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Determinants for the Types and Distribution of China's foreign-aided buildings in the global south

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Abstract

China's domestic construction market is becoming saturated, and with the support of the government, banks, enterprises, and overseas construction is experiencing sustainable development. Over the past 70 years, China's foreign aid has involved a large exchange of funds, manpower, and materials between donor and recipient countries. Under the guidance of policies, China's construction cooperation with third-world countries has become closer, and overseas project contracting and investment and financing business still show a growing trend. Under the background of global construction technology transfer, Chinese architecture is actively going to the world. This paper discusses the current situation of China's construction assistance from three aspects: types, distribution, and primary drivers, based on a dataset of 766 relevant projects since 1949. Through quantitative and descriptive analysis by inductive reasoning, there are three findings. First, China's architectural aid is mainly composed of five types: buildings for education, conferences, healthcare, sports, and public culture. Most of China's construction assistance is in Africa and Asia, with Oceania and Latin America becoming a growing focus. Secondly, China's policy is validated to be the stronger determiner through the spatiotemporal dynamics and the achievements in diplomatic relations. Thirdly, inspired by development geography, there is a significant correlation between China's construction aid and the development needs of recipient countries in the global South, which can be measured by the Human Development Indicator (HDI), Gross Development Product (GDP), and Global Quality Infrastructure Index (GQII) through linear regressions. Constructing a comprehensive and systematic picture of China's aided buildings can give designers, researchers, and policymakers fresh insight into the impacts and further tendencies of China's overseas architecture.

Keywords: China's architectural aid; Global South; Architectural types; spatiotemporal distribution; the development ability.

1. Introduction

China's construction assistance to countries in the global South has become an increasingly prominent issue, including explicit activity for some star projects, such as the headquarters of the African Union Centers for Disease Control and Prevention in Ethiopia (2023), Cultural Center of Mozambique (2022), and the National Stadium of Cambodia (2021). Despite this, there is plenty of buildings had been overlooked, including conference centers, stadiums, theatres, schools, and hospitals donated by the Chinese government or enterprises [1]. In general, Chinese-assisted projects are initiated by Communist Party leaders and executed through state-owned design institutes and construction companies. They reflect China's own development experience and diplomatic aspirations on politics and economics [2]. Architectural megaprojects are attractive to elites because of their value as monumental landmarks and their effects on job opportunities for the locals [3,4]. China's architectural aid has substantially impacted recipient countries' social development considering the size, cost, and popularity demonstrated in the political economy ([5,6]). The Chinese government and building professionals have expanded tremendous effort and overcome incredible difficulties to construct buildings and other infrastructures abroad. Therefore, the facts of China's architectural aid, and by extent the motivation as well as the ideology, was extensively respected and reflected in the type, distribution, and drivers. Taking this position as a starting point, this paper explores how the intricate relationship between Chinese construction aid and the Global South has been shaped and in turn influenced by China's interactions with the rest of the world.

After World War Two, an architectural transfer between the United States, the Union of Soviet Socialist Republics (USSR), China, and the Global South reshaped the world (Figure. 1). For the sake of political stability and national development, the Global South took advantage of socialist friendship to carry out architectural cooperation ([7-10]. Brautigam (2010) describes how Maoist-era aid programs became ideological tactics, with China's participation in the "Non-Aligned Movement" calling for cooperative support from the Global South. Cole Roskam (2015) viewed the turnkey building project as an efficient medium to promote China's "non-aligned" ideological agenda. During the 1980s, the Chinese government refought architectural knowledge, technology, and capital from Western Europe, the United States, and Japan[11]. At the same time, China adhered to exporting architectural design and construction to its allies in Southeast Asia, the Middle East, Latin America, and Africa [12]. Knowledge absorbed by Chinese designers lead to new architectural expressions in the Global South. To some extent, this building cooperation as a soft power helped China gradually gather international partners [13]. After 2000, China demonstrated mutually beneficial cooperation with Africa,

particularly by exporting sports buildings [9]. The motives of China's foreign aid and its impact on recipient countries are classic studies in the field of political economy [6]. But there is a lack of structured research on building types. Most architectural research mainly focuses on engineering construction [14] or limits the research to one category ([15,16]) and one period ([17,18]). Xue's latest book released in 2022 put forward "transformation modernism" to underline the undeniable value of China's architectural aid. Therefore, there is a need to study China-aided building types in a global context to provide better references to designers, researchers, and policymakers. Construction assistance has accounted for a large proportion of China's foreign aid, making China's assistance activities highly visible in the world. In order to better carry out overseas construction, it is inevitable to systematically study the history and theory of construction aid [15].

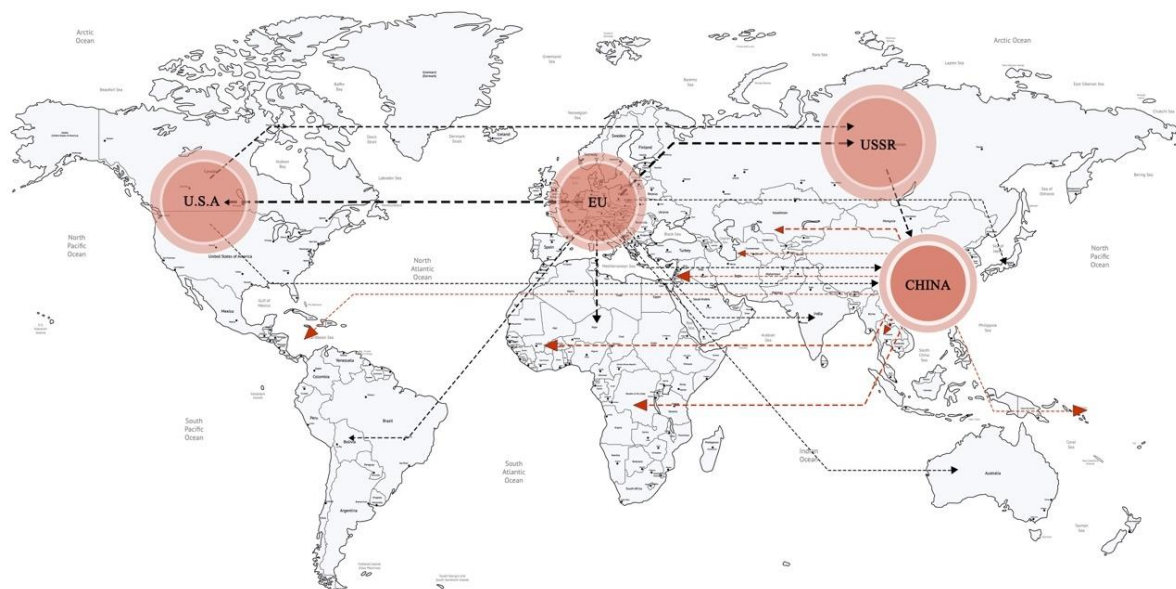


Figure 1. A Diagram of the worldwide Architectural transfer and China's buildings exported to the Global South

Over the 60 years from 1958 to 2018, more than 1,500 buildings were subsidized by the Chinese government and constructed by Chinese professionals in more than 160 countries, including railways, stations, factories, town halls, theatres, stadiums, schools, hospitals, and government buildings, as well as other forms of economic assistance in agriculture, water conservancy, education, transport, manufacturing, and health, involving investments equivalent to more than US\$100 billion from China State Council in 2021. According to literature review, most studies on China's foreign aid focus on politics, economy, historical evolution, international relations, and foreign trade. The research on the following package of project assistance is relatively scattered, and the special research in the field of construction is even less.

This paper explores the distribution of Chinese construction aid around building types and argues that China's policies and the development needs of recipient countries are the two main determinants. In addition to the involvement of state-owned design institutes, Chinese commercial engineering, procurement, and construction projects have been realized alongside and led by many foreign aid projects in the twenty-first century's "going out" wave. China's early foreign aid programs have led the way for commercial projects in the 21st century.

The research questions are as follows: 1: How is the spatiotemporal distribution of the main types of buildings aided by China for 70 years? 2: How China's policy contributes to the fluctuation of China's building assistance? Is there any significant correlation between architectural donations and the development need of the recipient? How did the correlation shift by architectural type? These questions will be approached through three subsections: 1) A five-type framework of 766 projects was constructed; (2) multiple analyses on central gravity and type distribution from temporal and geographical views; and 3) discussion of the drivers behind this aid are systematically analyzed, verified the impact of policy and development needs on aid. This book explores these unanswered questions and demystifies China's foreign aid programs. It considers the motives for building exports, which are directly or indirectly linked to complex social, political, economic, cultural, and ideological considerations.

2 Material and Method

2.1. Material

This paper figures out the main five types as the research object through the construction of a dataset. First, the original information of relevant projects about foreign-aided buildings are obtained from Chinese literature (678 items), the official website of the Chinese government (430 items), the official website of the Ministry of Commerce (449 items),

the official website of the Ministry of Foreign Affairs (271 records), AIDDATA¹ (472 records), foreign media (2000-2022; 694 records), project design agencies (86 records), etc., collected a total of 3080 records (Figure.2). Second, duplicate, unreliable, secondary repetitive records are eliminated. Third, 1750 projects over ten types were obtained after data cleaning. Then remove the building types with a small size and incomplete information (1037). Finally, by statistics, we find buildings for education, healthcare, conferences, sports, and public culture are five typical types (Table. 1), involving 766 projects located in 107 countries (Figure 2). The five types of architectural aid were identified and categorized by their function, most of these projects have clear architectural use. This data provides a solid foundation for the following research towards types, distribution, and drivers.

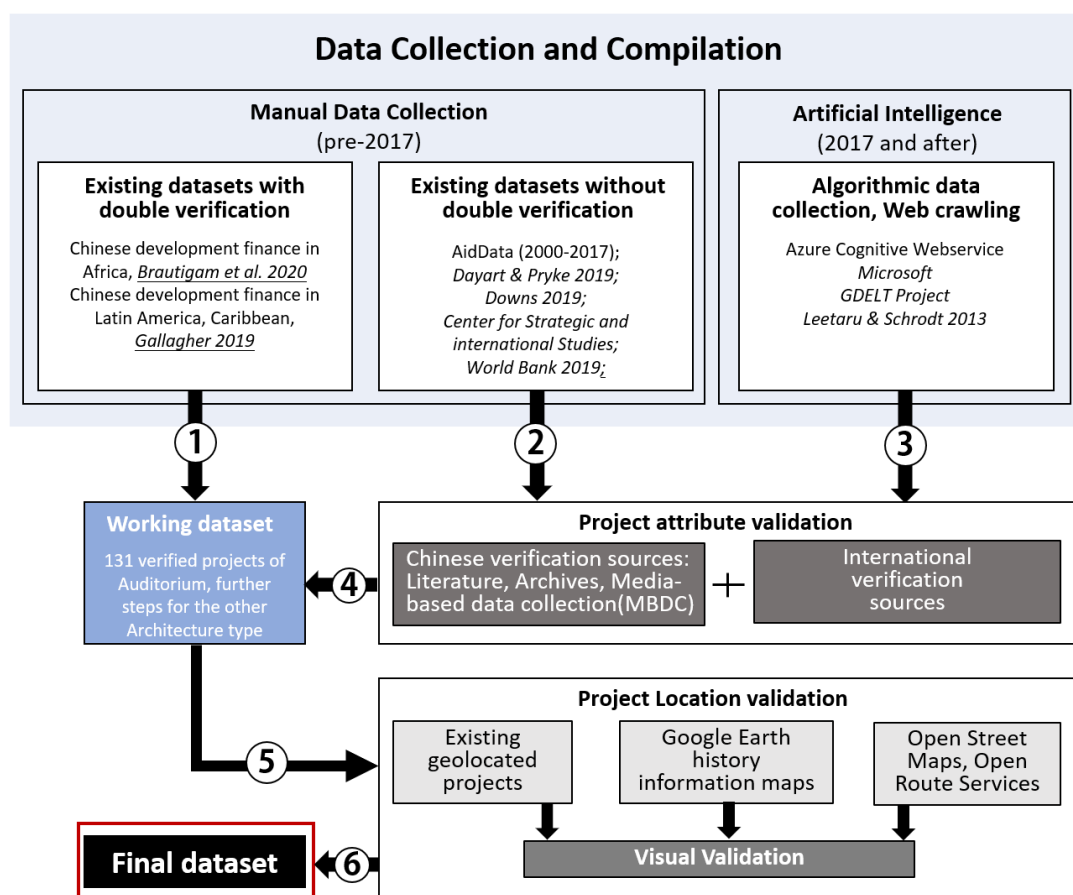


Figure 2. A framework of data collection and visualization analysis (Drawn by the author).

Table 1. The typology of China-aided construction. Source: author's dataset (766 items, involving 107 countries)

Typology	Common Representative	Start Year	Summit	Timespan	Amount	Countries
1 Education	schools, colleges, research institutes, etc.	1968	2009; 2013-2020	54	255	77
2 Conference	conference center	1962	2016; 2018	60	167	74
3 Health care	hospital	1960	2019	50	148	61
4 Sport facilities	stadium	1956	2008; 2012	66	145	68

¹ AIDDATA (Aiddata Global Chinese Development Finance Datasets_2.0) adopts TUFF (Tracking Underreported Financial Flows) method to collect data information, including the purpose, type, location, start time, geographical location, domestic and foreign economics, geography, etc. <https://www.aiddata.org/data/aiddatas-global-chinese-development-finance-dataset-version-2-0>.

5	Public culture	theaters, museums, libraries, etc.	1970	2014	57	51	34
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Notes: Because of the small number, lack of architectural attributes, or sensitive factors, the following categories were excluded: 1) Urban planning projects; 2) Production projects such as manufacturing zones, special economic zones, industrial parks, agricultural parks, and export processing zones (EPZs); 3) Commercial projects: shopping malls, business hotels, commercial centers, free trade zones (FTZ); 4) Transportation facilities: airports, railway stations, and other transportation infrastructure such as hubs, ports, highways, railways, etc.; 5) Economic infrastructure: energy and communication facilities, water conservancy, mines, etc.; 6) Military projects with a high level of confidentiality (such as buildings for national security or police); 7) Housing projects.

2.2. Method

For this study, China, and the recipient as the two main objects regarding China's architectural aid were explicit (Figure. 3). To figure out how these architectural aid projects connect China and the world, the article first raises five typical types and the evolution in the Chinese cultural context. It then conducted two dimensions of the allocation embodied in architectural aid. The two hypothetical drivers are then discussed and validated through the lens of development geography before embedding Chinese architectural intervention into an international context (Figure. 3).

Relatedly, there is a large body of literature on the determinants of China's aid. In summary, it is often argued that China's provision of foreign aid is primarily driven by 1) the policy and economic interests of aid donors [19-23] and 2) the developmental needs of recipients ([24,25]). Besides, some research also demonstrated these cross-border projects are normally driven by complementary needs, interests, and capabilities between the donor and recipient countries [20,23]. Based on this literature, we make a hypothesis that the policy of China and the development needs of the recipients separately are two main drivers of China's building aid regarding the main architectural types and then try to validate this assumption by regression analysis in this research.

This study applied the quantitative indicators of development geography to the analysis of the drivers. Development geography explores the social and economic development theories and strategies under the specific environmental conditions of the Global South, focusing on improving the sustainable livelihood capacity of underdeveloped areas and the level of regional green development [26-28]. Specifically, it uses quantitative indicators to measure the degree of development convergence in a country or region. Development can be measured in a number of ways. In this study, for measuring a state's development, both HDI, GDP, and GQII will be used (Table.2). These provide useful measurements of both economic and social factors and can capture a wide look at the state's condition at the time of reporting and fit the UN's definition [29]. Since these three indicators are prominent elements in measuring development capacity, it seems to serve as a reasonable proxy and warrants a closer look at the statistical relationships.

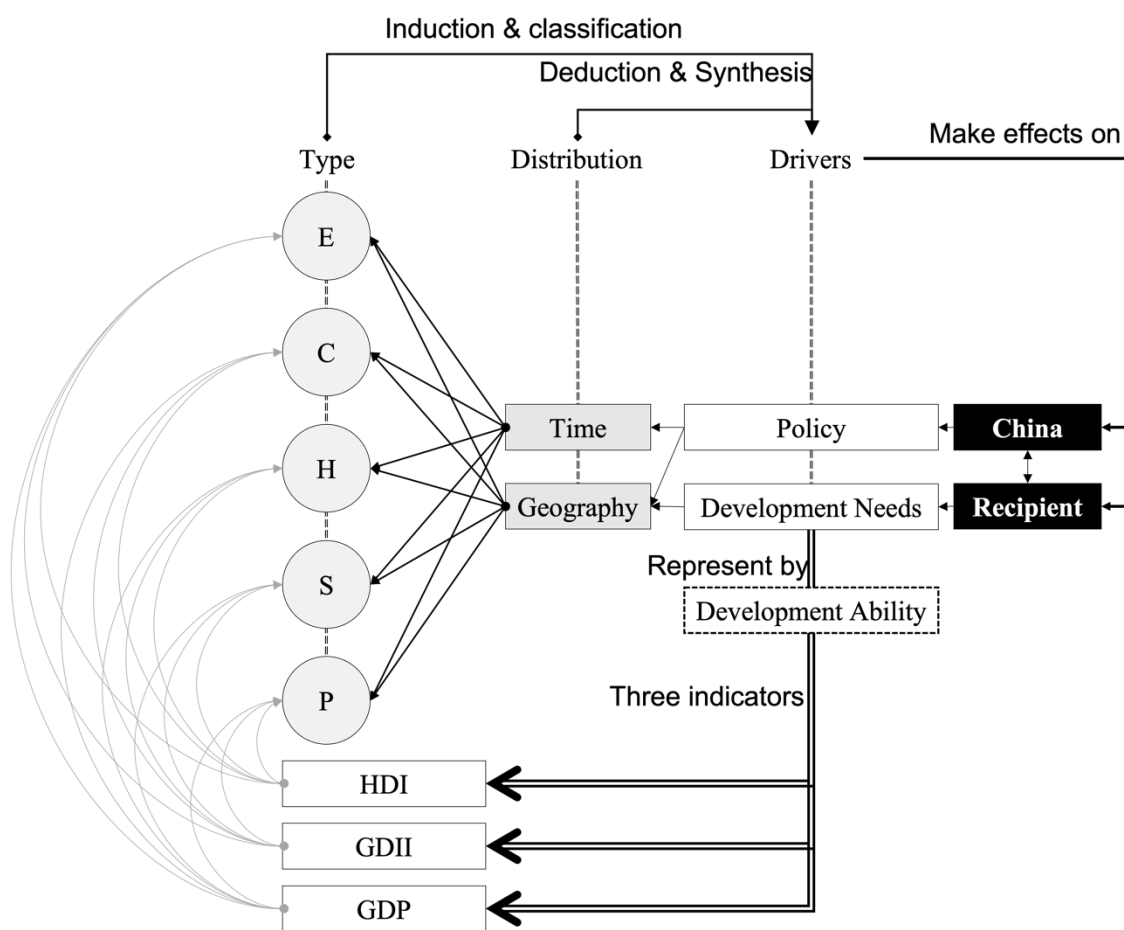


Figure 3. the Framework of this study to explore the type, distribution, and drivers of China's exported buildings. Legend- 1). E: represents buildings for Education; 2). C: represents buildings for Conferences; 3). H: represents buildings for Healthcare; 4). S: represents buildings for Sports; 5). P: represents buildings for Public Culture.

Table 2. The data source of three main indicators.

Indicator	Data Source
HDI ²	Data of HDI, source from https://hdr.undp.org/data-center/human-development-index#/indicies/HDI
GDP ³	Data of GDP, source from https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?most_recent_value_desc=true
GQII ⁴	Data of GQII, source from https://gqii.org/global-quality-infrastructure-index-2021/

3. Results

3.1Types

According to the author's dataset, China exported the main five-type buildings to the Global South (Table 1). These five categories belong to social infrastructure aimed at developing human resource potential and improving living conditions [30]. From the available data, the projects aided by China include support for design and construction, and China also provides resources such as machinery and facilities, as well as experts or workers with specialized knowledge, while also providing financial assistance [31]. Following is a brief introduction of each typical type (Table. 3).

² HDI is the main indicator to measure the development level and poverty level of countries around the world. It consists of three indicators: life expectancy, adult literacy rate, and the logarithm of GDP per capita. (United Nations Development Programme, n.d.).

³ GDP is a standard measure when looking into a state's economic development. In this study, GDP will serve as an indicator of economic strength and growth over time and the data will be collected from the World Bank's data center website (2023a).

⁴ GQII is a composite indicator that measures the overall level of infrastructure based on two perspectives: the infrastructure for transport and the infrastructure for electricity and water utilities.

1) Educational construction (E, 33%): Educational assistance is universally respected and pursued for its internationalism and humanitarianism. As a far-reaching public good, it is less likely to provoke resentment and antipathy in recipient countries and more likely to win international respect and acclaim, even if it is transregional, transnational, cross-political, and cross-cutting. -cultural and cross-ideological. Chen (2022) analyses the key influencing factors and design features of representative cases selected from a database of 182 projects in four main typologies: schools for disadvantaged groups (e.g. Ha'apai Secondary School, Tonga, 2001; Naxaithong Secondary School, Vientiane, Laos, 2020), vocational and police training schools (e.g. Chinoyi Teacher Training and Technical School, Zimbabwe, 1991; Nepalese Traditional Technical School, Chinoyi, Zimbabwe, 1991; Traditional Medicine Research and Training Centre, Nepal, 2011), political and diplomatic academies (e.g. Diplomatic Academy, Confucius Institute in Angola, 2018; Diplomatic Training Institute in Tunisia, 2019), and Confucius Institutes (University of Zimbabwe, 2006; National University of Lao People's Democratic Republic, 2010).

2) Conference construction (C, 22%): As urban landmarks, conference buildings are often considered to be representative of influential architecture for Chinese-assisted projects. These projects, such as the Bandaranaike Memorial International Conference Hall (BMICH) built in Colombo, Sri Lanka in 1964, contributed to the country's favorable national image, provided some economic benefits, and opened up opportunities for urban development. Thus, conference office buildings shape modern African cities and symbolize national independence by flaunting the government [30]. They play a role in enhancing the influence of countries and cities, strengthening international exchange and cooperation, and promoting economic development [31], as in the case of the AU Conference Centre and Office Building (AUCC), which was completed in Ethiopia in 2007. In addition, due to political demands, middle-income or low-income countries are starting to build conference buildings, such as the Bizwana Mulungushi International Conference Centre in Zambia, 2020.

(3) Healthcare construction (H, 19%): In the early years of New China, when the country's medical and economic base was relatively weak, healthcare assistance was mainly provided by medical aid teams ([32]), and there were very few healthcare buildings (e.g., National Health Centre in Nouakchott, Mauritania, 1975). These projects are fully managed by the Chinese government under the General Delivery Sector (GDS)1 and Contractor Sector Responsibility (CSR)2 systems ([33]). Since the reform and opening up, projects to address basic livelihood issues, especially schools, hospitals, farms, and water conservancy facilities, have become emerging areas. There has been a rapid increase in healthcare construction projects, such as the Barka Hospital in Jordan, which was completed in 2009. At the third and fourth sessions of the Forum on China-Africa Cooperation, the Chinese government proposed to build 60 new hospitals in Africa. Medical projects have become the core focus of China's assistance to Africa. The construction of medical projects is based on the main principles of economic efficiency and sustainability, and project management has changed from government-led to government-guided and enterprise-participation [34]. Since then, China has helped 61 countries and regions complete more than 100 medical projects. Medical projects serve as important supporting facilities to promote the development of local public health. They are the key to achieving many goals of social development and the coordinated development of economy and society. In addition, during the pandemic since 2019, there has been a significant increase in investment in healthcare, and the implementation of hospitals and CDCs has increased.

4) Sports construction (S, 19%): the most representative large-scale project construction is "Sports Stadium Diplomacy". This narrative spans 68 years, and 140 stadiums have been built in 61 countries, which most of these in Africa [9]. This number increased steadily before the 1980s, and then there was a more obvious increase [34]. The two peak periods of sports development in China were around 1987 and 2007, with the 1990 Asian Games and the 2008 Beijing Olympics driving the wave of sports development in China. Entering the new millennium, the total exceeds 100 and looks set to increase further under the BRI (eg. My Dinh National Stadium, Hanoi, Vietnam, 2000; National Wrestling Stadium, Senegal, 2018). The types of these sports venues include outdoor and indoor sports venues with different specialties, for example, football, basketball, gymnastics, swimming and diving, cricket, etc. Most of China-aided stadiums are donated for the preparation of major international sports events, and the Chinese government's commitment is made at the request of the recipient countries. Still, others are for improving local sports facilities or for other reasons. These stadium projects were initially implemented in Asia and Africa (1960s-1970s) and then expanded to Oceania and Latin America (1980s-1990s) and even to Europe (post-2000).

5) Buildings for Public Culture (P, 7%): With the growth of the economy and the contact with international culture, some the Global South pay attention to the reveal of their national confidence. Buildings for public culture are one of the vital mediums to show their image, meanwhile ricing the spiritual activities to the citizens. The aided cultural buildings are mainly theaters, cultural centers, libraries, museums, and activity centers, which provide daily cultural activities for citizens, as well as places for tourists to visit, consume, and relax. For society, cultural buildings play the role of social integration and guidance; for individuals, these projects dominate daily behavior and values and are indispensable in public behavior and life. Before 2000, cultural buildings had a composed function, holding meetings or activities, such as the Ghana national theater China donated in 1985 (tab. 3). During this period, this type works as the symbol of State power and national culture, supporting independence against the previous colonial occupation. After 2000, in general, the authority prioritizes this type, for sake of their positive effects on the civilization. Besides, the library projects like

Yemen national library built in 2008, provide a comfortable venue for the public to read, gather and study, improving human well-being. Especially in sub-Sahara Africa, cultural buildings, such as the Museum of Black Civilization in Senegal, Dakar, handover in 2015 (tab. 3), help rebuild the national cultural revival.

Table 3. Typical representatives of five types in three periods.

	Before 2000	2000-2010	2010-2020
Education	Chinoy Normal Technical School, Chinhoyi, Zimbabwe, 1991	The Middle School at Ha'apai, Tonga, 2001	The Naxaithong Middle School, Vientiane, Lao, 2020
			
Conference	Bandaranaike Memorial International Conference Hall (BMICH), Colombo, Sri Lanka, 1964	AU Conference Centre and Office Building (AUCC), Addis Ababa, Ethiopia, 2007	Bizbwana Mulungushi International Conference Centre, Zambia, 2020
			
Healthcare	National Health Centre, Nouakchott, Mauritania, 1975	Barqa Hospital, Jordan (Prince Hussein bin Abdullah II Hospital), 2009	China-cambodia Friendship Medical Building, Cambodia, 2020
			
Sports	Main Stadium of Pakistan Sports Complex, Pakistan, 1976	My Dinh National Stadium, Hanoi, Vietnam, 2000	National Wrestling Stadium, Senegal, 2018
			
Public Culture	National theatre, Accra, Ghana, 1985	National Library, Sana'a, Yemen, 2008	Museum of Black Civilization in Senegal, Dakar, 2015
			

3.2. Temporal dynamics

The geographical distribution of China's aid construction not only focuses on key areas but also considers fairness. All graphs illustrate the results of an analysis of the dataset.

There is a sequential increase in the total amount of China's donated buildings since 1949. Regarding the architectural type donated by China, E (33%) was at the top of the list, followed by C (22%), H (19%), and S (19%). By comparison, P (7%) accounts for the least, indicating most of the recipient countries are still under basic social

development to fit the fundamental necessities. Cultural construction is relatively weak in general. In conjunction with temporal elements, all types, except the S, has an obvious upward trend despite some fluctuation. Among these, E has the highest growth rate and reached its peak from 2010 to 2020. In contrast, the growth speed is soft on C, H, and P. Interestingly, the S has a slight decrease in the first decade after 2000. This information might provoke the overwhelming number of buildings for sports before 2000, which also can be examined by the data. But the decline that sank to a trough in the 2000s might be explained by the Olympics in 2008 in China since the investment and attention on domestic construction. Before 2010, E and C accounted for the top two seats, while after 2010, the construction of H exceed C, reaching the second on the list, which presents the attention on healthcare.

Similarly, in terms of distribution, African countries (68%), especially sub-Saharan Africa (63%) and neighboring countries in Asia (18%) are the key areas, Oceania (7%), Latin America (6%), Europe (1%), and many low-income countries have also received construction aid (fig. 4). Obviously, supported by the continental economic state, most of China's donated buildings are located in the lower development districts. During over seventy years, the amount in six districts substantially keeps rising. However, the peak one, sub-Saharan Africa tripled Asia in the second. Apart from the top two, the amount in other districts keep fewer, with Oceania surpassing that of Latin America from 2010 to 2022. North Africa and Europe are still at the lowest level considering the number of donated buildings due to the higher development on average (Figure. 4). In addition, the Sankey diagram (Figure. 4) is composed of a three-hierarchy structure, key nodes, and links. Flow variations of time, district, and type exhibited the direction, quantity as well as a proportion by the color and thickness. This temporal fluctuation toward types and geography indicates the pace of development and needs of recipient countries. The determinants of these changes would be discussed in the following sections.

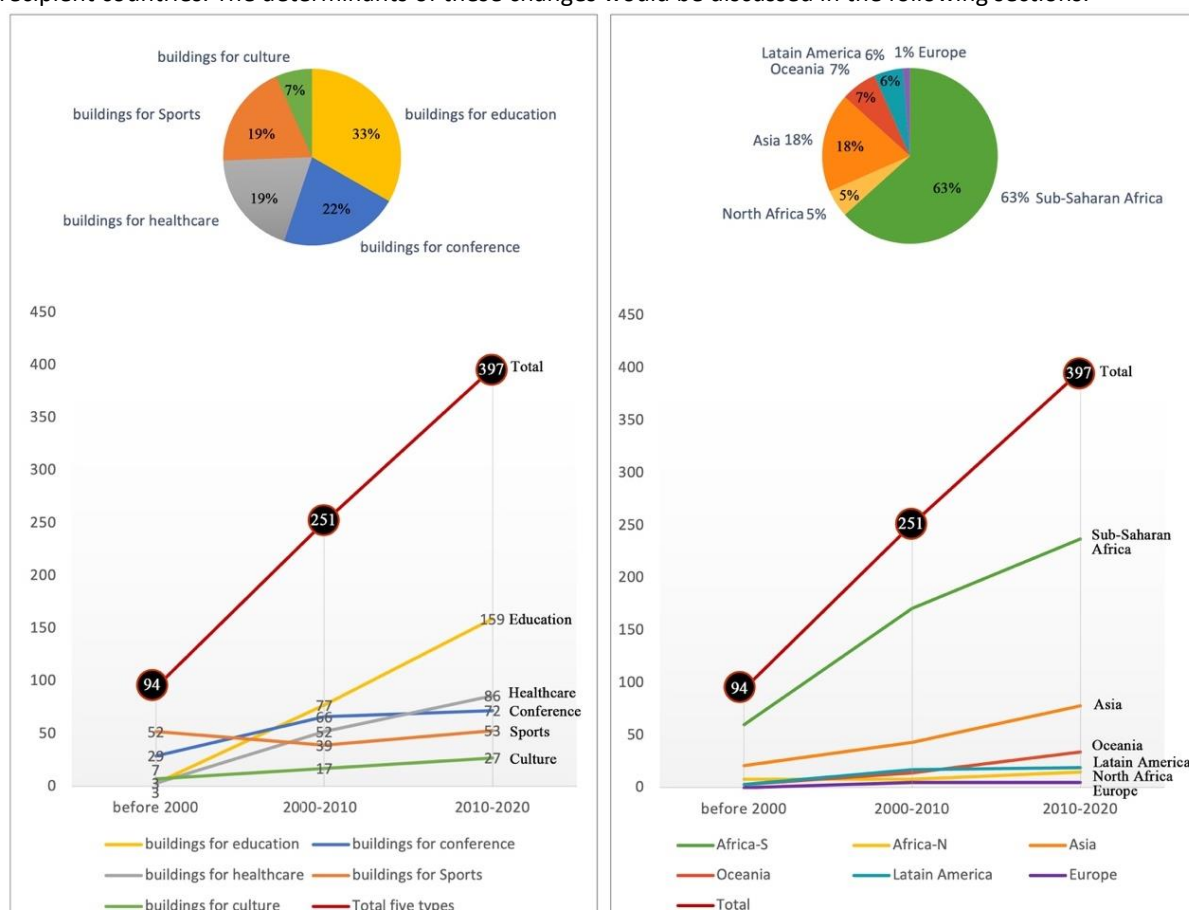


Figure 4. The pie charts and line graphs show the proportion and temporal fluctuation of Type and geography; the Sankey diagram below shows the overall flow from three periods (before 2000, 2000-2010, 2010-2020), six districts (Sub-Saharan Africa, North Africa, Asia, Latin America, Oceania, and Europe) and five types (buildings for education, conference, healthcare, sports, and public culture).

3.3. Spatial distribution

The proportion of each continent has been depicted in the previous section (Figure 4). At the continent scale, sub-Saharan Africa and Asia are China's focus. Figure 5 gives data on geographical distribution at the country scale. Most E and H are in South and East Africa, whereas most C, S, and P are in West and North Africa. Despite this wave in the amount, China remained constant exportation to these the Global South regardless of type. However, this slight changes in spatial aggregation show the dynamics of the gravity on foreign aid construction. The countries surrounding Asia are

the traditional areas for China's aid in construction, such as Pakistan, Cambodia, Mongolia, Sri Lanka, Indonesia, Nepal, Bangladesh, and North Korea. From 2002 to 2014, the spatial scope of China-aided construction expanded significantly and showed a trend of decentralized development. In 2014, the focus of aid shifted slightly from Africa [35] and Southeast Asia to the northwest and expanded to countries and regions that benefited from the BRI, such as Africa, Central Asia, and West Asia. Moreover, Zimbabwe, Senegal, and Algeria are at the top of this list compare with others in the Global South, of which the overall number of donated buildings by China is over twenty (Figure 5).

In the late 1990s, the world aid landscape shifted from infrastructure aid to capacity-building aid, with social services, poverty alleviation, and education shifting to areas of focus [36], possibly related to a variety of factors such as the instability of large-scale projects, high debt levels, and the end of the Cold War. As Glennie (2010, cited in Corkin, 2011) points out, by 2004, infrastructure aid from OECD countries had fallen to 31 per cent from 53 per cent in the early 1990s. While this fact underscores the shift in aid from political considerations to economic considerations, landmark building projects have enduring appeal among recipient country elites, supporting China's ability to maintain high-level bilateral relations through such projects. Examples include the African Union Conference Centre in Addis Ababa, the national football stadium in Ethiopia, the presidential palaces in Mozambique and the Sudan, and the Grand Theatre in Dakar. With their project capabilities, Chinese construction companies are winning bids and contracts to build similar projects on the continent, such as the \$2 billion Grand Mosque in Algeria.

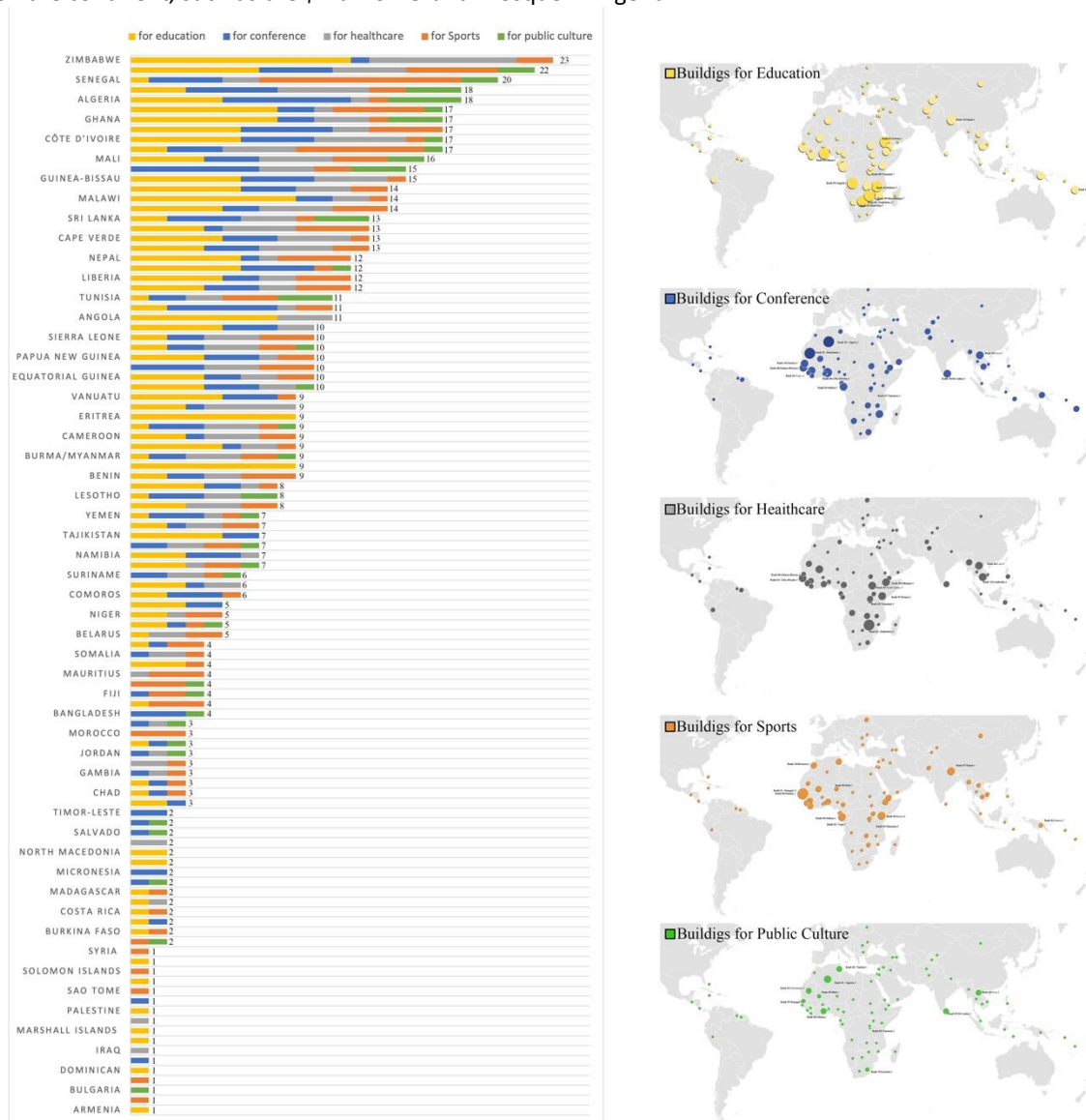


Figure 5. Geographical distribution and hierarchy as country of China's Architectural aid towards five types.

4. Discussion

4.1 Influence factor: Policy from the donor country

The evolution of China-aided activities can be divided approximately into three stages: free aid (1956-1978), rational aid (1979-1995), and institutionalized aid (1996-2021) [11,12,30]. The policy on foreign aid reflects China's guiding

ideology. Furthermore, establishing diplomatic relations with Neighboring and the Global South' diplomacy is a prominent content of China's policy [37]. In the 1950s, China's building aid aimed to help alliances in neighborhood countries such as Vietnam, North Korea, Nepal, and Mongolia. After the Bandung Conference in 1956, China expanded its assistance areas to non-socialist countries and also started construction assistance to sub-Saharan Africa, where most of the aid is free [3]. Second, the reform of foreign aid led to a market-guided policy in 1995 [28].

The Beijing Summit of the Forum on China-Africa Cooperation (2006 & 2018) highlighted the importance of African cooperation. BRI (2013) further strengthened the emphasis on economic infrastructure in aided construction. In a word, countries that receive more construction aid from China have more frequent exchanges with China in terms of materials, manpower, and ideas, and their preferences are close to China's in international affairs [38]. The United Nations General Assembly vote is the standard data to measure a country's diplomatic preference, and a higher consensus rate means that the two countries have closer diplomatic preferences[39].

Overall, before 2000, there are three peaks in 1975, 1985, and 1996. After 2000, especially after 2004, there is a dramatic rise, reaching the highest level in 2009, followed by a sharp drop till 2013. Since 2013, the rising was rebuilt. In 2016 it occurred to another climb, where reached the other peak in 2017. Likewise, after the second peak, there is a continuous fall, especially since 2019. Furthermore, compared with peak years of each type, shown as E (2009, 2015, 2017), H (2009, 2020), C (2006, 2016), S (2012, 2017), P (2008, 2010, 2017), there are some common features and special items. For example, before 2000, this moderate fluctuation was the same as the total trends. Whereas after 2000, the allocation of types had significant differences. For instance, both buildings for education (E) and healthcare(H) went up since 2004 (fig. 6). And then in 2009, the amount of E and H peaked at the highest whereas the other types keep lower conditions. Also, one of the most interesting findings was that after 2019 only type-H had a significant rise and then exceeds the others, reaching a new peak (Figure. 6).

The Foreign Construction Bureau and China State Construction Engineering Corporation were established. The Ministry of Construction held the first meeting on foreign aid affairs and set up special research laboratories and related institutions in 1960. The State Council sent experts to Africa to inspect more than 300 buildings in more than 50 projects for six months in 1973. Premier Zhou Enlai visited 14 countries including Asia, Africa, and Europe around 1964. In 1965, the establishment of eight specialized engineering and construction material supply companies support foreign aid well-organized development (Figure. 6). South-south cooperation (SSC) and the BRI, as well as the relations with African countries, strengthened consistently work effectively on the temporal and geographical distribution. Before 1995, foreign aid was driven by ideology. Aid-relevant issues and institutes were in the initial process. Since 1978, especially after 1995, market-oriented aid was executed. After 2000, in order to cooperate with the United Nation's Millennium Development Goals (MDGs), China put much more effort into the development and livelihood of the Global South.

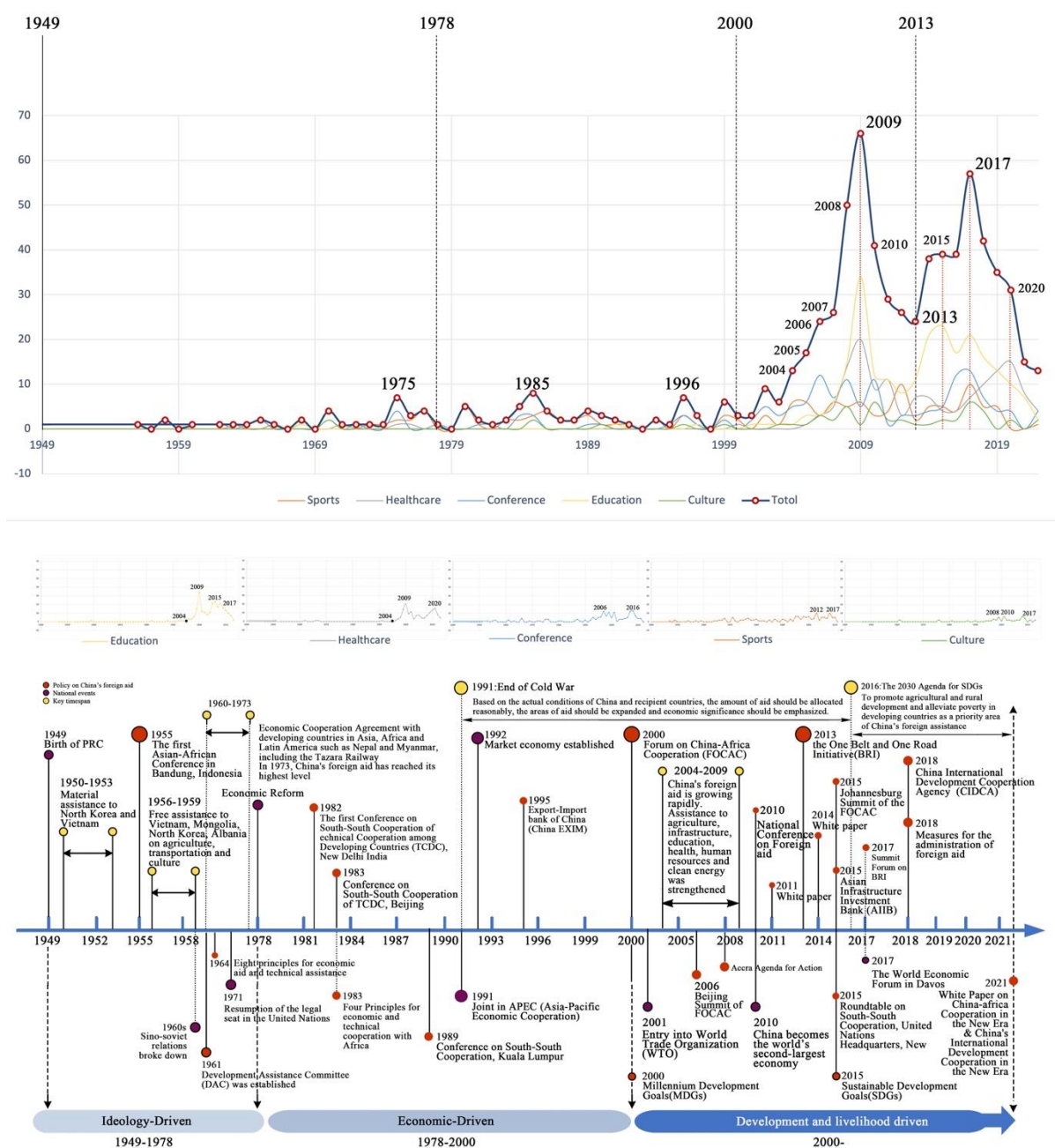


Figure 6. The number of China's exported buildings from 1949 to 2020. These changes and summit years have a linkage with China's policy on foreign aid.

As a supplement, given the important position of Africa in China's construction assistance and the importance of China-Africa cooperation in China's diplomatic relations since 2000, this paper divides China's aid countries into two categories: African countries (79) and other countries (28) and calculate the Correlation coefficients for the concordance rates between China and these two categories of countries [6].

4.2 Influence factor: Development abilities of the recipient country

China's foreign-aided projects aim to promote economic growth and improve the human well-being of the recipient country. It is specifically reflected in the HDI, GDP, and GQII [40]. We filtered the 99 recipients during the period from 1949 to 2022, collected relevant data, and conducted a correlation analysis (Table. 4 & Figure. 8). The correlation results are shown in the Table. 5.

First, the results witness that there is a relatively weak positive correlation between China's overall construction aid and the three indicators of recipient countries, showing that HDI (0.195) > GDP (0.0728) > GQII (0.052) (Figure. 8 & Table. 5). Furthermore, 82% of aided construction projects are distributed in low-income and low-middle-income countries,

indicating the purpose to improve the development capabilities of China's aid. Likewise, this finding that the correlation between China's construction aid and the level of GDP is not significant shows China's development projects generally aim to reduce economic inequality within and between regions [41]. The GDP volume of recipient countries had less effect on the decision-making of China's building investment [40]. During the 1990s, foreign aid was also positively associated with subsequent urbanization after controlling for income levels, population, and regional characteristics. If this link is explained causally, it turns out that foreign aid expands urban areas [24]. The AidData (2021) concluded that the infrastructure projects China participated in promoted the local economy and the overall development of surrounding areas vis the lights between 2000 to 2014. China's aid projects tend to flow into areas with high-lighting data in recipient countries [6]. From the perspective of sub-country distribution, China's aid is more likely to flow to the capital⁵, areas with a higher level of economic development, and areas with less road density. The sub-country distribution of China's aid is more pragmatic than political considerations [29]. Besides, Chinese aid projects have directly and indirectly created employment opportunities for local residents through relevant departments. Overall, China's development projects have a positive impact on the human development of recipient countries.

Second, further investigation via types provides sights into the difference between the needs and conditions of recipient countries for conducting buildings. The value of correlation (R^2) between HDI and each type implicated that compared with other types, buildings for healthcare ($R^2=0.21$) has a much more positive correlation with HDI. Similarly, regarding the correlation between GDP and types, buildings for education ($R^2=0.05$) and conference ($R^2=0.04$) are the categories prefer the recipient countries with better GDP. In contrast, healthcare ($R^2=0.02$) is obvious lower than the previous two types since the need of medical care to improve public health is relative urgency in lower development countries with small-sized GDP. Regarding GQII, the sequence is conference ($R^2=0.056$) and sports ($R^2=0.034$) are the top two. The intention of construction for education ($R^2=0.026$) and healthcare ($R^2=0.021$) prefer to improve the fundamental infrastructure. Different types of infrastructure projects have significantly increased short-term employment, and the construction of schools, hospitals, and hydropower facilities has also made local employment more sustainable [38].

Table 4. Ranking 99 countries based on the volume of China's aided buildings of five types and total amount, with the HDI, GQII, and GDP data.

	COUNTRY	DISTRICT	E	C	H	S	P	Total	HDI	GQII	GDP
1	Zimbabwe	Africa-S	12	1	8	2	0	23	0.571	0.416	14002
2	Tanzania (Zanzibar)	Africa-S	7	4	4	5	2	22	0.529	0.513	64123
3	Senegal	Africa-S	1	4	2	11	2	20	0.512	0.385	24409
4	Algeria	Africa-N	5	7	1	1	4	18	0.748	0.54	147323
5	Laos	Asia	3	5	5	2	3	18	0.613	0.296	18653
6	Ghana	Africa-S	8	2	3	1	3	17	0.611	0.465	67337
7	Congo	Africa-S	2	3	4	7	1	17	0.574	0.19	9964
8	Samoa	Oceania	8	2	1	5	1	17	0.715	0.19	829
9	Côte d'Ivoire	Africa-S	6	4	5	1	1	17	0.538	0.457	61502
10	Gabon	Africa-S	6	5	2	4	0	17	0.703	0.33	15145
11	Mali	Africa-S	4	3	4	3	2	16	0.434	0.367	17685
12	Mauritania	Africa-S	0	7	3	2	3	15	0.546	0.296	7428
13	Guinea-Bissau	Africa-S	6	4	4	1	0	15	0.48	0.283	1392
14	Ethiopia	Africa-S	5	2	4	3	0	14	0.485	0.523	95588
15	Zambia	Africa-S	6	3	3	2	0	14	0.584	0.387	18909
16	Malawi	Africa-S	9	2	2	1	0	14	0.483	0.448	8330
17	Sri Lanka	Asia	2	4	3	1	3	13	0.782	0.64	81120
18	Kenya	Africa-S	4	1	4	4	0	13	0.601	0.698	101048
19	Cambodia	Asia	4	3	4	2	0	13	0.594	0.356	26316
20	Cape Verde	Africa-S	5	3	4	1	0	13	0.665	0.265	1,870
21	Mozambique	Africa-S	6	4	0	1	1	12	0.456	0.422	14,557
22	Nepal	Asia	6	1	1	4	0	12	0.602	0.371	32,158
23	Djibouti	Africa-S	4	3	2	3	0	12	0.524	0.185	3,408
24	Liberia	Africa-S	5	2	2	3	0	12	0.48	0.187	3,068
25	Tunisia	Africa-N	1	2	2	3	3	11	0.74	0.63	39,226
26	Togo	Africa-S	2	6	1	2	0	11	0.515	0.329	5,719

⁵ The capital is a region with better economic development and a larger population. Places close to the capital have more convenient transportation, a higher level of overall infrastructure, low cost of project coordination and easy supervision.

27	Angola	Africa-S	8	0	3	0	0	11	0.581	0.398	62,724
28	Rwanda	Africa-S	2	2	3	2	1	10	0.543	0.344	10,428
29	Afghanistan	Asia	4	3	2		1	10	0.511	0.301	19,006
30	Guinea	Africa-S	0	4	3	3	0	10	0.477	0.189	14,238
31	Sierra Leone	Africa-S	2	2	3	3	0	10	0.452	0.206	4,140
32	Papua New Guinea	Oceania	4	3	1	2	0	10	0.555	0.295	23,283
33	Equatorial Guinea	Africa-S	4	2	2	2	0	10	0.592	0.138	10,028
34	Sudan	Africa-N	5	3	2	0	0	10	0.51	0.381	32,576
35	Burma/Myanmar	Asia	1	2	3	2	1	9	0.583	0.32	70,890
36	DR. Congo	Africa-S	1	3	3	1	1	9	0.48	0.449	46,062
37	Benin	Africa-S	2	2	2	3	0	9	0.545	0.364	15,292
38	Cameroon	Africa-S	3	1	3	2	0	9	0.563	0.344	39,036
39	Vanuatu	Oceania	5	3	0	1	0	9	0.609	0.133	864
40	Burundi	Africa-S	5	1	2	1	0	9	0.433	0.247	3,131
41	South Sudan	Africa-N	3	1	5	0	0	9	0.433	0.161	4,177
42	Botswana	Africa-S	9	0	0	0	0	9	0.735	0.483	15,872
43	Lesotho	Africa-S	1	3	2	0	2	8	0.527	0.278	1,906
44	Central Africa	Africa-S	3	0	3	2	0	8	0.397	0.182	2,321
45	Seychelles	Africa-S	4	2	1	1	0	8	0.806	0.395	1,198
46	Pakistan	Asia	0	2	2	2	1	7	0.557	0.715	261,726
47	Mongolia	Asia	3	0	1	2	1	7	0.737	0.531	13,385
48	Yemen	Asia	1	3	1	1	1	7	0.47	0.291	20,948
49	Uganda	Africa-S	2	1	2	2	0	7	0.544	0.399	37,733
50	Namibia	Africa-S	3	3	1	0	0	7	0.646	0.494	10,252
51	Tajikistan	Asia	5	2	0	0	0	7	0.668	0.224	7,898
52	Suriname	Latin America	0	2	2	1	1	6	0.738	0.3	2,538
53	Peru	Latin America	3	1	2	0	0	6	0.777	0.69	211,645
54	Jamaica	Latin America	2	1	0	1	1	5	0.734	0.451	14,228
55	Belarus	Europe	1	0	2	2	0	5	0.823	0.787	57,708
56	Niger	Africa-S	2	0	1	2	0	5	0.394	0.3	12,971
57	Tonga	Oceania	3	2	0	0	0	5	0.725	0.133	503
58	Grenada	Latin America	0	0	0	3	1	4	0.779	0.198	1074
59	Fiji	Oceania	0	1	0	2	1	4	0.743	0.324	3932
60	Bangladesh	Asia	0	3	0	0	1	4	0.632	0.509	355689
61	Mauritius	Africa-S	0	0	1	3	0	4	0.804	0.54	11341
62	Barbados	Latin America	1	0	0	3	0	4	0.814	0.337	4630
63	Vietnam	Asia	1	1	0	2	0	4	0.704	0.706	368002
64	Somalia	Africa-S	0	1	2	1	0	4	0.361	0.215	4918
65	Saint Lucia	Latin America	3	0	0	1	0	4	0.759	0.333	1770
66	Jordan	Asia	0	1	1	0	1	3	0.729	0.552	42609
67	Trinidad and Tobago	Latin America	0	1	1	0	1	3	0.796	0.412	22718
68	Lebanon	Asia	1	1	0	0	1	3	0.744	0.395	18734
69	Morocco	Africa-N	0	0	0	3	0	3	0.686	0.572	112220
70	Gambia	Africa-S	0	1	1	1	0	3	0.496	0.266	1806
71	Chad	Africa-S	1	1	0	1	0	3	0.398	0.281	10510
72	Egypt	Africa-N	1	1	0	1	0	3	0.707	0.823	396328
73	Indonesia	Asia	0	0	2	1	0	3	0.718	0.849	1E+06
74	Azerbaijan	Asia	2	1	0	0	0	3	0.756	0.516	41666
75	Antigua & Barbuda	Latin America	0	0	0	1	1	2	0.778	0.197	1389
76	Maldives	Asia	0	1	0	0	1	2	0.74	0.221	4712
77	Salvado	Latin America	0	1	0	0	1	2	0.673	0.427	24,784
78	Thailand	Asia	0	1	0	0	1	2	0.777	0.831	546,223
79	Burkina faso	Africa-S	1	0	0	1	0	2	0.452	0.345	16,082
80	Costa Rica	Latin America	1	0	0	1	0	2	0.81	0.606	59,645
81	Madagascar	Africa-S	1	0	0	1	0	2	0.528	0.394	14,199
82	Timor-Leste	Asia	0	2	0	0	0	2	0.606	0.119	1,920
83	Philippines	Asia	0	0	2	0	0	2	0.718	0.598	393,737
84	Kyrgyzstan	Asia	1	0	1	0	0	2	0.697	0.305	7,480

85	Nigeria	Africa-S	2	0	0	0	0	2	0.539	0.533	480,482
86	North Macedonia	Europe	2	0	0	0	0	2	0.774	0.603	12,510
87	Bulgaria	Europe	0	0	0	0	1	1	0.816	0.823	67,617
88	Bahamas	Latin America	0	0	0	1	0	1	0.814	0.313	11,560
89	Dominica	Latin America	0	0	0	1	0	1	0.756	0.224	77,883
90	Solomon Islands	Oceania	0	0	0	1	0	1	0.567	0.13	1,551
91	Guyana	Latin America	0	1	0	0	0	1	0.682	0.311	6,806
92	Romania	Europe	0	1	0	0	0	1	0.828	0.869	287,279
93	Iraq	Asia	0	0	1	0	0	1	0.674	0.527	201,472
94	Moldova	Europe	0	0	1	0	0	1	0.75	0.556	11,241
95	Armenia	Asia	1	0	0	0	0	1	0.776	0.385	12,813
96	Dominican	Latin America	1	0	0	0	0	1	0.742	0.412	545
97	Israel	Asia	1	0	0	0	0	1	0.919	0.701	467,532
98	Singapore	Asia	1	0	0	0	0	1	0.938	0.843	378,645
99	South Africa	Africa-S	1	0	0	0	0	1	0.709	0.908	415,315

Notes: Due to a lack of sufficient and reliable data, a considerable number of countries had to be excluded from this study. Africa-N means North Africa. Africa-S means Sub-Saharan Africa. Education (E), Conference (C), Healthcare (H), Sports (S), Public Culture (P). Column "T" presents the total amount.

From the perspective of Africa, China's construction aid has a more significant impact on countries in the sub-Saharan region, while the impact on North Africa is not obvious. It shows that China's aid in sub-Saharan Africa can help recipient countries improve infrastructure and promote economic growth. This is because sub-Saharan Africa has a low level of infrastructure, backward economic development, and low human development index [42]. China's aid to the region has provided funds and projects for its economic development, alleviating the existing problems of infrastructure construction in this region. The financing gap helps recipient countries improve infrastructure and promote economic growth. But in North Africa, the impact of China's non-construction aid on economic growth is not significant. This is because China's investment in North Africa and the number of projects are relatively small, and the development level of North Africa is relatively high [43]. Therefore, higher-quality facilities and funds are needed to significantly improve the development level of North Africa. In general, the lower the development capacity of the recipient country, the higher the positive impact of China's construction aid on GDP, GQII, and HDI.

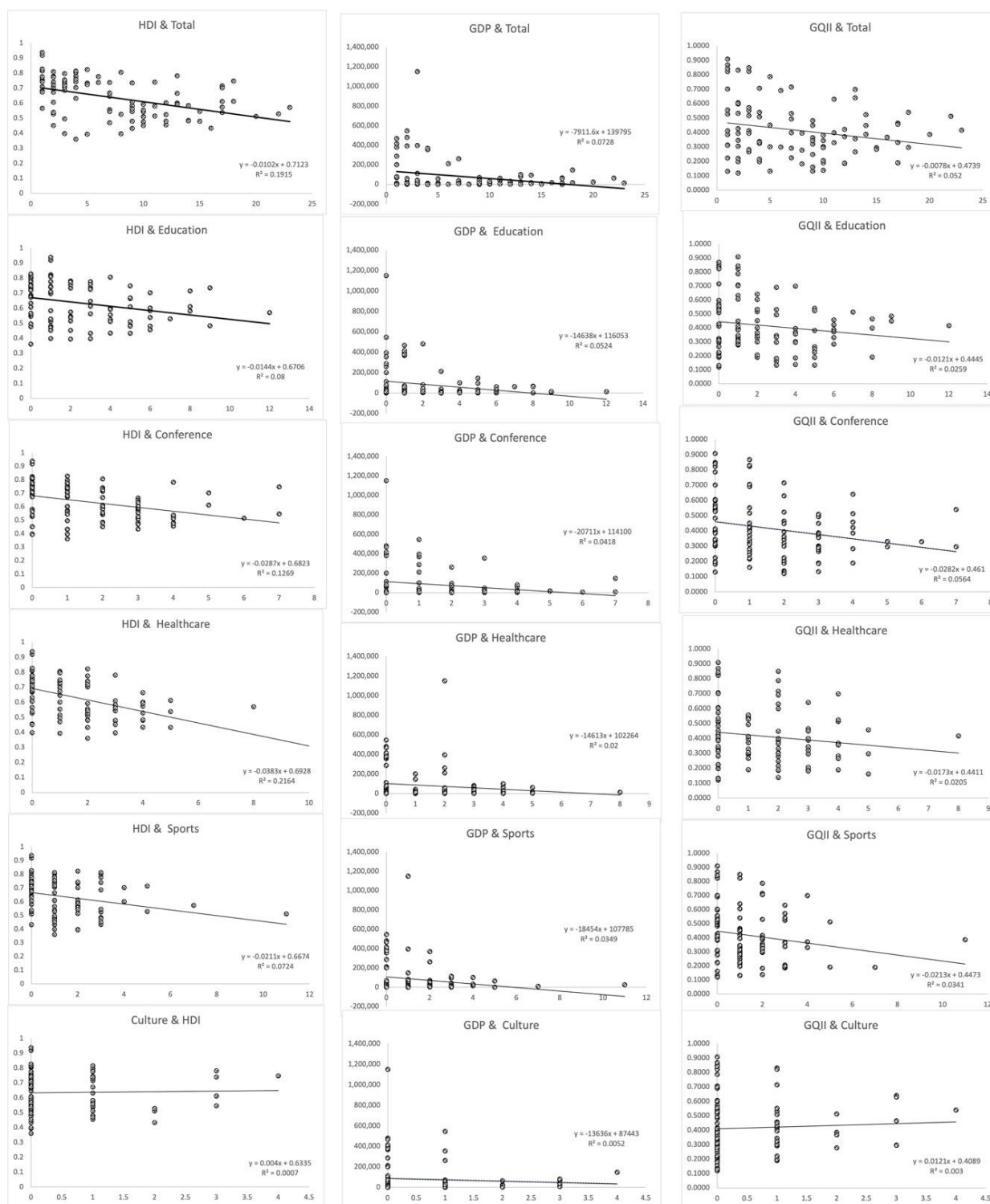


Figure 8. Correlations between the amount of China's five-type foreign-aided buildings and HDI, GDP, GQII.

Table 5. The results of the value of R^2

	X (Total)	X (E)	X (H)	X (C)	X (S)	X (P)
Y (HDI)	0.195	0.08	0.2164	0.1269	0.0724	0.0007
Y (GDP)	0.0728	0.0524	0.02	0.0418	0.0349	0.0052
Y (GQII)	0.052	0.0259	0.0205	0.0564	0.0341	0.003

5. Conclusion

This article expands the transnational dimension of China's architectural aid by investigating the five typical types. In doing so, this article contributes to the literature on transnational architecture, which is dominated by European and North American perspectives, and further clarifies the specificities of China's buildings in the Global South. It began with

a dataset with 766 projects towards five architectural types regarding China's exported buildings. A brief summary of its distribution of temporal dynamics and spatial shifts was elaborated.

In general, the spatiotemporal allocation of China's architectural aid has a comparatively different evolution and spatial variability before and after 2000[44]. At the initial stage, the wave of numbers was soft and always kept at a lower level whereas its geographical range rapidly expanded from neighboring socialist countries to worldwide. These overseas projects take seriously China's socialist utopian dreams and the Confucian philosophy of "sharing and giving"[30,45]. After 2000, plenty of China's policies linked with diplomatic strategies made by well-organized institutes led to the fluctuation to a large degree. The changing political climate and diplomatic relations decisively shaped China's state-sanctioned architectural production. Besides, each architectural type has separate peaks due to its social function whereas keeps a dynamic balance at the macro view [9]. For instance, before 2000, the number of buildings for sports and conferences has a priority because of their efficiency in social stability for a new independent local authority. While after 2000, with the proposal of MGDs, China's emphasis shifted to the social infrastructure, such as hospitals and schools [46]. It is noted that the majority of hospitals and schools are exported to countries with lower development ability, in other words, these countries need fundamental infrastructure projects for social improvement.

In terms of design form, there are certain regional differences in the design of foreign aid: the two main regions of China's foreign aid are Africa and Southeast Asia and West Asia. The general buildings in Africa have certain characteristics of colonial architecture. The recipient countries have requirements for the perfection of building scale, function and supporting facilities, but they have no special requirements for architectural form and style, and the architectural style is more modern; It has a long history and unique architectural styles. Recipient countries have high requirements for architectural styles and hope to embody traditions, but few can accept completely modern styles.

In addition, the literature suggests the donor's policy and the development needs of the recipient countries are two main drivers of China's aid. Through the analysis of the correlation between architectural aid and development needs, the drivers explained how China conducts construction aid of various types to fit the needs of developing countries and then improves development abilities, demonstrated by HDI, GDP, and GQII. These three indexes help identify the countries requiring immediate attention in a particular development. Countries with lower development abilities, especially countries in Sub-Saharan Africa, have more basic requirements to improve education and sanitation, fitting fundamental guarantees for the minimum standard of living [16,18,24]. In contrast, countries with higher development abilities such as countries in North Africa and Latin America ask for more conference facilities, stadiums, and other public cultural centers for urban development [32]. Thus far, this paper has developed the fact of China's overseas buildings in the Global South. It is argued that policy has a significant influence whereas this aid is to improve the development abilities. The outcomes can guide planners, policymakers, and practitioners in devising policies and architectural projects for balanced development. Countries in the Global South should be placed at various hierarchy levels considering different functional dynamics, population sizes, and priority needs for sustainable and balanced development [47]. This linkage between aid and development went on to deduce that China's architectural aid aims to change human livelihood and improve happiness.

Due to the uniqueness of construction in Asia, Africa, Latin America, and other countries with different social, economic, and urbanization levels and many fields, the research on China-aided construction is very complicated. Its history, distance, and language differences create a cognitive lack of understanding and communication. Therefore, conducting systematic research on the types of buildings aided by China is helpful for architectural theory to get rid of the discourse of European and American centrism, and to construct an equal identity in international academic and cultural exchanges.

For architects, it is possible to observe How to maintain a high design level of architectural production under extremely different real conditions, and how to connect it to the construction practice at all levels of society based on the principle of suitability. For urban designers, the special urban and rural structure and urbanization experience of recipient countries can lead to profound thinking in many aspects when comes to aid projects. For policymakers, in the process of formulating policies, full consideration should be given to the development capabilities of recipient countries, especially the level of infrastructure.

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