5. Role of Technical Assistance

The research found that the role of Technical Assistance (TA) in end-use is unpopular among respondent construction professionals who are more used to the 'sales representative' or 'marketing' description (with 5.2% variance explained compared to 3.9% for TA). Factors such as estimating for building materials and labour, and end-users' market discovery surveys, which require technical inputs, ranked 30th and 27^{th,} respectively. Carrying out cement and mortar trial mix and attendance of Technical Assistants in Blockmakers' bi-weekly or monthly Association Meetings ranked 22nd and 21st respectively; while the company identifying with renowned Estates and Property Developers and Technical Assistants selling directly to end–users' sites to boost sales representatives' monthly quota ranked 18th and 14/39.

5. Conclusion

This research determined factors influencing end–users' decision to purchase cement brand(s) by first identifying prevailing cement brands in the study area, then the factors of the purchase decision. The research sourced data through a questionnaire survey (203) administered to construction industry professionals randomly sampled from a list of active sites on Lafarge Cement Lagos Island (Simawa) and Mainland (Ikeja and Lekki – Ajah) Sales Excellence archive (as of March 2023) with one hundred and nineteen (119) returned; 58.6% return rate. Findings revealed that:

i. The most prevalent cement brand is DanCem (AHP eigenvalue = 0.39). The Lafarge brand seconds this – both Elephant Classic and Elephant Supaset cement have an eigenvalue of 0.23. BUA cement ranked ^{fourth} (0.10) while Purechem ranked least (0.05).
ii. The most prominent factor influencing end–users' decision to purchase cement brand(s) is the factor of company responsibility (Eigenvalue = 11.23), which explains 28.8% of the total Variance in the initial thirty-nine (39) itemised factors. This is followed by factors of cement and cement properties (strength, good workability, availability, dries faster, full bags, and good finishing (Mean = 4.24, Rank 4). Promptness of delivery to the point of use is also prominent (Mean = 3.81, Rank 9).
iii. The factors of company responsibility and self-decision in cement are the predominant influences in end–users' decisions to purchase cement.

6. Recommendations

The following recommendations are germane to the smooth running of the cement industry:

- Manufacturers should also pay attention to end-users and reward them accordingly, as they do wholesalers and retailers. Blockmakers feel undermined by cement companies.
- The study can help cement manufacturers become strategic in optimising their profits while also incorporating green practices into the manufacturing process of cement to protect the ecosystem.
- Cement companies' sales excellence and other associated departments should initiate timely market discovery surveys in order to keep pace with consumers' preferences and feedback on the range of products stocked and used.
- Cement companies should improve the career paths for field agents, engineers, and builders.
- The study is useful in motivating cement companies to assist in the sustainable development of the built environment. Hence, involvement in Corporate Social Responsibilities (CSR) should be seen as entrenched in the researcher's findings on company responsibility.
- Cement-making companies should do more publicity about their CSR activities (as part of their marketing strategies) to boost patronage.

7. Implications of Research for Stakeholders in the Cement Business

The current production rate of cement accelerates the depletion of natural resources, which results in the consumption of about 1.5 tonnes of limestone and clay per ton of cement (Miraki *et al*., 2022). Hence, there is a need to strongly emphasise and incorporate sustainability concerns (Sheth & Parvatiyar, 2021). Thus, further studies could examine the socio-ecological dimensions of cement for sustainable development, both in the context of businesses and the construction industry. The ratio of the company's haulage cost for cement to the end-user price, and its association with the availability of cement, could also be examined.

The findings of the research stress the need to increase technical input and improve cement properties (product quality) ahead of marketing concerns and promotion (Bonney *et al*., 2022; Pitso, Ligaraba, and Chuchu, 2023). This will ensure end-users have value for money and a transformative experience in the purchase and use of cement. Furthermore, retailing and relationship quality factors such as good working relationships with the retailer, the reputation of the supplier (retailer), the proximity of retail outlets to sites, and the jurisdiction of sales representatives/technical assistants to sell directly to the construction site are key for the research. This link between retail, technical support, and relationship quality dimensions is a theoretical basis for the research (Hennig-Thurau & Klee, 1999). It results in entrepreneurship, self-actualisation, and mission-driven outcomes (Sheth & Parvatiyar, 2021).

The question of how cement companies reduce complexity in buying situations comes to the fore because different buyers have different criteria for what constitutes the best alternative (Sheth & Parvatiyar, 1995; Hennig–Thurau *et al.*, 2002). Thus, product availability in sufficient quantities (rank 3), competitive pricing (rank 6), and a good transportation system for prompt delivery to the site (rank 9) must be leveraged to maintain smooth running and sanity in the industry. The industry has been blighted with numerous and recurring instances of payment for cement (in tons) without delivery, one month or more after.

Lastly, affordability of cement is an ensuing discussion on everyday blockmaking and building construction sites with prevailing realities such as lack of provision of credit facility of payment (rank 38), absence of favourable and flexible terms of payment and doing business (rank 35) and absence of discounted or subsidised price (for focus or sensitive markets) (rank 32). The business transitioned over the past six years and recapitalised, just like the Nigerian banking sector in 2005. This calls for a further overview of the supply chain and factors of haulage and transportation of cement.

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Appendix 1

Table 1: General information of respondents

N = 119	**Frequency(f)**	**Per cent (%)**
Sex		
Male	93	78.2
Female	26	21.8
Age (Years)		
36-45	46	38.7
26 -35	42	35.3
46-55	14	11.8
18-25	10	8.4
Above 56	7	5.9
Respondents' professional qualifications		
MNIOB	29	24.4
MNIQS	10	8.4
MNSE	6	5.0
MNIA	6	5.0
FNIOB	2	1.7
CIPM	1	0.8
CIPS	1	0.8
REDAN	1	0.8
No qualification	63	52.9
License/Registration with Council		
CORBON	29	24.4
QSRBN	10	8.4
COREN	6	5.0
ARCON	6	5.0
Not licensed/registered	63	52.9
Highest educational qualification		
BSc.	46	38.6
HND	33	27.7
MBA/M.Arch/M.Sc	31	26.1
ND	9	7.6
Respondent's area of specialisation		
Building	57	47.9
Civil Engineering	20	16.8
Quantity Surveying	16	13.4
Architect	10	8.4
Service (M&E) Engineering	8	6.7
Land Surveying	8	6.7
Category of respondent		
Project Site Engineer	50	42
Estate Developer & Facilities Manager	30	25.2
Individual Home Builder (IHB)	23	19.3
Blockmaker	16	13.4
Year of work experience		
6-10	42	35.3
1-5	37	31.1
11-15	26	21.8
16-20	7	5.9
Above 25	4	3.4
21-25	3	2.5
Types of projects		
Bungalow	53	44.5
Duplex	75	63.0
Commercial/Offices/Plaza	40	33.6

N = 119	Frequency(f)	Per cent (%)
Multi-storey buildings	29	24.4
Institutional/Schools/Hospital	24	20.2
Roads/Bridges/CVE Works	17	14.3
Electricity substation foundation/concrete poles	1	0.8

Table 4: Factors influencing end–users' decision to purchase cement

Factors	Loading	Mean	SD	Rank
Company				
• Company Involvement in Corporate Social Responsibility	.461	3.34	1.1892	**25**
• Partnering with research institutes (such as NBRRI, etc.)	.460	3.32	1.1345	**26**
• Issuing proforma invoices bearing the company labels and headlines to customers	.539	3.20	1.0860	**33**
• Provision of additional services such as estimating for building material and labour, market survey, etc	.692	3.23	0.9780	**30**
• Promptly addressing feedback from the end–users on-site to the company on the cement product.	.753	3.43	1.0622	**23**
• Timely market discovery surveys	.600	3.30	0.9962	**27**
• Offering fringe benefits to end–users at the end of each business year	.656	3.10	1.1818	**36**
• Intervention for interlocking block and kerb makers, and concrete electric pole makers	.657	3.25	1.1140	**28**
Cement				
• Availability of cement				
• Dries faster	.714	4.28	0.9381	**3**
• Cement strength	.675	4.08	0.8980	**5**
• Good workability	.721	4.34	0.8159	**1**
• Promptness of delivery to the site	.563	4.30	0.8978	**2**
• Bags always full	.592	3.81	1.0024	**9**
	.604	4.03	0.9472	**7**
Retailing				
• Good finishing	.622	4.24	0.8534	**4**
• Good colour/appearance	.446	3.52	1.0802	**16**
• Brand name/image	.727	3.67	1.0978	**15**
• Proximity of retail point or depot to the site	.672	3.76	1.0633	**12**
• Carrying out a cement and mortar trial mix	.589	3.44	1.0548	**22**
• Good working relationship with the retailer	.619	3.77	1.0770	**11**
• Reputation of the supplier (retailer)	.484	3.76	1.0248	**12**
• Sales Representative/Technical Assistant selling directly to the construction site.	.459	3.71	1.0427	**14**
Marketing				
• Years since the establishment of the cement company	.716	3.47	1.2131	**20**
• Digital advertisement	.792	3.24	1.1121	**29**
• Use of celebrities to promote a brand	.580	2.63	1.3268	**39**
• Creativity in packaging cement products	.528	3.08	1.1467	**37**
• Company innovation and cement product differentiation	.556	3.50	1.0567	**18**
• Cement brands currently dominating the market	.569	3.79	0.8913	**10**
Price				
• Price	.449	4.06	1.2233	**6**
• Provision of a credit facility for payment	.730	3.03	1.3433	**38**
• Favourable and flexible terms of payment and doing business	.770	3.18	1.0708	**35**
• Discounted or subsidised price (for focus or sensitive markets)	.489	3.22	1.3094	**32**
• Incentive for the prompt delivery of cement to the site	.594	3.23	1.1157	**31**

Factors	Loading	Mean	SD	Rank
Technical Asrenownedce				
• Company identifying with renowned Estates & Property Developers (e.g. Adron Homes) and carrying out cement/mortar trial mix	.608	3.50	0.9989	**18**
• Company sponsoring annual conferences/AGM of professional bodies	.740	3.20	0.0937	**34**
• Attendance of Sales Representatives (Technical Assistants) in Blockmakers' Association Meetings	.602	3.45	0.9633	**21**