

Empirical assessment of the impacts of Sino-African cross border relations in the construction industry: a Confirmatory Factor Analysis approach

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Abstract

Purpose – It is no news that Chinese construction companies are highly motivated to invest in Africa in terms of infrastructure and construction. This influx from the beginning of the millennium marked a game-changer for infrastructural development in most African countries. This study, therefore, explores how the partnership between China and Africa has impacted the construction industry in Africa with a focus on Nigeria.

Design/methodology/approach – A quantitative approach was adapted for the study, which is descriptive in nature, and the primary participants of the study were core construction professionals within the Nigerian construction industry. Data was collected via a structured questionnaire, and multivariate statistics was used to analyse the data.

Findings – The study results revealed that the benefits accrued from Chinese participation in the African construction industry can be classified into three distinct categories: socio-economic development through construction, land transportation system development and construction industry development. The study further revealed that Chinese involvement has been most beneficial to the development of the land transportation system in Nigeria with more investment in the construction and maintenance of roads and railways.

Originality/value – The study will serve as a basis for making informed future decisions on Chinese participation in the Nigerian construction industry as it exposes the impacts of the relationship within the current system. The outcome of this study can be used to refocus the partnership to ensure the optimum development of the local construction industry. The government and other relevant agencies can use the findings from this study to ensure that there is sustainable growth in the local construction industry through Chinese participation.

Keywords China-Africa relations, Construction industry, Cross-border relations, Infrastructure development, Foreign investments

Paper type Research paper

Introduction

A close-up aerial view across Africa will show that a large proportion still lacks a good road network, and some parts are even inaccessible, while railways or airports are even fewer (Akinshipe and Aigbavboa, 2020a). The influx of Chinese companies into Africa at the inception of the millennium marked the beginning of a game-changer for Africa's infrastructure. Over the past couple of decades, the Sino-Africa relationship has kept growing and waxing stronger. As the world's most populous country, which governs about 20% of the global population, China lacks enough natural resources to cater for its citizens



and is therefore considered a resource-poor country (Babatunde and Low, 2013). On the other hand, Africa as a continent is considered resource-rich, and its population can hardly exploit all the natural resources present on the continent. This disparity has brought both parties a mutually beneficial partnership (Dollar, 2016).

Du Plessis (2016) attributed two major factors to the continuous growth of China's relations with Africa. The first is that Chinese construction firms have been motivated to exploit opportunities in other countries because of the overcrowded Chinese construction industry. The second factor has to do with the level of inactivity in the African construction industry and the numerous opportunities brought about by the lack of adequate infrastructure within Africa. But in recent times, the Chinese have been criticised as wanting to colonise Africa. This can be connected to the large number of Chinese firms in Africa and their strong influence on the continent's infrastructural development and construction sector. Concerns have also been raised over the issue of Chinese construction firms moving in their own workers and materials as this does not support the mutually beneficial relationship with African countries as claimed (Dollar, 2016; Junbo, 2007; Du Plessis, 2016).

The African construction industry is still relatively underdeveloped when it comes to modern innovations (Zavari and Afshar, 2023). Compared to global standards, the technology deployed within the African construction industry is outdated and inferior (Sundaram *et al.*, 2011). The industry still struggles with diverse challenges to adopt emerging technologies (Adekunle *et al.*, 2020; John *et al.*, 2022). Chinese interest in the African continent is perceived as a means to an end for the African construction industry in the bid to catch up with the fast-evolving world (Alves, 2013). Several infrastructural stakeholders have applauded China's influence on developing African infrastructure and the construction industry. One project donor in Uganda sees Chinese investment in Africa as a positive trend for African infrastructure. Another donor residing in Nigeria sees Chinese investment as an opportunity for numerous local partners. Yet another donor residing in the US feels Chinese investment in Africa is a welcome development and describes it as clear-cut access to funds for infrastructural development (Infrastructural Consortium for Africa (ICA), 2015).

As a rapidly urbanising and developing continent, Africa should proactively meet and exceed global standards in all sectors, especially in the construction industry. This has necessitated a continuous partnership with China (Akinshipe and Aigbavboa, 2022). Babatunde and Low (2013) argued that while numerous studies have been carried out on Sino-African relations, little attention has been paid to the effects on the African construction industry. Consequently, the research question formulated for the study is: What are the impacts of Sino-African cross-border relations in the construction industry of developing economies? The study investigates how Sino-African relations have impacted the African construction industry using Nigeria as the area of study.

Literature review

The construction industry in developing countries: Nigeria as a case in point

According to Akanni *et al.* (2015), the Nigerian construction industry comprises a broad spectrum of organisations collectively responsible for constructing, altering, and repairing a wide array of buildings and civil engineering projects. This industry plays a pivotal role in Nigeria's economic growth and success. The critical importance of the construction industry to the national economy demands enhanced efficiency within the sector (Kadiri and Shittu, 2015; Ofori, 2012). The National Bureau of Statistics (2015) identified Nigeria as the most competitive economy in West Africa, boasting a vibrant construction industry experiencing a surge in construction activities. Ogunbiyi *et al.* (2017) emphasised the industry's significance during economic booms and recessions, with new projects launched in boom times and maintenance conducted during downturns. Olatunji and Bashorun

(2006) observed that approximately 6% of Nigeria's GDP is attributed to construction activities, which account for about 70% of the nation's fixed capital investment and provide 1–3% of job opportunities, totalling over three million jobs—a number that continues to grow due to rapid urbanisation.

Recent advancements in information technology have significantly influenced the construction industry, promoting global growth and enabling numerous firms to become transnational by expanding their operations into developing countries (Ogbu, 2018). African nations, including Nigeria, have benefited from the influx of transnational construction firms from China, Germany, the UK, and the US (Arewa, 2016). Babatunde and Low (2013) report that Chinese firms are active in over 70% of African countries, with a notable presence in Nigeria. Yet, the emergence of these transnational firms poses challenges to indigenous construction companies in Nigeria (Ogbu, 2018). The Nigerian construction sector is predominantly dominated by foreign and transnational companies, with Julius Berger Nigeria Plc leading the market. Nevertheless, it faces stiff competition from Chinese firms like the China Civil Engineering Construction Company (CCECC), which has recently secured significant projects from national and state governments and the private sector (Ogunbiyi *et al.*, 2017). The Nigerian president's 2016 visit to China resulted in over US\$ 6 billion in construction investments across key economic sectors (Omegoh, 2016).

In developing countries, the government is often the largest client of the construction industry, investing heavily in public infrastructure. Such investment boosts the construction industry and the economy and promotes socio-economic and national development (Oyewobi *et al.*, 2019). According to ICA (2015), governments of African countries are the largest investors in infrastructure on the continent, followed closely by China, making it a major financier of construction and infrastructure in Africa.

Sino-African partnership and Africa's infrastructural development

Over time, China has demonstrated a solid commitment to financing significant projects in Africa, positioning itself as a critical partner in the continent's economic growth and stepping in where European investments have traditionally dominated. Recognising infrastructure's critical role in Africa's ongoing development, China has made infrastructural projects its top investment priority. Between 2011 and 2013, China emerged as the leading investor in Africa's infrastructure, with annual investments estimated at US\$ 13.9 billion (Infrastructural Consortium for Africa (ICA), 2014). The pursuit of a reliable energy source to fuel economic growth has driven China's engagement with African countries, leveraging Africa's abundant natural resources (Renard and Nasser, 2011).

Chinese enterprises and financial institutions, encouraged by their government, have actively invested in Africa's infrastructure, particularly transportation, communication, and power sectors (Information Office of the State Council, 2013). These investments have led to the construction of roads, bridges, flyovers, ports, and railways, significantly boosting trade and economic development. Notably, Chinese companies have undertaken extensive railway projects across Angola, Kenya, and Nigeria, among others (Arewa, 2016). Furthermore, China's involvement extends to power infrastructure, exemplified by projects like the Malabo Gas Plant in Equatorial Guinea and a hydropower station in the Central African Republic. The country has also played a pivotal role in developing communication infrastructure and enhancing network quality through projects like the fibre-optic transmission network across Tanzania and six other countries.

China's funding of inter- and intra-country transportation projects in Africa aims to facilitate the movement of goods and people, thereby enhancing international trade.

Projects like the Lamu Port-South Sudan–Ethiopia Transport corridor and the standard gauge railway between Nairobi and Mombasa are poised to drive economic growth in their host countries and open Africa to further Chinese trade (Tukić, 2015). In January 2015, China and the African Union signed an MOU under Agenda 2063, committing to infrastructure development linking African capital cities via road, rail, and air (News 24, 2015). Additionally, agreements like the one between the Nigerian government and a Chinese company to develop mass housing in Abuja highlight the depth of China's involvement in Africa's urban development. In 2012, Africa hosted over 35% of China's international construction projects worth over US\$40.83 billion (Information Office of the State Council, 2013).

The 2015 African Union Memorandum of Understanding underscores China's role in advancing Africa's infrastructural landscape, promising the construction of high-speed railways, aviation routes, and highways within the ambitious framework of the African Union Agenda 2063. As Africa continues to develop, it faces the challenge of devising innovative strategies for sustainable growth while managing its relationship with China, an emerging global leader committed to improving the livelihood of its citizens. Africa's focus on accelerating infrastructure development and sustainability aims to meet the Millennium Development Goals, necessitating strategic policy formulations to foster beneficial relationships with foreign nations and promote a cohesive African agenda (Davies *et al.*, 2008).

Exploring the dimensions of the Sino-African partnership

China characterises its relationship with Africa as a mutually beneficial partnership, a perspective not fully shared by its African counterparts. This divergence in views became apparent during two joint conferences reported by Tukić (2015), where some African stakeholders expressed scepticism about the benefits of China's construction and infrastructure projects in Africa. The primary defence offered by Chinese representatives was that Africa has the autonomy to leverage these developmental projects to its advantage. The discussions highlighted the necessity for Africa to define, pursue, and uphold its own goals and objectives. The dialogue evolved beyond construction and infrastructure to emphasise Africa's need for proactive engagement in negotiations to secure optimal outcomes for its citizens. Ultimately, the consensus underscored the importance of effective and active African agencies in identifying and addressing the continent's infrastructure needs, suggesting that assistance from China should complement Africa's strategies. Thus, the future discourse should shift from "What can China do for Africa?" to "What can Africa do for itself?" (Akinshipe and Aigbavboa, 2020b).

Consequently, Africa's growth in infrastructure and construction will depend on negotiating agreements that align with the continent's needs. There's a pressing need to update infrastructure development terms in Africa, transitioning the Sino-Africa relationship from a primarily resource-exporter/donor dynamic favouring hard infrastructure to one fostering soft infrastructure capabilities. Such capabilities are essential for supporting, maintaining, sustaining, and expanding development projects without relying on foreign aid. Implementing the China–Africa capacity-building initiative, including scholarship and scholar exchange programs as agreed upon during the FOCAC VI in Johannesburg 2016, is crucial for this transformation (Du Plessis, 2016).

Methods

The study adopted a descriptive and quantitative methodology to investigate the impact of Sino-African relations on the Nigerian construction industry. A questionnaire survey was

chosen due to its effectiveness in gathering responses from a broad array of respondents, facilitating the quantification and objectivity of the research (Tan, 2011). A meticulously crafted close-ended questionnaire was distributed to construction professionals across Nigeria’s private and public sectors. This questionnaire was developed based on an extensive literature review, which helped identify various impacts of Sino-African relations on the construction sector, as detailed in Table 1.

Participants in this study included architects, construction managers, engineers, and quantity surveyors living and working in Nigeria, a country selected for its significant presence of Chinese construction firms and rapidly developing megacities. Maja-Pearce (2014) highlighted that Lagos State, Nigeria, alone hosts over 17,000 legally residing and working Chinese nationals, underlining its relevance to the study. The targeted respondents were construction professionals based in Lagos State, specifically those registered with their respective professional bodies. The study employed purposive and snowball sampling techniques, initially identifying professionals and subsequently using referrals for further participant recruitment. Out of 150 distributed questionnaires, 139 were returned and deemed suitable for analysis.

The survey method, frequently utilised to collect data from numerous respondents, allowed for comprehensive analysis and inference drawing from the collected data (Akinradewo *et al.*, 2022; Aliu *et al.*, 2022). The data analysis included the use of Mean Item Score for ranking identified impacts, Kruskal–Wallis *h*-test for assessing opinion differences among professionals, and both Exploratory and Confirmatory Factor Analysis (EFA and CFA) for evaluating impact uni-dimensionality and validating the constructs developed through EFA, as demonstrated by Ikuabe *et al.* (2022) and Ikuabe *et al.* (2023). Additionally, the dataset underwent tests for normality and non-parametricity, with a Cronbach’s alpha test confirming dataset reliability through a value of 0.866, indicating

Code	Variables	References
Bn.1	Expansion of domestic construction market	Akanni <i>et al.</i> (2015), Ogunbiyi <i>et al.</i> (2017)
Bn.2	Encourage effective cooperation with developed countries	Ogbu (2018), Akinshipe and Aigbavboa (2020b)
Bn.3	Access to aid for indigenous firms	Arewa (2016), Ogbu (2018)
Bn.4	Construction sector restructuring	Ogunbiyi <i>et al.</i> (2017)
Bn.5	Maximised project profitability	Omegoh (2016)
Bn.6	High rates of electrification	Oyewobi <i>et al.</i> (2019)
Bn.7	Extensive national rail network	Tukić (2015), Arewa (2016), Omegoh (2016), Akinshipe and Aigbavboa (2020a)
Bn.8	Extensive national road network	Tukić (2015), Arewa (2016), Omegoh (2016), Akinshipe and Aigbavboa (2020a)
Bn.9	Increased funding for road maintenance	Tukić (2015), Arewa (2016), Omegoh (2016), Akinshipe and Aigbavboa (2020a)
Bn.10	Improved rural access	Tukić (2015), Arewa (2016), Omegoh (2016), Akinshipe and Aigbavboa (2020a)
Bn.11	Increased penetration of ICT services within the construction industry	Sundaram <i>et al.</i> (2011), Akinshipe and Aigbavboa (2022)
Bn.12	Establishment of factories for materials fabrication and equipment assembly	Akinshipe and Aigbavboa (2022)
Bn.13	Training Nigerians to fabricate and produce various construction materials and equipment locally	Akinshipe and Aigbavboa (2022)
Bn.14	Improved ease of doing business for local construction firms	Ogunbiyi <i>et al.</i> (2017)

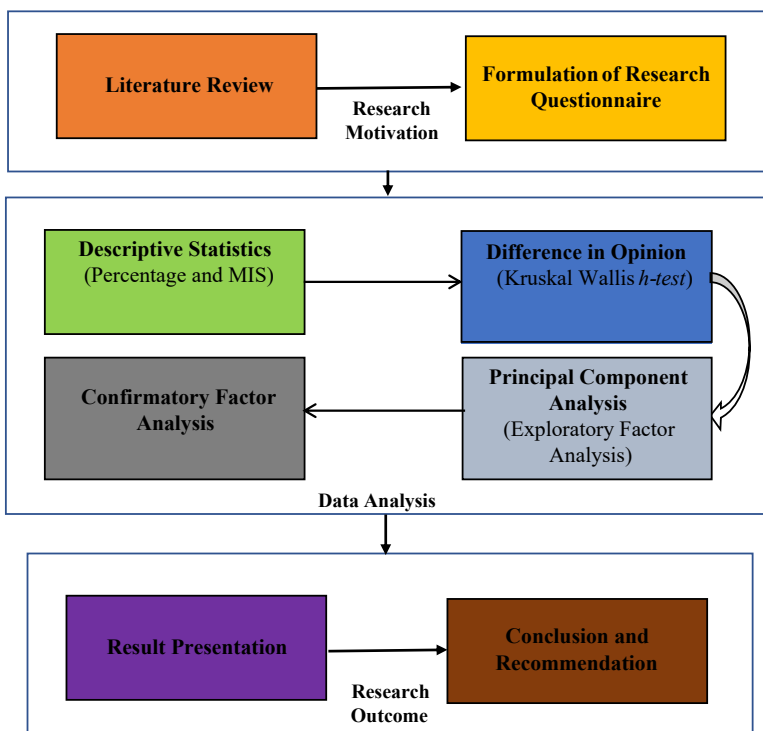
Source(s): Authors’ own creation

Table 1.
Referencing of
variables

strong internal consistency (John *et al.*, 2023; Pallant, 2010). This reliability suggests the dataset's suitability for detailed analysis to understand relationships between factors, clustering patterns, and factor confirmation. The methodological framework guiding this study is illustrated in Figure 1, showcasing the analytical tools and processes employed to dissect the impact of Sino-African relations on Nigeria's construction industry.

For this study, we collected data on the respondents' educational and professional backgrounds, employment histories, industry participation, and current job roles. According to the collected biographical information, the distribution among the professions was as follows: architects constituted 16.5%, construction managers 24.5%, engineers 28.8%, and quantity surveyors 30.2%. Furthermore, the data on industry experience showed that 30.9% of participants had a maximum of five years of experience, 38.8% had between six and ten years, 18.7% had between eleven and fifteen years, and 11.5% had over fifteen years of experience in the construction sector.

The biographical details also indicated that 33.1% of respondents were employed by consulting firms, 40.3% by construction companies, 20.1% worked for government agencies, and 6.5% were affiliated with academic institutions. In terms of academic qualifications, 8.6% held higher national diplomas, 51.8% had bachelor's degrees, 14.4% had postgraduate diplomas, 23% possessed Master's degrees, and 2.2% had earned PhDs. Notably, 62.6% of the respondents had experience working on projects involving Chinese partners, while 37.4% did not. This demographic provided insights from professionals with direct and indirect



Source(s): Authors' own creation

Figure 1. Research framework

experiences with Chinese partners, including those who have interacted through subcontracted work and supply chain management.

Results

The quantitative nature of the study necessitated the use of descriptive statistics and exploratory factor analysis. In addition, non-parametric and normality tests were performed on the collected data.

Results from the descriptive analysis

Table 1 presents the mean item scores (MIS) and skewness of the measured factors according to their rank, highlighting the importance of assessing data normality when selecting between parametric and non-parametric tests. The threshold for determining normality is a p -value of 0.05; thus, a p -value equal to or greater than 0.05 suggests a normal data distribution. In this study, the Kruskal–Wallis H test, a non-parametric method, was utilised to identify differences in responses between participants with and without prior experience working with Chinese construction firms. Table 2 illustrates respondents' evaluations of the benefits of Sino-African relations on Nigeria's construction sector.

Results from the exploratory factor analysis

Before performing Principal Axis Factoring (PAF), the data underwent a suitability check using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. The KMO value was significantly high at 0.817, surpassing the recommended threshold of 0.6, and Bartlett's test yielded a significant value of 0.000, indicating that it was well below the accepted level of 0.05. These results validated the applicability of EFA for the data set. Communalities were assessed, with all extraction values exceeding the 0.300 minimum, confirming their suitability for EFA.

Table 3 presents the eigenvalues for each variable in the dataset, adhering to Kaiser's criterion that eigenvalues greater than 1.0 are retained. Accordingly, three factors with 5.283, 1.946, and 1.310 eigenvalues were kept. These factors explain 37.737%, 13.900%, and 9.359% of the variance, respectively, cumulatively accounting for 60.996% of the variance across the 14 variables measured, underscoring the importance of each.

Table 4 displays the pattern matrix, illustrating how the factors are clustered. The table reveals that the EFA returned three factors and the significance-based arrangement of all variables under each factor.

Summary of results: impacts of the Sino-African relations

This research utilised 14 variables to conduct the EFA, leading to the categorisation of clustered factors. After thoroughly reviewing the data presented in Table 4, each clustered factor was assigned a descriptive name: Factor 1 as "socio-economic development through construction", Factor 2 as "land transportation system development", and Factor 3 as "construction industry development".

The variables in each category are highlighted in Table 5 along with the identified factors from the PAF.

Factor 1: socio-economic development through construction. Factor 1, titled "Socio-economic Development Through Construction," as detailed in Table 5, encompasses six variables unified to enhance Nigeria's economic growth through construction-related activities. These variables include fostering effective cooperation with developed countries (78.3%), expanding the domestic construction market (70.9%), maximising project profitability (62.9%), restructuring the construction sector (56.8%), providing access to aid

Codes		All respondents				CE		NCE		Diff	<i>p</i> -value
		Mean	SD	R	<i>p</i> -value	Mean	R	Mean	R		
Bn.8	Extensive national road network	3.84	0.836	1	0.000 ^a	3.86	1	3.81	1	0.05	0.921 ^b
Bn.7	Extensive national rail network	3.64	0.825	2	0.000 ^a	3.64	2	3.63	2	0.01	0.768 ^b
Bn.9	Increased funding for road maintenance	3.58	1.096	3	0.000 ^a	3.61	3	3.54	3	0.07	0.731 ^b
Bn.11	Increased penetration of ICT services within the construction industry	3.49	0.904	4	0.000 ^a	3.60	4	3.31	4	0.29	0.060 ^b
Bn.4	Construction sector restructuring	3.37	1.016	5	0.001 ^a	3.51	5	3.15	6	0.35	0.077 ^b
Bn.5	Maximised project profitability	3.29	1.003	6	0.001 ^a	3.32	6	3.25	5	0.07	0.617 ^b
Bn.2	Encourage effective cooperation with developed countries	3.19	0.967	7	0.001 ^a	3.30	7	3.00	7	0.30	0.050 ^b
Bn.12	Establishment of factories for materials fabrication and equipment assembly	3.16	0.957	8	0.000 ^a	3.26	8	2.98	8	0.28	0.068 ^b
Bn.1	Expansion of domestic construction market	3.13	1.034	9	0.000 ^a	3.25	9	2.92	9	0.33	0.097 ^b
Bn.13	Training Nigerians to fabricate and produce various construction materials and equipment locally	2.93	0.953	10	0.000 ^a	2.93	10	2.92	9	0.01	0.866 ^b
Bn.6	High rates of electrification	2.78	0.925	11	0.000 ^a	2.78	12	2.77	12	0.01	0.932 ^b
Bn.14	Improved ease of doing business for local construction firms	2.71	1.010	12	0.000 ^a	2.83	11	2.50	13	0.33	0.065 ^b
Bn.10	Improved rural access	2.64	0.985	13	0.000 ^a	2.54	13	2.81	11	-0.27	0.162 ^b
Bn.3	Access to aid for indigenous firms	2.40	1.061	14	0.000 ^a	2.41	14	2.38	14	0.03	0.929 ^b

Note(s): SD = Standard deviation; R = Rank

CE = Respondents with experience with Chinese firms

NCE = Respondents without experience with Chinese firms

Diff. = Difference in mean scores from respondents with and without experience with Chinese firms

^a The Shapiro–Wilk test result is significant at the significance level of 0.05 (hence, non-normal distribution at *p*-value <0.05)

^b The Kruskal–Wallis H test result is significant at the significance level of 0.05 (hence, no statistical differences at *p*-value <0.05)

Source(s): Authors' own creation

Table 2.
Descriptive analysis

for indigenous firms (54.3%), and achieving high rates of electrification (49.7%). This factor, which captures the economic benefits stemming from Chinese involvement in Nigeria's construction sector, accounts for 37.74% of the total variance.

Factor 2: land transportation system development. Factor 2, "Land Transportation System Development," presented in Table 5, comprises four variables that underscore the improvements in Nigeria's transportation infrastructure as a result of Sino-African relations. These improvements include the development of an extensive national road network (82.7%), an extensive national rail network (68.1%), increased funding for road maintenance (50.4%), and enhanced rural access (46.6%). This factor highlights the construction, maintenance, and renovation of roads and railways, contributing to 13.90% of the total variance.

Factor 3: construction industry development. Factor 3, "Construction Industry Development," also from Table 5, includes four variables that focus on advancing Nigeria's local construction sector. These are training Nigerians in the local fabrication and production of construction materials and equipment (78.7%), increasing ICT services penetration within the industry (60.3%), improving the ease of doing business for local construction firms (48.8%), and the establishment of factories for materials fabrication and equipment assembly (48.5%). This factor, which emphasises the development and growth of the local construction industry, represents 9.36% of the total variance.

Table 3.
Total variance explained

Factor	Total	Initial eigenvalues		Extraction sums of squared loadings			Rotation sums of squared loadings ^a
		% of variance	Cumulative %	Total	% of variance	Cumulative %	Total
1	5.283	37.737	37.737	4.816	34.398	34.398	3.873
2	1.946	13.900	51.637	1.493	10.661	45.059	2.514
3	1.310	9.359	60.996	0.815	5.820	50.879	3.037

Source(s): Authors' own creation

Table 4.
Pattern matrix

Variables	Factor		
	1	2	3
Bn.2 Encourage effective cooperation with developed countries	0.783		
Bn.1 Expansion of domestic construction market	0.709		
Bn.5 Maximised project profitability	0.629		
Bn.4 Construction sector restructuring	0.568		
Bn.3 Access to aid for indigenous firms	0.543		
Bn.6 High rates of electrification	0.497		
Bn.8 Extensive national road network		0.827	
Bn.7 Extensive national rail network		0.681	
Bn.9 Increased funding for road maintenance		0.504	
Bn.10 Improved rural access		0.466	
Bn.13 Training Nigerians to fabricate and produce various construction materials and equipment locally			0.787
Bn.11 Increased penetration of ICT services within the construction industry			0.603
Bn.14 Improved ease of doing business for local construction firms			0.488
Bn.12 Establishment of factories for materials fabrication and equipment assembly			0.485

Source(s): Authors' own creation

Codes	Variables	Eigen- value	% of variance	Factor loadings	Mean
<i>Factor 1</i>	<i>Socioeconomic development through construction</i>	<i>5.283</i>	<i>37.737</i>		<i>3.03</i>
Bn.2	Encourage effective cooperation with developed countries			0.783	3.19
Bn.1	Expansion of domestic construction market			0.709	3.13
Bn.5	Maximised project profitability			0.629	3.29
Bn.4	Construction sector restructuring			0.568	3.37
Bn.3	Access to aid for indigenous firms			0.543	2.40
Bn.6	High rates of electrification			0.497	2.78
<i>Factor 2</i>	<i>Land transportation system development</i>	<i>1.946</i>	<i>13.900</i>		<i>3.43</i>
Bn.8	Extensive national road network			0.827	3.84
Bn.7	Extensive national rail network			0.681	3.64
Bn.9	Increased funding for road maintenance			0.504	3.58
Bn.10	Improved rural access			0.466	2.64
<i>Factor 3</i>	<i>Construction industry development</i>	<i>1.310</i>	<i>9.359</i>		<i>3.07</i>
Bn.13	Training Nigerians to fabricate and produce various construction materials and equipment locally			0.787	2.93
Bn.11	Increased penetration of ICT services within the construction industry			0.603	3.49
Bn.14	Improved ease of doing business for local construction firms			0.488	2.71
Bn.12	Establishment of factories for materials fabrication and equipment assembly			0.485	3.16

Source(s): Authors' own creation

Table 5.
Grouping of variables
into factors

Confirmatory Factor Analysis

This study utilised Confirmatory Factor Analysis (CFA) to validate the constructs identified through Exploratory Factor Analysis (EFA), employing Robust Maximum Likelihood (RML) estimation to address the dataset's non-normality. Table 6 presents the constructs reflecting the impact of Sino-African relationships on the construction industry, including standardised coefficients (λ), z-statistics, the coefficient of determination (R²), and construct validity. Cepeda-Carrion *et al.* (2019) recommended using both Cronbach's alpha and Rho alpha tests to enhance model reliability. The standardised coefficients ranged from 0.872 to 0.475, indicating strong construct validity as they exceeded the 0.5 threshold, accounting for a significant portion of the model's variance. Cronbach's alpha and Rho alpha tests yielded coefficients of 0.785 and 0.799, respectively, signifying reliable constructs as per Hair *et al.* (2019), who stated that coefficients above 0.7 indicate good reliability. Z-statistics exceeding 1.96 confirmed the significance of the impacts identified, while R² values between 0.764 and 0.475 demonstrated the predictive accuracy of the factors, with group R² values for the three factors indicating robust explanatory power.

Table 7 outlines the fit indexes and derivative output estimates, showing that the Comparative Fit Index (CFI) and Goodness of Fit Index (GFI) stood at 0.937 and 0.976, respectively. According to Iacobucci (2010), a coefficient ≥ 0.95 indicates a good fit, while ≥ 0.90 suggests an acceptable fit, classifying the study's CFI as acceptable and the GFI as good. The Root Mean Square Error of Approximation (RMSEA) and Standardised Root Mean Square Residual (SRMR) were 0.033 and 0.061, respectively, with Bentler (1989) recommending values ≤ 0.08 for acceptable fit and ≤ 0.05 for good fit, thus deeming the RMSEA as good and the SRMR as acceptable. The Satorra-Bentler scaled chi-square

Groups	Label	Standardised coefficient (λ)	Z-Statistics	R^2	Significant at 5% level?	Group R^2	Cronbach's alpha	Rho coefficient
<i>Socioeconomic development through construction</i>							0.785	0.799
	Bn.2	0.872	8.337	0.722	Yes	0.689		
	Bn.1	0.810	7.249	0.708	Yes			
	Bn.5	0.726	11.614	0.638	Yes			
	Bn.4	0.692	4.741	0.694	Yes			
	Bn.3	0.645	8.845	0.682	Yes			
	Bn.6	0.553	7.005	0.551	Yes			
<i>Land transportation system development</i>							0.631	
	Bn.8	0.726	10.759	0.764	Yes	0.631		
	Bn.7	0.664	6.846	0.598	Yes			
	Bn.9	0.504	8.327	0.638	Yes			
	Bn.10	0.475	9.982	0.551	Yes			
<i>Construction industry development</i>							0.661	
	Bn.13	0.794	4.418	0.714	Yes	0.661		
	Bn.11	0.693	7.008	0.782	Yes			
	Bn.14	0.529	5.783	0.633	Yes			
	Bn.12	0.488	11.783	0.599	Yes			

Table 6.
CFA of the impacts of Sino-African relations in the construction industry

Source(s): Authors' own creation

Fit index	Cut-off value	Estimate	Resultant
$S - B\chi^2$		9.338	
df	$x > 0.00$	2	Good fit
CFI	$x \geq 0.90$ (acceptable)	0.937	Acceptable
	$x \geq 0.95$ (good fit)		
GFI	$x \geq 0.90$ (acceptable)	0.976	Good fit
	$x \geq 0.95$ (good fit)		
RMSEA	$x \leq 0.08$ (acceptable)	0.033	Good fit
	$x \leq 0.05$ (good fit)		
SRMR	$x \leq 0.08$ (acceptable)	0.061	Acceptable
	$x \leq 0.05$ (good fit)		
NFI	$x \geq 0.90$ (acceptable)	0.949	Acceptable
	$x \geq 0.95$ (good fit)		
NNFI	$x \geq 0.90$ (acceptable)	0.984	Good fit
	$x \geq 0.95$ (good fit)		
RMSEA 90% CI		0.001:0.033	Acceptable range
p -value	$x > 0.05$	0.00	Acceptable range

Table 7.
Robust fit indexes for constructs

Source(s): Authors' own creation

($S-B\chi^2$) value was 9.338 with 2 degrees of freedom, leading to a normed chi-square of 4.669, which falls within [Byrne's \(2013\)](#) recommended range of 3.00–5.00, affirming the model's appropriateness despite the chi-square test's sensitivity to sample size and data normality.

Discussions

The analysis results grouped the variables under *socio-economic development through construction*, *land transportation system development*, and *construction industry*

development. Corkin and Burke (2006) highlighted the benefits of Chinese involvement in Africa by stating that the relationship is arguably most impactful in the construction sector. This is because the sector allows infrastructure development, which is a major need in Africa that China can easily meet. Furthermore, the investment in infrastructure is a big boost for the construction industry and the economy at large, as well as a significant advancement for socio-economic and national development (Oyewobi *et al.*, 2019).

As a benefit of Sino-African relations in Nigeria, *socio-economic development through construction* (factor 1) returned an average mean score of 3.03. This factor confirms that the partnership with China in the Nigerian construction industry has moderately benefited the growth and development of the national economy. Among the three benefits returned from the factor analysis, the development of the national economy ranks third and last. With a mean score slightly above 3, it indicates that the involvement of the Chinese in the construction industry has impacted Nigeria's economy and socio-political development, albeit only slightly. The socio-economic benefits of Sino-African relations with Nigeria include restructuring the construction sector, maximising project profitability, optimising cooperation with developed countries, and expanding the local construction markets. From the study, it can be concluded that the partnership is barely beneficial in providing regular electricity and funds for indigenous construction firms.

The first factor, Socio-economic development through construction, encompasses variables such as the expansion of the domestic construction market, encouragement of effective cooperation with developed countries, maximised project profitability, construction sector restructuring, access to aid for indigenous firms, and high electrification rates. These variables reflect the multifaceted impacts of Sino-African relations on the construction industry. The findings align with the broader literature on the subject. Previous research by Akanni *et al.* (2015), Ebekozi *et al.* (2023), and Ogunbiyi *et al.* (2017) highlights the significant role of the construction industry in driving economic growth, particularly in developing countries like Nigeria. The presence of Chinese firms in Africa has catalysed the expansion of the construction market and encouraged cooperation with developed countries (Ogbu, 2018). The study's results corroborate the notion that Sino-African relations have contributed to socio-economic development through the construction sector.

Land transportation system development (factor 2) as a benefit of Sino-African relations returned an average mean score of 3.43. These results highlight that the development of the land transportation system is the most significant benefit of Sino-African relations in Nigeria. Since one of the responsibilities of the government of every country is the provision of cheap means of transportation, roads and rail construction became a crucial aspect of Chinese involvement in Africa, and in this case, Nigeria. This has made land transportation system developments the most significant benefit of Sino-African relations. Results from the study also pointed out that Chinese involvement in the Nigerian construction industry has been valuable as it has aided in constructing and repairing roads and railways. Furthermore, the partnership has also helped in enhancing rural access.

The second factor focuses on land transportation system development, including variables such as establishing an extensive national road and rail network, increased funding for road maintenance, and improved rural access. These variables underscore the pivotal role of transportation infrastructure in facilitating economic activities and connectivity. The study's findings align with existing literature, emphasising the significance of a well-developed transportation system for economic growth (Tukić, 2015). The presence of extensive road and rail networks is essential for the efficient movement of goods and people, and increased funding for road maintenance contributes to the sustainability of transportation infrastructure (Tukić, 2015). Improved rural access is

crucial for inclusive development, ensuring that even remote areas can participate in economic activities.

Construction industry development (factor 3) as a benefit of Sino-African relations in Nigeria returned an average mean score of 3.07. This factor highlights how the Nigerian construction industry has grown and developed through its partnership with China. Among the three benefits from the factor analysis, construction industry development ranks second. With a mean score slightly above 3, it can be deduced that China's involvement in the Nigerian construction industry has helped its growth. From the results, the Nigerian construction industry has slightly improved in inculcating ICT into construction projects, establishing construction materials factories, acquiring skills, and easing business for local construction firms. It is safe to conclude that part of the progress in the construction industry can be attributed to China's operations in Nigeria.

Construction industry development encompasses variables related to training local labour, integrating ICT services, improving business efficiency, and establishing local factories for materials fabrication and equipment assembly. These variables reflect the critical aspects of modernising and enhancing the capabilities of the construction industry. This factor resonates with the literature, emphasising the need for technological advancements and skill development in the construction sector (Sundaram *et al.*, 2011; Adekunle *et al.*, 2020). The integration of ICT services is crucial for bringing the African construction industry up to global standards (Akinshipe and Aigbavboa, 2022). Additionally, efforts to improve the ease of doing business for local construction firms and establishing local factories demonstrate a commitment to fostering indigenous capacity and self-reliance (Ogunbiyi *et al.*, 2017; Akinshipe and Aigbavboa, 2022).

Implications

Two major factors contribute to the continuous growth of China's relations with Africa in the construction industry. The first is that Chinese construction firms have been motivated to exploit opportunities in other countries because of the overcrowded Chinese construction industry. The second factor concerns the level of inactivity in the African construction industry and the numerous opportunities brought about by the lack of adequate infrastructure in Africa. The influx of Chinese companies into Africa at the start of the 21st century marked the beginning of a game-changer for Africa's infrastructure and the construction industry. Although localisation strategies are still minimal within the Sino-African partnership, it is of utmost importance that the Chinese operations in Africa must transfer relevant knowledge, skills, techniques, and expertise into the African construction industry.

Furthermore, the Nigerian system has made it easy for foreign enterprises to function fully without meeting the necessary requirements, often bypassing essential institutional prerequisites and regulatory mandates. Consequently, Chinese construction firms have taken advantage of this laxity in that many Chinese enterprises within the country do not fulfil the portion of the deal that covers the transfer of technology and skills. The Nigerian government must intensify efforts to enforce technology transfer agreements to develop indigenous capacity and, by extension, improve the construction industry.

Historically, no country has advanced while not fully controlling its science and technology. Therefore, Nigeria and the African continent should prioritise redefining the Sino-African relationship to concentrate on achieving the best infrastructure development possible through expanding the local construction industry. Only Africa can help grow its infrastructure and construction industry efficiently by negotiating agreements and contracts that better suit the continent and its countries. Furthermore, infrastructure development terms in Africa need to be updated. The Sino-Africa relationship needs to shift from a resource-exporter/donor

relationship, which only encourages hard infrastructure development. The updated terms must promote the development of soft infrastructure capabilities required to support, maintain, sustain and expand developmental projects without any foreign aid.

With the prevalent interest in Africa, especially in its natural resources, and the current rate of investment in the growth and development of the continent's infrastructure and construction, individual nations need to set up an efficient regulatory system and framework that will enable and encourage responsible exploration of natural resources. This regulatory framework must be put together in such a manner that will ensure equal benefits for both countries involved. It must cover the definite amount of resources to be explored from the African nation, the resulting investment value and the number of jobs for locals to create. This regulatory framework must also include enforceable agreements that will provide for adequate localisation of skills and technology, localisation of construction materials production, standardised construction quality, prioritisation of local firms and workers, and an efficient funding source for local construction firms.

Finally, it is worth noting that Nigeria and other African countries have the resolution to determine how they want to exploit developmental projects to benefit them. They must identify, support and strongly maintain their goals and objectives in all international partnerships. The Nigerian and other African governments must be proactive in negotiating deals to get the best for their citizens. This can only be achieved through fully functioning and active indigenous agencies which can identify and determine the construction and infrastructure needs of the local society. Therefore, the question for the future should not be "What can China do for Africa?" but "What can Africa do for Africa?"

Conclusion

The presence of China in Africa has been beneficial to Africa, as well as to the African construction industry. The partnership has catalysed the development of various public facilities, the construction industry and the socio-economic status of African countries. This study aimed to identify the impacts of Sino-Africa relations in the Nigerian construction industry. This study's empirical and theoretical findings segmented the impacts of the Sino-African relation on the African construction industry into *socio-economic development through construction*, *land transportation system development*, and *construction industry development*. Consequently, the study's findings outline that the cross-border relationship between the Chinese and the Nigerian construction industry has resulted in significant infrastructural improvement. This covers areas such as expansion and restructuring of the construction market. Also, empirical findings from the study portray that the three derived constructs are all significant.

The influx of Chinese companies into Africa at the start of the 21st century marked the beginning of a game-changer for Africa's infrastructure and the construction industry. Although localisation strategies are still lacking, the inherent governance system has made improperly regulated Chinese participation easy. The government must intensify efforts to ensure that regulations are upheld and enforced to develop indigenous capacity and, by extension, improve the construction industry.

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