Housing is Dynamic, Not Static

Shifting the Development of Affordable Housing
with Circular Materials and Methods
in Kenya

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ABSTRACT

In the built environment, the continuous growth and expansion of urban areas worldwide have become alarming. The built environment is continuously developing in an unsustainable manner, and in the mid-term future, resources will be scarce if practices are not changed. Therefore, new building materials and methods need to be implemented to mitigate the substantial problem and prevent a point of no return. This research focuses on the Global South taking Kenya as a single case study to investigate the following research question: How can NGOs support local stakeholders in Kenya to shift the production of affordable housing by the use of circular materials and methods? This research design was conducted through a double-diamond framework, and data was collected in a qualitative manner. The objective is to understand housing practices in the local market to seek alternatives to shift affordable housing development into circular practices. By these means, this research attempts to provide information on the processes of support that NGOs can give to implement circular materials and methods in housing, strategies to create acceptance and adaptation of these materials in the local market and the ways to create economic and social value through circularity in the built environment. A comprehensive literature review was made to develop a foundation of knowledge for the empirical study.

Furthermore, as a result of the empirical study and the triangulation of data between the literature review and the research findings, a guideline for NGOs to help local stakeholders shift to circularity was created. The output of this study endeavours to develop an understanding of how the demand and the supply of circular materials and methods need to be tackled to be able to disseminate circularity in the local built environment and create the shift towards the use of these innovations and new building practices. As a result, the depletion of natural resources and the amount of CO_2 emissions produced by the built environment in Kenya can be controlled while providing affordable and adequate housing for the country.

Key Words: Affordable housing, Global South, Kenya, Circularity, Circular Building Materials, Innovation, Low-income Population, Scarcity of resources, Built Environment, Frugal Innovation, Diffusion Innovation, Social Entrepreneurship, Social Norms

“Every problem is an opportunity in disguise”

John Adams

TABLE OF CONTENTS

Introduction 01

1.0 Problem Statement
1.1 Circularity and Sustainability 02
1.2 The Global South and The Affordable Housing Market 05
1.3 Kenya and The Affordable Housing Market 07
1.4 Habitat for Humanity and its role in Kenya 08
1.5 Purpose of Research 09
1.6 Research Questions 09
1.7 Goal and Objectives of the Research 10

2.0 Theoretical Background
2.1 Policies and Politics in the Urban Market 11
2.2 Diffusion Innovation Theory on Enterpreneurship 13
2.3 Frugal Innovation, Sustainability and Buisness Models 15
2.4 Social Entrepreneurship 18
2.5 Connecting Concepts and Understanding Constraints 21

3.0 Research Method
3.1 Research Design 23
3.2 Qualitative Research 23
3.3 Data Collection and Analysis 25
3.4 Actor Network 26
3.5 Interviews and Questionnaires Methodology 28
3.6 Ethical Considerations 29

4.0 Circularity in Kenya
4.1 Present Low-Income Housing Situation 30
4.2 Kenya's Building Codes 31
4.3 Circularity in the Built Environment 31
4.4 Social Norms 32

5.0 Kenya in the Built Environment
5.1 Method of Analysis 35
5.2 Questionnaire 35
5.3 Questionnaire Findings 36
5.4 Limitations from Questionnaire 39
5.5 Interviews 39
5.6 Interviews Findings 40

5.7 Limitations from Interviews 55

6.0 Interpretation of Research Findings
6.1 Process of Support to Implement Circularity 56
6.2 Strategies Evoking Change Towards Circularity 58
6.3 Creating Economic and Social Value Through Circularity 60
6.4 NGOs Support Towards Local Stakeholders in Kenya 61

7.0 Conclusion 63

8.0 Reccomendations
8.1 Reccomendations for Further Research 65
8.2 Reccomendations for Practice 66

Reflection 67

References 69

Appendix
Appendix A: Definitions 74
Appendix B: Questionnaire Template 75
Appendix C: Interviews Protocols 80
Appendix D: Data Results Sankey Diagrams 92
Appendix E: Reccomendations for Habitat for Humanity 104
Appendix F: Research Management Plan 106

INTRODUCTION

Today, 85% of the global population is of low income, and most of this population belongs to developing countries in the Global South (Roser, M., Ortiz-Ospina, E. 2013). This means 85% of the world lives on less than $30 (international dollars) per day, and from that percentage, two-thirds of this population lives on $10 per day. (Roser, M., Ortiz-Ospina, E. 2013). The urban Global South is a region of the world that is experiencing rapid exponential urbanisation. Cities are growing in number, making it harder for the poorer sections of society to obtain adequate housing and security of tenure. As a result, an increasing number of people are living in substandard housing conditions, with a projected 2 billion by 2030 (Smets,P., et al. 2014). This situation is not only alarming concerning the quality of living of a significant number of populations but also the fact that the built environment continues to develop in an unsustainable manner. Currently, the built environment uses around half of all materials consumed globally (Sprecher, B., et al. 2021). As an effect, resources will be scarce in the medium-term future if practices are not changed.

New strategies and innovations are being developed in the built environment to solve these sustainability issues. Circularity has become an alternative, trying to mitigate the use of natural resources and stimulate the reuse of materials for future constructions. Still, that is only the first step to being able to transform the built environment. Strategies on how to implement circularity from a stakeholder's perspective become a fundamental action to make the change possible. There needs to be a multidisciplinary and comprehensive approach towards sustainable urban development to make this shift. Partnerships between different stakeholders and collaborations between local producers are key in this process (Smets,P., et al. 2014), especially if affordable prices are a determinant for circular materials and building methods to be implemented in affordable housing.

To understand how to mitigate the unsustainable urban growth and seek opportunities to make a shift in affordable housing development in the Global South, Kenya will be taken as a case study. Considering that the Global South entails different countries, cultures and economic situations, this report focuses solely on Kenya and its built environment to provide in-depth research. This research will be guided by Habitat for Humanity International, taking the standpoint of NGOs. The main focus of this research will be to find alternatives on how these entities can support local stakeholders in Kenya to make a shift in the built environment, focusing on circular materials and methods in affordable housing. NGOs are essential stakeholders; they are part of the supply market and have user involvement on the demand side. Therefore, as a stakeholder, they become active actors who influence communities, are indirectly related to the government and are private-sector driven. Hence, they become a key actor to be able to seek opportunities for change to make a shift in the built environment in the affordable housing sector. As a result of this research, a guideline will be delivered, providing affordable, innovative, sustainable and long-term solutions that can bring circular affordable, low-income housing production to scale.

1 PROBLEM STATEMENT

1.1 CIRCULARITY AND SUSTAINABILITY

Sustainable Development

The Brundtland Report states: “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development, 1987, p. 41). For sustainable growth to happen, inhabitants’ basic needs and rights must be satisfied. Sustainable development is often defined as a long-term equilibrium between society, the environment, and economic growth. A world in which human and natural systems may coexist and even prosper over time (Smets, P., et al. 2014). In terms of environmental integrity, sustainability has also become a key concept. Mineral resources are limited and depleted, and man-made by-products and human interference pollute the biosphere, threatening nature’s equilibrium and biodiversity loss. The growing urbanisation of natural regions due to city expansion has contributed to worldwide biodiversity loss and climate change. There is growing concern about environmental changes, and as a result, societies are becoming more aware of the need to convert to sustainable practices. The shortage of resources is a problem that governments and organisations are constantly attempting to solve to achieve balanced development. Ecological practices have an essential role in establishing long-term growth in many countries (Górecki, J. 2019). As a result, “alternatives” to traditional patterns of physical, social, and economic growth need to be considered to prevent issues such as natural resource depletion, ecosystem damage, pollution, overpopulation, rising inequality, and degradation of human living circumstances (Smets, P., et al. 2014).

Sustainable Production

Sustainable production is an environmental protection strategy based on continuous, coordinated, preventive action in processes to increase the efficacy of products and services while lowering the risk to people and the environment. A comprehensive approach is required for good decision-making about sustainable development, which attempts to increase the quality of life while protecting social equity, biodiversity, and natural resource diversity. It indicates that economic issues should be studied, considering their implications for social issues, policies, and the environment (Górecki, J. 2019). Environmental sustainability insights may also be used for low-income housing in the Global South’s cities. In particular, more emphasis should be devoted to the interaction between technology and social solutions for long-term behaviour, economic, and governance transformations, which are mediated by the built environment and physical places (Smets, P., et al. 2014). It is essential to separate the following sectors to unravel the complicated links between sustainability and low-income housing in cities. First, low-income urban housing cannot be made sustainable until environmental and energy issues are addressed. Therefore, urban design that leads to a densification of the built-up area, for example, can promote sustainability by lowering carbon footprints and implementing hazard-resilient measures. Second, technology and production may play a significant part in creating disaster-resistant construction materials that are long-lasting. Prefabricated construction components, for example, may be recycled, and locally manufactured building materials save transportation costs, all of which contribute to the long-term viability of low-income housing (Smets,P., et al. 2014). Still, the technical difficulty is enormous. The task at hand is to turn house construction, which is now expensive and complicated, into a process that is both affordable and simple (Turner, J. 1972). Third, policies are required to minimize carbon emissions, avoid man-made hazards, and guide suitable and educated city design that incorporates affordable initiatives. Increased collaboration between national and local state levels and urban management and urban governance requires targeted policies (Smets, P., et al. 2014).

Circularity

Product reuse and material recycling have become an alternative to promote conservation by requiring fewer natural resources to be extracted to produce new materials. It also entails generating less waste and releasing fewer hazardous substances into the soil, water, and air. This results in a shift from grey to green resources and energy (Potting, J. et al. 2017). There is a shift from a linear economy, which is the traditional mode of processing materials, to a circular economy, which encourages material recycling. In a linear economy, natural resources are extracted to make new materials, which are then used to construct objects that are either burned or disposed of in landfills after use.

Materials from abandoned items should ideally keep their original quality in a circular economy so they can be reused in similar products. As a result, no natural resources are needed to generate new materials, and discarded goods are no longer seen as waste. In practice, this ultimate circularity is unlikely, in which a product cycle is closed since the materials can be reused. However, there is a concerted effort to realise this ideal condition through circular economy transitions (Potting, J. et al. 2017). Meanwhile, there are two types of circularity: economy

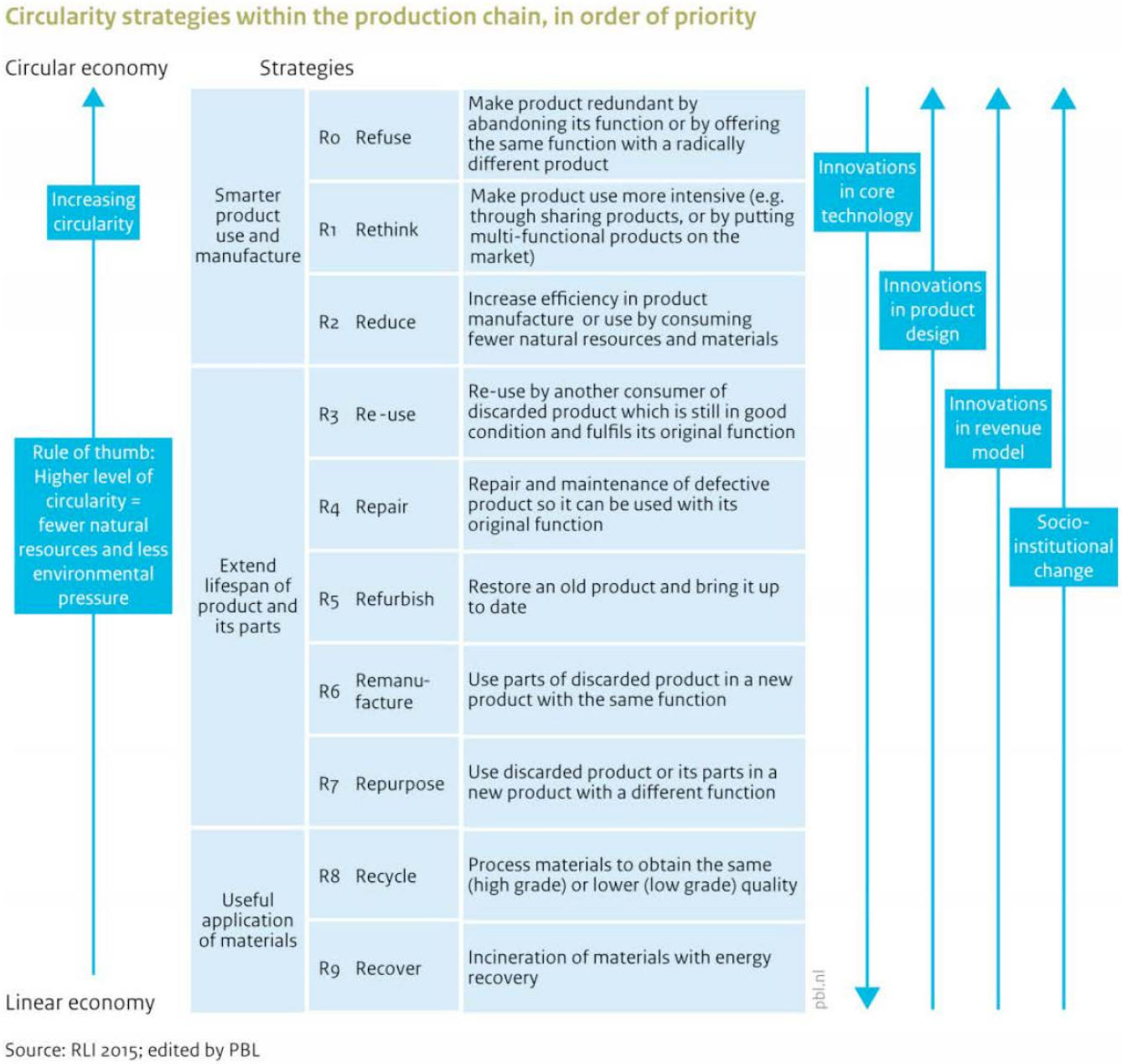


Figure 01. Circularity within the production chain. Nine R's Model. (Also known as 10 Rs). Potting, J. et al. 2017

with feedback loops and circular economy. (Van Buren et al. 2016).

Van Buren et al. (2016) state that "A circular economy aims for the creation of economic value (the economic value of materials or products increases), the creation of social value (minimisation of social value destruction throughout the entire system, such as the prevention of unhealthy working conditions in the extraction of raw materials and reuse as well as value creation in terms of the environment (resilience of natural resources)"(3). These economic values can be shown through the 9 R's (or 10 Rs) framework depicted by Potting et al. (2017), which shows the transition from linear to circular economies utilising various tactics; this can be observed in Figure 01.

The degree of circularity in the nine R's emphasises the "recovery of energy" through the combustion of material flows. It is a method of recovering energy by extracting the value of resources at the end of their life cycle. While energy recovery and recycling, which degrade materials to repurpose them for a new function, are at the heart of the recycling-based economy, the goal is to become entirely circular (Van Buren et al. 2016). "The recycling economy and a fully circular economy differ from each other in that the recycling economy does still involve the input of raw materials and the generation of waste (residuals), while the loops are closed in a circular economy." (Van Buren et al. 2016. 3). Figure 02 depicts the contrasts between the linear economy, the recycling economy, also known as the economy with feedback loops, and the circular economy.

The built environment currently consumes around half of all materials utilised globally. As a result of urbanisation and population growth, the demand for materials in the urban environment is expected to continue to rise. Materials must be acquired as much as possible from demolishing structures that are not being used, rather than from primary sources, to increase material efficiency (Sprecher, B., et al. 2021). Through circularity, a great alternative can be enhanced in the built environment to intertwine technology and produce new materials while pushing forward sustainability and preserving natural resources. As technology and material efficiency advance, affordability becomes an important theme to address in housing to mitigate the scarcity of resources and CO_2 emissions provoking climate change.

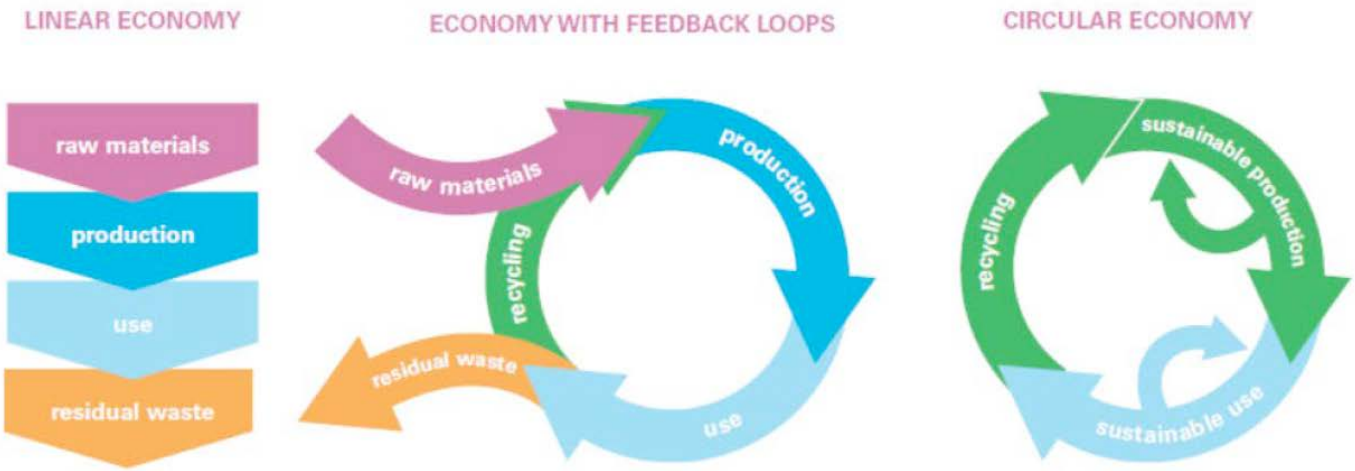


Figure 02. Differences between linear economy, economy with feedback loops, and circular economy. Van Buren, N. et al. 2016.

1.2 UNDERSTANDING THE AFFORDABLE HOUSING MARKET IN THE GLOBAL SOUTH

Affordable housing in the Global South relies on the supply provided by different stakeholders such as the government, private companies, end-users in a self-building procedure and NGOs, while the demand is continuously growing by the population in need. Owner-occupied and rental housing production and consumption are strongly intertwined with the core factors of construction: land, finance, construction skills, and building materials. Such parts of the construction process are necessary on a local level, but they must be viewed from the perspective of political economics. Given their limited means on housing investment, it is difficult for local and national governments in the Global South to offer and establish good housing conditions. Therefore, low-income people cannot rely solely on their governments for housing. For large-scale housing production in developing countries, private sector participation, such as building companies, financial institutions, and banks, as well as resident participation (Smets, P., et al. 2014) and NGOs, is critical. For a house to become affordable, there needs to be a combination between earning capability and availability of savings and credit in a household. The size and regularity of a household income and its physical possessions become determining factors for a housing loan to be given (Smets, P., et al. 2014). In that sense, land, construction mechanisms and building materials need to become accessible in prices for a house to become affordable.

Needs are met in the market based on financial capabilities rather than urgency. Alternatively, supply is delivered in response to "effective demand," as defined by traditional economists (Turner, J. 1972). There should be clear boundaries between "effective demand" in the market, "needs" in terms of appropriate housing and living circumstances as experienced by housing users, as well as the idea of official and legal housing requirements as set by local or federal governmental agencies (Turner, J. 1972). Developers, contractors, manufacturers, suppliers, realtors, insurance companies, financing institutions, and other housing actors are mainly concerned with the effective demand for housing as a product. They also focus on those households among the total population which can and are willing to pay the given price for a housing product the industry and the market supplies (Turner, J. 1972). Therefore, if resource scarcity wants to be mitigated and a shift into sustainable practices such as circularity intends to be implemented in affordable housing, the focus for change starts with what the market supplies and how they approach the effective demand. The market needs to provide goods and services that are efficient, effective, and affordable for households to buy and incorporate sustainable practices in the built environment.

Official housing standards set the bar for what government agencies and inspectors will accept. People who set minimum standards rely on their values and the professional judgments on those who set them. This influences the technical approach and implementation procedure executed in the supply market. The enforcement of unrealistic minimum standards has the power to worsen the housing conditions for the poor and creates a debate on the meaning and value of housing for people. On the other hand, for the owner or renter, financing and insurance institutions, and society, these norms are meant to function as quality monitors and protections (Turner, J. 1972). Hence, the need for circular materials and building methods to be affordable, given that the housing market cannot only focus on sustainable practices concerning materials but also on the type of housing being provided to the end-user. The precarisation of housing due to the standardisation processes needs to be mitigated. For that matter, strategies for the development of circularity need to be supported by the supply stakeholders to provide a good that complies with the environmental sustainability need and the effective demand. If the implementation of these circular materials and methods is not held correctly, the shift will never be made.

Legal minimum requirements, according to John Turner (1972), are a notion created by public authorities, whereas user needs exist independently of the market and the government. They are based on the users' perceptions of human urgencies. User de-

mands are relevant to the market's supply side, but only to the extent that they can be translated into effective demand. Finance, management, technology, and marketing are controlled by the housing sector and, to a lesser extent, government laws. Private firms supply the market with only those dwelling goods that guarantee a profit at low risk. On the supply side, producers have complete control over the manufacturing process's placement, entry, and departure points. They also fully understand the industry, including its risks and profit potential, as well as aggregated business alliances, information sharing, and political lobbying operations. On the demand side, users have limited freedom of choice, mobility, and market expertise, as well as little or no awareness of tenants' rights, building regulations, housing and health standards. The enforcement agencies or procedures that enforce them also have minimal access to information about alternatives. They're also very isolated and individualistic (Turner, J. 1972). To make the most use of limited housing resources, each household must have options and ways to use them. People who do not have the freedom to make their own decisions are unable to use housing as a means of meeting their needs. If there is no wide "palette" where they can create a combination that suits their needs, the housing action will be approached by minimising costs and paying as little as possible (Turner, J. 1972). These ideas are also supported by Richard Sennet (2018), wherein an open way of design, a catalogue of parts, can give freedom to people to choose different materials that appeal to them and satisfy their needs. But, if this is limited, people will keep on using what is traditional and familiar.

Nonetheless, it is important to understand that in the modern urban world, ongoing advances are being created in the system for better alternatives and efficiency. The problem strikes on one hand when there is too much diversity, given a lack of coherence and purpose to growth surges, which leads to little efficiency and stagnation. On the other hand, too much efficiency will lead to little diversity and fragility of the system, leading to crashes in the system (Smets, P., et al. 2014).

The development of effective housing policy and planning is critical. However, it is important to consider the nature of housing and the relationships between housing as a consumer good and housing as an economic good with a market value. Housing provides a basis for households and individuals to escape poverty and improve their wealth and well-being as a consumption good (Beall, J., Fox, S., 2009). The following factors should be prioritised in urban housing design for long-term sustainability. First, only by integrating policies and strategies from a multidisciplinary, comprehensive, and pluralist approach can sustainable urban development be realised. Second, form partnerships; collaboration across the public, private, and civic sectors and provide the cornerstone for moving these initiatives ahead. Local multi-sector collaborations may aid in the formation of the synergies required for a successful urban development strategy. Third, residents' active interest and participation. Without an outspoken public with access to decision-making at all levels of project and policy development, from the very early stages of needs assessments through the final implementation phase, the chances of establishing long-term solutions are slim (Smets, P., et al al. 2014). Community groups and socially aware professionals must form alliances to combat industry, financing institutions and government agencies' coalitions and strengthen low-income people's political power (Turner, J. 1972).

1.3 KENYA AND THE AFFORDABLE HOUSING MARKET

Kenya is the third-fastest-growing country in Sub-Saharan Africa, with Nairobi as the second-fastest-growing city (UN-Habitat 2010). Currently, the country's urban population has increased by 28% in 2020 (The World Bank 2021), and it is predicted that by 2050 the living population in urban areas will be 48% (Hendriks, B. 2014). Of the current population, 61% live in informal settlements (CAHF. 2021), where slums are home to an estimated 10 million Kenyans across the country, accounting for 36% of Nairobi's population (CAHF. 2021). Since independence, Kenya has had a significant housing shortage. The country has an annual housing demand of 250,000 units but can only provide an estimated supply of 50,000 units. As an effect, there is a housing deficit of 2 million units, equal to an 80% deficit in demand (Habitat for Humanity. 2020). Due to population increase and poor financial resources and administrative capacities of urban centres, the authorities have been unable to ensure that yearly housing production keeps pace with the expected expanding annual housing need. Meeting the increasing demand for housing has remained a key concern since the 1990s, despite introducing new approaches, policies, and programmes (Hendriks, B. 2014).

Since its independence, the private sector has dominated the housing market. During the 1970s and 1980s, state-assisted sites and services projects provided a significant amount of regulated public sector housing, which has recently reverted to a new cycle of state-supported affordable housing (Hendriks, B. 2014). Kenya has grown rapidly during the last two decades, despite a lack of government-subsidised housing and appropriate private sector supply. In Nairobi, the city's poor and low-income residents mostly rely on unregulated private sector housing and some unregulated self-help housing (Hendriks, B. 2014). The formal private sector mostly serves the housing market segments of higher-income and upper-middle-income people. Overall, more than 80% of new houses are built for this segment. The private development portfolio is estimated to contain fewer than 30% of low-income, affordable housing units, but low- and lower-middle-income earners account for 83% of demand (Hendriks, B. 2014). The goal of Kenya Vision 2030 (2012) is to achieve "an adequately and decently housed nation in a sustainable environment" (19). The Kenyan Constitution guarantees every individual the right to accessible and adequate housing and decent sanitation standards. To achieve its progressive realisation, the state will pursue legislative, policy, and other actions, including the establishment of standards (Hendriks, B. 2014). Complementary to the Vision 2030, a medium-term strategy called the Big Four Agenda was established, where affordable housing became one of the big four pillars of this strategy.

However, in 2020 there were 26,971 mortgage loans. Although there has been a rise over time, it has been little compared to demand, indicating a market expansion opportunity (CAHF. 2021). Still, this means that most middle-income individuals cannot afford the typical fixed mortgage required to purchase a starter home (Hendriks, B. 2014); consequently, housing affordability is a key challenge in the country. It is important to note that personal savings are utilised by 54% of Kenyans for house construction, followed by bank loans (which are used by 19%) and mortgages (which are used by only 6% of Kenyans). Sacco (Savings and Credit Cooperative Societies) loans account for 11% of the loans (CAHF. 2021). According to data from 2019, "Kenya population and household census shows high ownership of homes nationally at 61.3%, with 38.7% of the national population renting. The situation is different for urban areas with 21.3% ownership and 78.7% rental." (CAHF. 2021.142).

Land continues to be a critical component in the supply of affordable housing, accounting for 60% of the total development cost. Despite the pandemic, land prices in Nairobi and its dormitory towns/satellite towns have continued to rise, with overall prices in Nairobi rising by 0.3% and increases of 1.1% in satellite towns, highlighting the challenge of Kenya's escalating land costs in providing affordable housing (CAHF. 2021). The lack of affordable land limits housing development. Despite the government's land reforms, more work is needed to obtain land and the bulk infrastructure required for the mass manufacturing of houses (CAHF. 2021). Given the

high demand for affordable housing, there needs to be a shift in how real estate development is being handled to provide housing to the low-income population in an adequate manner.

1.4 HABITAT FOR HUMANITY AND ITS ROLE IN KENYA

Habitat for Humanity started in Kenya in 1982 and has focused on vulnerable housing groups, community infrastructure, advocacy, and livelihood empowerment. Habitat Kenya assists vulnerable communities in Kenya that live in inadequate housing, lack access to clean water and sanitation and earn less than $1 per day. It brings together international and local volunteers, as well as community and corporate partners, to assist in the construction of accessible, low-cost housing and the promotion of homeownership for these marginalised populations to break the cycle of poverty (Habitat for Humanity. 2020). Besides the housing programme, Habitat Kenya delivers solutions that benefit and impact entire communities, such as water and sanitation, energy solutions, school development, and other community infrastructures. In advocacy, the organisation assists women and other vulnerable groups in acquiring land tenure through official and informal land ownership methods through our advocacy program. Also, they support county government policymakers in promoting policies, legislation, processes, and practices that improve access to appropriate, affordable housing and living standards (Habitat for Humanity. 2020). Finally, the entity is committed to improving community members' economic well-being by teaching financial literacy to women, youth, and other community groups, as well as developing and marketing alternative building materials (such as interlocking stabilised soil blocks) and educating construction artisans on appropriate building technology and quality standards (Habitat for Humanity. 2020).

Terwilliger Centre for Innovation in Shelter

The Terwilliger Centre for Innovation in Shelter is a specialised department from Habitat for Humanity that promotes more efficient and accessible housing market systems, allowing millions of families the opportunity to afford housing. Habitat for Humanity ambition, through The Terwilliger Centre, is to push forward the implementation of the United Nation's member states' New Urban Agenda. This department focuses on market-based housing solutions guided through 5 major principles: Strive for scale to reach many families, sustainability, focus on the private sector, avoid market distortion and act as a facilitator (Habitat for Humanity International. n.d.).

In the strive for scale to reach many families, the department approaches through a market-based initiative, possibilities on how to achieve large-scale impact through successful business models. Small interventions are valid while the projects prove to be sustainable. This leads to the second principle, sustainability. For projects to be sustainable, the businesses delivering the product must recover their costs and generate some profit, nonetheless providing an affordable product. Consequently, the solution being provided aligns with the market incentives. Although Habitat for Humanity works as a non-profit organisation, its role in the private sector is very important. To provide affordable housing, they work with contractors, cement companies, equipment suppliers, banks and other stakeholders. They focus on stimulating the private sector to work alongside them in initiatives where they can seek profit, making the initiative of creating affordable housing expand. To prevent market distortion, their fourth principle, The Twelliger Center, favours the use of indirect subsidies that promote lasting solutions. These will benefit households after the intervention that is being made through the company. Finally, their role is to become a facilitator. This implies acting as a catalyst, causing changes in the market system without becoming a part of it. While remaining outside the housing market, this entity provides consulting services and technical assistance to market actors and companies to help low-income households get affordable housing (Habitat for Humanity International. n.d.).

Besides this initiative, the Terwilliger Center aims to improve the overall performance of the housing market system by implementing tactics that improve or change consumer behaviour and improve building codes or municipal housing policies to serve the underserved better. As an organisation, its aim is to encourage other market players to replicate their

work to create broader market change (Habitat for Humanity International. (n.d.).

The Terwilliger Center's assistance is designed in such a way that market participants retain ownership and responsibility for the initiatives, ensuring that they are long-term and do not require ongoing financial support. Working as a facilitator and catalysing changes in housing market systems leads to more accessible, inclusive, and resilient housing markets over time (Habitat for Humanity International. (n.d.).

1.5 PURPOSE OF RESEARCH

This research provides insight for NGOs who want to guide local stakeholders in the built environment to create a shift in their building practices. Its societal relevance is present by providing a guideline on how to evoke change and the positive effects on the local community and the built environment that could be made. Given that Kenya has a growing urban population and a severe housing shortage, researching how to implement sustainable and circular building practices and materials in affordable housing is important for the country and the world.

In terms of scientific relevance, this research is significant given it seeks new alternatives that can be implemented in the built environment, focusing on affordability, sustainability, innovation, and adaptation. It is important to highlight that traditional architecture used to be circular and sustainable in the past. Unfortunately, industrialisation made the built environment unsustainable and unaffordable for low-income and poor people. Circularity is a new topic in the built environment, and there is limited research focused on developing countries about the topic. Therefore, this research adds to the scientific field by providing concepts and relationships about circularity in the built environment focusing on Kenya. It also incentivises further research about the subject in the country and around the Global South.

1.6 RESEARCH QUESTIONS

The main idea of this research proposal is to provide an investigation setting where the following question can be answered:

How can NGOs support local stakeholders in Kenya to shift the production of affordable housing by the use of circular materials and methods?

To be able to answer the main question the following sub-questions were generated:

1. How can a process of support for circular materials and methods be created by NGOs to implement affordable and simple to build houses, while being both efficient and effective?

2. How can NGOs evoke change through strategies to create acceptance and adaptation of circular materials in the supply local market?

3. How supporting local stakeholders in the use of circular materials and methods create economic and social value, preventing precarization of affordable housing?

The idea is to provide a solution and support a better way for NGOs to advise how to shift the use of circular materials in the built environment to local stakeholders in Kenya. This shift will provide an opportunity for sustainable building in the country and mitigate resource scarcity in the future.

1.7 GOALS AND OBJECTIVES OF THE RESEARCH

The main goal of this research was to provide insight into how can NGOs support local stakeholders in Kenya to implement circularity in affordable housing. To make it happen, the idea was to create a guideline where NGOs could have guidance on how to approach the situation to evoke change. As objectives for achieving the main goal, a comprehensive study was conducted to gain a thorough understanding of how to develop strategies to encourage the adoption of circular materials and construction methods, as well as to gain insight into how this change can provide economic and social value in affordable housing. Also, comprehend the possibilities for building with circular materials in a simple and cost-effective manner. To obtain results of these objectives, data collection was handled through interviews with different actors, and online questionnaires and documents were collected for data analysis. This provided knowledge and insight into the actual situation in the built environment in Kenya; it helped to understand the levels of circularity that are being handled nowadays, the low-cost building technologies and other variables to propose new alternatives to the present problem.

This study aims to assist NGOs in gaining knowledge to influence local stakeholders and execute the use of circular materials and construction processes for affordable housing in Kenya. Circularity is a mechanism that can aid and mitigate resource depletion in the world. In this specific case, it allows sustainable urban development to happen. The research was conducted in a single case study which delivered as a final result a guideline for NGOs. This research aimed to raise awareness about the world's reality concerning building practices and the need to make a change for sustainability in the urban built environment. Finally, the idea was to inform and educate a community of interest for changes to start happening in the construction of affordable housing.

2 THEORETICAL BACKGROUND

The theoretical background will discuss four concepts: Policies on Urban Market, Diffusion of Innovation, Frugal innovation and Business Models and Social Entrepreneurship. These concepts were selected in a way that can relate to circularity in the built environment in the following manner. Policies in the built environment determine the possibilities builders and suppliers have for construction. It's within them that opportunities for change can happen, and it is fundamental to be aware of their importance and power when a shift in the current dynamics of the environment is being proposed. Circularity is a new theme in the built environment; to disseminate information about it, diffusion of innovation is necessary. Products made through circular processes are innovative, and the way they are showcased and communicated to a community can determine if new ideas will penetrate the market. Circularity focuses on mitigating the use of natural resources and providing new building techniques. Frugal innovation in the built environment focuses on creating quality materials with the least number of resources. In that sense, it aligns with circularity, and its approach can provide important insight into how to address new materials in the construction industry. Finally, social entrepreneurship is key to pushing forward these innovations, given that enterprises offer a product or service that satisfies an unmet need. They are socially oriented, and these entities can propel the change needed within the built environment to shift towards circularity. The main idea of this chapter is to provide an overarching view of these themes to create relationships that could guide answering the research questions.

2.1 POLICIES ON URBAN MARKET

Nowadays, countries experiencing urbanisation have significantly fewer resources per capita and far greater populations in most situations. City administrators and policymakers worldwide are under-resourced when trying to cope with such record numbers, especially considering the growing prevalence of urban poverty (Payne, G. 2014). The growth rate of secondary cities in Africa and other continents in the Global South also puts a lot of pressure on local governments to respond, even if many lack the necessary authority or institutional capacity (Payne, G. 2014). Urbanisation is a process that generates asset growth. However, it is often not a financial issue constraining the development of economically efficient and socially inclusive urban housing markets. The reluctance from those who formulate or approve policies, the bureaucratic inertia, the personal interests of the actors and their fear of failure on the part of officials often inhibit the development of flexible and pragmatic regulations for new challenges (Payne, G. 2014).

Following Pugh (1994), evolution and innovation are the two characteristics that identify policymaking. Evolution is characterised by change and development, which encompasses incremental changes and large redirections based on the "learning by doing" experience in the case of low-income housing policies. In housing practice, innovation expresses new ideas and principles, of which some are linked with major modifications (Pugh, C. 1994).
Policies and practices are influenced by agreements which are linked to acceptance. Therefore, innovation happens in action and practice, although several variables could alter the outcome, such as commitment, competence, and the context of implementation (Pugh, C. 1994).

To house the Base of the Pyramid (BoP) on a long-term basis, solid urban policies must be established that balance the interests of all stakeholders. The twenty-first century's housing difficulties are forcing a major shift in the innovation and size of private

market-based affordable housing in conjunction with the government. There is no such thing as a one-size-fits-all solution (Ferguson, B., Smets, P., Mason, D. 2014). To capture the vast effective demand of the various segments of the BOP, a spectrum of physical housing options, financing methods, and construction technical assistance services must be bundled and priced effectively. For this to happen efficiently, the private sector needs to collaborate with the government and citizen organisations (Ferguson, B., Smets, P., Mason, D. 2014). For greater integration with urban economies, housing finance capital systems and overall development in the low-income housing policy have been shifting away from project-by-project. This sets a significant mark in housing policy agendas that deepen and widen while raising awareness of the importance of economics, policymaking, political economy, and institutional development in housing practice and assessment (Beall, J., Fox, S. 2009).

Entrepreneurship in the field of affordable housing is growing rapidly. The goal is to maximise value creation while minimising costs. Stakeholders need to work together to provide the required services the diverse BoP segment has in housing problems (Ferguson, B., Smets, P., Mason, D. 2014). A trusted market needs to be enhanced, involving neighbourhood citizen-sector organisations. Formal public and private-sector organisations frequently lack expertise and access to low-income neighbourhoods; still, they can hire and fund capable community organisations to reach out to these populations (Ferguson, B., Smets, P., Mason, D. 2014). A collaborative or communicative approach shift reflects the understanding that “people, though their everyday activities, also make cities, and often in ways that ignore the visions of planners. This is
particularly apparent in the fast-growing cities of low-and middle-income countries where the reach of planning is limited: people create their own settlements informally, without a centralised vision or a coordinating entity, and service them according to their own means” (Beall, J., Fox, S. 2009. 204). Flexibility is also necessary, given it requires ongoing communication and collaboration. It not only increases the likelihood of effective solutions but also generates advances in real freedoms by allowing a larger number of people to participate in determining their own future (Beall, J., Fox, S. 2009). Lastly, low-cost housing buildings and basic services have seen an exponential jump in technological innovation (Ferguson, B., Smets, P., Mason, D. 2014). A kaleidoscope of local initiatives and opportunities can be pushed forward in the market. The difference is made the moment policies begin to shift, assisting in accelerating the affordable housing movement.

2.2 DIFFUSION INNOVATION THEORY ON ENTREPRENEURSHIP

Diffusion of Innovations

Even when an idea has apparent benefits, its adoption might be challenging. Many innovations take a long time, from when they become available in the market to when a community generally embraces them. As a result, it becomes a challenge for many individuals and organisations to know how to accelerate the rate of dissemination of a new product (Rogers, E. 2003). Diffusion is the method through which an innovation is conveyed to members of a social system over time through specific routes. It's a unique form of communication in that the messages are all about new ideas. It implies a social change, described as the process by which a social system's structure and function are altered. Social change occurs when new ideas are developed, disseminated, and adopted or rejected, resulting in certain outcomes (Rogers, E. 2003). This can arise in changing government regulations or policies, for example, or implementing new technologies in the market. An idea, behaviour, or thing seen as new by an individual or a community adopting it is referred to as an innovation. An innovation's newness can be measured in terms of knowledge, persuasion, or adoption (Rogers, E. 2003).

Following Rogers (2003), innovations can be identified through five different characteristics: relative advantage, compatibility, complexity, complexity, trialability and observability. Relative advantage is the degree to which an innovation is considered superior to the idea it replaces. The degree of relative advantage can be assessed in terms of money, but other aspects, such as social prestige, convenience, and satisfaction, are equally essential. It doesn't matter if an innovation offers a significant objective advantage. What matters is if a person sees the invention as beneficial. The higher an innovation's apparent relative advantage, the more quickly it will be adopted (Rogers, E. 2003). Compatibility is when an innovation is congruent with the potential adopters' existing values, past experiences, and needs. An innovation that is incompatible with a social system's values and conventions will not be adopted as quickly as a suitable innovation (Rogers, E. 2003). Complexity is when an innovation is thought to be difficult to grasp and applied. Most members of a social system can understand some advances, but for others, it becomes more difficult to comprehend, and its implementation will take longer (Rogers, E. 2003). Trialability is the extent to which an innovation can be tried out on a small scale. New ideas that can be tested through instalments are more likely to be adopted than innovations that are not divisible (Rogers, E. 2003). Observability is when an innovation's results are visible to others. Individuals are more inclined to adopt an invention if they can see the results of it more easily. The exposure of a novel idea encourages peer conversation (Rogers, E. 2003). In general, individuals will accept innovations they believe have a better relative advantage, compatibility, triability, observability, and less complexity than other inventions (Rogers, E. 2003).

Purposive Dissemination

Purposive dissemination, also known as designing for diffusion, entails taking extra steps early in the development process to increase the likelihood of an innovation being noticed, positively perceived, adopted, adapted, and implemented (Dearing, J. W., Cox, J. G. 2018). In this case, the innovation should be disseminated, which means that its reach is extended to those areas and demographic segments with the highest need and sufficient capacity to adopt and implement the innovation effectively (Dearing, J. W., Cox, J. G. 2018). External validity is the innovation's ability to create beneficial outcomes across various sites that must be evaluated. This implies the need for it to be reviewed based on theory and evidence from the perspectives of stakeholders who will apply the innovation in purposeful distribution (Dearing, J. W., Cox, J. G. 2018). How potential adopters view the innovation's features and the availability of implementation support in advance of demand from providers is another indicator that will provide knowledge towards the innovation's readiness (Dearing, J. W., Cox, J. G. 2018). The stimulation of diffusion requires a formative assessment of advice-seeking networks among potential adopters of innovation. When the great majority of people decide whether to adopt, such data can statistically and graphically identify which few potential adopters are highly influential (Dearing, J. W., Cox, J. G.

2018). Finally, formative evaluation along the full supply chain, such as supply, delivery, and support of an innovation, can help lower the barriers before the innovation is launched. This includes paying attention to perceived incentives that can be modified to meet different types of stakeholders (Dearing, J. W., Cox, J. G. 2018). These can be both monetary and core oriented. Formative evaluation can indicate the adoption of strong obstacles contributing to environmental change (Dearing, J. W., Cox, J. G. 2018).

Effects of Innovations in Society

Given the great majority of innovations fail to diffuse and never accelerate up an S-shaped curve (Figure 03), diffusion is an unusual consequence. This happens given that an innovation is defined as something potential users perceive as new, not necessarily better. Therefore, unworthy innovations can spread and be adopted, whereas effective innovations are frequently blocked (Dearing, J. W., Cox, J. G. 2018). Most people assess an innovation based on subjective evaluations of peers who have adopted the innovation rather than scientific studies conducted by specialists. As a result, these peers function as role models, with others in their system imitating their innovative behaviour. This is identified as the communication channel (Rogers, E. 2003). Through a good communication channel, developers who share or relinquish control of an innovation's implementation while being faithful to the core of their product and yet allowing peripheral components to be customised might accomplish the innovation approach to grow through diffusion by making a continuous course of corrections (Dearing, J. W., Cox, J. G. 2018).

Diffusion changes societies over time as a result of waves of innovation. On the one hand, given that high-income groups tend to adopt innovations earlier than poor communities, these shifts might emerge as disparities in knowledge, disproportionate access to government and commercial services, and rising inequality (Dearing, J. W., Cox, J. G. 2018). On the other hand, concerning policy change, researchers discovered that knowledge of actual outcomes in policy diffusion is less important than beliefs about an invention's effectiveness. This means that who has previously accepted an innovation is more critical to decision-makers than what was adopted and what consequences it had (Dearing, J. W., Cox, J. G. 2018). This outcome reflects the importance of imitation and mimicry, following historical studies in different places. As a background effect, policy attention and enactment in neighbouring states and governmental agenda-setting can drive policy consideration at the state level. Following policy diffusion studies, Dearing and Cox (2018) state that policy attention and enactment in neighbouring states and governmental agenda-setting can become stronger predictors of state policy adoption. Therefore, intermediary actors such as professional associations are essential in policy diffusion (Dearing, J. W., Cox, J. G. 2018).

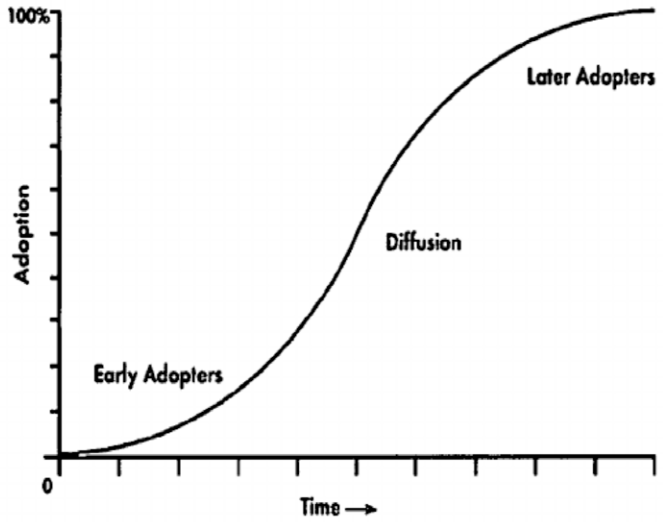


Figure 03. The Diffusion Process. Rogers, E. 2003

2.3 FRUGAL INNOVATION, SUSTAINABILITY AND BUSINESS MODELS

Frugal Innovation

Frugal innovation entails (re)designing products, services, and business models to dramatically reduce costs and enhance functionality while maintaining user value to reach affordable solutions for people, particularly in low-income areas (Leliveld, A., Peša, I. 2021). Radjou and Prabhu (2015) state the principle of frugal innovation as "doing better with less". It has been presented as a win-win, socially responsible business opportunity that combines large turnovers and profits to achieve development objectives. This debate has begun to examine issues such as how to marry profits with social goals, presuming that business operations can help to achieve the long-term goal of poverty reduction by integrating the BoP people into efficient value chains and market structures (Leliveld, A., Korringa, P. 2017). It is a process that involves the actions of various stakeholders, including not only the original inventors but also the producers, consumers, and distributors who disseminate and operationalise the innovations for them to be accepted by society. In this context, frugal innovation refers to processes of invention, adoption, adaptation, appropriation, and transformation (Leliveld, A., Korringa, P. 2017). The built environment can be seen through different stakeholders such as the architects, contractors, investors and end-users. Consequently, it can be observed as systems encompassing all institutional, organisational, social, and political dimensions rather than just building products for construction.

It is important to note that the necessity to develop low-cost goods and services to break into BOP markets and/or reach out to low-income people may lead to a "race to the bottom" where environmental regulations are not taken into account (Leliveld, A., Korringa, P. 2017). There is increasingly widespread awareness about environmental pollution and resource depletion, leading to an urgent need to invest in sustainable, green practices. These new practices provide transformations with a low-carbon footprint that could generate a production and consumption pattern based more on circularity and usage instead of mass production and waste creation (Rosca, E., Reedy, J., & Bendul, J. C. 2017). Therefore, the need to employ sustainable practices in frugal innovation is fundamental for this practice to work in a long-term scenario. The challenge of making it affordable becomes more evident.

Frugal innovations can help to promote sustainable development by increasing the ability to develop communities to purchase products that meet their requirements, minimising the use of natural resources, and promoting inclusive economic growth by including local communities in the value chain (Rosca, E., Reedy, J., & Bendul, J. C. 2017). These innovations can provide profit opportunities for companies, although providing low-cost goods and services does not solve the structural causes of poverty. Similarly, reduced resource consumption does not always imply environmental protection. Sustainable development, defined as socially inclusive and ecologically friendly economic growth, is a complex, multifaceted problem that demands interventions from various levels and stakeholders (Rosca, E., Reedy, J., & Bendul, J. C. 2017). Following the UN World Summit on Sustainable Development (2002), sustainable development is defined as 'economic development, social development and environmental protection as interdependent and mutually reinforcing pillars (8). As a result, sustainable development is growth and progress aimed at achieving long-term viability by balancing economic, social, and environmental factors.

Sustainability

Focusing on ecological development and striving for the preservation of resources while having a social and economic balance, it is important to note and distinguish between the efficiency of the product, which concerns the supply side and the sufficiency of the product in the market, which concerns the demand side (Rosca, E., Reedy, J., & Bendul, J. C. 2017). Both are important to approaching sustainable development. With the emphasis on resource efficiency, the participation of low-income actors, and the nature of bringing together stakeholders, frugal innovation can pave the way for long-term growth. According to Rosca et al. (2017), three requirements must be met for frugal innovation to

support more inclusive development processes. First, businesses should commercialise low-cost products and services. Second, value chain operations should include low-income players. Third, natural resources should be used as sparingly as possible. It is key to emphasise that for frugal innovation to work as a source of empowerment for informal actors, they need to influence the innovation processes and their distribution. People at the BoP require meaningful power over innovative processes and the allocation of earnings, wages, and pricing. (Leliveld, A., Korringa, P. 2017). In this regard, it is crucial to research how can frugal innovations contribute to sustainable development through the circularity of materials and building methods and provide opportunities to every stakeholder in the process.

Business Models in Enterprises

A large share of the markets in developing countries are at the base of the pyramid. Due to their strong growth rates, these market categories provide great opportunities. They introduce novel innovations and business models that offer higher value at a low cost and open new markets, enabling competitive positioning. With their business models firmly set towards environmental and social sustainability, firms strive to participate in frugal innovations due to supply and demand-side resource scarcity (Musona, J. 2021). In such situations, business model experimentation is crucial for promoting frugal innovation acceptance and spread. As a result, business models describe how value proposition, value generation and delivery, and value capture interact (Musona, J. 2021). This has an impact on organizational structure for future promptness and malleability. Business models become tools for capturing value created from multiple sources. According to Musona (2021), they can help strategically market new processes, goods, and services. Furthermore, business models can be created by altering competition parameters to provide a competitive advantage. Thus, Prabhu (2017) argues that a radical and systematic innovation model must be implemented for world economies to satisfy the demands of present and future populations. One that is based on frugality principles and focuses on meeting the needs of many people with a small number of resources.

Businesses may create value for end-users and impact a country's local economic development, but they may not capture value, which translates to money. This relates to the situation where business ventures seeking to create an impact while serving the poor are intertwined with local economic development. Still, co-creation and inclusive innovation can create an ecosystem perspective in which enterprises do not solely focus but also looks at other beneficiaries, such as local producers and distributors. While the BoP may provide new business opportunities, the business model needs to be integrated into the local context for the innovation to be adopted by the market (Howell, R., et al. 2017). Additionally, the cost of a good or service needs to match the customers' willingness to pay. Financing schemes and low-price points to reach low-income consumers are essential in business models for emerging markets. Also, it is important to note that business models may differ to businesses with a social focus or operating for the BoP (Howell, R., et al. 2017). Chesbrough (2007) provides six different business model types that can address some of the challenges of value creation and capture, which can be introduced for frugal innovations. These can be observed in Table 01.

In the market in developing countries, it is important to understand that it may take longer in an emerging market context to get a return on investment, implying that value creation is delayed. Institutional voids and market failure are significant concerns when designing business models in the BoP segment (Howell, R., et al. 2017). Low-income consumers may not always make purchasing selections based on long-term requirements and interests. As a result, a business-oriented approach to development effect must consider both positive and negative externalities and the business model's potential beneficiaries (Howell, R., et al. 2017). Due to a lack of efficient resources and institutions, it is essential to create a market for a product, which demands the development of an 'interactive' business model which functions with and within an entire ecosystem. Ecosystem development could emerge due to a company's attempt to enter the market or as a result of collaborations with NGOs and competitors (Howell, R., et al. 2017). NGOs can help reach out to rural and low-income regions, and they may better understand the situation. Furthermore, the NGO-busi-

ness model allows for greater resource leveraging (Howell, R., et al. 2017). Several business model patterns have been identified by Rosca et al. (2017) where vital aspects for emerging sustainable, frugal innovation are portrayed. 1) There needs to be a more collaborative and inclusive value chain. 2) More education, training, and knowledge need to be entailed. 3) There needs to be a provision of basic services that increase the standard of living. 4) Local competencies, resources, and capabilities are used to determine a business model's sustainability in developing countries. 5) Local NGOs involvement increases the success of the business model. Finally, it is crucial to keep in mind that business models that can be flexible and share value with the local communities with which companies are doing business are key to success (Howell, R., et al. 2017).

Despite the connections between frugal innovation and the construction environment, there is a lack of theoretical information that connects these two topics. This doesn't imply frugal innovation is not happening and progressing in the built environment. The built environment is constantly innovating in new materials that are recycled to provide more sustainable building products; this can be observed with the ISSB blocks. Still, sustainable development is a concept that implies many variables. For it to be affordable, environmentally sustainable and circular, there is still a long way between innovation, implementation and adaptation. In this matter, circularity becomes essential to this problem, given that the circular economy concentrates on increasing resource efficiency and reusing and recycling materials.

Business Model Types

Type	**Characteristic**
Undifferentiated	Price and availability are competitive, and customers who buy based on those criteria are served.
Some differentiation	Allows the organization to target a different type of customer than those who buy based solely on price and availability (such as a performance-oriented customer). As a result, the company will be able to offer a new and less crowded market niche.
Segmented	Compete in different market segments
Externally aware	Open to external ideas and technologies
Innovation process integrated	Suppliers and customers have access to the firms innovation process
Adaptive platform	Key suppliers and customers become business partners. Both technical and business risk may be shared.

Table 01. Business Models Types. Chesbrough, H. 2007

2.4 SOCIAL ENTREPRENEURSHIP

Following Zahra et al. (2009), social entrepreneurs contribute significantly and in various ways to their communities and societies, using business models to provide innovative solutions to complicated and persistent social issues. They propose that social entrepreneurship "encompasses the activities and processes undertaken to discover, define, and exploit opportunities to enhance social wealth by creating new ventures or managing existing organisations in an innovative manner" (Zahra, S. et al. 2009. 519). Social entrepreneurs are increasingly recognised for contributing to a country's social, economic, cultural, and environmental prosperity. This type of venture has been identified as an innovative way of addressing unmet socio-economic needs in an environment; where traditional providers, such as charitable and voluntary sector organisations, have been criticised as bureaucratic and resistant to change. And the public sector has become overstretched (Mulgan and Landry, 1995; Leadbeater 1997). Therefore, scholars, governments, media, and non-governmental organisations increasingly recognise the value of social entrepreneurial responses to current problems (Christie & Honig, 2006).

Some of the most distinguishing features of social enterprises are diversity and variability. The third (service) sector includes a wide range of organisations, including social businesses, that, while committed to addressing unmet social needs, differ in the forms and structures they use, the activities they engage in, and the client groups they serve (Shaw, E., Carter, S. 2007). According to the Social Entrepreneurship Initiative (SEI), social enterprises can be classified in one of three ways: "as for-profit organisations which use their resources to creatively address social issues; as not-for-profit organisations which help individuals establish their own small, for-profit businesses or, as not-for-profit ventures which create economic value to fund their own programmes or to create employment and training opportunities for their client populations" (Shaw, E., Carter, S. 2007. 420). It is important to note that they are distinct from benevolent actions such as charitable gifts and sponsorship of community events because of their business orientation (Shaw, E., Carter, S. 2007). Social enterprises operate in complicated multi-agency situations that require them to have an open and porous attitude to that environment, regardless of their legal form. They are defined by their commitment to building long-term relationships with their customers and other community stakeholders (Leadbeater, C. 1997), as well as their development of social value which varies in their desire for economic value generation (Stevens, R., et al. 2015).

Social wealth development versus economic wealth creation is the major distinction made between the business sector and social entrepreneurship (Stevens, R., et al. 2015). Still, it is important to emphasise the uniqueness of combining social and economic missions in the organisational form. These can be reflected in the organisation's goals, values and identity (Stevens, R., et al. 2015). Following Stevens et al. (2015), the social is about meeting basic human needs more efficiently than present markets and institutions can. The purpose of attaining sustainable development is to meet social demands. On the other hand, economic value creation is primarily concerned with increasing economic return and shareholder wealth rather than with the public benefit. Therefore, companies created to bring about change in a specific socially-oriented method rather than providing a financial return on investment are known as social enterprises (Stevens, R., et al. 2015). Still, social entrepreneurs often pursue economic and social goals to pursue a specific opportunity. Nonetheless, they seek chances for social change and betterment rather than profit maximisation (Zahra, S et al. 2009).

Zahra, et al. (2009) explain in their perspective that the economic and social link can be considered total wealth. Therefore, they acknowledge that any economic and social value created may incur and offset the economic and social costs. In this scheme, the forgone costs of other opportunities that were not perused are also considered. Given the scarcity of human and financial resources, any assessment of social wealth creation should include opportunity costs. The social and economic value that would have been lost if these resources had been put to better use (Zahra, S et al. 2009). The total wealth

benchmark demonstrates how entrepreneurial firms can generate varying degrees of economic and social wealth. Nonetheless, the social wealth standard provides a useful tool for assessing social opportunities and projects. It also highlights the uniqueness and value of the social enterprise. It is important to understand that innovation is key in these types of organisations. If it is not engaged, the service provided ends up outside the field of social entrepreneurship (Zahra, S et al. 2009). Therefore, social entrepreneurs locate underutilised resources within people, buildings and equipment and construct a way to provide a good use or service to them to satisfy unmet social needs (Shaw, E., Carter, S. 2007).

Types of Social Entrepreneurships

Zahra et al. (2009) build upon the work of various academics and provide the vision of three different types of social entrepreneurship. There is the Social Bricoleur, Social Constructionist, and Social Engineer. The social bricoleurs focus on exploring and addressing small-scale local needs. This means they combine existing resources to solve problems and provide new opportunities through intimate knowledge of locally available resources and the local environmental conditions (Zahra, S et al. 2009). Although they target small in scale problems, they manage to mitigate serious local social difficulties. As a result, they push forward to a social equilibrium enhancing social wealth (Zahra, S et al. 2009). Social constructionists exploit opportunities and market failures by filling gaps for underserved clientele. In this sense, they propose reforms and innovations to a broader social system. They are characterised by their skills in building, launching and operating firms that meet social needs that aren't being met by current institutions, businesses, NGOs, and government agencies (Zahra, S et al. 2009). For-profit businesses typically lack the incentive or the foundation to address social issues, necessitating the creation of these groups. As a result, they build organisations that fit the magnitude and complexity of the societal problems they want to solve. The effective organisational reaction can be fairly minor in some circumstances, but it can also be regional, national, or even global in scope (Zahra, S et al. 2009). The strengths of these entrepreneurs are not based on local knowledge; rather, they are based on their unique ability to detect and pursue possibilities that generate societal wealth by developing and reorganising the systems that supply products and services. Traditional sources of support for these businesses include governments, non-governmental organisations, and charity foundations. Collaborative social initiatives that combine the resources and capacities of for-profit and non-profit organisations can produce mutually beneficial outcomes in today's dynamic and complex climate (Zahra, S et al. 2009). Finally, Social Engineers identify systemic issues in current social institutions and propose a revolutionary change to fix them. As a result, these entrepreneurs frequently see fundamental issues in societal systems and institutions and propose revolutionary transformation as a solution (Zahra, S et al. 2009). They are the driving forces behind innovation and change, causing creative destruction to eliminate outdated systems, structures, and processes in order to replace them with newer, more appropriate ones. By splintering and replacing current, often dominant institutions with more socially effective ones (Zahra, S et al. 2009). Social Engineers frequently target national, international, and global societal challenges. The revolutionary and ideological nature of the reforms they offer are frequently considered subversive and illegitimate, and they pose a danger to established institutions. As a result, their ability to act depends on their ability to accumulate sufficient political capital in order to gather other required resources and gain legitimacy (Zahra, S et al. 2009). It is fundamental to denote the different ways these entrepreneurs act in managerial styles. Social bricoleurs may operate in a very informal manner. In order to scale up and operate in a larger organisation, social constructionists develop a more complex and formal management system. Lastly, social engineers are charismatic leaders who benefit by attracting public attention and rallying support for their aims (Zahra, S et al. 2009). Given the diminishing supply of public funding, all social service organisations must investigate new strategies to generate social capital or alternate sources of income. Lessons from the competitive sector could be extremely useful in ensuring the long-term survival of social entrepreneurs (Zahra, S et al. 2009).

In the quest for social wealth, one of many social entrepreneurs' best strengths is to inspire, coordinate and mobilise commercial and non-commercial partners, donors, volunteers, and employees. To

accomplish social initiatives, it is often necessary to form collaborative connections (Zahra, S et al. 2009). Networking is important for developing trust and credibility, intending to encourage the community to support their activities; consequently, local support and loyalty are essential to moving means (Shaw, E., Carter, S. 2007). Still, to gain support, entrepreneurs jeopardise their local credibility and personal relationships by involving and leveraging their contacts to gain support for their businesses (Shaw, E., Carter, S. 2007).

Social Enterprises in the Built Environment

Social companies' challenges in the construction sector are very similar to those they face in other industries. Among them are building trust, managing hybridity, securing finance, assessing social impact, and achieving scale (Loosemore, M. 2015). However, there is a lack of research concerning insights from the construction sector and their link to social entrepreneurship. Several issues are recognised, such as: procurement practices that favour industry major parties, established supply chain relationships, expensive tender bureaucracy, lack of experience working with social enterprises and their fear that working with social enterprises will reduce the competitiveness in the industry (Loosemore, M. 2015). Few social enterprises are working in the construction sector nowadays, but a trend is pushing it forward to grow. One of the driving factors for the development of social enterprises in the construction industry is the growing tendency in many countries to require companies to demonstrate a "social value" for public contracts during the procurement process, besides the standard criteria of time, quality, safety and price (Loosemore, M. 2015). The current problem is that there are no general criteria to measure social value; therefore, it becomes complicated to set some standards. Nevertheless, the construction industry has a significant potential to use social enterprises and contribute positively to society (Loosemore, M. 2015).

A huge opportunity is the creation of employment for disadvantaged groups of people, which in the construction sector can provide a series of networks that expand to other sectors of the economy. This situation can address growing social problems such as poverty, unemployment, discrimination, and inequality (Loosemore, M. 2015). Unfortunately, one of the problems researchers have considered is the lack of competitiveness in the social entrepreneurship business model. The underlying tensions and conflicts that can arise in combining economic and social goals represent significant obstacles to addressing the value proposition of social enterprises (Loosemore, M. 2015). Therefore, social enterprises must have a sustainable business plan in the construction sector to succeed. Another challenge for social entrepreneurship is to scale up, but if they manage to do so, they can achieve important economies of scale, enabling more work and becoming more profitable. Larger social enterprises are also more resilient, and their actions can have a greater impact (Loosemore, M. 2015). Finally, balancing the economic and social goals to create a sustainable business is also challenging. Prioritising social objectives over economic objectives could lead to a failure to obtain financial sustainability. As a result, it is necessary to create effective ecosystems where social enterprises focused on the construction industry can flourish and grow (Loosemore, M. 2015).

2.5 CONNECTING CONCEPTS AND UNDERSTANDING CONSTRAINTS

Following the concepts presented in the theoretical background, it is important to understand their interrelationships and connections. As seen in Figure 05, policies encompass the other four principles outlined in the triangle. Even though the research's main concept is circularity, the starting point is policies, given circularity cannot be implemented without regulations. It is critical to recognize its significance in the built environment and to acknowledge that innovation would be impossible to achieve without them. The second concept to be targeted is circular economy, which occupies the top of the pyramid due to its importance. In this case, circular economy provides an alternative to rethink how to push forward development considering economic, social and environmental factors to mitigate scarcity of resources, provide housing for vulnerable communities and diminish human health risks. Consequently, a circular economy connects with social entrepreneurship and frugal innovations. For circularity to be effective in the low-income affordable housing spectrum, the market's end product must be efficient, of good quality, and affordable. Therefore, the methods and materials that are being implemented must be tackled in a frugal manner. Hence, circularity and frugal innovations connect with social entrepreneurship, given social entrepreneurship focuses on providing a service to an unmet need. This is accomplished through social innovations that will generate a social impact in a determined community. Circular economy has become a social cause for social entrepreneurs to embrace and help to work with environmental issues, job creation, and long-term economic growth. As a result, circular frugal innovations are pushed through social entrepreneurship for the innovations to come along. Following Padilla-Rivera. et al. (2020), the shift to circular economy must be viewed as a socio-technical transition in which existing production structures, enterprises, models, goods, and consuming behaviours are fundamentally altered. Finally, diffusion of innovation becomes a key concept in this triangle, given the right skills and methodology need to be applied for innovations to be adopted by the market and to be successful. Without a good strategy of implementation and diffusion, innovations will not be taken by consumers. Therefore, the key to adopting a good product is understanding how to make it attractive to the market. Figure 04's most important feature is that all concepts are interconnected. Without one concept, the others would struggle to implement circularity in affordable housing.

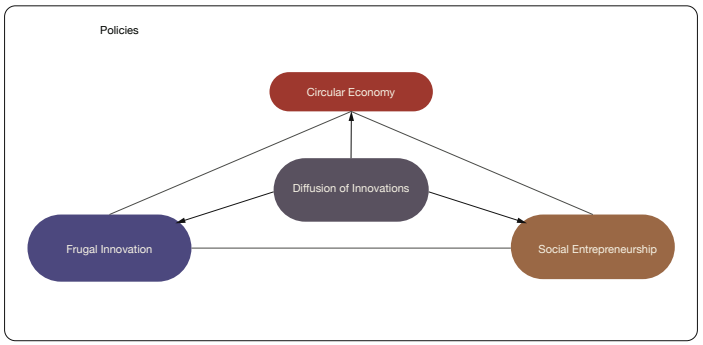


Figure 04, Connecting Concepts. Own Illustration.

Barriers to Social Entrepreneurship Growth

Governments have become more committed to the stimulation and development of circular economy. One of the driving forces behind the market economy's development and growth is entrepreneurship. Likewise, NGOs play an essential role in the development process by providing various support services to potential entrepreneurs; as a result, the success of new enterprises can be increased, and entrepreneurship can be stimulated (El Chaarani, H., Raimi, L. 2021). El Chaarani, H., Raimi, L. (2021) state that NGOs are becoming more active in the sustainable agenda by establishing new techniques for connecting with business groups and providing guidance for policies to be changed in countries to stimulate more sustainable development. As facilitators, they provide support in interventions related to funding and identification of the market's needs and regulations (El Chaarani, H., Raimi, L. 2021). Nonetheless, various barriers make the process challenging, given some countries have passed social support laws to encourage innovation and social entrepreneurship. Still, the way they are set in many cases is inefficient and unhelpful (Naderi, N., et al. 2020). Following Naderi et al. (2020) there are several barriers to market entry that need to be considered, such as value-based, socio-economic,

and institutional barriers. The following characteristics, as seen in Figure 05, are set in every variable: for the value-based barriers, ethical value differences, growth philosophy and political views; for socio-economic barriers, access to finance, access to human capital and identity authenticity; for institutional barriers, customer culture, business norms, as well as a lack of understanding or ability to meet established requirements (Naderi, N., et al. 2020). Such constraints will probably restrict attempts to expand social enterprises. Also, the public's negative perception of social enterprises creates external barriers to their growth (Naderi, N., et al. 2020).

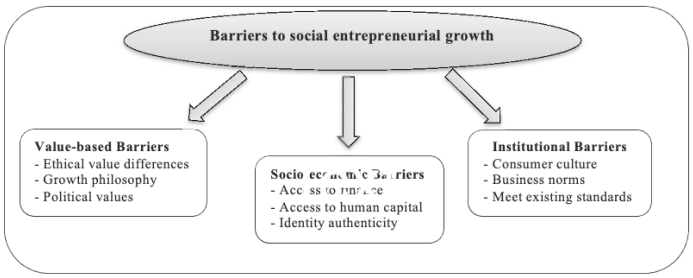


Figure 05, Barriers to social entrepreneurial growth. (Naderi, N., et al. 2020)

Limitations of Circularity Information for Developing Countries

Concerning circularity, the world nowadays is only 9% circular (Kirchherr, J., Van Santen, R. 2019). Kirchherr and Van Saten (2019) state that businesses are beginning to lose interest in circular economy due to the difficulties of its implementation. Besides this limitation, there is a significant bias concerning circular economy literature, given that 95% of it is focused on developed countries. Therefore, a great amount of its theory could be irrelevant to developing countries, given they have different governmental frameworks, availability and access to finance, professionals' knowledge and training and available infrastructure (Kirchherr, J., Van Santen, R. 2019). Hence, there are limitations of information to help practitioners in these countries, which can alter the results of circular economy implementation.

To conclude, it's important to identify the connections between concepts and the constraints and limitations discovered to achieve this research's goals. This will help in pursuing new opportunities and actively searching for solutions. As a result, guidance on how to better answer the research questions could be provided.

3 RESEARCH METHOD

This chapter describes the methodologies utilised at various stages of the research. The next subsections will cover the research methodology and data collection and analysis design.

3.1 RESEARCH DESIGN

This research was designed in a case study manner. A case study was appropriate for the research topic since it could be used for various purposes, such as explanatory and descriptive research, generating theory, and initiating change (Blaikie, N., & Priest, J. 2019). It investigates a contemporary phenomenon within its real-life context, which in the field of study was circularity in the built environment in Kenya. This case study inquiry coped with a technically distinctive situation in which there were more variables of interest than data points, which, consequently, relied on many sources of evidence (Blaikie, N., & Priest, J. 2019). This could be seen in themes of interest such as levels of circularity in Kenya, how the built environment works in the country, geopolitics and the economy to shift toward sustainable development on affordable housing. Results relied on multiple sources of evidence that guided the data collection and analysis. It is important to note the limitations this research had. Given it is a case study research, findings were confined to the case study and generalisations to another context that is not Kenya cannot be made.

Given the main focus was Kenya and how NGOs can support local stakeholders to shift the development of affordable housing using circular materials and methods, this case study was designed as a single case study. Following Yin (2003a), a single case study can be an embedded case study, where there are several sub-units to be able to answer the main research question. This situation can also be seen as an instrumental case study following Stake (2005), as the investigation provides insight into an issue such as circularity in affordable housing. Furthermore, it was directed into obtaining a better understanding to develop a generalisation that resulted in a guideline for NGOs to approach circularity.

3.2 QUALITATIVE RESEARCH

Qualitative data collection was used to collect data and give a data analysis for the project. The inquiry was directed by interviews, papers, publications and documents about the subject. These were used as data sources to collect data and analyse it. Consequently, the logics of inquiry that were performed in this research were inductive and deductive. Inductive logic enables the researcher to select a set of qualities, collect data relevant to those traits, and then derive generalisations from that data (Blaikie, N., & Priest, J. 2019). The deductive logic of inquiry proposes a theory that may be tested in order to obtain an explanation for a relationship between two concepts. Inductive logic can be used to establish the association (Blaikie, N., & Priest, J. 2019). In this sense, inductive logic is an open coding mechanism, and deductive logic is a closed coding mechanism that intertwines and guides the research for data collection.

To analyse data in a structured manner, the double-diamond framework was used. This structure is made up of two diamonds that reflect a process of expanding an issue through divergent thinking and then focusing on action through convergent thinking (Design Council. 2019). The diamonds are divided into four sections, known as discover, define, develop and deliver, as seen in Figure 06.

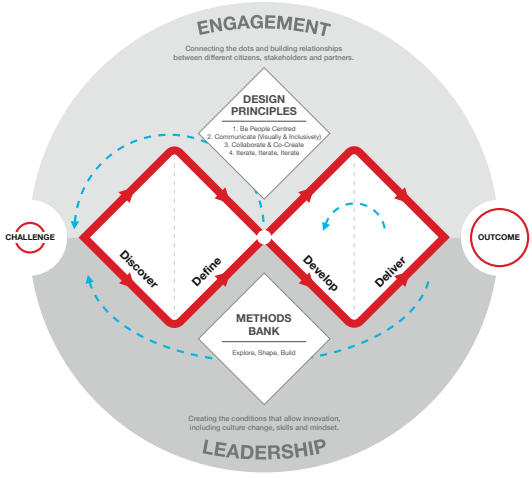


Figure 06. Double Diamond Framework. (Design Council. 2019)

To understand how this framework was used through the research, Table 02 describes each section and relates it to the logics of inquiry. It is important to note that while executing this framework, the process was not linear. As a result of this research, a guideline for the development of circularity in affordable housing in Kenya was created.

The table and its characteristics define each part of the double diamond framework; the approach

Section	Characteristic	Logic of Inquiry
Discover	Provides the opportunity of helping people understand what the problem is. It entails speaking and spending time with the people who are affected by the issues that are being delt in the research (Design Council. 2019).	Inductive
Define	Provides the oportunity to state an insight about the information that is gathered from the discovery phase and describe it in a way that can help define the research challenge in a distinctive manner (Design Council. 2019).	Inductive
Develop	Provides the opportunity to give answers to through people towards the stated problem, where inspiration from other projects takes place (Design Council. 2019).	Deductive
Deliver	Provides different solutions are tested out in a small-scale, filtering the solutions that do not work and improving the ones that have potential to succeed (Design Council. 2019).	Inductive/ Deductive

Table 02. Double Diamond Framework Description. (Design Council. 2019)

of this framework concerning the thesis is set in the following manner.

Discover: In this phase, the problem statement is explored, where information from different sources was gathered to understand a problem, a need and a gap to where the research could be directed. Consequently, the diamond opens up as an allegory to an exploratory phase of information. Placing this stage into context, the discovery phase can be observed through the research about circular economy, developing countries' housing markets and the need to integrate circular materials into affordable housing.

Define: In this stage, the problem statement was defined, and there is a scope to the problem. The research questions were elaborated, and a methodology on how to approach the problem statement was created. Therefore, the diamond closes and narrows down to properly define the research. Taking this into context, the research question narrowed the scope to different areas. A location was defined, which is Kenya. The main stakeholder was picked, NGOs and the definition of the research was set on how NGOs can support local stakeholders to shift the development of affordable housing by using circular materials and methods.

Develop: In this stage, the diamond opens up again, given an exploratory phase starts. This phase was directed toward the data collection of the research. Different stakeholders were approached to gain knowledge and insights about the local situation in the built environment in Kenya. Travelling to Kenya was also an important part of this exploratory phase, given that it was the best way to understand the location and the environment in which the research was set. This information provided the possibility to analyse and create data that could lead to a series of results to answer the research question.

Deliver: The final stage of this framework was defined by the results generated from the developing stage. In this case, the final delivery was a guideline where an answer to NGOs could be provided on different aspects. These are identified in the following way:

1. Different processes of support can be given to different stakeholders to implement circularity.

2. Strategies that could evoke change towards circularity, understanding the power of purpose on businesses and different institutions.

3. A guidance on how to make circularity a cultural norm for it to be enhanced by the country.

As a result, the double diamond framework is completed when providing a final outcome. As stated before, every stage generates new findings and, in some cases, goes back to earlier phases to redefine processes that happened. As findings and knowledge expanded, the approach to problem-solving the research changed.

The main change from the first plan to executing the research was the approach of the questionnaires. Initially, questionnaires were thought to be made for the same participants who would be interviewed after. The objective was to start discovering through the lens of the stakeholders the present situation, challenges and opportunities of the built environment in Kenya, so after interviews could go into more in detail. During the process, interviews had to be prioritised for practical reasons and aiming for better engagement in data collection from the participants. Consequently, only a few stakeholders performed both questionnaires and interviews. As a strategy mechanism to obtain more data, the questionnaire was opened to stakeholders in the built environment who would not be interviewed. Hence, a broader information spectrum was collected.

3.3 DATA COLLECTION AND ANALYSIS

Three ways to gather data are primary, secondary, and tertiary. For this research, all three were executed, given each can provide important content for the study's outcome. Primary data was held in the form of interviews and questionnaires. Secondary data was held with data gathered by different researchers from Habitat for Humanity and other NGOs or organisations to acquire information that could be relevant to continuing the case study. A limitation of this data could be that the data to be analysed was addressed as a specific research problem, and the questions for it were posed in a different context. It's also impossible to assess the data's quality, and the information could be outdated. Nonetheless, gathering material for analysis was necessary. Finally, tertiary data was gathered from government census reports and other key organisations that have produced research reports that may be useful to the investigation. This information was required because there is data that is difficult to obtain by the researcher's means. Therefore, there is a dependency on public or private organisations that have already collected the data.

Given the different types of data collected, their sources are different. Natural social settings, semi-natural settings and social artefacts are three ways this research approached data collection for analysis. In the natural setting, there are three categories: micro-social, meso-social and macro-social. For micro-social, where face-to-face interaction with social actors is needed, a trip to Kenya was made to understand the context where the research is being performed. The immediate interaction with people and their environment provided valuable information for data collection. For meso-social, the built environment's local stakeholders took an important role. These are organisations and communities that have established goals. Finally, for macro-social, Habitat for Humanity played the most crucial role, given it is a large social entity and the research was conducted through this organisation. In the semi-natural setting, individuals as informants and representatives of organisations had an important role. This means that interviews and questionnaires were performed with actors who work in certain organisations. They

were the ones who provided information for data collection regarding circularity, the built environment and affordable housing. In this area, it is important to note that a local office from Habitat for Humanity in Nairobi, with whom direct contact was established. As part of the team, they became facilitators for different stakeholders in the built environment for data collection. For the last source of data, social artefacts provided useful information. In this area, Habitat for Humanity's internal reports about certain past investigations were useful for data analysis.

A relational analysis was used to analyse the data. Concepts were identified, and relationships between them were established. To draw conclusions for this investigation, direct quotations were used. As a result, examples of concepts were collected for analysis to discover commonalities, differences, patterns, and structures. As a strategy, and as previously indicated, a combination of inductive and deductive approaches were used in semi-structured interviews for data collection. The inductive approach is a bottom-up strategy that begins with observations that form a pattern, leading to a tentative hypothesis and, eventually, a theory. To analyse this data, open coding was used to code the information and then closed coding filtered down the concepts to the main overarching codes. To develop this, relationships between overarching themes were established. As a result, there was a discussion of the interrelationships. The deductive approach, a top-down strategy in which the analysis begins with theory to form a hypothesis and then provides observations that lead to confirmation, was made with topics drawn from the literature. Themes were assigned using a closed coding method, and a narrative was built using the relationships between concepts. Finally, Atlas TI was employed as a mechanical system to deliver the analysis. This software provided the tools needed to code and organise quotes systematically so connections, conclusions, and observations based on analysed data would be generated.

3.4 ACTOR NETWORK CONFIGURATION

To collect data, stakeholders were identified and categorised so a differentiation could be made between their goals and how they interact with other stakeholders. The following groups of actors were acknowledged as key players in the research and the people to whom interviews and questionnaires were conducted.

- Providers of circular products
- Organisations pushing forward circularity (NGOs)
- Government institutions focused on circularity
- Architectural firms and Building Contractors
- Technical Upskilling Institutions
- Educational Institutions
- End Users

To understand how they relate to each other Figure 07, shows an actor configuration where the links between each other can be overserved and an explanation of these connections following the designated number of the map is provided. Taking into reference Wang et al. (2015) actor network configurations, Figure 08 was designed.

1. End users buy from material suppliers. They are mutually affected, given the suppliers will only offer what the demand is willing to buy, and the demand can only satisfy its need with what the market offers.

2. Technical upskilling institutions teach artisans how to build. They are the ones who will end up being hired to work in big companies. These artisans will influence their communities by advising on new materials and building methods. They also train the community on how to self-build properly.

3. Educational Institutions influence architects and building contractors on sustainable ways to approach the built environment, given they are the ones who provide the knowledge about materials and building methods in the built environment. How these future architects and contractors are trained will determine how they approach the built environment.

4. Architectural firms and building contractors hire artisans from technical upskilling institutions. Specifications made with new materials will be learned by artisans. Technical upskilling institutions can shift their knowledge preparation if innovations are made.

5. Government policies affect how architectural firms and contractors approach sustainable building practices.

6. Organisations are pushing forward circularity and influences technical upskilling institutions, helping them provide education to new artisans.

7. Providers of circular products and architectural firms mutually influence each other, given that architects specify designs based on what the market supplies. At the same time, depending on the demand of these stakeholders, a push for materials suppliers can happen for innovation and sustainability of the materials they offer.

8. Policies made by the government influence how building knowledge is provided in educational institutions.

9. Government building policies influence the type of materials that can be sold in the market.

10. NGOs can steer and influence the creation of new building policies.

11. NGOs can help push forward new circular products and their implementation in the market.

12. NGOs, through community participation, can help provide knowledge about sustainable building practices and create a change in perception about building materials and methods.

13. Educational institutions can become incubators of innovations concerning materials. They can help entrepreneurs learn what needs to be pursued to obtain more sustainable building practices. At the same time, they can educate these entrepreneurs on how to build their companies.

Following these connections, a methodology on how to approach interviews and questionnaires was designed. Through this approach, information was gathered in the best possible manner to compare data from different stakeholders and perform a good analysis.

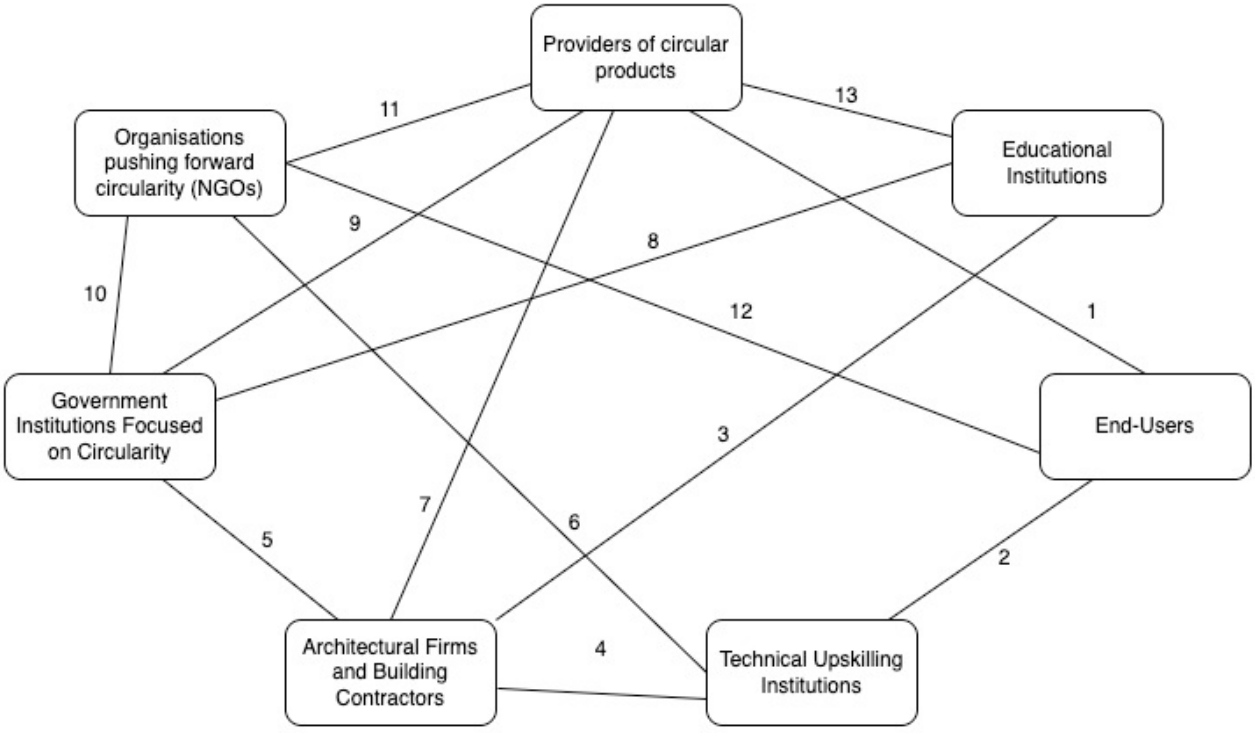


Figure 07. Actor Network Configuration.

3.5 INTERVIEWS AND QUESTIONNAIRES METHODOLOGY

Primary data collection was essential for obtaining credible study results. Creating questionnaires and interviews becomes a strategy to get as much insight as possible, as it diversifies the stakeholders' approach. Questionnaires were disseminated to reach players in the built environment who can provide valuable insights into the Kenyan situation while not essential for interviewing. Furthermore, interviews were conducted with stakeholders who require a deeper understanding and insight to acquire a more holistic view of the environment and its current state. Therefore, the method of approach to obtaining data was very different. The language used throughout the process was English, which is the common language between the researcher and the participants. It's worth noting that English is the official language of Kenya; hence, all participants who were approached were fluent in the language. The size selection was determined by the number of individuals who wanted to participate. While interviewing individuals and delivering questionnaires, a snowball effect occurred, providing the opportunity to reach different stakeholders in the built environment. The sample size selection was made by stakeholders directly involved in Kenya's built environment.

In terms of the questionnaire, considering the actor-network is very diverse, the questionnaire provided questions that anyone in the built environment could answer. Consequently, questions were elaborated in the following manner: First, identify from which group of stakeholders the actor comes from, keeping their identity completely anonymous. Secondly, seek how involved the company they work at is concerning environmentally sustainable practices. Thirdly, understand the challenges, opportunities, and accomplishments they work at concerning circularity and sustainability. These questions provided the opportunity to compare data and seek similarities and differences in perspectives concerning the same topic. The questionnaire template that was handed to different stakeholders can be observed in Appendix B.

Interviews, on the other hand, were held differently. The interview protocol slightly changed between groups of stakeholders, given their practices are different even though they belong to the built environment. Therefore, an established structure was defined, but the questions within each segment might change depending on the dependency the actor that is being interviewed belongs to. The segments of the interview are the following:

- Background
- Present situation
- Opportunities
- Challenges
- Impact

Background: provided insight into the organisation the interviewee works at and their role in the organisation. It provided insight into their involvement in affordable housing and the formal and informal housing sector.

Present situation: provided information about up to what extent the company was focused on environmentally sustainable practices, such as circularity and how they advocate these practices in their organisation.

Opportunities: These questions relate to the opportunities the organisation can generate to make a shift into circularity and how to approach different actors while doing so.

Challenges: These questions provide information about the organisations' main challenges concerning implementing circularity in the market.

Impact: provide information on the impact the organisation has made on the built environment and the adoption rate of environmentally sustainable building methods.

As a result, a holistic view of every stakeholder's situation was observed within these segments. The data collected from these interviews was analysed through coding from the main divisions of the interview protocol for results to be obtained.

The interview protocols can be observed in Appendix C.

Data Collection Through a Blended Mode

Given that the project was being held in Kenya, a blended mode into the data collection approach was designed. This means data was collected presently in Kenya and online. The questionnaire was sent virtually through a link to stakeholders to fill in. Therefore, any stakeholder could access it through their computers or mobile phones anytime they wanted. On the other hand, interviews were held in two different ways, through an online meeting platform such as Zoom and presently. Depending on the timeframe of the research, interviews were held accordingly. This provided the opportunity to collect data before the Kenya trip and after if needed, offering the possibility of not solely depend on being onsite for data collection.

3.6 ETHICAL CONSIDERATIONS

This research conducted interviews with individuals concerning topics related to circularity in the built environment. Subjects were not subjected to any risk concerning the potential benefits that were provided, given interviews were based on knowledge of a specific topic. They were adequately informed and given an informed consent letter to sign and approve the interviews that were directed in advance. Subjects were free to withdraw without any implications during the research. Even though the research focuses on affordable housing for vulnerable populations in Kenya, vulnerable communities were not interviewed. Therefore, there was no need to take special precautions throughout the research. Interview protocols were created and presented for the interviews, so interviewees were fully aware of the research objectives. The online equipment was Zoom application program and an audio recorder for physical interviews. In this matter, the equipment didn't put at risk any of the subjects that were interviewed. Personal data from the research was protected by separating contact details from research data. Data was stored in a safe place, access to it was constrained, and subjects were anonymized and pseudonymized. Also, information that was not under the consent of the subject was not used. Finally, a checklist with detailed information about the structure and protocol of the interviews and specifications on how they will be conducted was presented to the Human Research Ethics Committee (HREC) for approval.

4 CIRCULARITY IN KENYA

This chapter provides an overview of Kenya's built environment. It focuses on the current state of low-income housing, the country's building code, the path toward developing circularity, and the social norms that influence community decision-making regarding housing. This data helps to clarify where the country stands in the housing sector and how it affects circularity in the built environment.

4.1 PRESENT LOW-INCOME HOUSING SITUATION

The built environment in Africa can be divided into two types: formal and informal. Unplanned and unregulated development of buildings with insufficient access to vital infrastructures such as water, power, and sanitation networks characterizes the informal built environment (World Economic Forum. 2021).

In several African countries, micro, small, and medium-sized enterprises (MSMEs) dominate the informal built environment economy, accounting for more than half of the sector's businesses. Small and medium businesses account for 80% of the Kenya Federation of Master Builders, representing 2,500 contractors (SMEs). The formal built environment is controlled, planned, and capital-intensive, in contrast to the informal built environment. The formal built environment provides access to the majority of infrastructure networks while also promoting the health of its inhabitants. In Africa, only a few huge corporations are successful. However, only 30% of African households can afford to live in a formal built environment (World Economic Forum. 2021).

When it comes to informal and incremental housing, in most cases, professional architects and engineers are not involved in designing and constructing these structures. Instead, local materials and skills are used, and the structures are upgraded and extended incrementally as financing, time, and resources become available (World Bank Group. 2019). In this sense, purchasing a "prebuilt" home is uncommon in Kenya, particularly among low-income families. Rather, most low-income families build their homes over time, adding to them as their money allows. The walls of semipermanent buildings are usually composed of mud or iron sheets, and the roofs are made of thatched hay or iron sheets (Habitat for Humanity. 2019). Small shacks (3 by 3 meters) made with wood, tin, galvanized iron sheets, and latticed wooden strips covered with mud make up an estimated 70% of Nairobi's housing stock (World Bank Group. 2019). For permanent structures, the walls are made of brick or stone, while the roofs are made of iron sheets. Households can and do live in both sorts of structures for lengthy periods of time. Permanent constructions are more expensive and last longer; many households aim to create permanent structures if they have enough money. Households may also build semipermanent houses first and then update the walls or roof to permanent materials later (Vasudevan, R. 2019).

Given that these constructions are unsafe or do not provide good sanitary conditions, it is critical to provide some direction for these structures, which account for many of the country's construction stock. Building regulatory systems that do not recognize these types of construction can deprive a large percentage of the population of the benefits of regulated construction. They have the potential to restrict research and development for enhancing traditional processes, materials testing, and quality control, as well as render alternative types of construction even more vulnerable to long-term and disaster hazards (World Bank Group. 2019).

Figure 08. Kibera, Nairobi. 2022. Authors Image.

4.2 KENYA´S BUILDING CODES

Kenya adopted its first National Building Code in 1968. It was an exact duplicate of the British Building Regulations of the time (World Bank Group. 2019). A new draft of the building code, known as the "Planning and Building Regulations, 2009," started to be developed in 2009 in response to the Building Code's limitations. In 2011, the draft building code was modified and renamed "National Building Regulations, 2011" (World Bank Group. 2019). While the draft was being worked on, The Local Government Act of 1968 maintained the enforcement of the 1968 building code until 2012. After, The Local Government Act was abolished by the County Government Act in 2012 as part of the devolution process (World Bank Group. 2019). As a result, law does not require adherence to the 1968 code. The problem is that there has been no replacement, and the 1968 building code remains part of the construction industry's informal reference (World Bank Group. 2019). This has become a significant constraint given that the 1968 building code is already over half a century old. As a result, it does not reflect current scientific knowledge of construction technology or changing cultural expectations (World Bank Group. 2019). Currently, a new draft is being worked on, the "National Building Regulations 2020". This code provides a new set of components from the previous drafts, representing a considerable improvement from the 1968 code. For instance, the previous building code prohibited the use of secondhand building materials. In contrast, the new building code, on the other hand, outlines a significant shift toward using Circular Economy principles in the construction industry (Karcher, S., et al. 2020). In this sense, a great difference is that the former is performance-based, whereas the latter is materials-based. Materials that can perform a certain function can be utilized as long as they meet the accepted criteria for that function, which includes being tested by a recognized standards body and meeting a known Kenya Standard ('KS') or its equivalent (Karcher, S., et al. 2020). As a result, other innovative materials could be used and/or reused to achieve the same or similar purpose, subject to a performance test. Any material saved or recovered from a construction site that is good and fit for purpose can be reused. Hence, materials that would otherwise be considered unusable garbage can be reconstituted into a new product and reused (Karcher, S., et al. 2020). Many stakeholders in the built environment believe the new Building Code will be approved this year 2022, but it is uncertain due to political elections.

4.3 CIRCULARITY IN THE BUILT ENVIRONMENT

By 2050, Africa's urban population is predicted to nearly triple, to 1.34 billion people, increasing demand for structures and construction materials, including cement, iron, and steel. The production of these materials accounts for 11% of total CO2 emissions from the construction industry (World Economic Forum. 2021). Emissions are expected to rise by 2050, as the cement and concrete industries develop by 12–23%, while the global steel industry grows by 15–40% (World Economic Forum. 2021). Furthermore, existing structures are rarely renovated, recycled, or remodelled, resulting in large emissions throughout operation and deconstruction. If sustainable construction is not implemented, rising demand and restricted recycling could result in increased pollution over the next decade (World Economic Forum. 2021).

The continent's expanding population and rapid urbanisation will put more strain on resources and make it more vulnerable to climate change. By 2050, Africa's metropolitan population will have grown to 1.2 billion people, with around half of them living in an informal built environment. Furthermore, Africa has not yet built 80% of the buildings it will require by 2050 (World Economic Forum. 2021). Kenya's population increased from 38 million to 47 million between 2009 and 2019. (KNBS, 2019). The country's natural resources are severely threatened by conflicting economic interests and increased demand (for example, rapid population growth) (Karcher, S., et al. 2020). Therefore, developing a green economy is the only realistic road to long-term economic growth.

Circular economy is a new concept in Kenya. Still, the country is on the path to strategically in-

tegrate circularity in critical sectors, which will result in the emergence of new enterprises engaged in redesigning, recycling, and waste management (Netherlands Enterprise Agency, 2021). Circular Economy can help the building industry find new ways to thrive while conserving resources. While the private sector has the greatest innovation potential, the government should assist it as a driver and enabler of business development for all stakeholders throughout the value chain (Karcher, S., et al. 2020). As a mechanism to provide solutions for housing, in 2006, the Ministry of Housing launched the ABMT (Appropiate Building Materials and Technology) programme. This programme entitles building processes, materials, and tools that are cost-effective, safe, creative, green/environmentally friendly, and appropriate for the location's climate, socioeconomic conditions, and natural resources (State Department of Housing and Urban Development 2017). Despite the slow pace of development, several construction-related circular economy product services are currently emerging on the market; for example, the Interlocking Stabilised Soil Block (ISSB). Other stakeholders are also advocating for change, for example, The Kenya Green Building Society (KGBS), an independent, non-profit membership-based society registered with the World Green Building Council. They are a key stakeholder in the private sector promoting the larger green building agenda. KGBS is responsible for certifying the built environment, advocating for green construction, and training green construction experts. KGBS is the Kenyan market's leading Green Building movement, ensuring that buildings are designed and constructed sustainably (Karcher, S., et al. 2020).

As a downside, through the government, the circular economy topic is primarily promoted by Kenya's Ministry of Environment, Forestry, Water and Natural Resources, rather than being horizontally prioritised across the Kenyan national government. The Vision 2030 goals of Kenya's economic policy, have potential synergies with circular economy principles. Still, the mainstreaming of circular economy aspects in Kenya's overall economic policy has been very limited, despite some progress since adopting the Green Economy Strategy and Implementation Plan (Karcher, S., et al. 2020). Until now, Kenya's approach to promoting circular economy activities has been somewhat scattered, and national awareness remains one of the main obstacles to a completely circular economy in Kenya.

4.4 SOCIAL NORMS

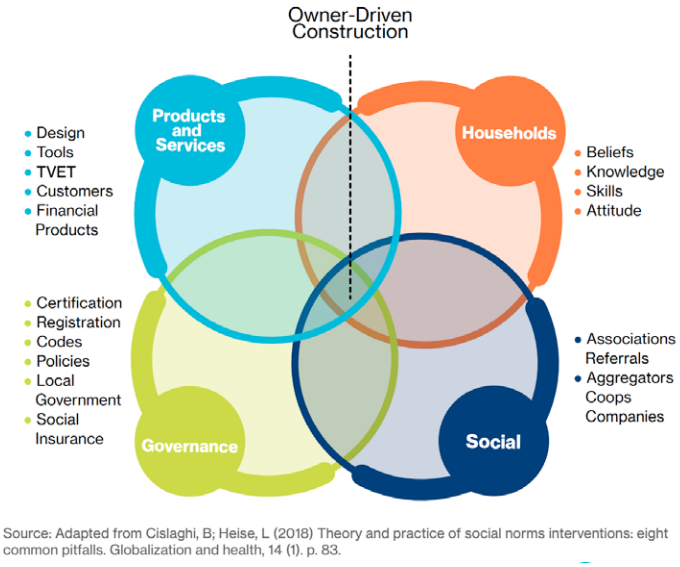
The unwritten standards of ideas, attitudes, and behaviours regarded as acceptable in a specific social group or culture are referred to as social norms. Norms provide a set of expectations for how people should act and help to maintain order and predictability in society (Mcleod. 2008). The concept of norms is crucial for comprehending general social influence and conformity. Social groups' recognised standards of behaviour are referred to as social norms (Mcleod. 2008). Friendships, workgroups, and nation-states are among these groups. Conformity is defined as behaviour that adheres to certain standards, and roles and norms are frequently used to understand and predict human behaviour (Mcleod. 2008). It is fundamental to understand the dynamics of social norms, given they play an important role when a behavioural shift wants to be introduced, such as implementing circular materials and building methods in society.

Social norms are an essential aspect of the decision-making process of low-income households and construction labourers, also known as fundis in Kenya (Vasudevan, R. 2019). People take decisions concerning materials and design options depending on the flow of information they receive on specific topics. These vary from price, neighbourhood style and security of tenure to how to select a mason and which are the qualities of a good home (Vasudevan, R. 2019). An individual, a large group of actors in the community or even communication conduits like the Internet, Facebook, or television advertisements, could greatly influence a person's decision-making (Vasudevan, R. 2019).

People make judgments based on what they perceive is expected, not just on knowledge. The informal standards that regulate group behaviour and expectations are known as norms. In other words, social norms establish what constitutes "normal" and suitable behaviour for a given community. As a result, influencing social norms can be a strong method for accelerating large-scale or systematic

change. A shift in social norms can result in shifts in ordinary behaviour and practices (Vasudevan, R. 2019).

Figure 09 shows an adapted framework produced by Vasudevan (2019) from the Cislaghi and Heise (2018) framework to understand the determinants of behaviour in people to understand better how social norms influence people's choices and actions. Four domains are depicted in this diagram, each of which represents a separate attribute that generates influence.



Source: Adapted from Cislaghi, B; Heise, L (2018) Theory and practice of social norms interventions: eight common pitfalls. Globalization and health, 14 (1). p. 83.

Figure 09. Determinants of Stakeholder Behaviour. (Habitat for Humanity. 2019)

Following this framework, it is possible to understand which aspects can influence a stakeholder in the building process of housing and, in that sense, grasp an idea of how they influence a shift to circularity in materials and building methods. Decisions are taken not only because of the product or service but also the variables a household affront, the building policies and regulations currently adopted and the social entities that influence the decision-making of every actor.

Finally, it is important to acknowledge who are the groups of people or the circumstances that play a key role when it comes to influencing the decision-making in housing construction in Kenya. Savings groups, fundis, family members, Internet, prices and security of tenure are some of the main actors in this situation. Savings groups encourage members to save by using peer pressure and providing loans essential to their members' home-building efforts. Fundis, typically rely on word-of-mouth within their networks and at the building sites where they operate for job prospects and knowledge about new materials and technology. They follow the clients' wants when it comes to materials, but if they are doubtful about what material to use, they will suggest what is in their knowledge (Vasudevan, R. 2019). Housing design, including the materials used, is frequently influenced by cost. Although a few households can save enough to purchase permanent materials, such as bricks or stone for walls, most individuals choose the least expensive materials that would allow them to begin construction within the budget they had set (Vasudevan, R. 2019). Family members who have previously built are likely to offer advice when asked for materials, design, and labour guidance. Intermediaries (typically in-laws) can also help organise the process, acquire materials, and locate a fundi while building at home (Vasudevan, R. 2019). Likewise, the Internet is becoming an increasingly important aspect of the home-building process, with consumers using websites and communication apps to find services and service providers using websites and communication apps to advertise. This is especially true for homebuilders with a larger income. Finally, the security of tenure could be one of the reasons why temporary materials are employed in informal settlements. Households are hesitant to spend significant funds in a structure they may be forced to abandon (Vasudevan, R. 2019).

Social Norms Attributes

Social norms and their power of influence can be determined by three attributes, prevalence, strength and relevance. Prevalence can be determined by the extent to which the norm is present and popular across the reference group and its influence on a collective level. Not all norms are held by all people, so their prevalence depends on how much the norm can become an obstacle or an enabler (Vasudevan, R. 2019). The strength of a social norm relates to how much it influences behaviour and how difficult it is to deviate from it. Lastly, relevance refers to how a social norm can hinder achieving a behavioural change (Vasudevan, R. 2019).

Conclusively, it's critical to understand how social norms might affect the implementation of circularity in Kenya's built environment; so the strategies that need to be implemented to ensure circularity are not obstructed by these behaviours.

5 EMPIRICAL RESEARCH ANALYSIS

This chapter presents the empirical data that was gathered. It provides an in-depth examination of the current situation in Kenya regarding circularity in the built environment based on the findings of questionnaires and interviews.

5.1 METHOD OF ANALYSIS FOR INTERVIEWS AND QUESTIONNAIRES

The process of analysis of data was divided between questionnaires and interviews. They were analysed independently, given the format of collecting data was different. Compared to the in-depth interviews, questionnaires had a much broader approach to getting an insight into the built environment in Kenya. Still, they were tested several times to approach the different participants in the best possible manner and guarantee responses that could provide insightful information for the research.

To analyse data Atlas.ti was used as a tool to code and arrange information in different groups. These were established strategically to understand the present situation, challenges, opportunities and accomplishments or impact every organisation was generating. To have a better visualisation of every group and the topics it gathered, sankey diagrams were made. These diagrams worked as a schematisation and visualisation of the connections between stakeholders and the variables of the group they were confronted with. Through this mechanism, a better understanding of which variables affected each stakeholder could be made. Sankey diagrams were made for both questionnaires and interviews. Each diagram can be consulted in (Appendix D) if further information is needed regarding the findings and results of the data collection of this research.

5.2 QUESTIONNAIRE

A questionnaire was chosen as a supplementary qualitative research tool to reinforce the data from the in-depth interviews. Its goal was to expand the network of people involved in Kenya's built environment and collect more data, as interviews could limit the number of stakeholders from whom data could be acquired. As a result, questionnaires would reach a number of persons who would not be interviewed yet worked in the built environment and could contribute valuable information to the study.

Stakeholders from a wide range of backgrounds were invited to participate. These individuals were divided into several groups depicted on the network map. In this case scenario, participants were asked to respond to twelve questions divided into themes such as:

-Their current work situation.
-Challenges they face concering circularity.
-Opportunities they see for pushing forward circularity in the future.
-Accomplishments the company has made in terms of environmental sustainability practices.

The online survey polled 13 people with first-hand expertise in the built environment or who work in organisations that support construction-related businesses. These gave a variety of viewpoints and ideas on important topics. The participants were conformed by architectural firms and building contractors, organisations advocating for circularity, suppliers of circular products and educational institutions.

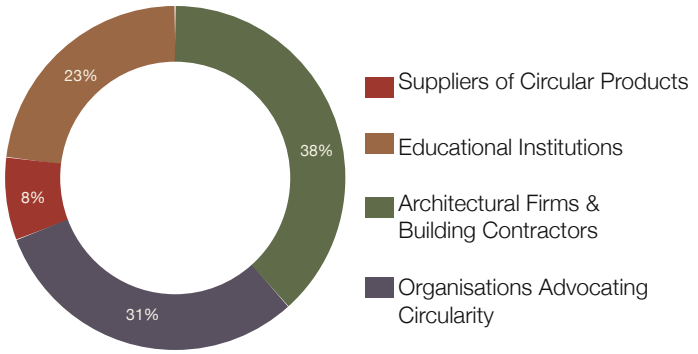


Figure 10. Participants on Questionnaire.

5.3 FINDINGS OF QUESTIONNAIRE

The information gathered in the questionnaire created sub-themes while grouping information into common topics. Given that the questionnaire entries were limited, general results are being provided from the collected data. A more detailed and in-depth analysis is provided in the interview section. Nonetheless, the findings from this section are important for the final results.

Present Situation was the first group to be observed, with information directed between the organisation's sustainable actions, community involvement generated by the organisation, and no community participation generated by the organisation. From those actions, there is a positive response concerning existing community participation where groups of people are involved in these practices. Still, there is a lack of community participation on behalf of certain organisations. These results could be interpreted in a way where initiatives concerning environmental sustainability are happening, and different groups of people are starting to approach it from different angles. Some organisations are creating community participation, which helps to educate and diffuse information to increase awareness of these new practices. Others don't see an opportunity how to involve the community or do not have the means to do it.

This information can create relationships to create a network of concepts between groups and sub-themes. Figure 11 provides a brief interpretation of how the sub-themes start connecting with the present situation group and how they relate to the organisation's accomplishments or impact concerning environmental sustainability. As a result, it can be seen that there needs to be community participation to create an environmentally sustainable impact in the built environment. Without it, these actions will not replicate and become a new normal.

Challenges were the second group to be observed. The main challenges that can be identified are a lack of awareness about sustainable building practices, economic challenges, cultural perspectives, and building regulations. The latter inhibits the possibilities for innovation and new practices to be enhanced by the stakeholders, creating a lack of professional know-how. Other challenges mentioned were a lack of government incentives and corruption. The lack of government incentives results in a lack of market offer, reducing and limiting the opportunities to change materials and construction processes. Finally, corruption is linked to political interests, making it difficult to implement environmentally sustainable policies.

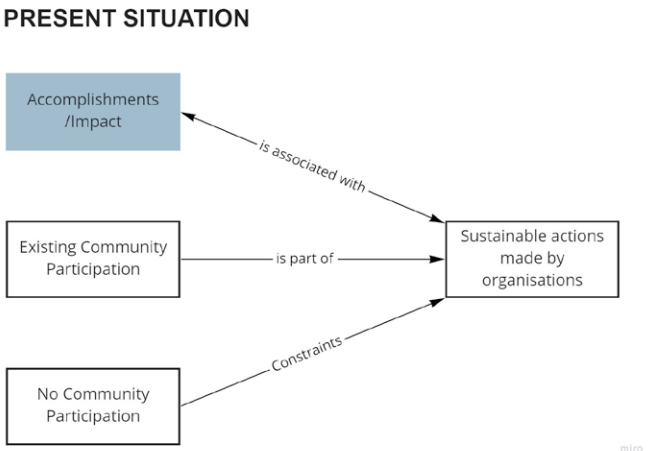


Figure 11. Stakeholders Present Situation Network.

> "Clients do not understand some of these environmentally sustainable building practices therefore perceive it as too theoretical or a waste of time."
>
> *Participant Alpha. Architecture Firm and Building Contractor. 2022*

From the information provided, networks are created to connect groups and sub-themes. Figure 12 depicts different connections between topics that create a better idea of how challenges are linked to one another and how they prevent accomplishments and impacts from happening in the built environment. As it can be observed, every topic is interconnected to the other. In order to create an impact in the built environment, all challenges must be tackled where opportunities arise.

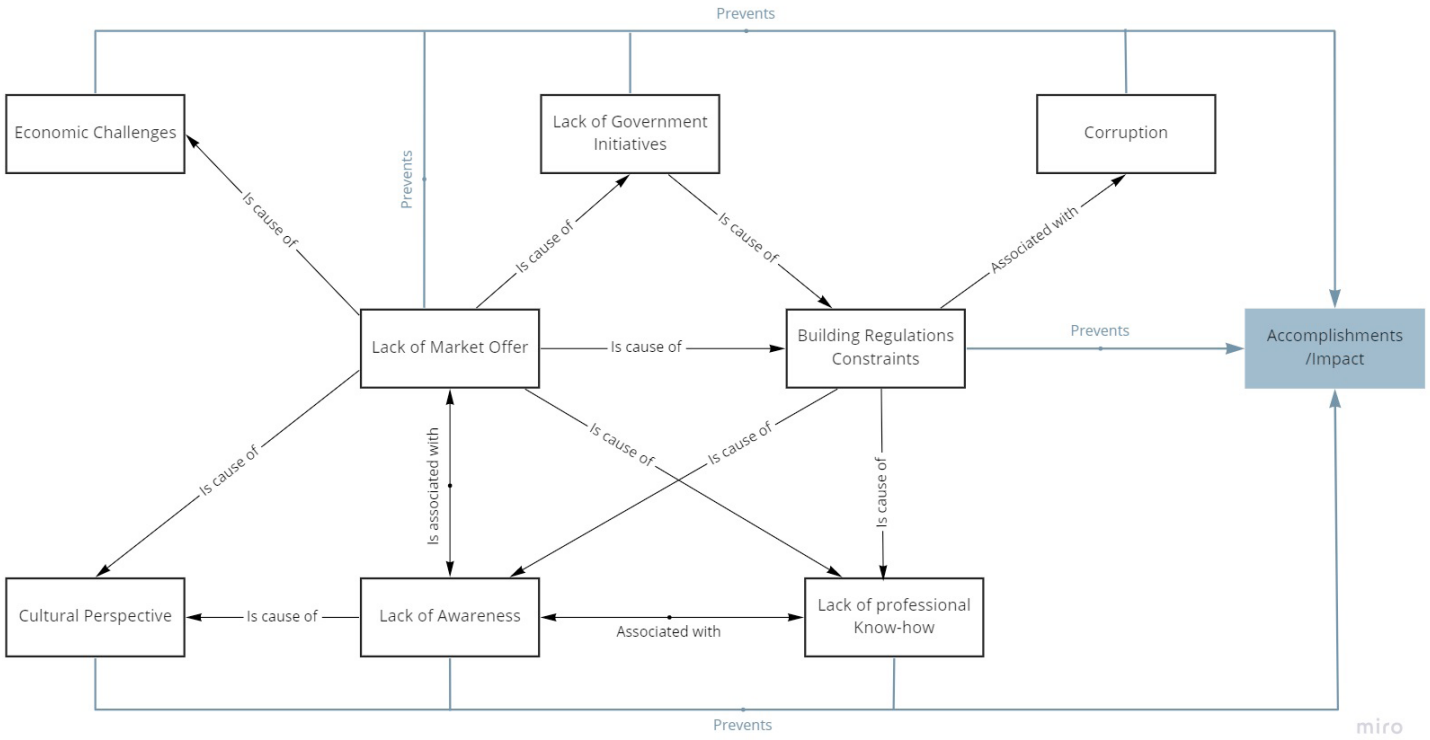


Figure 12. Challenges Networks.

> "Most donors do not view housing as a pathway to green growth. We have done a lot of proposal on sustainability, but most of the funding goes to sectors like agriculture, health etc."

Participant Beta. Organisation Advocating Circularity. 2022

Opportunities were the last group to be observed, and a diverse number of possibilities were identified through different stakeholders. To generate an impact on society and be able to create a shift toward circularity and sustainable building practices, various factors come into play. A new building code and regulation policies are fundamental to provide different stakeholders with opportunities to innovate and scale up their new proposals. These new policies can generate sustainable incentives for people to be more involved and engaged in making a change.

As an effect, there is community involvement. Community involvement can only become strong if there is a good network between stakeholders, an awareness of what the market is offering in innovations for the built environment and education nationwide, an understanding of what circularity is, and the importance of sustainable practices. Awareness of what the market offers not only associates with a good network between stakeholders but also generates interest in creating proper training for masons to learn how to build with these new materials. This training comes hand-in-hand with proper education of architects and building contractors who need to

> "It is key to leverage local governments to accepting green building guidelines into their planning permission stages as well as the building codes."

Participant Gamma. Organisation Advocating Circularity. 2022

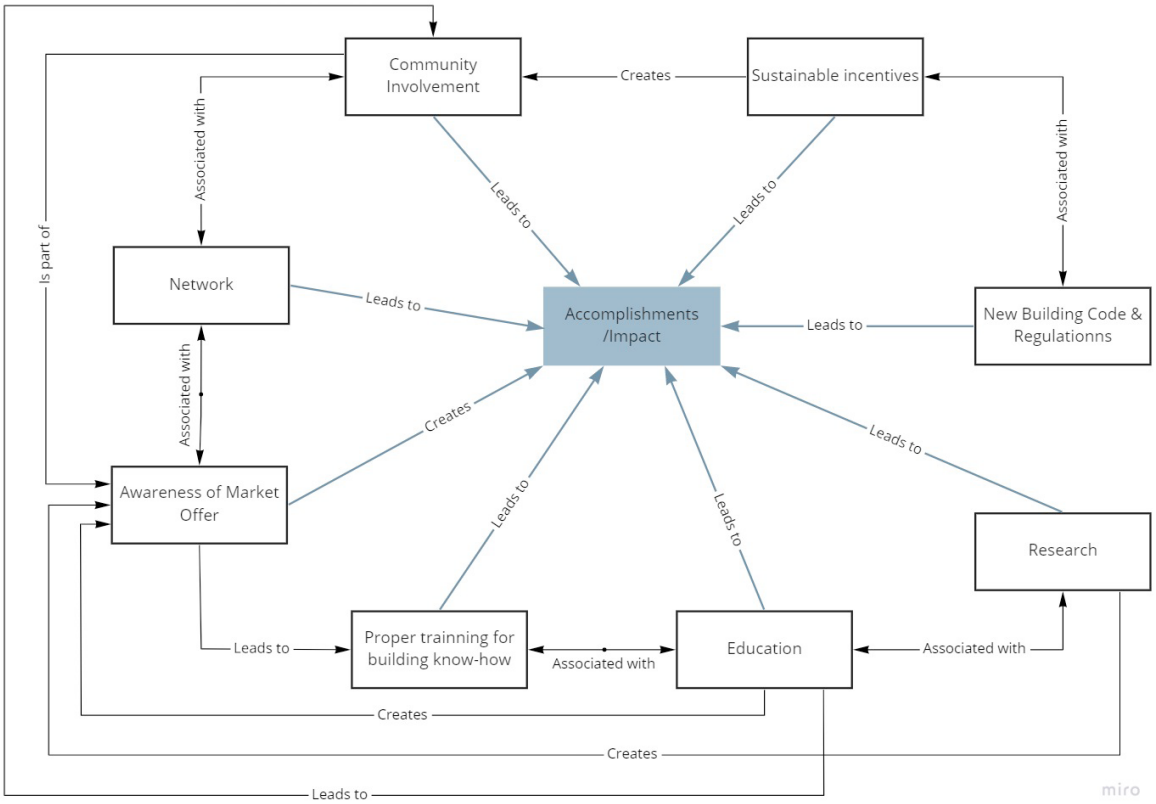


Figure 13. Opportunities Networks.

know about the new materials and building methods to specify them and adopt them in their projects. Finally, there needs research, which is linked with education and creates the possibility not only to create awareness of the market offer but also to create new products and dynamics on how to improve the built environment through circular and sustainable materials and building methods.

To visualise the information gathered from the opportunity data, a network map of opportunities connected to accomplishments and impact was constructed. Figure 13 depicts the various links that begin to portray tactics for advocating a transformation in the built environment.

> “We need proper training and knowledge dispersion to the people involved in the building industry and also clients.”

Participant Delta. Architecture Firm and Building Contractor. 2022

5.4 LIMITATIONS OF QUESTIONNAIRE

The online questionnaire had several limitations in the research. The number of persons who responded to the online survey was not as high as expected. As a result, data regarding the number of replies and the diversity of stakeholders is insufficient. 13 replies are inadequate to construct a comprehensive analysis from the questionnaire. It's also worth noting that just four of the six separate categories of stakeholders from the network map who were eligible to respond to the questionnaire did so. As a result, any input from a different group of stakeholders could have influenced the research findings.

Aside from the low participation percentage, finding different stakeholders who could answer the questionnaire was challenging. As a result, the number of people invited to participate and distribute the questionnaire among coworkers to increase the response rate was extremely low. In addition, interviews were prioritised, and interviewees were heavily reliant on sharing the link with their peers. Unfortunately, the lack of engagement is fairly noticeable when looking at the different groups who participated.

Finally, there was a problem with consistency in the questionnaire's phrasing to underline circularity in the questions. Even though the questionnaire began with an introduction paragraph describing the ideas of circularity, the questions in the questionnaire would refer to environmentally sustainable practices rather than strictly circularity. This opened up a lot of options for answering the questions. As a result, a few participants concentrated on circularity in response to specific questions, while others offered information on a broader range of environmentally sustainable practices.

5.5 INTERVIEWS

In-depth interviews were chosen as the main elements of the qualitative research. Their purpose was to approach stakeholders involved in Kenya's built environment and collect data from different people working in other areas of the construction industry. As a result, a holistic approach to the research could be made. From the actor-network map, every group of players was approached except for the end-users. The reason is that most of the information that the end-users could provide is of common knowledge to the other actors, given that most of them are not only immersed within the culture but deal with them as clients on a daily basis. Information about social norms and cultural perspectives could also be retrieved from previous research projects, and the other stakeholders provided the information to answer the research questions. Nonetheless, end-users were kept present throughout the whole research through questions that addressed them, but performing in-depth interviews was not seen as necessary.

Different stakeholders were invited to participate in this exploratory phase. Consequently, different interview protocols were designed because their focus areas tended to change. The interview protocols followed the same structure, divided into a present situation about their work, challenges, opportunities and impact generated by their entity. Questions would vary depending on who was being interviewed so that questions fit best into their working area. In Appendix C, three different models of the interviews can be observed.

Finally, 24 people with first-hand experience in the built environment were interviewed. Two of them were strongly involved in two different groups, architecture firms and academia. Given that their insight was valuable in both fields, interviews were conducted so that they could answer separately about each of the areas they work in. Consequently, there is a total of 26 entries from in-depth interviews for the research. The participants were conformed by architectural firms and building contractors, organisations advocating for circularity, suppliers of circular products, educational institutions, government

institutions and technical-upskilling institutions. The following graph shows the number of people that were interviewed in every group.

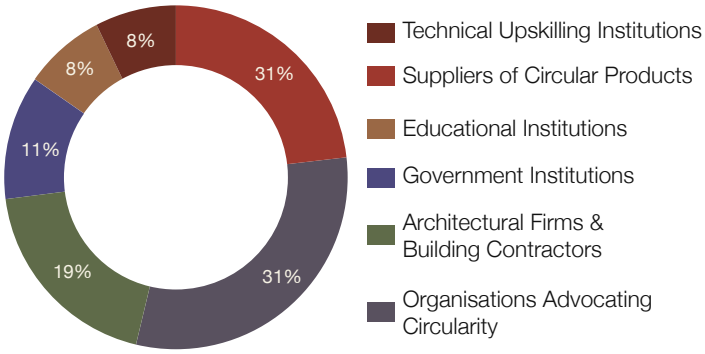


Figure 14. Interviews Participants.

5.6 FINDINGS OF INTERVIEWS

The information gathered from the 26 interview responses was organised into four key themes: stakeholders' present work situation, challenges, opportunities, and accomplishments. Sub-themes based on information provided about the same topic were established from those groups. As a result, a more in-depth study could be conducted based on each participant's knowledge about each topic.

Circularity's Present Situation

*Present Situation*is the first group to be observed, where different variables became a recurrent subject throughout interviews. To understand how these players were addressing the built environment, it was important to distinguish whether they worked for the high-end or in the affordable market sectors. This provided a holistic insight into the views and perspectives of end-users and how these professionals approach circularity in their built environment.

From architectural firms and building contractors, it could be concluded that many stakeholders feel in a comfort zone using conventional materials in their work environment. They all advocate for environmental sustainability in different manners, such as passive design, sustainable energy implementation and, in some cases, the use of circular materials that can be found in the market. Community participation is very small, given they only interact with their direct clients. Still, they emphasized the cultural perceptions and social norms end-users have when it comes to new materials. Some architects expressed how people like to use materials they know and will guarantee them a time certainty of the project. Others expressed how social and cultural norms dictate material choices and the lack of interest in trying something new. Still, many provide different strategies for creating acceptance of innovations, such as publishing documents or using buildings to educate people within the context. In a country that is led by cost-effective paradigms and the need for products to be affordable to all the effective demand, understanding that sustainability and affordability can be obtained at the same time is

key to creating a culture change. Design plays a key role when shifting the mindset of a community. The power of demonstrating how circular and sustainable materials can look like aspirational materials to the community can create a ripple effect for behavioural change. It is not easy, given many clients have a negative view of recycled materials, but it is just a consequence of a lack of awareness. Therefore, another strategy that has been implemented is using social media and exhibitions to showcase their projects and ideas.

In the case of suppliers of circular products, the following can be concluded from all the variables presented in the present situation of stakeholders. Given the job of these groups of players is to supply circular products to the built environment, they have an active role in advocating for circularity and environmental sustainability daily. Therefore, their job relies on creating strategies to accept and adopt these new materials and providing strategic business models to scale. In some cases, one of the strategies is to provide new material to the market and create an industry in the area. Therefore, local manufacturing workshops and small factories provide locals with jobs and opportunities. Partnerships and networking become key to creating awareness of their product and co-work with like-minded people that could provide opportunities for their business to grow. Through different approaches, these enterprises manage to generate knowledge about the benefits of circular materials and tackle the negative view about materials that are not well known. They also push different stakeholders to get out of their comfort zone with conventional industrial materials and change cultural perceptions and social norms.

> "We are creating a lot of awareness, whether it is billboard, online platforms, Facebook, Twitter, or Instagram. We have a show house ready and we are attending to expos."

Participant Epsilon. Suppliers of Circular Products. 2022

For educational institutions, these entities focus on providing knowledge to students and future professionals. Even though sustainability is a topic being handled, circularity is not a subject being taught directly. Still, there is an expectation from the students to implement or investigate sustainable solutions when they work in a studio. In certain cases, it is part of the curriculum to incorporate sustainable design materials or solutions such as recycled materials or materials with low embedded carbon. As a consequence, circularity is being looked at indirectly, but there is a clear statement that it is still not as strong as it could be.

Government institutions are advocating sustainability in different ways. Their focus is on any housing, whether high-end or affordable, given that one of their main goals is to push forward The Big Four Agenda, which has as one of its main pillars housing. Currently, they are advocating for the new building code to be approved, which provides multiple opportunities for innovations to be adopted in the built environment. To create acceptance and adaptation, they have provided an exhibition place called The Affordable Housing Village, where different stakeholders can build an exhibition house for people to learn about different types of innovative materials to build a house. Still, until the new building code is not approved, government-funded construction is focused on conventional materials. They also have an Alternative Building Materials and Technologies (ABMT) team, who work as advisors concerning new materials. Finally, partnerships between different stakeholders and the government become a foundation to generate change.

Organisations advocating for circularity are strongly pushing forward various initiatives to create a change in the built environment. Their advocacy for circularity and sustainability is very strong, as well as their strategies to create acceptance and adaptation. Some organisations focus on creating awareness by demystifying and breaking down the complex processes of building a house. They create a sustainability plan to educate as many Kenyans as possible through different platforms and media. Some push minimum green standards, such as IFC EDGE certifications, so developers start striving for change. Others seek ways to create a balance between the planet, people and profit, where there is

> “Our role is to downscale advanced scientific technology to the benefit of the public. The circular economy and circular building materials are an area that we’re particularly interested in as a way of resource. Not only because of the resource consumption, but on the chemical safety side.”
>
> *Participant Zeta. Organisation Advocating Circularity. 2022*

less impact on the planet by promoting innovative materials. This mitigates the depletion of natural resources and CO2 emissions, creates an impact on people by providing jobs and ensures the enterprises offering circular solutions to the market stay in business. Research is also a way of creating awareness of what is happening in the built environment and can strongly help change cultural perceptions and social norms. Partnerships become fundamental to being able to achieve their set goals. These entities help ventures already making a change in the industry, aiding them in overcoming barriers they are experiencing. Education through workshops and community participation are other ways the creation of awareness is handled through these companies. Through a wide range of networks, they help connect people to create a movement pushing forward circularity.

Finally, like the other technical upskilling institutions, stakeholders have strong advocacy and strategy to shift towards sustainable building practices. One of the ways these entities strive for change is through upskilling people to learn how to build with different materials. Although circular materials are not taught in their curriculum yet, they are starting to teach about environmentally sustainable technologies such as solar energy. Others have developed

PRESENT SITUATION

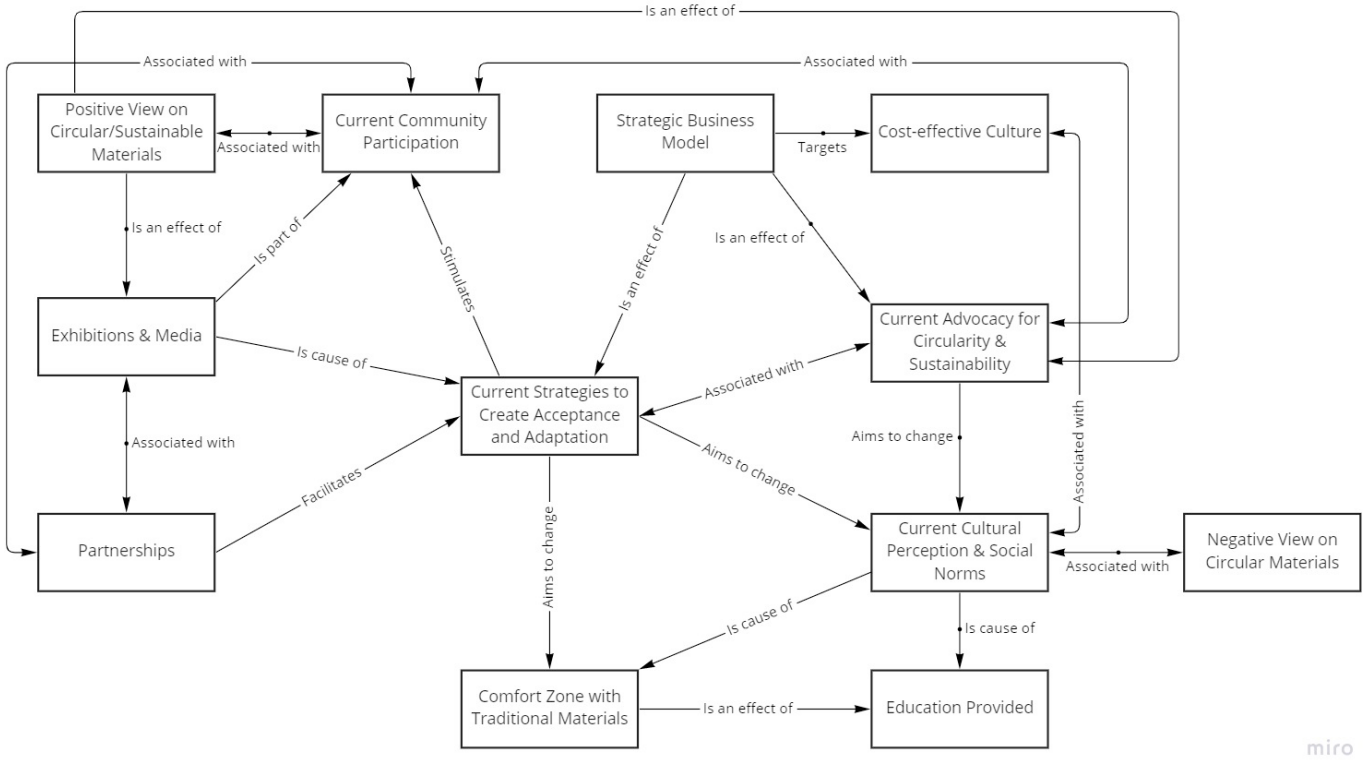


Figure 15. Present Situation Networks.

tools in a platform area where different stakeholders can manage their journey in the housing ecosystem. Through this platform, partnerships and networks are created to promote awareness of the multiple stakeholders involved in the housing sector. Even though their work with circular materials and building methods is not as active as other stakeholders, their influence and network towards the community are very high, leading them to have great opportunities to lead a change.

> "The aim here is to make the communities around us know that we have new approaches in construction, in training construction workers and the use of materials."

Participant Eta. Technical Upskilling Institutions. 2022

In order to understand how all the topics between the theme of present situation are related, a network map was created. Figure 15 aims to understand better the information presented through the interviews. The idea is to create a holistic view of the present situation of the built environment concerning circular materials, building methods and the current local situation through perspectives and social norms.

Challenges to Implement Circularity

Challenges were the second group to be observed throughout the interviews. In this section, it was essential to understand the differences and similarities every group of players is struggling with on their journey to make a shift to circularity. The aim is to understand where each group of actors is currently, identify their constraints and hurdles, and then look for opportunities and ways to bridge the gaps to move circularity ahead.

One of the biggest challenges for all the stakeholders is the absence of a new building code and regulations that support actors to start using circular materials. As stated before, the building code is outdated and constrains the building industry from using innovative materials and building methods in the country. Still, innovations are outpacing policies as a sign of stakeholders striving for environmentally sustainable practices. Nevertheless, not having a regulatory policy that supports innovations and environmentally sustainable practices makes it very hard for the market to make a change in the built environment.

According to architecture firms and building companies, besides the building code, there is a lack of awareness of circularity and what the market offers. Some architects have a vague idea of what circularity means and the different types of materials that are being offered. This becomes a challenge when it comes to design, given they are not capable of specifying any circular material that could help buildings become circular. In other cases, some architects are aware of what is being offered in the market, but the market offer is not big enough to find every time a material that adjusts to their designs. Besides that, the local labour force to build with these materials is scarce. Therefore, the lack of market offers and professional know-how becomes a huge constraint when designing circular ensembles. Cultural perception and social norms are also huge constraints, given that clients are reluctant to use new materials to construct their projects. First, as a first impression, there is a caveat of innovation being expensive, which makes people averse to trying something new. Second, there is a lack of trust based on the idea that any ensemble that will be built needs to be strong and the materials that symbolize strength are concrete or stone. As a re-

> "One of the biggest challenges is introducing any new building material, even if it's not sustainable. Just any new building material. Its been hard enough facing cultural norms such as: this is how we have been building."

Participant Theta. Architectural Firms and Building Contractors. 2022

"I know that as architects we have the tools to push for new materials. But the reality is that when the client is paying you, if he says, no, then there is very little you can do in that particular moment. "

Participant Iota. Architectural Firms and Building Contractors. 2022

sult, the knock effect comes into play, and people need to see buildings built with any new material being proposed; they need to know that it has been standing for several years without falling. Therefore, it becomes challenging for architects to specify what they cannot prove and for innovators to sell a new product in the market. Third, the concept of aspirational materials trickles down from the high-end to the low-income populations. Every client has certain expectations of what their house should look like and the materials used. Investing in a house is a life project for many families, and not only it is a dream and a great economic sacrifice. Therefore, as a social expectation, they believe they should be scaling the social ladder through all the effort they are investing in this project. Hence, bringing recycled materials or vernacular building practices is only seen as a downscale to their aspirations or a symbol of poverty. Fourth, there is a lack of influence on behalf of architects and building companies. They are restricted by the power the client has over them, and even if they propose new materials for the projects, the client has the final decision upon it. Clients want to build with materials they know and what they think is the quickest. Clients don't want to be the first to experiment with new materials; they want someone else to do it first so they can have feedback on it. They are not keen on taking a risk because that can also be reflected in the budget. Consequently, there is a lack of support and education concerning alternative ways of building around the community.

For suppliers of circular materials, one of their main challenges is selling their products in the market. The building code is a major constraint for any innovator in the market. Yet, as stated before, innovations are outpacing policies, and this initiative has made it possible for these new ventures to provide different alternatives in the built environment. Still, there are many challenges to scaling up in an industry that is noted as conservative. These challenges are directly linked to economic struggles. In a country where most of its inhabitants are of low income, frugal innovation must be implemented fully. Given these ventures are social enterprises, the price of their product needs to be low to stay competitive in the market. Therefore the profit margin of their product is not big. It is enough to keep the companies going but not enough for capital expenditure. Consequently, there is a high dependency on grants and investors to be able to scale up, given there are many financial restrictions for them. Getting a loan from a bank is challenging, given the country has high-interest fees for loans due to the fluctuating currency. Therefore, the banks' interest rate increases the product price dramatically if a product is just starting in the market. Another alternative are cooperatives, better known as Savings and Credit Co-Operative Society (SACCOs). These organisations are associations that require a membership and a lump sum investment of money to be able to ask for a loan afterwards. Interest rates are still high, and becoming part of one of these associations could also be a constraint for some companies. As stated with architecture and building companies, cultural perceptions and social norms are also a great challenge for these social enterprises to scale. Both are linked to the country's lack of awareness, lack of trust and education. There is a lack of knowl-

"You have to stay at the bottom where you're doing small scale in the clients small volumes and then keep scaling slowly. That is the challenge of the building industry, it's a capital-intensive industry, and it needs a lot of support to enter the market fully."

Participant Kappa. Suppliers of Circular Products. 2022

edge about these products' benefits, making it a challenge for some companies to change the mindset of various actors. Customers are price-sensitive, and sometimes the unit price of certain products is higher than traditional materials. The difference between products is the total cost of construction per m2. Some innovations propose faster construction times, less materials and an environmental component. Unfortunately, creating this type of conscientisation is a challenge and requires time. Hence, it becomes a challenge for these ventures to create social acceptance at a faster rate. Still, early adopters have accepted the product positively, and these companies are with their hands full of orders. Their problem is that given they can't scale up fast, they are bound to work only on small projects while slowly scaling. As a result, becoming mainstream is quite challenging. Adding to this challenge, all innovations require special training to be built correctly. Every product has a different technique. The lack of professional know-how is linked to the enterprise's capacity to train masons to learn new building methods. As a result, there is not enough labour force to upscale quickly either. Finally, corruption slows the process for many in the industry. Different political interests can constrain certain actors to move forward with their ventures, making it hard to succeed on a great scale in the market.

Educational institutions have a different set of challenges. To begin with, there is a strong lack of awareness and knowledge from the teachers about circularity. Interviewees believe there is a high possibility that every colleague has a different idea of sustainable design. Hence, every teacher focuses on what they believe sustainability in architecture is. As a result, there is a lack of exposure to circular materials and building methods solutions for the students. There is also a lack of networks related to organisations and entities that could provide information and knowledge to the academic field about circularity. Therefore, the academic field stays in a comfort zone, teaching what they know and following the outdated building code. Finally, there is a lack of influence to change curriculums and architecture dynamics. Change needs to come from the higher spheres in the institution; these changes usually take time in academia. Consequently, teachers are bound to what they can control. There are initiatives to teach about sustainability; the problem

> "The limitation from the student side would be the lack of exposure, perhaps to these solutions. A lot of the staff, including myself, maybe are not aware of what's in the market."
>
> *Participant Lambda. Educational Institutions. 2022*

is it hasn't been enforced in a way that could make an impact to create a notorious change.

Governmental institutions are the regulatory entities and the policymakers who can strive for change from a top-down approach. Their power within the country is very strong, and yet there are certain challenges they have to face. There is a lack of awareness concerning materials and their cost-effectiveness of them. There is a perception that environmentally sustainable materials are more expensive than conventional materials. Also, there is a misconception about new materials directed to the idea that these are for high-income individuals and high-end projects. Likewise, there is a thought that these products are not profitable. As a result, the acceptability of these materials and their use in projects is challenging. The price sensitivity of the market also brings specific challenges; given stakeholders are focused on buying the cheapest materials the market provides, even if their quality is not the best. This creates a great number of problems in different ensembles after the projects are completed. People are also driven by the materials that are offered in the market. The availability of materials in the country determines an important choice factor. People trust locally available and what they have seen and tested over time. Therefore, when it comes to governmental projects throughout the country, entities select materials with which they are familiarised. Lack of education is also a great constraint for regulations to work well. County governments do not have the knowledge to be able to regulate and evaluate sustainable specifications of buildings that are being planned. This lack of knowledge disables the opportunity to enforce environmental sustainability measures in new proposals. Still, the problem also

> "County governments, for example, do not have adequate capacity, technical capacity, to be able to manage some of the basic things required for buildings to be sustainable."
>
> *Participant Mu. Government Institutions. 2022*

relies on an outdated building code which doesn't enforce environmentally sustainable measures. The speed at which the government is approving new regulations is also problematic. Innovations are outpacing policies, and the slow process of updating building regulations is creating a bottleneck situation in the country's built environment.

Technical upskilling organisations are surrounded by different challenges when it comes to circularity. The availability and accessibility of circular products in the market play a key role in their challenges. First, there is a lack of awareness of where to find these products and how to access them. Innovations come from start-up companies; unfortunately, these innovations are not easy to obtain throughout the distribution chain. Consequently, upskilling institutions cannot compromise to materials they are bound to buy from one producer. There needs to be easy access to it for them to train masons or raise knowledge of the materials' availability to people planning to build their own homes. Second, there are a number of stereotypes and preferences toward products that are linked to social norms and cultural perspectives. So, even when these organisations are trying to bring new materials solutions, there are challenges in penetrating the markets. Another big problem is that suppliers of environmentally friendly materials are not marketing well their products. There is a lack of trust within the community with their marketing scheme, given their selling point is provided by how much the building of their house will be with their product. But they do not include the other elements they need to build a house in their selling point. So, people believe they will save a lot of money, and at the end of the game, the difference is very slim, or maybe they end up paying even more. Therefore, good communication and marketing of the product are very important to gain market trust and for entities to start accepting innovative materials in their organisations.

> "One of the biggest challenges I think, even within new technologies is people will not know about it. But where do I get it? How do I access it? You know, accessibility is one of the roles."
>
> *Participant Nu. Technical Upskilling Institutions. 2022*

Organisations advocating circularity foresee various challenges in their scope to push circularity forward in the built environment. Beforehand, it is important to explain the concept of cost-effectiveness, given in the Kenyan culture it becomes extremely relevant when approaching an innovation or building method. The concept of affordable is very broad, given affordability brings out a question. For whom is it affordable? Therefore, cost-effective becomes a term employed for the effective demand of any product selling in the low-income and mid-income markets. A cost-effective product is seen as low price, good quality and not time-consuming. Keeping this concept in mind, accessibility to products is a challenge given they are not available throughout the whole country and transportation costs increase prices up to an extent where the cost-effectiveness of a product can start being affected. Therefore, the need for local suppliers is key to success in the project, and that implies building a network of suppliers. For some companies, it could become a challenge given there need to be an investment for that, making it hard for new ventures to make it in a short time span. As an effect, organisations advocating for circularity are challenged when trying to advocate for these products. This problem is linked to the challenges suppliers have to scale up. A good number of enterprises focusing on supplying circular materials have a great demand for their products. Still, they can only cover a small fraction of it because of their production capacity. Some organisations advocating for circular materials help these ventures scale up, but their help is limited in some cases.

> "Kenya is a very random place, if I can put it that way. We have stakeholders with regards to materials and especially on the circular economy, but I can tell you that there is not one specific place where you can go and find them. You have to maneuver your way around it."

Participant Xi. Organisations Advocating Circularity. 2022

Therefore, companies cannot scale up at a faster rate, and it becomes challenging to solely advocate for materials that cannot supply the demand. On the other side of the spectrum, conservatism towards using new building materials is very high. People are in a comfort zone, and in some cases, stakeholders are unwilling to take a risk, especially if circular materials could alter their expected profit. As a result, cultural perceptions and social norms based on the misconception that recycled materials are of lower structural strength or will lower your social status play a part in this issue. But cultural perceptions are not the only ones that affect the market. Corruption becomes a significant challenge in leading the uptake of materials. Certain organisations express the situation where they feel the government has its wheelhouse concerning how they work. So having separate stakeholders to influence the government becomes difficult, especially with tender premiums. These are stakeholders strongly related to the government and, consequently, always winning the public tenders. This situation affects everything from roads to housing in the country. Parallel to this situation, there are two types of manufacturers. Some make money in terms of product assembly or on-site mixing. They are primarily focused on inputs, and they're not necessarily interested in anything on the innovation side unless it's something they can import through their existing supply chain with contractor relationships. Then there are the established manufacturers who have their pricing models and economies of scale, and they see circular building materials as a competitive threat to put them out of business. So, if these stakeholders have a good network within the market, they can manage to make it very hard for innovations to upscale in the construction industry. Hence, organisations advocating for materials struggle in this uphill battle.

Other challenges that are handled are the building code regulations and the standards. Innovations are outpacing building regulations, as has been stated before, but there are no standards that support the low-income market. Tools such as LED or EDGE certification systems are used for projects only focused on the high-end. They haven't started to be implemented fully in affordable housing. There are also no metrics for innovations and standards to assure the quality of products. The lack of knowledge of this situation and how to address it to push forward mechanisms such as circularity becomes a problem. Economic challenges are also a big challenge. Access to finance becomes challenging for SMEs and end-users. When it comes to end-users, most of the country is in the informal sector. This means that existing financial institutions can never provide funding to people in the informal sector for a period longer than three or four years. This situation dictates that people will have to build incrementally. Therefore, SMEs that are providing circular materials should address a market that could build incrementally with their technology and, in that sense, be able to provide materials at any time they are needed. But it is also a challenge for certain users, given that banks are not providing loans for new materials and are a liability. Therefore, they create a barrier to getting loans to build a house with circular materials. Still, it is important to remember that most of the investment in housing by end-users is made out

> "I think the biggest challenge to be honest is corruption... we've been trying to see how we can leverage or at least bring down the whole corrupt system that normally goes around materials."

Participant Xi. Organisations Advocating Circularity. 2022

of savings or SACCOs, due to the financial barriers that exist through banks. As an effect, organisations advocating for circularity also need to consider the economic challenges that come along with the built environment, understand the end-users and seek ways to support SMEs to approach the market with a product that satisfies the existing demand.

Networks are very important to be able to influence a whole country. That means access to cities, villages, and rural areas of Kenya. Providing information, access, and awareness about these new building technologies' advantages and benefits requires good networks to achieve change. Some of these organisations work on ventures no one else has attempted. For that, they need strong partnerships willing to pioneer through new scopes. Finding the right partners can sometimes be very challenging for these organisations. Furthermore, communication platforms are opportunities to disseminate information; collaborative associations mostly conform to these. Communication access in certain cases can be challenging through these organisations. Therefore, the challenge is focused on addressing these associations to empower them so that they

> "The biggest challenge is getting people to understand that if you have a low income, like even if it's half a shilling, that half a shilling should award you the ability to buy safety, to buy dignity, to buy comfort, to buy happiness, the same way one million insurance does. "

Participant Omicron. Organisations Advocating Circularity. 2022

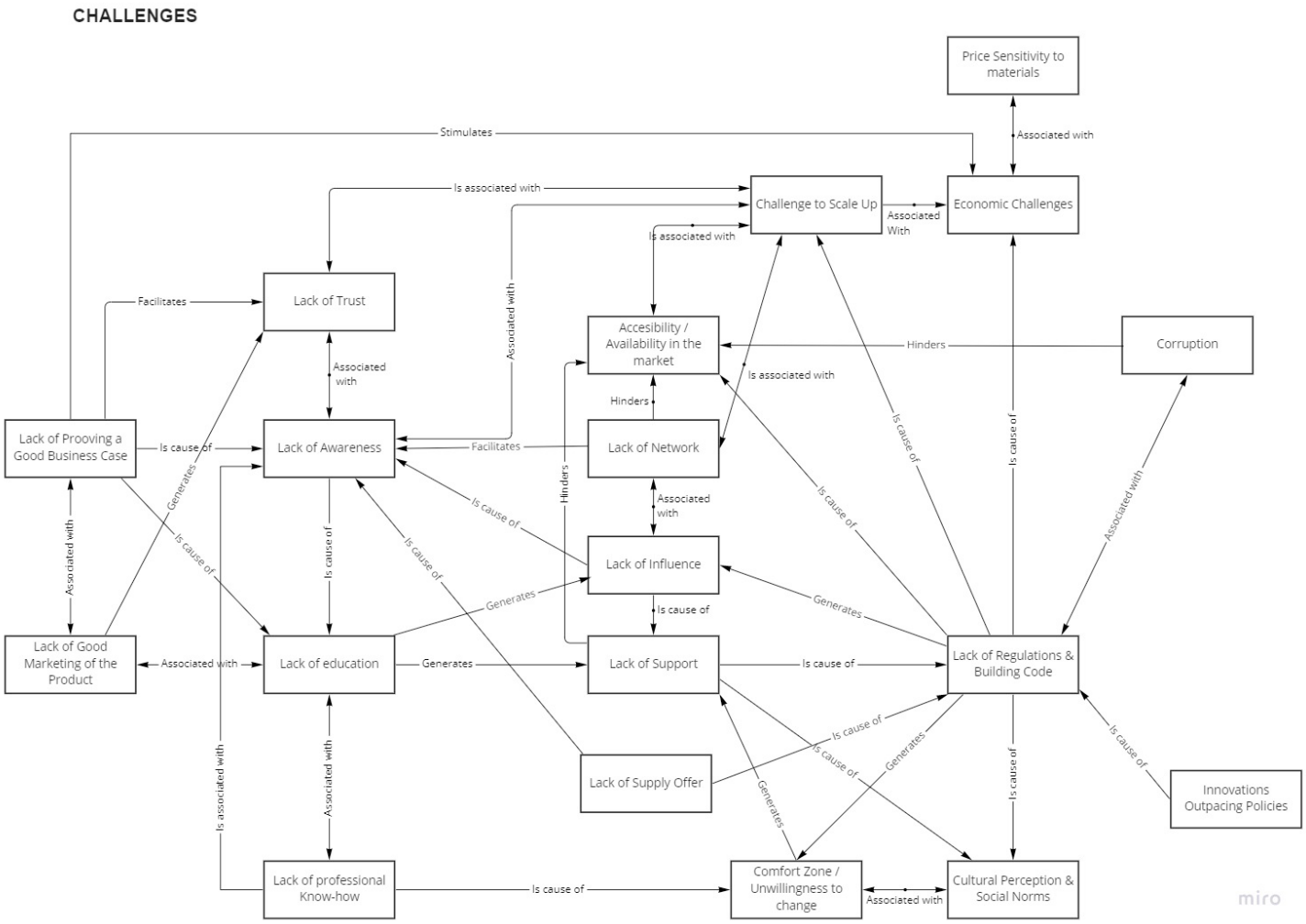


Figure 16. Stakeholders Challenges Networks.

can demand environmentally sustainable buildings with circular materials. If there is no well-established network through associations in the built environment, disseminating any innovation is very challenging. Hence, the challenge is leveraging the message about circular materials throughout these platforms to get the information and knowledge across. By those means, there needs to be support and the lack of it can become a big constraint. Getting new ideas through organisations is not easy, especially when a base of information has to come through for people to understand new materials and building methods. In this scenario, it is important to understand that Kenya is a country where money drives the actions taken. For many stakeholders, there needs to be a security that will not be affected monetarily. Therefore, a good communication strategy and a solid network need to push the agenda through all mediums.

To understand how all the topics between the theme of challenges are related, a network map was created. Figure 16 aims to better understand the information presented through the interviews. The idea is to create a holistic view of the challenges of the built environment concerning circular materials, building methods and the current local context.

"Kenya is a very capitalistic economy, no pun intended, show me the money. It's not working if the product is not moving. People feel it's not their role to educate. They are thinking: am I making my money? In the rest, they are thinking, I'm not a socialist, I'm not the government, I'm not a priest. It is not my place to do that."

Participant Pi. Organisations Advocating Circularity. 2022

Opportunities to Implement Circularity

Opportunities are the third group to be observed throughout the interviews. In this section, it was important to understand the different types of opportunities that can arise from the challenges presented. The aim is to grasp where each group of actors feel there could be opportunities in their working area to create solutions for the future.

There are many opportunities for stakeholders to start making a change towards circularity. A new building code and regulations allowing innovation of materials and building methods are key to opening the market. For every stakeholder, there is an urgent need for policies to meet needs and environmentally sustainable standards to have the freedom to grow, educate, create awareness and penetrate the market as intended. Keeping that in mind, for architectural firms and building companies availability of circular products in the market is key to specifying them in future projects. If products are at a local level reach, the initiative to make a change could start to happen. Products need to be cost-effective, and they must prove to the effective demand that they will save time and money, given these are key points in selecting materials. There also needs to be a diversity of products in the market to have possibilities to choose and incorporate in the best way circular materials and building methods in the new housing projects. Awareness of what circularity is and the innovations that are starting to be offered in the market is also crucial for a change of behaviour to happen. Understanding the importance of environmentally sustainable materials, the staggering reality about the depletion of materials if there is no chance in building practices and the solutions the market is proposing. Architectural firms and Building companies can become great influencers for people to see what can be done with these new materials. The opportunity is in them to create a ripple effect in the market. Community inclusion and participation are also important from the perspective of architectural firms, the nurturing of young professionals to be fully aware of the spectrum of efficiencies and benefits of designs and materials. Changes start to happen when the community is brought into the conversation, given they are provided knowledge to fill in the awareness gap. There also needs to be a good communication strategy for people from

the high-end to implement the same type of circular materials low-income people could use for their projects. Through this strategy, the shift to circularity will trickle down throughout the country. A great opportunity for circularity is linked with government support. The government has a very strong network of players in the building industry, given they control all the planning and approvals of what will be built. If they push all these building contractors and architecture firms to shift and compromise to the Sustainable Development agenda, it will help companies invest in circular materials. Social media and activity in different platforms that can create a visualisation of projects and use of circular materials become a great opportunity to create awareness in the community and impulse other companies to start using them. Finally, exhibitions are a great way to create momentum. Built projects are an opportunity to create conversations about materials.

For suppliers of circular products, opportunities start when having the possibility of scaling up to be able to distribute their products in economies of scale. This implies decentralisation in the production chain to cut transportation costs and mass production, which makes the products cost-effective to the effective demand. Decentralisation of the production of materials also creates the opportunity to provide jobs to the communities both in the construction sites and the production factories, given these are the people that will be working with the materials

> "We built on momentum with the projects that we have, which provide good examples. Previously, we didn't have a portfolio of projects. So now that we do, it's easy to point out, like, oh, but we did this and it's working. So it's easier to have the conversation now than before."

Participant Theta. Architecture Firms and Building Contractors. 2022

in the area. Making materials that are easy to use also provide the opportunity for expansion, given it doesn't require a lot of skill, it saves time, and consequently, it saves money. Therefore, it attracts the market to adopt new materials and building methods. To be able to scale up, decentralise the supply chain and be able to adopt economies of scale, a great opportunity for these organisations are partnerships. A good network and solid partnerships that provide funding and investment to make these organisations grow can guarantee a bigger scope in the market for circular innovations, better product dissemination and the opportunity to generate a more significant impact. Funding is one of the advantages partnerships can help these enterprises, but networks can also help create partnerships

> "Now we need to break down those numbers in such a way that the long-term social housing aspects can be looked into. So we need partners who can be able to fund it in a bigger way."

Participant Rho. Suppliers of Circular Products. 2022

with strong influencers who can advocate for circular materials in communities. Community leaders around the country can influence the decision-making of many inhabitants. If well connected, these people could also help suppliers grow, increasing the demand for certain products and creating new opportunities for suppliers. Community participation is also vital for expansion. If community inclusion is made, awareness about new products can be created. These can be supported through exhibitions, community workshops, and a good communication strategy. Anything that is illustrative for making communities understand what the market is offering can help to create acceptance and adaptation of innovations. This will promote word of mouth, and in social norms and mechanisms, good feedback from early adopters will potentially create enthusiasm in other community members, creating an impact on making the product mainstream. Finally, there needs to be

government support for suppliers to be able to create the impact and change they want. Their support of innovations with funding, exhibitions, regulations and using these new materials in public projects will open up the possibilities for change.

For educational institutions, opportunities to strive for change start with education. Educating future professionals, as well as teachers, about what circularity is and its importance of it is the first step. For educators, research is also an opportunity to generate materials improvement and market knowledge to suppliers. It also creates awareness and expertise for the community, especially for those responsible for carrying the message in their professional work. Incorporating circularity in the curriculum to teach design strategies that mitigate the depletion of materials, as well as the production of CO_2, is a strategy that becomes an opportunity for creating awareness. Exposure to projects, solutions and companies that work with these innovations is key to creating a change. Aside from lectures and research, university-hosted workshops and conferences open to the public can give possibilities for

"We have to work with the communities, we have to hire the young people…We are working with churches, or we are hoping to have that workforce in churches. Because in Kenya people listen to their religious leaders. So that's another avenue that we are using."

Participant Sigma. Suppliers of Circular Products. 2022

learning and knowledge dissemination across the country. That implies the creation of a good network of people willing to work with the university to provide lectures on and off-campus and provide insightful information to the community. Finally, there needs to be a willingness to be open to

"Education has a huge impact. We're training the future architects and it's going to be up to them to really define how Nairobi or how Kenya looks like."

Participant Lambda. Educational Institutions. 2022

new schemes from what educational institutions are working on, and there needs to be funding to create opportunities for research to happen.

Government Institutions have the power to create multiple opportunities in the built environment to strive for change and impulse circularity as part of building policies and regulations. Approving a new building code that substitutes the obsolete 1968 one is the first step toward change. Likewise, regulations on the standardisation of materials need to be done to be able to fix the criteria for new materials. These will generate trust among the community when being used. Furthermore, policy incentives need to be made to help new entrepreneurs push their ventures. Only through these incentives can a diversity of materials happen in the market, and start-ups can make it to the market. Also, these incentives will make building companies and suppliers of current materials make a shift for sustainability. To wrap this initiative, there needs to be a willingness for new discussions about materials and building methods and support them. A good communication strategy is also needed to push forward the agenda. Guided by global initiatives such as making the world CO2 emission-free and pushing forward circularity, governments need to communicate well with all their partners in the built environment to align the same ideas and concepts to push the circular agenda in Kenya. Good partnerships and networks are also essential to gaining support and momentum. For those matters, the government needs to create community participation and inclusion. This implies the inclusion of SMEs providing circular products to the built environment in the country, as well as creating awareness about these new building practices. Finally, there needs to be funding, and

it becomes an opportunity for research, incubators for start-ups, exhibitions and conferences to push forward the agenda.

> "You know policies are driven from the top for them to take route. So, there is a need to have leadership in this theme to drive this agenda."

Participant Sigma. Government Institutions. 2022

For technical upskilling institutions opportunities arise between education and networks between different stakeholders who can introduce innovations to these organisations. Education comes in hand with the opportunity to generate training sessions for masons and community members on the professional know-how to build with these new technologies, given end-users want their homes to be built by people who are confident about the building method and the materials that are being used to build their homes. Networks are essential to know what the market is offering and to train and provide information to people about new building practices. For change to also happen, there needs to be a great support for circular materials, which implies the community participation of engineers, architects, contractors and all the stakeholders that are involved in the built environment, given their technical opinion is very powerful when it comes to shifting the public perception and the government acceptance of the new materials. Finally, there needs to be a good communication strategy to create awareness of the circular materials that are being brought to the market as well as to change cultural perspectives about them. That way, people will be open to use these new technologies and the training of workers for these innovations is fruitful. Different communication media becomes essential, such as social media, TV and radio. Also, community centres, sports clubs, religious groups and associations. It is important for these technical upskilling institutions to let people know of the new innovations they are implementing in their training programs and the new opportunities there are in the market. As

> "It is an opportunity for us to train fundis in the use of innovative and locally available materials. We envision a future where this becomes mainstream, other than being the odd one out."

Participant Tau. Technical Upskilling Institutions. 2022

a good strategy it is important to have ambassadors that can support the organisations initiatives. These ambassadors are the ones who will have the power to motivate people to be trained with these new building methods and to learn about the new materials. The best strategy and opportunity to penetrate the message of these entities throughout the community is if there are successful stories about the impact these new opportunities have provided to its participants. Positive stories told by common people move faster and are grasped in a better way given people can relate in an easier manner.

Organisations advocating circularity are enablers to new opportunities in the built environment. As enablers, they have the chance to create awareness and educate local stakeholders. These organisations can reach communities, enterprises, and the government. Hence, they have the chance to spread information through community participation in an easier manner and be able to inform people about circular materials and building methods. These actions provide the opportunity to change social norms and behaviours that are constraining the momentum of circularity in the country. Organisations advocating for circularity have a good network; this can be used as an opportunity to connect different stakeholders, create awareness of what is in the market and establish partnerships with different companies and institutions to bridge the circularity gap in the built environment. These organisations can also provide education in different ways. Technical assistance to new enterprises focused on circular products can help as guidance for companies to have an impact in the market. This implies helping companies build up a good business case,

where they can de-risk their business models and have a solid proposal for the market. Also, there can be support through educational institutions to incentivise research and use findings in the market to improve the local built environment situation. As organisations with a strong power to influence, these entities can help push forward policy-oriented initiatives in the built environment, providing opportunities to create policies oriented to the market in the best possible manner. Finally, organisations advocating for circularity can provide monetary funding to SMEs. Funding enables SMEs to penetrate and scale up in the market. It generates opportunities to diversify the market offer of materials by creating interest in new stakeholders to venture with their products. It provides accessibility of materials around the country, incentivises economies of scale and achieves cost-effective competitive and attractive products for the effective demand. As a result, it opens up multiple opportunities for stakeholders to create a positive impact in the country while transitioning from conventional materials to circularity.

In order to understand how all the topics between the theme of opportunities are related, a network map was created. Figure 17 aims to better understand the information presented through the interviews. The main idea is to create a solid idea of how concepts within opportunities interrelate to make a shift towards circularity efficiently.

"Funding I think it's the biggest challenge for most people who are working in sustainable construction. Most investors want to see something working on the ground before they are able to put their money in. So we need to break that gap, to help this ventures move from the starting stage, to a place where they're already being profitable."

Participant Upsilon. Organisations Advocating Circularity. 2022

"To be able to make a lot of impact, we need more stakeholders to come on board, and the development agencies to come together and recognize housing as an avenue to achieving sustainability."

Participant Upsilon. Organisations Advocating Circularity. 2022

Accomplishments and Impact

Circularity is a means to an end by building in an environmentally sustainable manner. It is not an easy target and a starting movement in Kenya. Still, impact and accomplishments are already starting to happen and are important to highlight. The acceptance and adoption of circularity are low, but it is slowly growing. Despite the number of circular product suppliers being small, they have managed to create new jobs and get acceptance from early adopters. The government is in the process of providing a new building code that will allow opportunities for circularity to be enhanced in the built environment. Educational institutions are starting to plant seeds about sustainability in the built environment and are keen to start learning and teaching about circularity. Technical up-skilling institutions are open to start teaching about new building methods and are starting to work with interlocked stabilised soil bricks (ISSB). Finally, organisations advocating circularity are continuously working on creating awareness about environmentally sustainable alternatives in the built environment. Networks, partnerships, funding and education for communities are some strategies that are being developed to strive for change.

OPPORTUNITIES

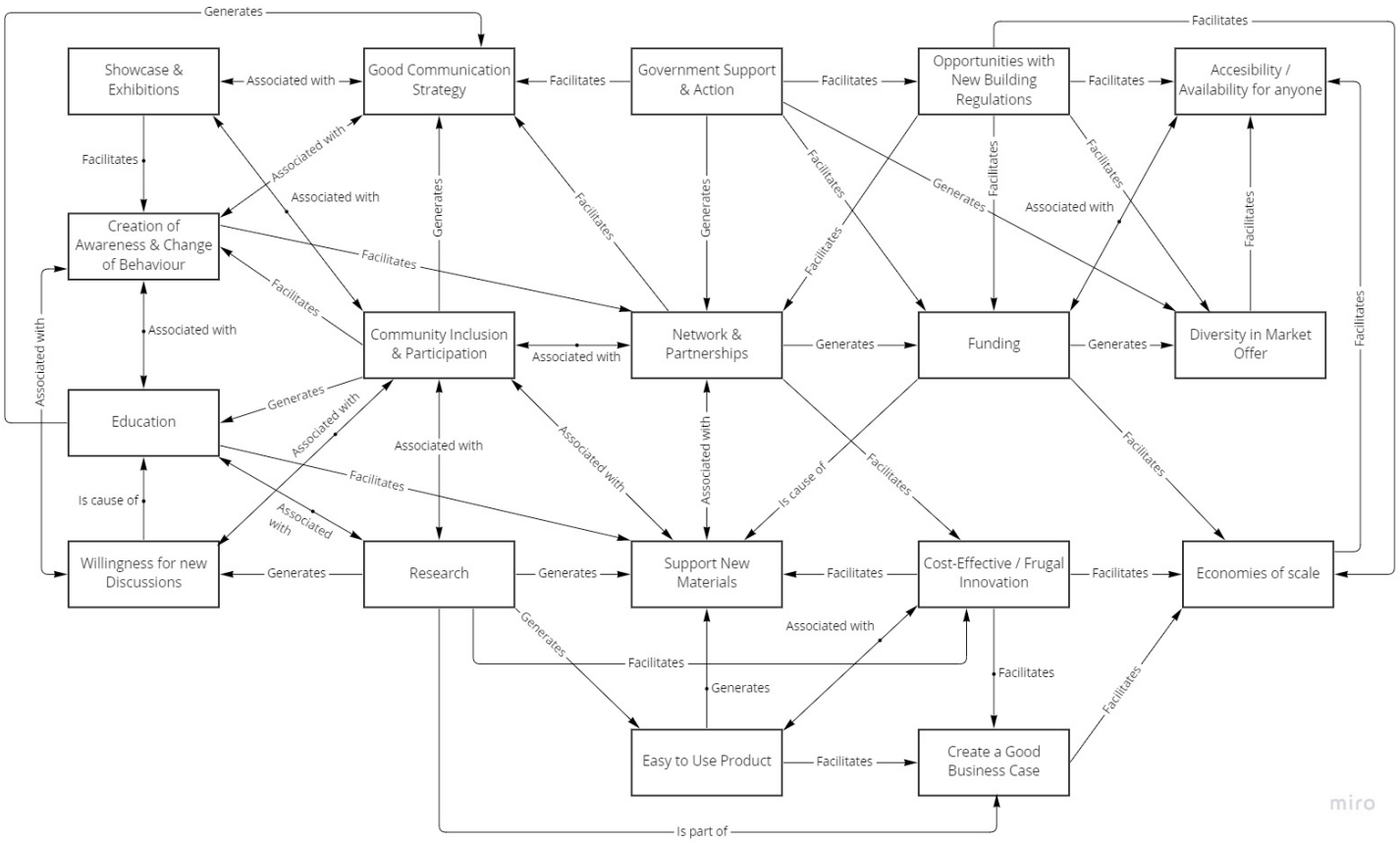


Figure 17. Stakeholders Opportunities Networks.

5.7 LIMITATIONS OF INTERVIEWS

The interviews were conducted as part of the qualitative research approach to conduct a comprehensive case study. The interviewees were chosen using the criteria that they all had to be fully involved in the built environment. All of the interviews were successful because they gave an in-depth understanding of Kenya's built environment, and each delivered information relevant to their area of work and duties. Still, numerous stakeholders are involved in the built environment, and the number of interviews with some stakeholder groups may not have been sufficient. In each group, the number of actors interviewed varied considerably. In certain cases, such as governmental institutions, insight from other governmental entities could have greatly influenced the research. Access to particular groups of stakeholders was also a limitation of this research due to restricted connections. The lack of response from certain actors limited the number of interviews and the spectrum of information from certain groups of players. Finally, since interviews were the primary source of data collection, the data quality varied from actor to actor. Comparisons between stakeholders were difficult to make in certain cases, given each player works for a different organisation with a different approach to the built environment. Consequently, the quality of information is very biased to every actor's perspective.

6 INTERPRETATION OF RESEARCH FINDINGS

This chapter presents a triangulation of the findings, theoretical background, and the answering of research questions. Each sub-chapter responds to a single sub-question addressed in the research. Section 6.4 answers the main research question and a guideline for NGOs to support local stakeholders in Kenya in transitioning to circular materials and building methods.

6.1 PROCESSES OF SUPPORT TO IMPLEMENT CIRCULARITY

How can a process of support for circular materials and methods be created by NGOs to implement affordable and simple to build houses, while being both efficient and effective?

Implementing circularity in Kenya is challenging yet attainable. There needs to be support from different stakeholders to achieve it successfully. One of the country's most prevalent challenges, following the questionnaires, interviews and data collected from reports and papers, is the built environment's outdated building code and regulation policies. This situation affects all local stakeholders to shift in the construction industry, given that it becomes a constraint and disables any innovation that is not aligned with conventional materials and building methods. Following the interview findings and referring to Payne (2014) from the literature, it can be observed that the bureaucratic inertia and reluctance from those who approve policies constrain the country from developing economically, efficiently and in a socially inclusive manner through the urban markets. Although the lack of opportunities has obliged innovations to outpace policies, as seen with the number of startups starting to surge in the country, their growth in the market is limited to the country's building regulations. Consequently, there needs to be a process of support to create flexible and pragmatic regulations that can adapt to the new challenges the country has to face. This support process can be led by organisations that can influence and provide insightful knowledge to government institutions on achieving a new building code that becomes inclusive for all stakeholders. These entities are also key to creating pressure and accelerating procedures for building regulations to be availed. Following Pugh (1994) and the idea of policy-making through evolution and innovation and bringing these ideas into context, a good process of support to policy-making institutions can be delivered by NGOs, given they have first-hand knowledge of what is happening in the local context. This knowledge can suggest the change and development of new standards-aligned present situations. Hence there can be an easy acceptance and adaptation of new regulations. This provides the opportunity to push forward circularity in the built environment and create leverage from government institutions, the private sector, and the end-users.

Solid policies must be constructed to house the BoP on a long-term basis, balancing the interests of all stakeholders. As a result, a collaborative effort involving the private sector, citizens' organisations, and the government is required. As influencers and entities that form partnerships with many stakeholders, NGOs have the ability to capture the great effective demand in the market and provide different solutions that can meet the various needs in the BoP segment. This implies alternatives in building materials, methods, and financial opportunities. Ferguson et al. (2014) state that formal public and private-sector organisations frequently lack expertise and access to low-income neighbourhoods. Therefore, they can benefit from organisations with the knowledge and access to them. Keeping in mind that in the Kenyan context, 61% of the current population lives in informal settlements (CAHF. 2021), it is key to fully understand the country's BoP to achieve holistic building regulations that apply to every citizen. These include environmentally sustainable standards for low-income housing that are attainable by the majority of the population without compromising the costs and living quality of the final users.

Although building regulations and policies nest the opportunities and constraints for the development

of the urban market, support for circularity in the affordable housing segment needs to be embraced by other stakeholders too. Social enterprises focused on producing circular building materials require different types of support to achieve their main goal. These producers, who stand in the scope of creating frugal innovations, are focused on designing cost-effective, easy-to-use and efficient materials. Following Leliveld (2021) and referring to literature, their goal is to enhance functionality while maintaining user value, making products attainable for the low-income market. The issue within this business model is how profit can marry social goals and make these social enterprises profitable to scale up at a rate where these innovations are available and of easy access to the BoP market in Kenya. From the interviews and questionnaires, it could be observed that some of the main challenges suppliers of circular products had were economic constraints to scale up through financial institutions and low profit margins. Consequently, these enterprises are unable to satisfy the BoP demand; thus, the circularity movement in the built environment is a constraint to small projects and orders. Subsequently, the distribution chain of the products is very limited, and their accessibility in the market becomes a challenge. Keeping in mind the fact that the built environment is a capital-intensive industry, scaling up to penetrate the market is the only alternative to be able to make a shift from conventional materials to circular building materials and methods. The only way these ventures can become solid enterprises where profit marries social goals is to achieve economies of scale. Its only through this means these ventures will be able to provide environmentally sustainable materials at an affordable price. Price sensitivity is a denominator when it comes to the selection of products in the country. Therefore, social enterprises handling frugal innovations need to be highly supported until they can function independently. NGOs could help support these enterprises in various ways. First, creating awareness about the necessity of circular materials and building processes in the construction sector is required to distribute and operationalise the innovations for them to be accepted by society. If consumers are aware of the importance of making a change concerning materials and see a sense of purpose across cultures, it will encourage people to make a change. This involves architects, contractors, investors and end-users. Second, by providing a good network of distributors willing to sell these innovations around the country, accessibility and acceptance of the product can happen. Third, a network of investors and enterprises who have like-minded ideas and are willing to create partnerships to help each other and make the business grow. Fourth, provide alternatives to these ventures on how to derisk their business model to become a solid enterprise. Fifth, provide opportunities for stakeholders to showcase and exhibit their products. This will create awareness, community inclusion and participation in what is happening in the built environment and opportunities to sell the product more easily. Sixth and most importantly, funding. Given Kenya's financial institutions are an obstacle for social enterprises to grow due to the high-interest rates, funding is needed as a mechanism of support for SMEs to grow in the market. Following these support methods, the adoption and adaptation of circularity can be achieved in this context.

The diversity of supply offer is essential for circularity to strive through the market. As seen in the case study, the lack of diversity constrains the possibilities of implementing circularity in projects. Like in any other industry, consumers need a catalogue of possibilities to choose from. Since circularity is such a new topic in the industry, materials research must be done for new alternatives to come through the market. In that sense, support from NGOs can be provided through incubators that provide funding for ideas to not stay at the first stage and become future suppliers in the industry. This initiative will support the creation and elaboration of new materials. Consequently, community inclusion and participation will strive for circular frugal innovations in the built environment.

6.2 STRATEGIES EVOKING CHANGE TOWARDS CIRCULARITY

How can NGOs evoke change through strategies to create acceptance and adaptation of circular materials in the supply local market?

There are several barriers to market entry that need to be tackled to create a shift from conventional materials to circular building practices in Kenya. As seen in the case study and referring to the literature, social entrepreneurship has to confront value-based, socio-economic and institutional barriers (Naderi., et al. 2020). All of these have been confirmed throughout the case study. As facilitators, NGOs play an important role in the development process by providing support services to potential entrepreneurs. For this support to be fruitful, a set of strategies need to be implemented to create acceptance and adaptation of circular materials in the country.

The diffusion of innovations becomes a key strategy for market entry. One of its main challenges is knowing how to accelerate the dissemination rate of a new product, given it implies social change. Referring to literature, Rogers (2003) states social change occurs when new ideas are developed, disseminated, and adopted. These types of changes can be seen in the change in government regulations or the implementation of new technologies in the market. In Kenya's case, it can be observed that frugal innovations are starting to be adopted by the market. Following the interviews, the demand from early adopters has been high, and social entrepreneurs are finding it difficult to meet it. Circular materials and construction processes are still not widely accepted, and strategies for disseminating these innovations are needed to close the gap between early adopters and the mainstream. These strategies need to be tackled through a good communication strategy to create awareness and change of behaviour. For this to come into effect, community inclusion and participation are targeted. Therefore, good strategies need to be well-formulated in order to achieve success. The following strategies could be followed from the NGOs position as enablers to help circularity propagate in Kenya's culture.

As a communication strategy, the diffusion of innovations needs to be targeted in different ways. Rogers (2003) states that most individuals assess an innovation based on subjective evaluations of peers who have adopted the innovation. These peers are seen as role models to whom individuals imitate their innovative behaviour. This system is known as a communication channel. This interpersonal communication network drives the diffusion process by creating a mass of adopters within a community. Opinion leaders need to be targeted as a strategy to propagate the message. These role models have the power to informally influence other individuals and create a behaviour change. Opinion leaders are critical when properly disseminating an innovation, as most ideas are exchanged between people with similar beliefs, education, or social status. The number of adopters grows rapidly after leaders accept and start telling others about an innovation. In Kenya, different types of leaders have the power to trickle down this information. Educational leaders include teachers in schools, universities and upskilling institutions, religious leaders, and community leaders. All these people have the power of influence, given they are socially accessible to the community. Their social participation is important for messages to have access effectively. Given a house is a lifetime endeavour and a significant investment for most families, taking a chance on innovative materials is not easy. As a result, individuals need to see a product they can relate to, starting with role models. That way, they can communicate the message about the materials without hesitation. In Kenya, as seen in the case study, the lack of trust in new materials is very high, and the knock test is very important for people to be assured of the quality of a product. Therefore, institutional ensembles where these leaders congregate their followers, students, and community should be the first type of buildings built with circular materials. These places become easy to access to prove the quality of a product and a way to validate the words of the leaders talking about it. Churches, schools, and community centres are buildings where NGOs can help to build for the community. Consequently, a permanent exhibition and showcasing of the circular materials and building practices are enhanced,

and the whole community can embrace them. After being built, leaders could continue the movement with their own houses to back up the message being transmitted. As an opportunity for strengthening community participation and inclusion, the community can help build the institutional ensembles. This will upskill on-site masons with new building techniques, it will provide jobs, and people can easily see how these new materials work. Those community experiences will decide whether to adopt or not an innovation. The power of role models to whom a community can relate and the communication of their experiences is a high determinant of it. Therefore, to reinforce the message, NGOs can gather these leaders to provide awareness and education about the importance of circular materials. If a sense of purpose is continuously transmitted through the years, then it will become a cultural norm, and it is that cultural norm that will make people change towards circularity.

Interpersonal communication is a very effective communication channel, but its reach can be limited to a singular community. Hence, other types of communication need to be targeted to expand the knowledge and reinforce the information community leaders are expressing. Mass media has a strong effect and a powerful influence on behavioural change. It targets different community segments, providing a visual aid and creating the opportunity to inform individuals about circularity. TV and social media are very powerful in Kenya; thus, broadcasting and providing information through social platforms become an ideal strategy to inform the country about these new building practices. As seen in the case study, certain organisations are already recurring to these features to speed up the creation of awareness about circularity. As NGOs, it is key to keep supporting these organisations on these types of initiatives and to incentivise other organisations to start doing so as well. Social media has a great advantage; it allows individuals to participate, ask questions and get informed. Opening those channels for people to ask questions and be heard increases the chances of an idea being accepted and adopted in the country. It's important to remember that changes that align across scales are more likely to last. If it doesn't coordinate across scales, it may revert to past patterns over time.

The shift to circularity in the built environment cannot only be focused on social enterprises creating innovations for the market. It is important to acknowledge that the built environment is a massive industry composed of stakeholders with solid corporations providing materials and employment to the country. These companies must also be incentivised to make a change, given that the future of circularity on a national level depends not only on SMEs but also on large businesses. As seeds are planted and the demand for circular materials starts growing, there is a chance for these corporations to start seeking alternatives for innovation. Still, based on the case study and the corruption scenario in Kenya regarding material interests, NGOs can play an important role in addressing this issue. NGOs can create workshops and programs that create awareness among these companies about the importance of circular materials. They can help enable transitional possibilities for companies to make a shift towards circular materials. Most importantly, they can influence the government to increase the pressure on these large companies through policies if they resist change. These types of alternatives could start making a shift at a faster speed, providing enough supply to the whole community and satisfying the demand, hence, creating an impact on a larger scale. Only if the whole country aligns towards the same mission of shifting to circularity will the means to the end be attained.

6.3 CREATING ECONOMIC AND SOCIAL VALUE THROUGH CIRCULARITY

How supporting local stakeholders in the use of circular materials and methods create economic and social value, preventing precarization of affordable housing?

To create economic and social value through circularity, it is important to understand what types of social enterprises are working towards the same goal in order to have a clear strategy for addressing circularity. Following Zahra et al. (2009) in the literature, there are three different types of social enterprises: social bricoleurs, social constructionists and social engineers. The social bricoleurs, characterised by addressing small-scale needs through locally available resources, produce circular materials in Kenya. Even though these organisations are small, they are managing to mitigate serious local difficulties, such as depletion of natural resources and reduction of CO2 emissions. They are also striving to provide adequate housing to low-income communities through cost-effective frugal innovations. Still, they have the potential to scale up and fill an unmet need nation wise.

Social constructionists are characterised by their skills in building, launching and operating firms that meet social needs that are not addressed by NGOs or government agencies (Zahra et al. 2009). These companies in Kenya can be identified as technical upskilling institutions. Technical upskilling institutions train masons on building practices or provide knowledge to individuals on how to confront the complexities of building a house independently. Incremental housing is a fact and a reality in Kenya. Consequently, these companies are filling the gap through practical education to satisfy a need that will not be met through any other entity. The knowledge these entities provide becomes the principal source of education in the housing system for certain individuals. These entities' power over a community can be crucial to generating change.

Finally, social engineers are characterised by revolutionising societal systems and providing new solutions to unmet problems. They are the driving forces behind innovation and change (Zahra et al. 2009). NGOs, in this case, are the social engineers in Kenya. They are the ones who can support smaller social enterprises achieve their targets. They can accumulate sufficient political capital to gather required resources and are seen as charismatic leaders who benefit by attracting public attention and rallying support for their aims. As it can be observed, all three types of social enterprises work in different manners to achieve societal goals. Therefore, it is important to look at each of them in detail.

Referring to literature, it could be stated that social bricoleurs have an undifferentiated business model. Perhaps, it could be considered that these companies could strive to have some differentiation by offering circular products following Chesbrough (2007) business model types. But their aim is to achieve a mainstream market that will buy their product based on price and availability. These companies create economic value through the co-creation and inclusive innovation of ecosystems that help producers of raw materials and distributers (Howell, et al. 2017). Following the interviews, they provide a more inclusive value chain by providing education, training, and knowledge. They create employment for disadvantaged groups of people, which in the construction sector, following Loosemore (2015), can provide a series of networks that expand to other sectors of the economy. They also create social value by providing cost-effective products that will improve the quality of living for the customers while being environmentally sustainable. Although their value chain needs to be reinforced, as seen in the case study, to have a stronger distribution process, it is one of the aims they target to achieve as they scale up their ventures.

Social constructionists are characterised by implementing innovative process-integrated business models. Following Chesbrough (2007), they provide opportunities for suppliers and customers to access the firm's innovation processes. These companies create economic value through the co-creation and inclusive innovation ecosystems that help producers of circular materials and distributors in Kenya position themselves in the market. As technical up-

skilling institutions, they create social value through the creation of awareness, education, and job opportunities. They are the ones who train the masons and the local community on how to build their own houses. They provide, through different methods such as phone applications or technical schools, a number of possibilities to learn about materials and building practices. To construct appropriate homes across the country, social constructionists can benefit from the support of NGOs by strengthening their networks, diversifying the materials they supply and learning new building methods.

Lastly, the social engineers create a market for a product, which requires the creation of an "interactive" business model that works with and within an ecosystem (Howell. et al. 2017). Following Howell et al. (2017), these organisations have the potential to develop ecosystems by reaching out to rural and low-income areas where they may have a better grasp of the issue. As a result, NGOs can help create an ecosystem development for social bricoleurs and social engineers where the demand for circular materials becomes active. Their access to remote areas of Kenya and the communities becomes a fundamental link to strive for circular building practices. As social engineers and by supporting the social enterprises mentioned before, they create a market where social and economic values are enhanced. Likewise, they prevent the precarization of housing by providing opportunities to low-income households with adequate housing with cost-effective materials. Their influence in the demand and supply market makes them the key players who revolutionise and strive for change.

6.4 NGOs SUPPORT TOWARDS LOCAL STAKEHOLDERS IN KENYA

This section attempts to respond to the main research question using a roadmap to circularity, following the preceding sub-chapters that addressed the research's sub-questions. As a result of this research, a guideline was created that focuses on the role of NGOs and how they can support local stakeholders. The main research question is provided to understand where this guideline stands in the context of this research.

How can NGOs support local stakeholders in Kenya to shift the production of affordable housing by the use of circular materials and methods?

The aim is to provide guidance to NGOs on how to take a step towards circularity and advocate in a way that has an impact. This guideline allows NGOs to understand how they may assist local stakeholders in transitioning to circularity in the built environment.

Following the different kinds of support and strategies NGOs can create in the built environment, Figure 18 defines how these key points align to evoke change. Circularity is a means to an end, which translates to building with environmentally sustainable materials and mitigating the depletion of natural resources on the planet. To achieve this, it is also important to understand that circularity works within the market through demand and supply. Circular materials and building methods are a product and services offered to the market. To stay in the market, they need to be demanded by the local community. Therefore, an ecosystem of development needs to be established for a demand to be created. To form this ecosystem, as it can be seen in Figure 18, NGOs need to persuade the government to **develop building regulations** that are updated to the new innovations. This will allow circular materials and construction processes to be included in the building code. Likewise, it is necessary to **create awareness** among communities and stakeholders on the importance of changing sustainable building practices. For stakeholders such as archi-

Guideline for NGOs to Help Local Stakeholders Shift to Circularity

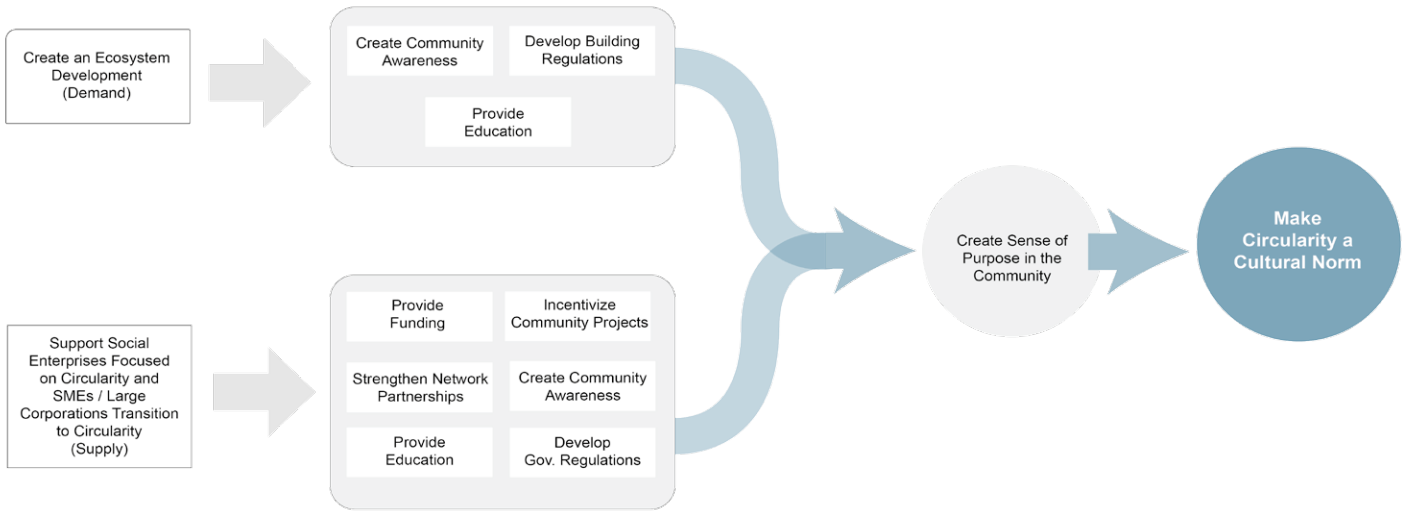


Figure 18. Guideline for NGOs to Help Local Stakeholders Shift to Circularity.

tects, masons and construction businesses, raising awareness is critical so they can begin looking for alternative materials on the market. Changes in specifications during the design and building process are the first steps to evoking change. Finally, **education** must be prioritised to produce knowledgeable professionals eager to embrace change when they start their professional working life. Therefore, educational institutions and upskilling organisations need to provide sufficient knowledge to their students about circularity to make this initiative a movement.

Parallel to creating the demand, the supply needs to be generated. The supply can convince the demand side that there are new and better possibilities to approach the built environment. To create a supply, different actions need to be taken. First, **creation of awareness** to suppliers about circularity. Second, **education** for social enterprises on how to de-risk their business models to provide economic value as well as social value to the community. Likewise, education for SMEs and large corporations on how to transition from their current offer of materials to circular ones. Third, monetary **funding** to social enterprises to help them expand their businesses and scale-up, achieving economies of scale. Also, promote incubators and support new ventures so the market can provide a variety of products. Fourth, provide a **strong set of networks** so these companies can create partnerships with investors and other stakeholders to enable their businesses to grow and their products to gain wider market access. Fifth, **incentivise community-focused projects** that can be constructed by these social enterprises, allowing them to showcase circular products and building practices while also establishing trust among the communities directly involved. Sixth, **influence the government** to put pressure on firms who are reluctant to change, enacting restrictive laws to limit and regulate the use of conventional materials.

Consequently, a sense of purpose within the country is created by establishing demand and supply. Thinking circular and acting toward it becomes the mission of the community, and it starts becoming a habit. As a result, this habit becomes a cultural norm, given every individual perceives circularity as a responsibility to fulfil. They also understand the value it generates to the ecosystem, and it establishes how they visualise the way the built environment should be addressed.

7 CONCLUSION

The exponential growth and expansion of urban areas worldwide have contributed to the depletion of natural resources and the development of the built environment in an unsustainable manner. Circularity in the built environment is imperative to mitigate the use of natural resources and create an environmentally sustainable ecosystem in the construction industry. Around half of all materials consumed globally are used by the built environment; hence, a shift in the usage of natural resources needs to be made. Kenya is the third fastest growing country in sub-Saharan Africa (UN-Habitat. 2010), and by 2050, 48% of its population will live in urban areas (Hendriks. 2014). There is a housing shortage of 2 million units, equivalent to 80% of the deficit in demand. From this demand, most of it is composed of low and lower-middle-income people. Of the current population, 61% live in informal settlements where slums are home to an estimated 10 million Kenyans across the country (CAHD. 2021). NGOs play an important role in the built environment, given they are enablers who have an active role through public and private stakeholders. As facilitators, they can reach rural and low-income areas and know the pains of vulnerable communities in-depth. Likewise, their strong influence on the government and private companies makes them key players in addressing change. Consequently, this research focused on *how can NGOs support local stakeholders in Kenya to shift the production of affordable housing by the use of circular materials and methods?*

Through a single case study and qualitative data collection, this research targeted three key points to resolve the research question. 1. Processes of support for circularity to be enhanced through simple-built houses while being efficient and cost-effective. 2. Strategies to evoke change and create acceptance and adaptation of circular materials in the local supply market. 3. Creation of economic and social value through circularity in the affordable housing market. To embrace circularity and as a method of support, an ecosystem of development needs to be established. In synthesis, there are five ways NGOs who are focused on the built environment can provide support in the construction industry:

First, influencing the government to update building codes and regulations to enable circular materials and methods to be used by the built environment. These regulations provide opportunities for the country to seek environmentally sustainable materials. Second, in a country where social norms are so strong, creating awareness among all stakeholders is fundamental to generating an understanding of what circularity entails. Third, education about circularity needs to be provided in diverse institutions for young professionals to be eager to implement these innovations in the future. Education can also be provided to SMEs supplying circular products and urge knowledge concerning how to de-risk their business models to become solid enterprises. Fourth, networks and partnerships are key to helping social enterprises push forward their circular ventures in the market. NGOs have a strong network of stakeholders who can connect these enterprises, opening opportunities for investment and partnerships. Fifth, NGOs can support local stakeholders through funding. Social enterprises struggle to scale up due to economic challenges. Funding becomes an essential method of support to help these companies grow and achieve economies of scale. It can also help incubators to push new ideas and provide a diversity of supply in the market.

A good communication strategy must be executed to create acceptance and adaptation of circular materials. This entails three main targets for it to be achieved. First, create awareness about circularity through community participation and inclusion, for example, through the use of role models. Therefore, if opinion leaders are willing to advocate circularity, chances are higher the message will ripple through the target community. Second, provide exhibitions and showcases through institutional buildings. If buildings, where people are congregated are built with circular materials and are constructed with people from the community, trust will be enhanced. This will demystify cultural beliefs about these materials and will start changing people's perspectives about these innovations. Third, the use of mass media, such as TV and social media, among others, is fundamental to diversifying the message through different communities. This becomes a visual aid and an opportunity to inform individuals about circularity.

Additionally, influence the government regulations that constrain the use of conventional materials. It is key to remember that there are currently SMEs and large corporations that supply conventional building materials. These companies need to transition to make a shift towards circularity, given they are important actors in the built environment. A process of inclusion needs to be made with them to achieve a holistic impact in the country.

Finally, social enterprises need to be strongly supported to create economic and social value through circularity. Social enterprises are not solely focused on profit; their social mission ensures establishing cost-effective prices in the market for low-income people. They provide a more inclusive value chain through education, training, and knowledge. As a social value, they guarantee environmentally sustainable and adequate housing to customers. Therefore, if these companies scale up and achieve economies of scale, the change towards circularity becomes accessible in affordable housing.

If the depletion of natural resources is not mitigated and circularity is not enhanced, mid-term scarcity of resources will become a global problem in the future. Circularity is a means to an end, and Kenya is starting to push forward circularity in the country. The movement can accelerate exponentially if the right support is provided to all stakeholders and there is a will for change. Last but not least, more research and innovation need to be done on the subject to obtain a holistic view of the circular built environment in Kenya.

8 RECOMMENDATIONS

This chapter presents a series of recommendations for further research and practice in Kenya's built environment. The distinction between both chapters is made to depict a series of topics that could be researched in the future based on observations and discoveries made while performing the present case study; and recommendations of actions that could be set into practice in the local context of Kenya. These could help profound the knowledge about circularity in the country's built environment and enhance better practices for its implementation.

8.1 RECOMMENDATIONS FOR FURTHER RESEARCH

For further research in the domain of circularity, developing countries, frugal innovations, and the built environment, there are several topics that could be investigated and considered in the future. As stated in this research, one of the greatest limitations is the significant bias concerning circular economy literature, given that 95% of the research papers are focused on developed countries. As a result, much of its theory may be irrelevant for developing countries due to differences in governmental frameworks, financial availability and access, professional expertise and training, and infrastructure (Kirchherr., Santen. 2019). Circularity is starting to be enhanced by developing countries. Still, there is a pressing need for further research to be done in a context where these countries can relate, learn and practice the knowledge provided.

In the built environment, frugal innovation is constantly happening. Still, research directed within that scope is limited. Developing countries are constantly seeking innovative materials for the base of the pyramid that are cost-effective and inclusive. Further research into frugal innovations and circular materials, which are critical for the growth of countries in the Global South, needs to be done. The information offered is limited, and it is critical for developing countries to understand the subject better to advance circularity in the built environment. This will benefit new businesses, organisations advocating for circularity, and the government in updating built-environment policies and regulations.

Finally, in the built environment, social enterprises are starting to grow. Unfortunately, information is limited in a capital-intensive industry. The tendency to create social value is growing, especially when countries are confronted with the UN Sustainability Goals and the pressing global need to improve the quality of life of vulnerable communities. Further research on the following subjects would be recommended. 1. Social enterprises in the built environment, 2. strategies on how to scale up in the market, achieving economies of scale without losing track of the social value being created. 3. Social enterprises achieving circularity in the built environment in the Global South. Those would be topics that would be valuable for many social enterprises and countries that are striving to make a change in the built environment.

8.2 RECOMMENDATIONS FOR BUILDING PRACTICE IN KENYA

For recommendations in building practices in Kenya, such as using materials and building methods, it would be good to keep in mind the following advice. Price sensitivity is important to address when offering new materials to the society. It can become the biggest challenge for people to create acceptance and adapt to innovations, especially in a culture that believes environmentally sustainable materials and innovations are more expensive than conventional materials. In Kenya, circular materials such as interlocked stabilised soil blocks are cheaper than stone, the material that is commonly used in Nairobi and its surroundings. But the machines that make these blocks imply a lump sum investment that can be difficult to handle for certain actors. If seen as a projection of the future, the machine can serve a whole community. It can provide the possibility to build numerous houses at a very low cost, providing opportunities to have adequate housing for vulnerable communities. The same story repeats itself with other materials. Unit price, the material might be slightly more expensive than conventional stone blocks. But if a comparison is made between conventional and circular materials by m2, circular materials offer a more cost-effective product. In some cases, it can even be cheaper than conventional products, given their design doesn't require additional materials in construction. As a recommendation, a good marketing strategy is necessary, where good communication about the subject is directed to the clients. This implies creating a clear understanding to clients about the benefits of innovations in the long run and their advantages pricewise to conventional materials. It is key to have a transparent marketing scheme, where prices being talked about are about the segment of the house that will be built and not the entire house. Wrong communications can create a false idea of the full house price and not what is being sold. Consequently, it can generate a lack of trust and an obstacle for people to use a circular material instead of a conventional one.

Concerning circular materials, responsibility needs to be upheld by different stakeholders when a product comes to the end of its cycle. It is important to know how these materials will be collected, upcycled, and recycled to stay inside the circular loop. An alternative can be created within the business models of the producers of circular materials, where the collection of materials is proposed to reuse. It is critical to provide solutions in the built environment for these innovations after they have outlived their usefulness and to know how to proceed with them, or else circular innovations will continue to work in a linear manner, never closing the loop of circularity.

REFLECTION

"The measure of intelligence is the ability to change."

Albert Einstein

Circularity in the built environment is a topic I am fully interested in, given that it is an alternative solution to unsustainable building practices. The exploitation of natural resources and CO_2 emissions have become a global problem that needs to be urgently addressed. On the other hand, housing for vulnerable communities in developing countries has been a topic I've been attracted to since I can remember. Coming from a developing country and understanding the housing needs of vulnerable people and the construction practices of the vast majority of the Global South's population, finding sustainable and environmentally friendly housing opportunities becomes critical. In this sense, both topics have made me wonder how vulnerable communities can access adequate and affordable housing while employing environmentally friendly materials. A great number of the world's population is at the base of the pyramid, and if change doesn't happen with them, possibly a sustainable built environment in the planet will not be obtained. Therefore, I selected these two topics to work on, thinking of solutions to embrace change and provide alternatives to those who need shelter and have a limited income capacity.

This topic relates to my Master's track, Management in the Built Environment, and my Master's programme Architecture, Urbanism and Building Sciences, given it is related to housing and design construction management. The research focuses on shifting business models in the built environment to provide alternative materials to conventional ones and more up-to-date building methods. Consequently, housing in vulnerable urban areas should be affordable while being constructed sustainably in the future.

The built environment is complex, and many variables have to be taken into account to provide a holistic approach to the problem. This thesis has been an iterative process where findings and new learnings happen every day. Understanding circularity, the role of stakeholders, frugal innovations, social entrepreneurship, diffusion of innovations, housing policies, the build environment context in the Global South for affordable housing, and Kenya (a completely new country to me) have been all learning topics throughout the process. These have provided me with new perspectives and mindsets to approach my research. From these topics, I've learned that both the supply and demand sides must adjust their behaviour to implement circularity. We will only see change by implementing new strategies focusing on innovations, regulations, policies, affordability, accessibility, efficiency, effectiveness in materials, and building methods.

The theoretical background laid the groundwork for the rest of the study. During the beginning phase of this research, an exhaustive literature review was conducted. The literature review resulted in a greater understanding of how to approach circularity in the built environment in the affordable housing segment, as well as the various processes that must be considered to approach circularity holistically within the built environment. This provided a solid foundation for developing a research design that was focused on the research questions and the desired outcome.

Data collection was an ongoing learning process in many aspects. Creating a survey was not as easy as expected, given the questions must work for every stakeholder, no matter their specific focus. At the same time, questions must be easy to understand but intelligently formulated to gain as much information as possible. This process took me quite a while to master, yet after sending the questionnaire to different people, I saw many areas where it could have been improved. Word choice is key to mastering the questions, and in my case, I wasn't as specific as I should have emphasised circularity in every question. Therefore, as an improvement, being specific about the topic can provide better outcomes. On the other hand, the interviewing process was insightful and yet challenging. Due to time limits for interviews in some circumstances, as well as the hectic schedules of stakeholders to be questioned, I learned that interview questions should be broken into three portions: 1. information I need to have,

2. information that is good to have and 3. information that is nice to have. Interviews need to be conducted strategically, and the risk of not collecting the most important data is always there because of time constraints. Therefore, a good organisation within the interview protocols is always key to gathering all the required information.

The interview stage of the thesis was planned to be made in a blended mode. Data would be collected virtually in The Netherlands, and a short trip to Kenya was planned to gather the rest of the data that couldn't be collected virtually. After travelling to Kenya, meeting with stakeholders, visiting companies and understanding the country's reality, I strongly believe the time I stayed in Kenya was not enough. The difference in reaction of people while meeting you virtually and personally is huge. While in Nairobi, people wanted to connect me with stakeholders I didn't know of or Habitat for Humanity, working on circularity and affordable housing. Also, casual conversations sometimes ended up bringing new ideas, new people I could be connected to and insight that possibly would have never happened during the interviews. The experience of understanding how the country works, also helps for the questions to flow in the interviews, creating deeper conversations with the interviewees. As a lesson learned, it is important to have a plan before travelling and meeting people to create a network before the trip. But data collection becomes way more efficient and substantial while being in the country the research is being focused. Time limitations might pay a price while collecting data up to a certain extent.

The learning process of data analysis and creation of results was possibly one of the most exhausting parts of the thesis, given the time constraints and the amount of data that was gathered. Even though there are tools for transcriptions to be done, the time invested in correcting transcripts to analyse data was overwhelming. From having the transcript done for data analysis and final results, the time left was too short, and the information to be processed was extensive. Therefore, it became a constant battle with time to finish the research as it was intended. Yet, it was fascinating to be able to connect topics and problems and start understanding the challenges and possible solutions that can help the country strive for change.

Reflecting on the process that has come along with this research, I can truly say that it has been an insightful journey. It has been a journey that has taken me out of my comfort zone to constantly teach me new ways of thinking, diverse possibilities to approach a problem, multiple paths to solve the problem and the opportunity to learn and embrace a new country and culture.

This thesis topic has been challenging, and without the help of my mentors and the Habitat for Humanity team, overcoming every challenge in the process wouldn't have been possible. They all have provided knowledge, sources, contacts, and conversations that have guided me to continue my research. I believe my progress has been good, and my work consistency has helped me accomplish all the scheduled tasks. The takeaway of this process is to repeatedly ask myself if the information I am gathering will help me answer my research questions. It is always essential to keep that in mind, so I don't lose track and go off the path. Also, understand that it is good to have a plan, but always allow yourself some extra time for unexpected events that might provide insight and information that were not expected to happen. Lastly, keep on working consistently to achieve the goals and outputs set to finish the thesis successfully.

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APPENDIX

APPENDIX A: DEFINITIONS

Affordable Housing: "Affordable housing is housing that is appropriate for the needs of a range of very low to moderate income households and priced so that these households are also able to meet other basic living costs such as food, clothing, transport, medical care and education"(NSW Government. 2019).

Base of the Pyramid (BoP): "A term in economics that refers to the poorest two-thirds of the economic human pyramid, a group of more than four billion people living in abject poverty"(Britannica. n.d.).

Circular Economy: The circular economy is a production and consumption model that encourages people to share, lease, reuse, repair, refurbish, and recycle existing materials and products for as long as it is possible. The product's life cycle can be extended in this way and eliminate waste to the absolute minimum. When a product reaches the end of its useful life, its materials are reused as much as possible. These can be put to good use over and over again, resulting in increased value (European Parliament. 2021).

Direct Subsidies: is a payment made by the government to a third party for which no goods or services are exchanged. As a result, money is paid, but the government gets nothing in return (Boyce, P. 2020).

Effective Demand: The willingness and ability of consumers to acquire things at various prices is referred to as effective demand. It demonstrates the quantity of items purchased by consumers, as determined by their ability to pay (Pettinger, T. 2018).

Indirect Subsidies: are those that do not have a set monetary value or require actual financial expenditures. They can include government-supported actions such as price reductions for necessary goods or services. This enables the required items to be purchased at a lower price than the current market rate, resulting in cost savings for individuals who benefit from the subsidy (Investopedia, 2021).

ISSB (interlocking stabilized soil blocks): are mixed-soil bricks that can be obtained on or off the construction site. To increase its properties, the soil is generally blended with cement, water, and other additions. An ISSB machine compresses the dirt, and the blocks are set in a staggered arrangement with mortar, similar to other types of brickwork (Engineering for Change. 2021).

NGO: "A non-governmental organization (NGO) is a non-profit group that functions independently of any government. NGOs, sometimes called civil societies, are organized on community, national and international levels to serve a social or political goal such as humanitarian causes or the environment." (Folger, J. 2021)

Social Value: "is the quantification of the relative importance that people place on the changes they experience in their lives. Some, but not all of this value is captured in market prices. It is important to consider and measure this social value from the perspective of those affected by an organisation's work." (Social Value UK. 2021).

APPENDIX B:
QUESTIONNAIRE TEMPLATE

Development of Affordable Housing through Circularity in Kenya

My name is Natalia Téllez, I'm a research intern at Habitat for Humanity, working in the Terwillinger Center for Innovation in Shelter. Currently I am working on my MSc graduation thesis at TU Delft entitled "Housing is Dynamic, Not Static: Shifting the Development of Affordable Housing with Circular Materials and Methods in Kenya". To get into context, circularity is defined as strategies and innovations that are being developed to stimulate the re-use of materials. The whole idea is to enable the production of "new" materials in a sustainable manner. As part of it, I focus on answering the research question: "How can NGOs support local stakeholders in Kenya to shift the development of affordable housing by the use of circular materials and methods?". In order to do so, I am researching about the changes, opportunities, and challenges different organisations are facing at present times to achieve environmentally sustainable practices in the build environment. If the implementation of sustainable materials and building methods become adopted by all stakeholders, CO2 emissions will be reduced, and the depletion of natural resources will be controlled. This research project is aimed to create a theoretical framework where insight can be provided into to NGOs so they will have the tools on how to support local stakeholders to implement and scale circularity in affordable housing.

All the information shared in this questionnaire will remain anonymous and will only be used for the sole purpose of this research. The following process will last approximately 15 minutes.

1.

What type of organisation do you work in? *

- Non-Governmental Organisation (NGO). (E.g. Habitat for Humanity)
- Private Sector Firm (E.g. Gjenge Makers)
- Educational Institution (E.g. The Tool Kit iSkills)
- Architecture Firm and Building Company (E.g. Build X Studio)
- Government Institution (E.g. Architectural Association of Kenya)
- Other

2.

Please describe your role in your organisation *

- Specialist
- Manager
- Executive
- Technician
- Consultor
- Other

3.

How involved is the role of your organisation concerning environmental sustainability in the build environment? Scale 0-5. 0 being none and 5 being fully involved. *

Value

4.

What practices that facilitate environmental sustainability does your organisation carry out? *

5.

Is your organisation involving community participation for developing and implementing innovative ideas for sustainable materials and methods? Community participation is related to the approach of community members in the neighbourhood or city to hear their ideas and demands. If your answer is yes could you explain how? If the answer is no, could you explain why? *

6.

Do you think there is a way your organisation could incentivise the use of sustainable building methods and materials in local stakeholders? Local Stakeholders are for example: end users, building companies, investors, and developers. If your answer is yes could you explain how? If the answer is no, could you explain why? *

7.

What are 1-3 main challenges to incorporating environmentally sustainable building practices in your organisation's work? *

1

2

3

8.

What are 1-3 main challenges to incorporating environmentally sustainable building practices in the local and national context? *

1

2

3

9.

How could your organisation help transform the perspective of stakeholders in the built environment to stimulate a shift towards sustainable practices? *

10.

Are there any accomplishments related to environmentally sustainable projects in your organisation? If yes, could you explain and provide examples. *

11.

Do you see opportunities in your organisation to stimulate environmental sustainable building practices? If your answer is yes could you explain how? If the answer is no, could you explain why? *

12.

Do you see opportunities outside your organisation that could stimulate sustainable building practices? If your answer is yes, could you explain them. *

APPENDIX C: INTERVIEWS PROTOCOLS TEMPLATE

Interview Protocol Government Organisations

Interviewer: Natalia Tellez
Title: Housing is Dynamic, Not Static: Shifting the Development of Affordable Housing with Circular Materials and Methods in Kenya
Interviewee: (NAME)
Organisation: (NAME)
Role: (NAME)

I. Introduction

Good morning/afternoon! Thank you again for giving me your time and allowing me to interview you today.

My name is Natalia Téllez, I'm a research intern at Habitat for Humanity, working in the Terwillinger Center for Innovation in Shelter. Currently I am working on my MSc graduation thesis at TU Delft entitled "Housing is Dynamic, Not Static: Shifting the Development of Affordable Housing with Circular Materials and Methods in Kenya". To get into context, circularity is defined as strategies and innovations that are being developed to stimulate the re-use of materials. The whole idea is to enable the production of "new" materials in a sustainable manner. As part of it, I focus on answering the research question: "*How can NGOs support local stakeholders in Kenya to shift the development of affordable housing by the use of circular materials and methods?*". In order to do so, I am researching about the changes, opportunities, and challenges different organisations are facing at present times to achieve environmentally sustainable practices in the build environment. If the implementation of sustainable materials and building methods become adopted by all stakeholders, CO2 emissions will be reduced, and the depletion of natural resources will be controlled. This research project is aimed to create a theoretical framework where insight can be provided into to NGOs so they will have the tools on how to support local stakeholders to implement and scale circularity in affordable housing.

This interview is structured around 5 themes.

- Background
- Present situation
- Challenges
- Opportunities
- Impact

All the information shared during this interview will remain anonymous and will only be used for the sole purpose of this research. Your informed consent has been collected as a proof that you have agreed to participate in the interview.

The following process will last approximately 40 to 60 minutes. As we go through the questions, feel free to stop me at any time, if you would like any clarifications or feel the need to take a break.

I would like to ask for your permission to record the interview. The recordings will be properly stored and anonymised with respect to your privacy.

II. Questions

1. Background

a. Could you briefly describe in which organisation you work in and what is your role in it?
b. Up to what extent is your organisation focused on affordable housing in the built environment.
    i. Is your organisation only focused on formal buildings or is the informal housing segment also taken into account?

2. Evaluation of the present situation

a. Does your organisation advocate to provide knowledge about new innovations concerning circular materials and building methods?
b. How does your organisation advocate environmental sustainability in the built environment?
    i. Is there a process of support for the implementation of circular materials and building methods in the built environment?
c. What strategies are implemented by your organisation to create acceptance and adaptation of circular materials?
    i. What is their view in the implementation of sustainable innovations in the built environment?

3. Challenges

What are the main challenges for organisations to implement environmentally sustainable practices?

a. What challenges your organisation has to support different local stakeholders in the use circular materials and methods to create an economic and social value for these new innovations?
b. What challenges your organisation has to create awareness on the benefits of sustainable building technologies to change cultural perception of these innovations?

4. Opportunities

a. What opportunities do you see in the built environment (local stakeholders) to make a shift to circular materials and building methods innovations for them to be adopted?

5. Impact

a. What impact has your organisation made creating a shift towards circular materials and new innovations?
b. What is the adoption and acceptance rate by local stakeholders to sustainable building methods and materials?

III. Conclusion

The previous question marked the end of the planned part of the interview.

In case you would like to add something, feel free to do so. At this point you can ask any question that may have arisen to you throughout the interview.

I will now stop recording.

[stop recording]

As a next step, the recording will be transcribed and analysed. This is being done in to synthesise the interview findings in a systematic way that will form an input for the design framework of my research.

I am sincerely thankful for your time and effort to participate in this interview. Your contribution is a valuable part of my research and can be used to improve the way NGOs are striving to make a shift within local stakeholders to implement circularity. The recording will be handled with all the necessary processes that will safeguard both the academic integrity and your individual rights as an interviewee.

The results of the research can become available to you once the graduation project is completed.

Interview Protocol Organisations Pushing Forward Circularity

Interviewer: Natalia Tellez
Title: Housing is Dynamic, Not Static: Shifting the Development of Affordable Housing with Circular Materials and Methods in Kenya
Interviewee: (NAME)
Organisation: (NAME)
Role: (NAME)

I. Introduction

Good morning/afternoon! Thank you again for giving me your time and allowing me to interview you today.

My name is Natalia Téllez, I'm a research intern at Habitat for Humanity, working in the Terwillinger Center for Innovation in Shelter. Currently I am working on my MSc graduation thesis at TU Delft entitled "Housing is Dynamic, Not Static: Shifting the Development of Affordable Housing with Circular Materials and Methods in Kenya". To get into context, circularity is defined as strategies and innovations that are being developed to stimulate the re-use of materials. The whole idea is to enable the production of "new" materials in a sustainable manner. As part of it, I focus on answering the research question: "*How can NGOs support local stakeholders in Kenya to shift the development of affordable housing by the use of circular materials and methods?*". In order to do so, I am researching about the changes, opportunities, and challenges different organisations are facing at present times to achieve environmentally sustainable practices in the build environment. If the implementation of sustainable materials and building methods become adopted by all stakeholders, CO2 emissions will be reduced, and the depletion of natural resources will be controlled. This research project is aimed to create a theoretical framework where insight can be provided to NGOs so they will have the tools on how to support local stakeholders to implement and scale circularity in affordable housing.

This interview is structured around 6 themes.

- Background
- Present situation
- Challenges
- Opportunities
- Impact

All the information shared during this interview will remain anonymous and will only be used for the sole purpose of this research. Your informed consent has been collected as a proof that you have agreed to participate in the interview.

The following process will last approximately 40 to 60 minutes. As we go through the questions, feel free to stop me at any time, if you would like any clarifications or feel the need to take a break.

I would like to ask for your permission to record the interview. The recordings will be properly stored and anonymised with respect to your privacy.

1. Background
    a. Could you briefly describe in which organisation you work in and what is your role in it?
    b. Up to what extent is your organisation focused on affordable housing in the built environment.
        i. Is your organisation only focused on formal buildings or is the informal housing segment also taken into account?

2. Evaluation of the present situation
    a. How does your organisation advocate environmental sustainability in the built environment in Africa?
    b. What strategies are implemented by your organisation to create acceptance and adaptation of the circular materials in Kenya?

3. Opportunities
    a. What opportunities your organisation provides environmentally and economically in the affordable housing segment?
    b. What opportunities do you see with the local stakeholders to create interest on circular materials and sustainable building methods?
    c. What opportunities do you see to create awareness and knowledge to people on how to build with circular materials to implement and scale this building method?

4. Challenges
    a. What are the main challenges to implement affordable housing in Kenya?
    b. What are the challenges to create acceptance from communities to acquire houses through circular materials and sustainable building methods?
    c. What challenges your organisation has with different local stakeholders to create awareness about the economic and social value that can be created with circular materials and sustainable building methods?
    d. What challenges your organisation has to create a change on cultural perception of traditional building practices and shift to sustainable ones?

5. Impact
    a. What has been the impact of your organisation in generating communities and organisations to create a shift from unsustainable traditional building practices to circular materials and building methods?
    b. What is the adoption and acceptance rate by local stakeholders to sustainable building methods in Kenya?

III. Conclusion

The previous question marked the end of the planned part of the interview.

In case you would like to add something, feel free to do so. At this point you can ask any question that may have arisen to you throughout the interview.

I will now stop recording.

[stop recording]

As a next step, the recording will be transcribed and analysed. This is being done in to synthesise the interview findings in a systematic way that will form an input for the design framework of my research.

I am sincerely thankful for your time and effort to participate in this interview. Your contribution is a valuable part of my research and can be used to improve the way NGOs are striving to make a shift within local stakeholders to implement circularity. The recording will be handled with all the necessary processes that will safeguard both the academic integrity and your individual rights as an interviewee.

The results of the research can become available to you once the graduation project is completed.

Interview Protocol Educational Institutions

Interviewer: Natalia Tellez
Title: Housing is Dynamic, Not Static: Shifting the Development of Affordable Housing with Circular Materials and Methods in Kenya
Interviewee: (NAME)
Organisation: (NAME)
Role: (NAME)

I. Introduction

Good morning/afternoon! Thank you again for giving me your time and allowing me to interview you today.

My name is Natalia Téllez, I'm a research intern at Habitat for Humanity, working in the Terwilliger Center for Innovation in Shelter. Currently I am working on my MSc graduation thesis at TU Delft entitled "Housing is Dynamic, Not Static: Shifting the Development of Affordable Housing with Circular Materials and Methods in Kenya". To get into context, circularity is defined as strategies and innovations that are being developed to stimulate the re-use of materials. The whole idea is to enable the production of "new" materials in a sustainable manner. As part of it, I focus on answering the research question: "*How can NGOs support local stakeholders in Kenya to shift the development of affordable housing by the use of circular materials and methods?*". In order to do so, I am researching about the changes, opportunities, and challenges different organisations are facing at present times to achieve environmentally sustainable practices in the build environment. If the implementation of sustainable materials and building methods become adopted by all stakeholders, CO2 emissions will be reduced, and the depletion of natural resources will be controlled. This research project is aimed to create a theoretical framework where insight can be provided to NGOs so they will have the tools on how to support local stakeholders to implement and scale circularity in affordable housing.

This interview is structured around 5 themes.

- Background
- Present situation
- Challenges
- Opportunities
- Impact

All the information shared during this interview will remain anonymous and will only be used for the sole purpose of this research. Your informed consent has been collected as a proof that you have agreed to participate in the interview.

The following process will last approximately 40 to 60 minutes. As we go through the questions, feel free to stop me at any time, if you would like any clarifications or feel the need to take a break.

I would like to ask for your permission to record the interview. The recordings will be properly stored and anonymised with respect to your privacy.

II. Questions

1. Background

a. Could you briefly describe in which organisation you work in and what is your role in it?
b. Up to what extent is your organisation focused on affordable housing in the built environment.
    i. Is your organisation only focused on formal buildings or is the informal housing segment also taken into account?

2. Evaluation of the present situation

a. Does your organisation advocate to teach about new innovations concerning circular materials and building methods?
b. How does your organisation advocate environmental sustainability in the built environment?
    i. Is there a process of support and teachings for the implementation of circular materials and building methods in the built environment?
c. What strategies are implemented by your organisation to create acceptance and adaptation of circular materials?
    i. What is their view in the implementation of sustainable innovations in the built environment?

3. Challenges

a. What are the main challenges for your organisation to implement environmentally sustainable practices?
b. What challenges your organisation has to support different local stakeholders in the use circular materials and methods to create an economic and social value for these new innovations?
c. What challenges your organisation has to create awareness on the benefits of sustainable building technologies to change cultural perception of these innovations?

4. Opportunities

a. What opportunities do you see in the built environment (local stakeholders) to make a shift to circular materials and building methods innovations for them to be adopted?
b. How can education and community involvement be reached so awareness about the importance of sustainable materials can be disseminated and knowledge on how to use them be materialised?

5. Impact

a. What is the impact your organisation is generating in future architects and organisations to create a shift from traditional building methods and materials to circular materials and new innovations?
b. What is the adoption and acceptance rate by local stakeholders to sustainable building methods and materials?

III. Conclusion

The previous question marked the end of the planned part of the interview.

In case you would like to add something, feel free to do so. At this point you can ask any question that may have arisen to you throughout the interview.

I will now stop recording.

[stop recording]

As a next step, the recording will be transcribed and analysed. This is being done in to synthesise the interview findings in a systematic way that will form an input for the design framework of my research.

I am sincerely thankful for your time and effort to participate in this interview. Your contribution is a valuable part of my research and can be used to improve the way NGOs are striving to make a shift within local stakeholders to implement circularity. The recording will be handled with all the necessary processes that will safeguard both the academic integrity and your individual rights as an interviewee.

The results of the research can become available to you once the graduation project is completed.

Interview Protocol Producers of Circular Products

Interviewer: Natalia Tellez
Title: Housing is Dynamic, Not Static: Shifting the Development of Affordable Housing with Circular Materials and Methods in Kenya
Interviewee: (NAME)
Organisation: (NAME)
Role: (NAME)

I. Introduction

Good morning/afternoon! Thank you again for giving me your time and allowing me to interview you today.

My name is Natalia Téllez, I'm a research intern at Habitat for Humanity, working in the Terwillinger Center for Innovation in Shelter. Currently I am working on my MSc graduation thesis at TU Delft entitled "Housing is Dynamic, Not Static: Shifting the Development of Affordable Housing with Circular Materials and Methods in Kenya". To get into context, circularity is defined as strategies and innovations that are being developed to stimulate the re-use of materials. The whole idea is to enable the production of "new" materials in a sustainable manner. As part of it, I focus on answering the research question: "*How can NGOs support local stakeholders in Kenya to shift the development of affordable housing by the use of circular materials and methods?*". In order to do so, I am researching about the changes, opportunities, and challenges different organisations are facing at present times to achieve environmentally sustainable practices in the build environment. If the implementation of sustainable materials and building methods become adopted by all stakeholders, CO2 emissions will be reduced, and the depletion of natural resources will be controlled. This research project is aimed to create a theoretical framework where insight can be provided to NGOs so they will have the tools on how to support local stakeholders to implement and scale circularity in affordable housing.

This interview is structured around 5 themes.

- Background
- Present situation
- Challenges
- Opportunities
- Impact

All the information shared during this interview will remain anonymous and will only be used for the sole purpose of this research. Your informed consent has been collected as a proof that you have agreed to participate in the interview.

The following process will last approximately 40 to 60 minutes. As we go through the questions, feel free to stop me at any time, if you would like any clarifications or feel the need to take a break.

I would like to ask for your permission to record the interview. The recordings will be properly stored and anonymised with respect to your privacy.

1. Background
    a. Could you briefly describe in which organisation you work in and what is your role in it?
    b. Up to what extent is your organisation focused on affordable housing in the built environment.
        i. Is your organisation only focused on formal buildings or is the informal housing segment also taken into account?

2. Evaluation of the present situation
    a. How does your organisation advocate environmental sustainability in the built environment?
    b. What strategies are implemented by your organisation to create acceptance and adaptation of the circular materials in Kenya?
        i. What is the communities view in the implementation of these building methods in the built environment?

3. Opportunities
    a. What are the opportunities your product and building method provides to the communities environmentally and economically?
    b. What opportunities do you see with the local stakeholders to create interest on your product and building method?
    c. What opportunities of adoption in a bottom-up approach do you see in the community to adopt this building method?
    d. What opportunities of adoption in a top-down approach do you see in the community to adopt this building method?
    e. How can awareness and knowledge be disseminated on how to build with your product and building method in Kenya to implement and scale this building method?

4. Challenges
    a. What are the main challenges for your organisation to implement your product and building method in the built environment?
    b. What are the challenges to create acceptance between the communities of your building method?
    c. What are the challenges to scale up in your organisation so more stakeholders are interested on implementing this building method in their housing?
    d. What challenges your organisation has with different local stakeholders creating economic and social value with the construction material you offer?
    e. What challenges your organisation has to create awareness on the benefits of environmentally sustainable building practices to change cultural perception of unsustainable industrial building practices?

5. Impact
    a. What is the impact your organisation is generating in communities and organisations to create a shift from industrial unsustainable traditional building methods and materials to circular materials and building methods?
    b. What is the adoption and acceptance rate by local stakeholders to your product and building method in Kenya?

III. Conclusion

The previous question marked the end of the planned part of the interview.

In case you would like to add something, feel free to do so. At this point you can ask any question that may have arisen to you throughout the interview.

I will now stop recording.

[stop recording]

As a next step, the recording will be transcribed and analysed. This is being done in to synthesise the interview findings in a systematic way that will form an input for the design framework of my research.

I am sincerely thankful for your time and effort to participate in this interview. Your contribution is a valuable part of my research and can be used to improve the way NGOs are striving to make a shift within local stakeholders to implement circularity. The recording will be handled with all the necessary processes that will safeguard both the academic integrity and your individual rights as an interviewee.

The results of the research can become available to you once the graduation project is completed.

APPENDIX D: QUESTIONNAIRE SANKEY DIAGRAMS RESULTS

ORGANISATIONS ADVOCATING CIRCULARITY

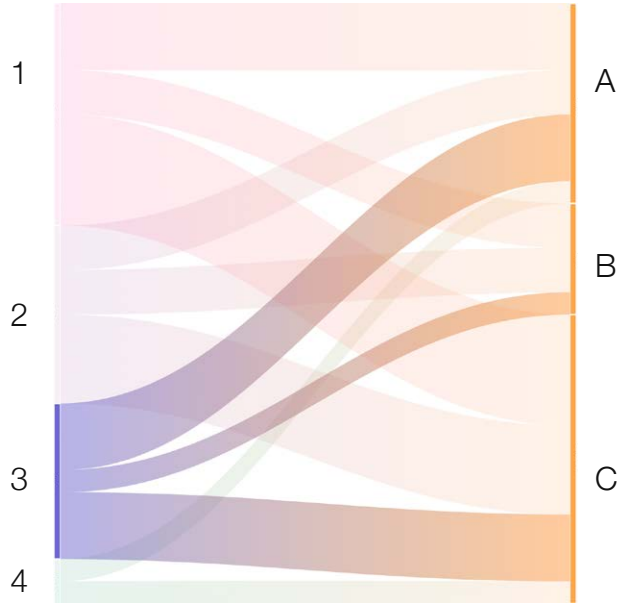


Figure 20. Organisations Advocating Circularity Present Situation Indicators.

EDUCATIONAL INSTITUTIONS

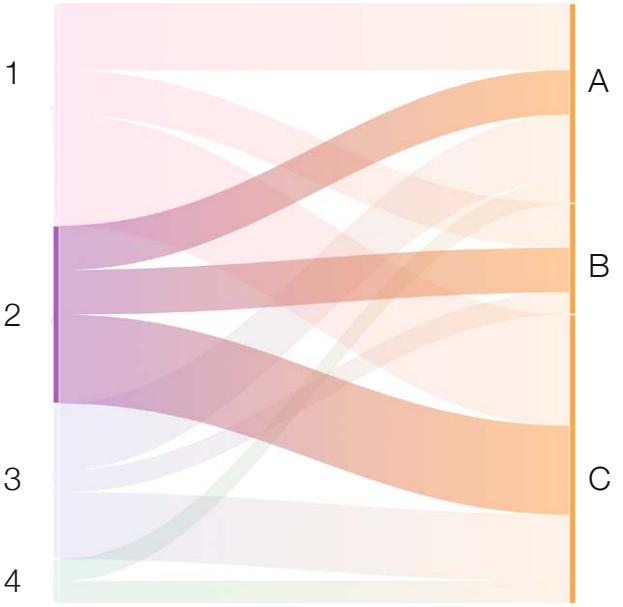


Figure 21. Educational Institutions Present Situation Indicators.

KEY
1. Architecture Firms and Building Companies
2. Educational Institutions
3. Organisations Advocating Circularity
4. Suppliers of Circular Products

STAKEHOLDERS PRESENT SITUATION

ARCHITECTURE FIRMS AND BUILDING COMPANIES

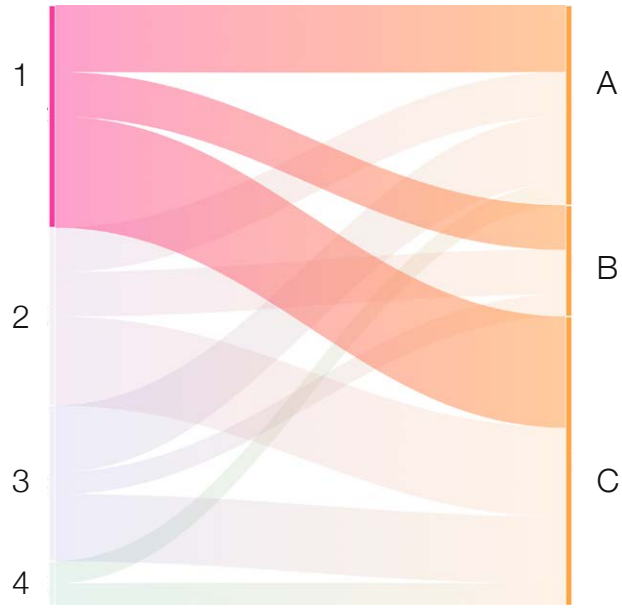


Figure 22. Architecture Firms and Building Companies Present Situation Indicators.

SUPPLIERS OF CIRCULAR PRODUCTS

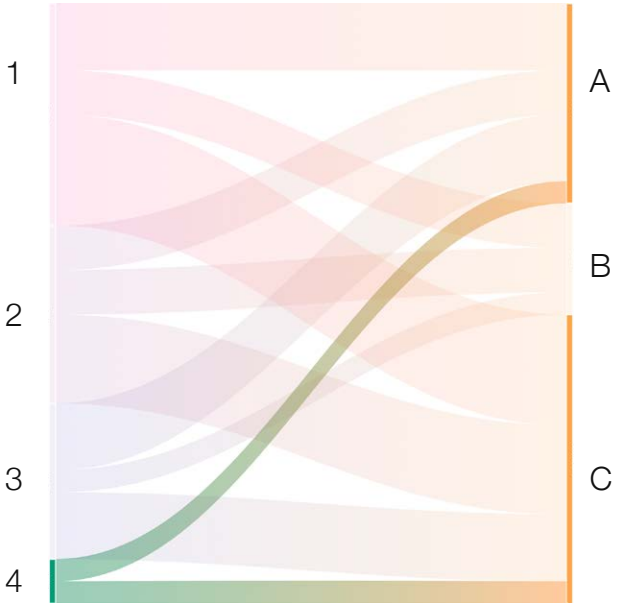


Figure 23. Suppliers of Circular Products Present Situation Indicators.

A. Community Participation
B. No Community Participation
C. Sustainable Actions Made by Organisations

STAKEHOLDERS CHALLENGES

ARCHITECTURE FIRMS AND BUILDING COMPANIES

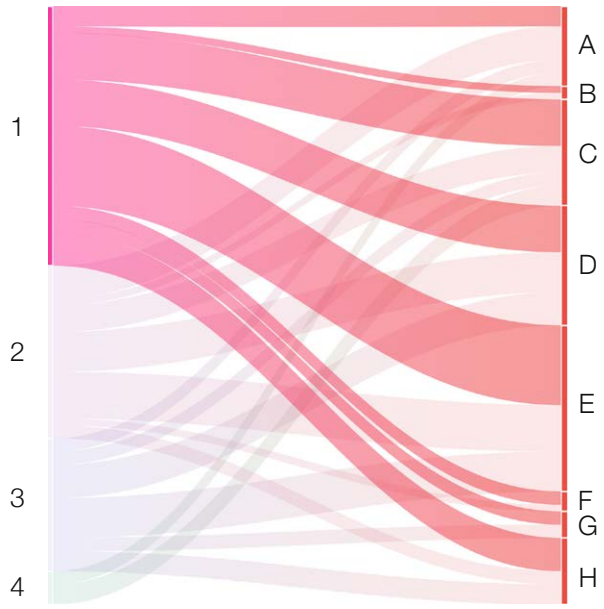


Figure 24. Architecture Firms and Building Companies Challenges Indicators.

EDUCATIONAL INSTITUTIONS

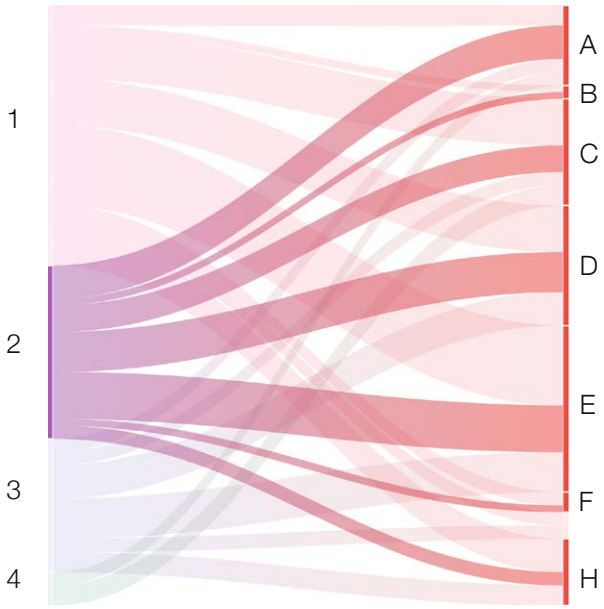


Figure 25. Educational Institutions Challenges Indicators.

ORGANISATIONS ADVOCATING CIRCULARITY

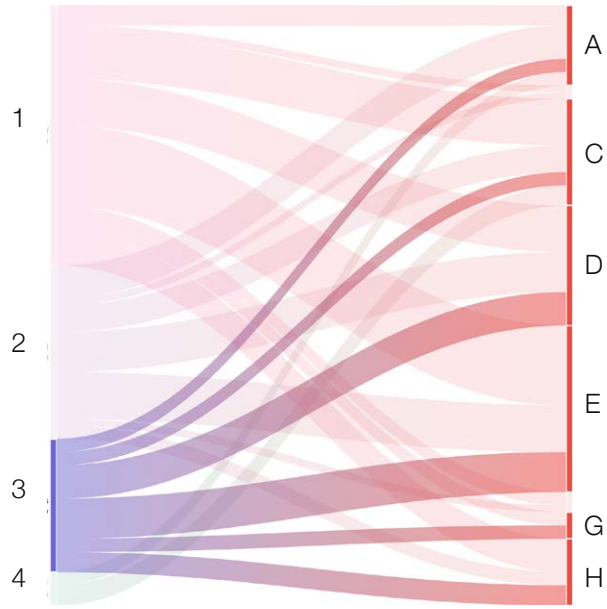


Figure 26. Organisations Advocating Circularity Challenges Indicators.

SUPPLIERS OF CIRCULAR PRODUCTS

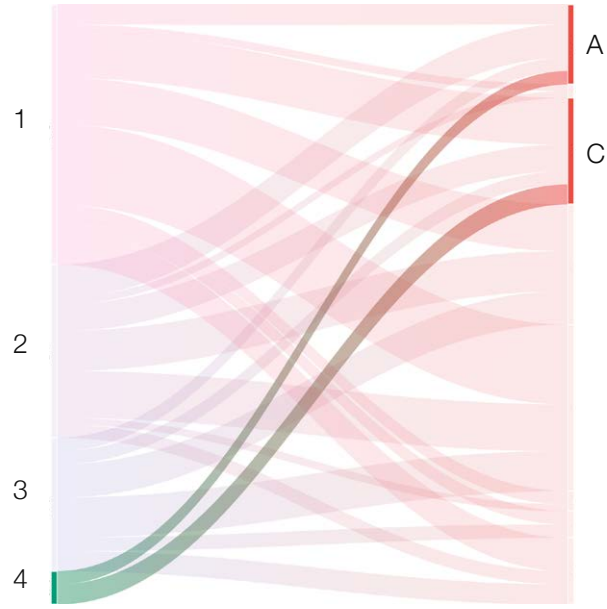


Figure 27. Suppliers of Circular Products Challenges Indicators.

KEY

1. Architecture Firms and Building Companies
2. Educational Institutions
3. Organisations Advocating Circularity
4. Suppliers of Circular Products

A. Building Regulations
B. Corruption
C. Cultural Perspective
D. Economic Challenges
E. Lack of Awareness
F. Lack of Gov. Incentives
G. Lack of Market Offer
H. Lack of Professional Know-How

STAKEHOLDERS OPPORTUNITIES

ARCHITECTURE FIRMS AND BUILDING COMPANIES

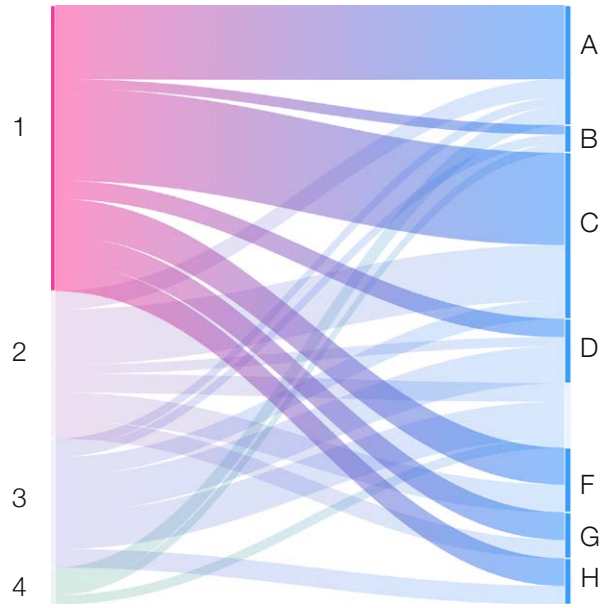


Figure 28. Architecture Firms and Building Companies Opportunities Indicators.

ORGANISATIONS ADVOCATING CIRCULARITY

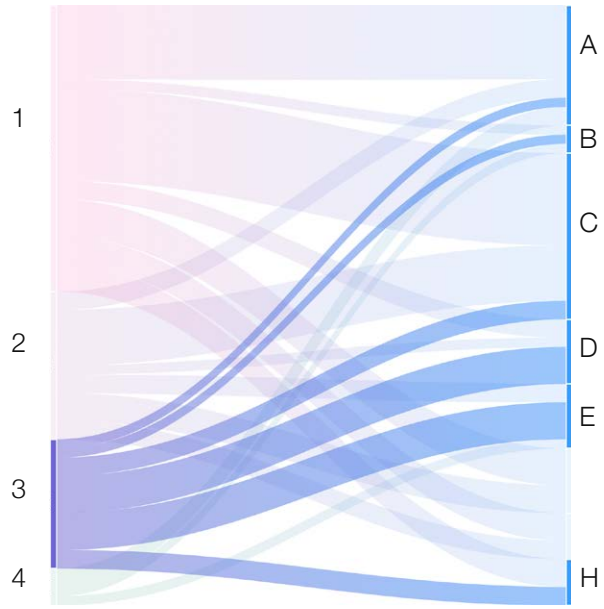


Figure 30. Organisations Advocating Circularity Opportunities Indicators.

EDUCATIONAL INSTITUTIONS

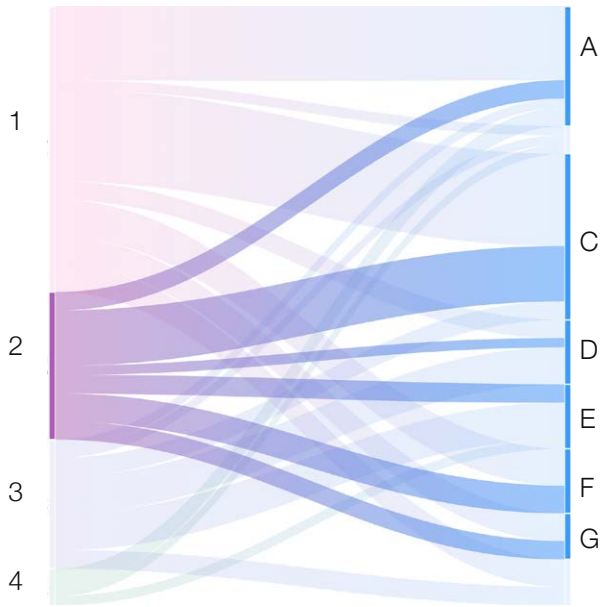


Figure 29. Educational Institutions Opportunities Indicators.

SUPPLIERS OF CIRCULAR PRODUCTS

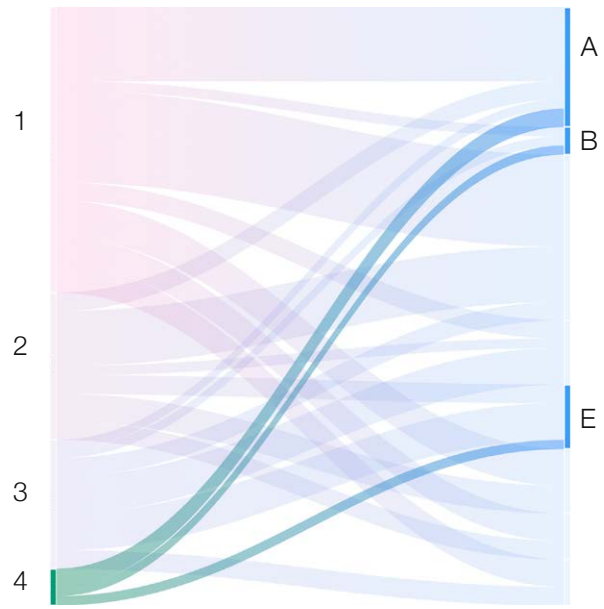


Figure 31. Suppliers of Circular Products Opportunities Indicators.

KEY

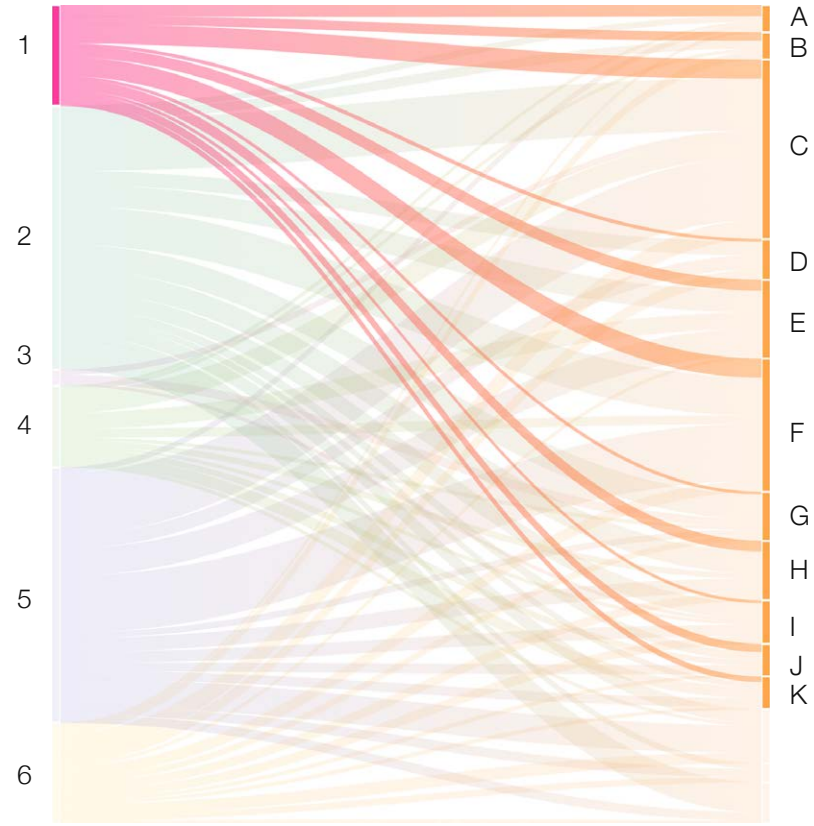
1. Architecture Firms and Building Companies
2. Educational Institutions
3. Organisations Advocating Circularity
4. Suppliers of Circular Products

A. Awareness of Market Offer
B. Community Involvement
C. Education
D. Network
E. New Building Code and Regulations
F. Training for Building Know How
G. Research
H. Sustainable Incentives

INTERVIEWS SANKEY DIAGRAMS RESULTS

STAKEHOLDERS PRESENT SITUATION

ARCHITECTURE FIRMS AND BUILDING COMPANIES



KEY

1. Architecture Firms and Building Companies
2. Suppliers of Circular Products
3. Educational Institutions
4. Government Institutions
5. Organisations Advocating Circularity
6. Technical Upskilling Institutions

A. Comfort Zone with Traditional Materials
B. Cost-Effective Culture
C. Advocacy for Circularity & Sustainability
D. Community Participation
E. Cultural Perceptions & Social Norms
F. Strategies to Create Acceptance and Adaptation
G. Education Provided
H. Exhibitions & Media
I. Focus on Affordable Housing
J. Focus on High-End Housing
K. Negative view on Circular Materials
L. Partnerships
M. Positive view on Circular Materials
N. Strategic Business Model

Figure 32. Architecture Firms and Building Companies Present Situation Indicators.

SUPPLIERS OF CIRCULAR PRODUCTS

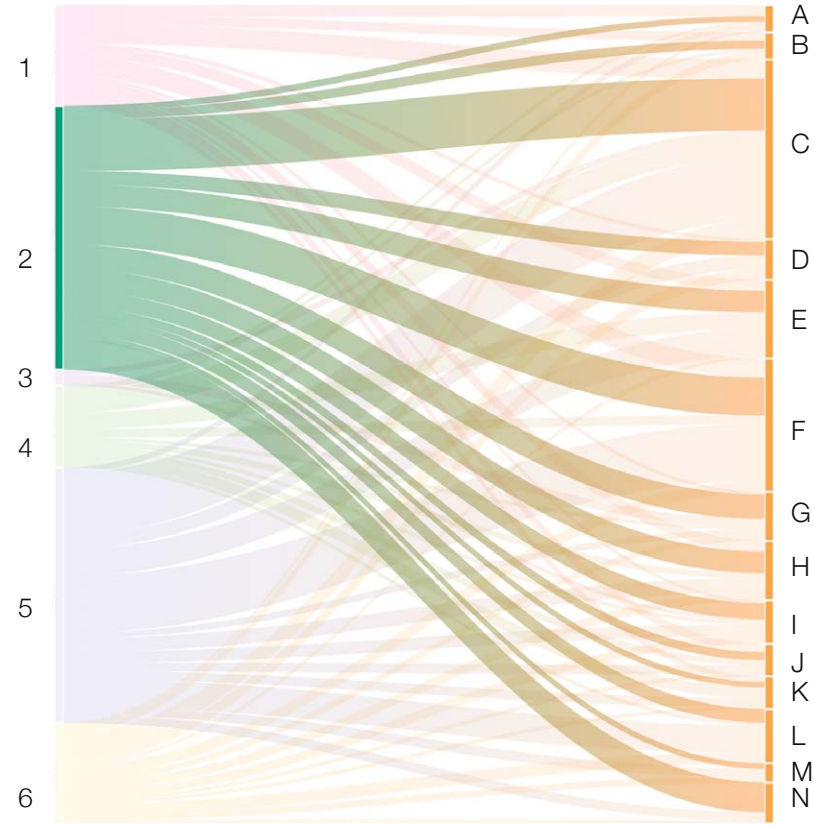
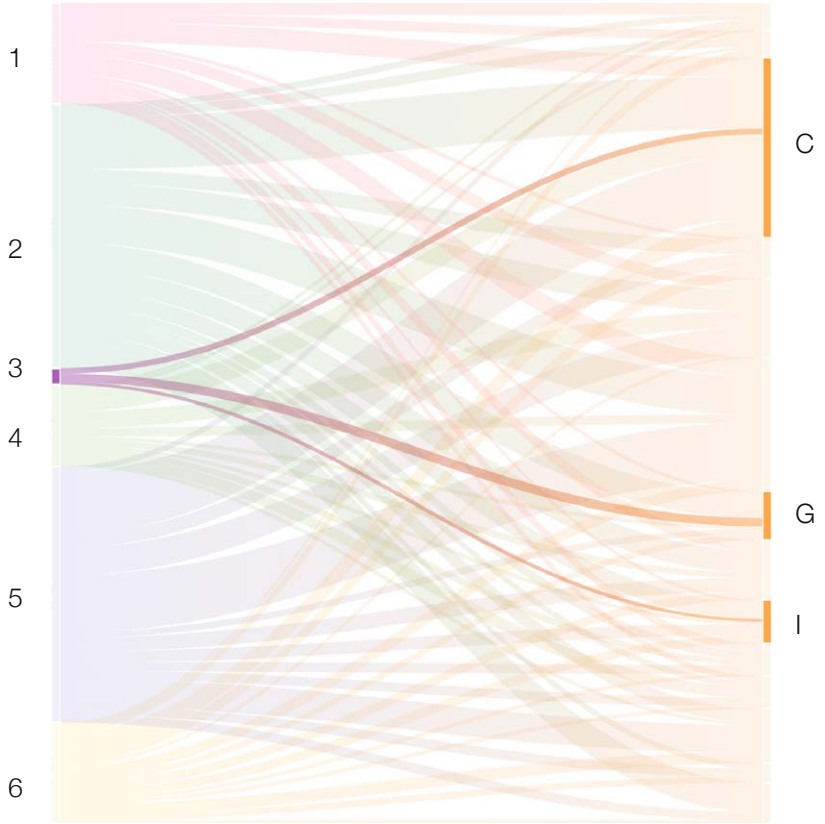


Figure 33. Suppliers of Circular Products Present Situation Indicators.

STAKEHOLDERS PRESENT SITUATION

EDUCATIONAL INSTITUTIONS



KEY

1. Architecture Firms and Building Companies
2. Suppliers of Circular Products
3. Educational Institutions
4. Government Institutions
5. Organisations Advocating Circularity
6. Technical Upskilling Institutions

A. Comfort Zone with Traditional Materials
B. Cost-Effective Culture
C. Advocacy for Circularity & Sustainability
D. Community Participation
E. Cultural Perceptions & Social Norms
F. Strategies to Create Acceptance and Adaptation
G. Education Provided
H. Exhibitions & Media
I. Focus on Affordable Housing
J. Focus on High-End Housing
K. Negative view on Circular Materials
L. Partnerships
M. Positive view on Circular Materials
N. Strategic Business Model

Figure 34. Educational Institutions Present Situation Indicators.

GOVERNMENTAL INSTITUTIONS

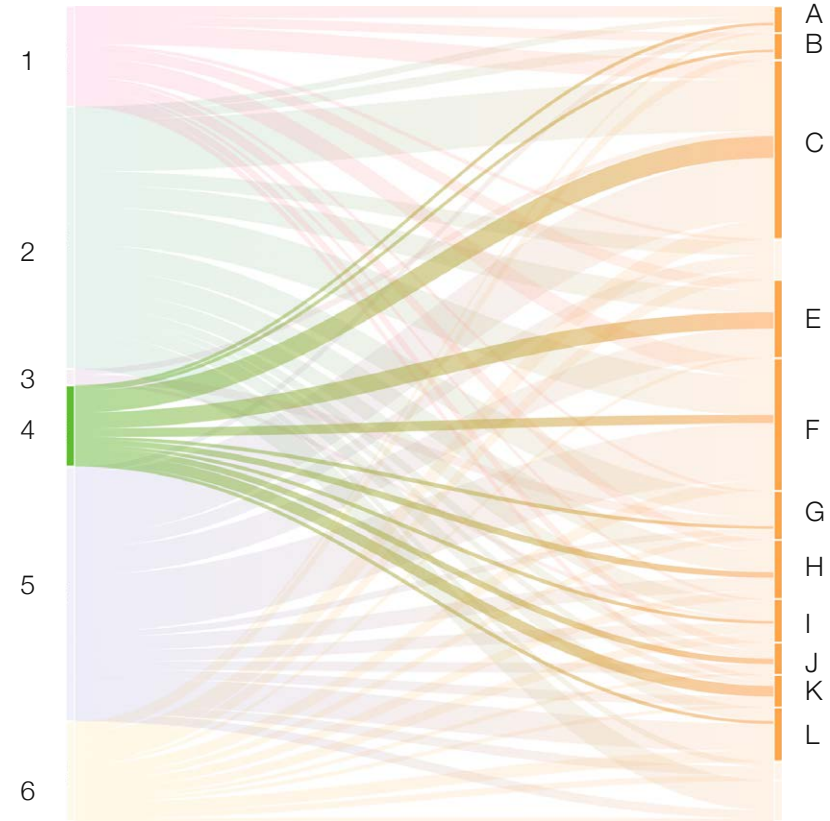
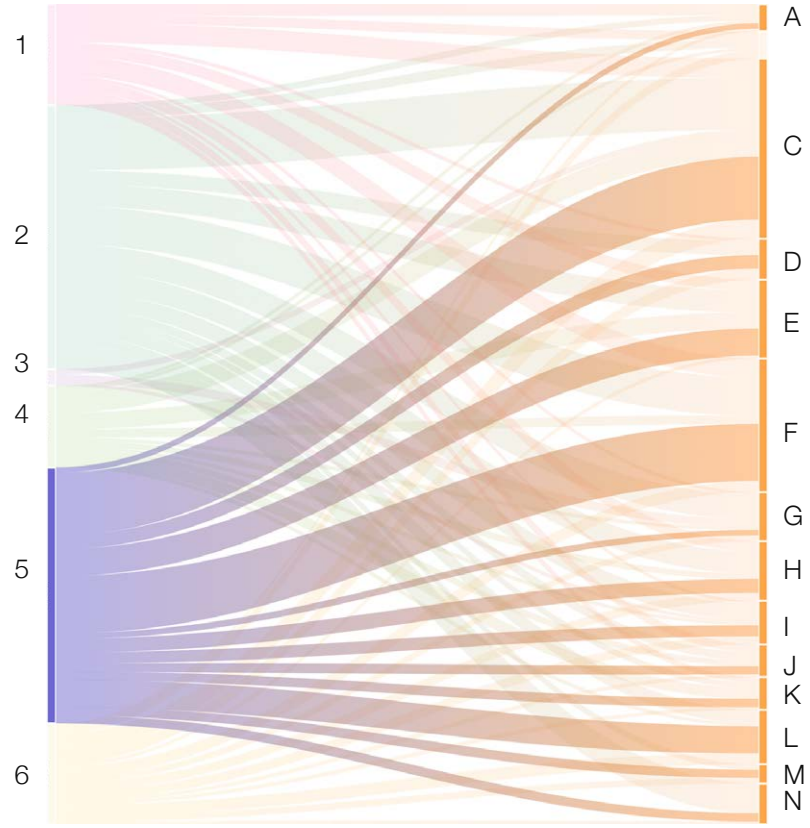


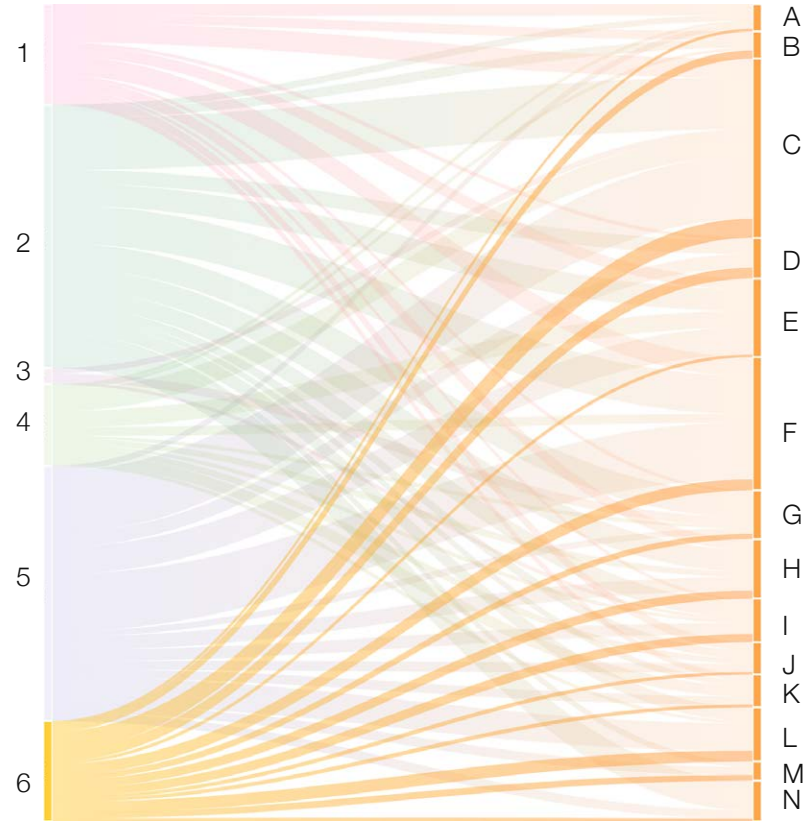
Figure 35. Suppliers of Circular Products Present Situation Indicators.

STAKEHOLDERS PRESENT SITUATION

ORGANISATIONS ADVOCATING CIRCULARITY



TECHNICAL UPSKILLING INSTITUTIONS



KEY

1. Architecture Firms and Building Companies
2. Suppliers of Circular Products
3. Educational Institutions
4. Government Institutions
5. Organisations Advocating Circularity
6. Technical Upskilling Institutions

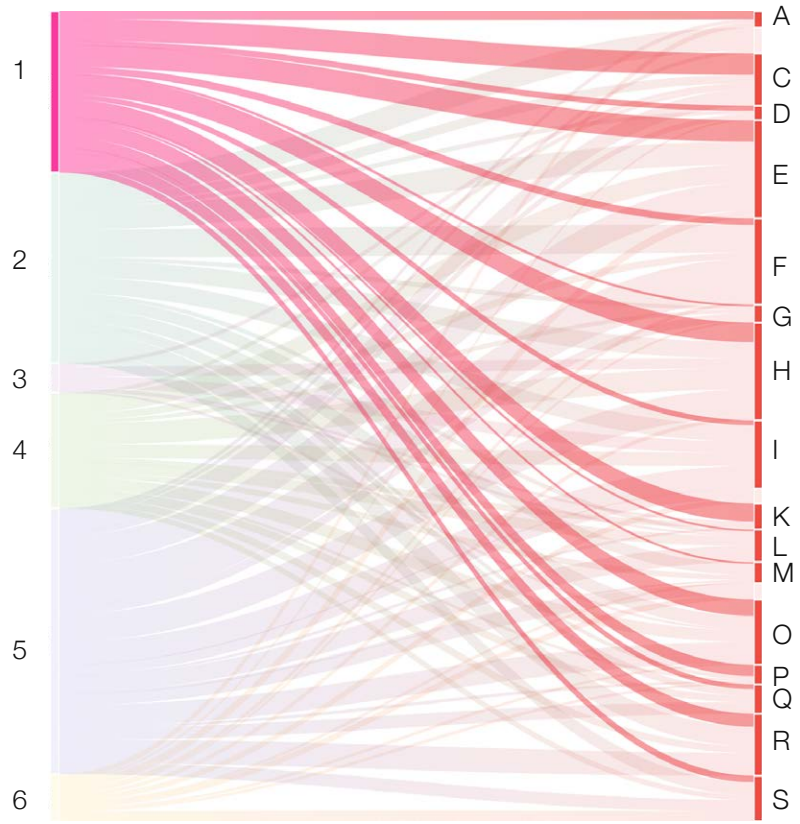
A. Comfort Zone with Traditional Materials
B. Cost-Effective Culture
C. Advocacy for Circularity & Sustainability
D. Community Participation
E. Cultural Perceptions & Social Norms
F. Strategies to Create Acceptance and Adaptation
G. Education Provided
H. Exhibitions & Media
I. Focus on Affordable Housing
J. Focus on High-End Housing
K. Negative view on Circular Materials
L. Partnerships
M. Positive view on Circular Materials
N. Strategic Business Model

Figure 36. Organisations Advocating Circularity Present Situation Indicators.

Figure 37. Technical Upskilling Institutions Present Situation Indicators.

STAKEHOLDERS CHALLENGES

ARCHITECTURE FIRMS AND BUILDING COMPANIES



KEY

1. Architecture Firms and Building Companies
2. Suppliers of Circular Products
3. Educational Institutions
4. Government Institutions
5. Organisations Advocating Circularity
6. Technical Upskilling Institutions

A. Accesibility and Availability in the Market
B. Challenges to Scale Up
C. Comfort Zone / Unwillingness to Change
D. Corruption
E. Cultural Perception & Social Norms
F. Economic Challenges
G. Innovations Outpacing Policies
H. Lack of Awareness
I. Lack of Education
J. Lack of Good Marketing of the Product
K. Lack of Influence
L. Lack of Network
M. Lack of Professional Know-How
N. Lack of Prooving a Good Business Case
O. Lack of Regulations & Building Code
P. Lack of Market Offer
Q. Lack of Support
R. Lack of Trust
S. Price Sensitivity to Materials

Figure 38. Architecture Firms and Building Companies Indicators.

SUPPLIERS OF CIRCULAR PRODUCTS

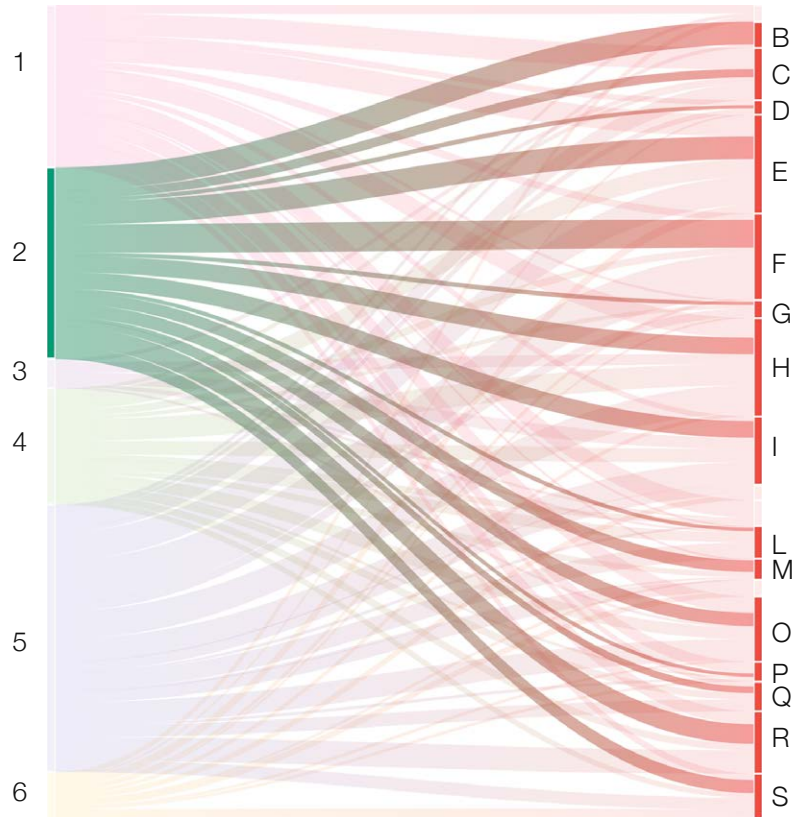
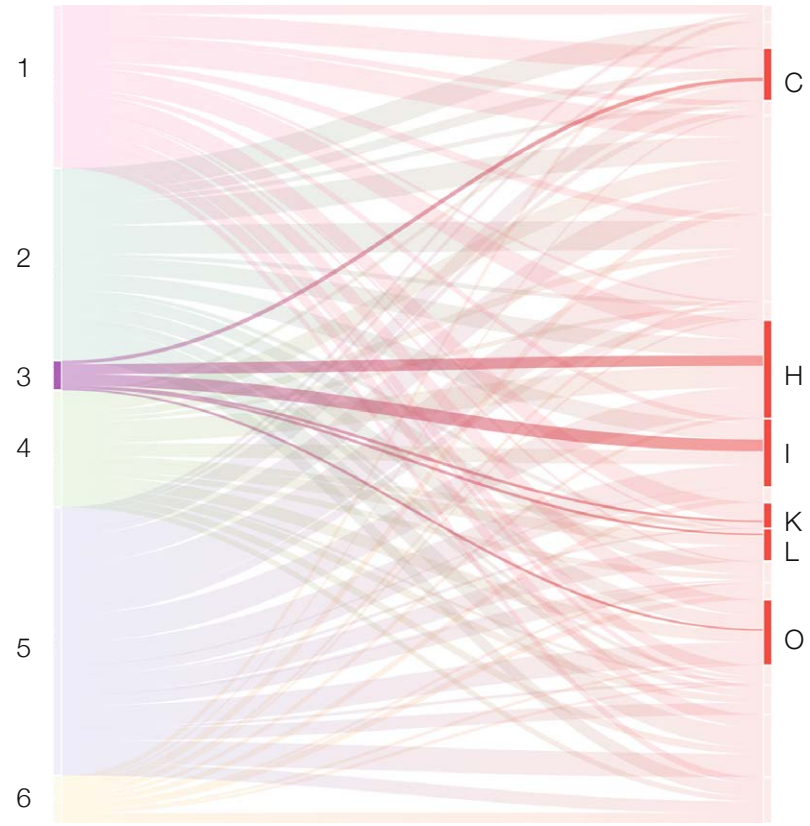


Figure 39. Suppliers of Circular Products Challenges Indicators.

EDUCATIONAL INSTITUTIONS



KEY

1. Architecture Firms and Building Companies
2. Suppliers of Circular Products
3. Educational Institutions
4. Government Institutions
5. Organisations Advocating Circularity
6. Technical Upskilling Institutions

A. Accesibility and Availability in the Market
B. Challenges to Scale Up
C. Comfort Zone / Unwillingness to Change
D. Corruption
E. Cultural Perception & Social Norms
F. Economic Challenges
G. Innovations Outpacing Policies
H. Lack of Awareness
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K. Lack of Influence
L. Lack of Network
M. Lack of Professional Know-How
N. Lack of Prooving a Good Business Case
O. Lack of Regulations & Building Code
P. Lack of Market Offer
Q. Lack of Support
R. Lack of Trust
S. Price Sensitivity to Materials

Figure 40. Eduactional Institutions Challenges Indicators.

GOVERNMENTAL INSTITUTIONS

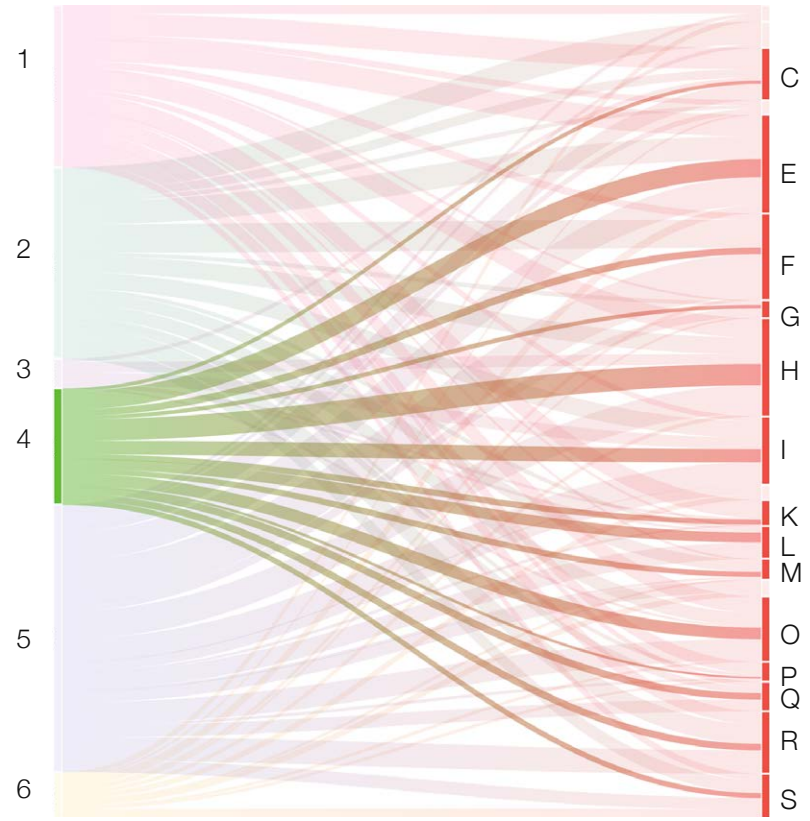
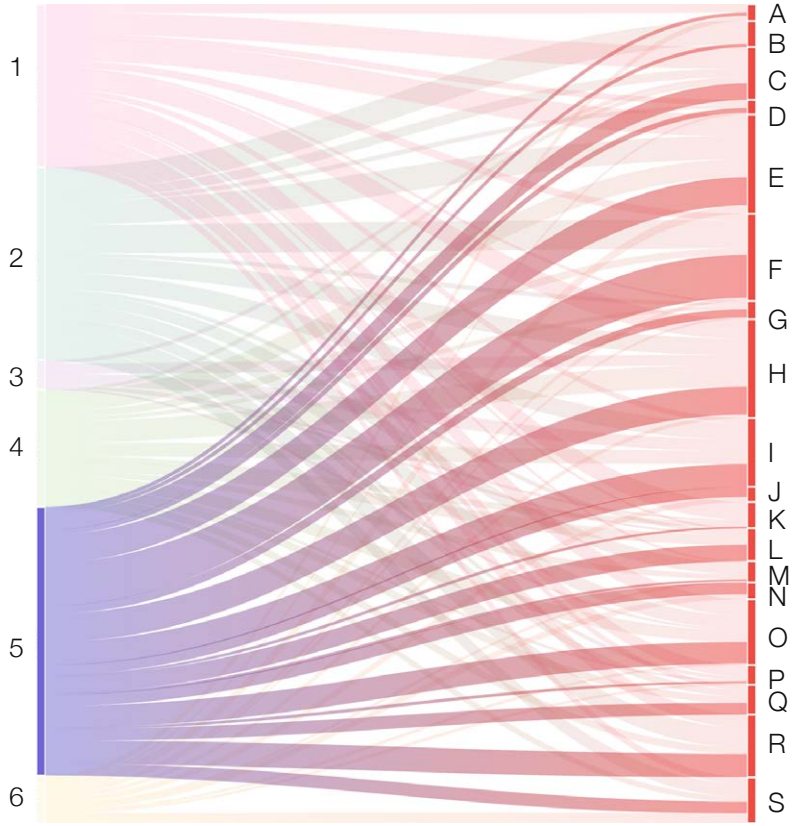


Figure 41. Governamntal Institutions Challenges Indicators.

ORGANISATIONS ADVOCATING CIRCULARITY



KEY

1. Architecture Firms and Building Companies
2. Suppliers of Circular Products
3. Educational Institutions
4. Government Institutions
5. Organisations Advocating Circularity
6. Technical Upskilling Institutions

A. Accesibility and Availability in the Market
B. Challenges to Scale Up
C. Comfort Zone / Unwillingness to Change
D. Corruption
E. Cultural Perception & Social Norms
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N. Lack of Prooving a Good Business Case
O. Lack of Regulations & Building Code
P. Lack of Market Offer
Q. Lack of Support
R. Lack of Trust
S. Price Sensitivity to Materials

Figure 42. Organisations Advocating Circularity Challenges Indicators.

TECHNICAL UPSKILLING INSTITUTIONS

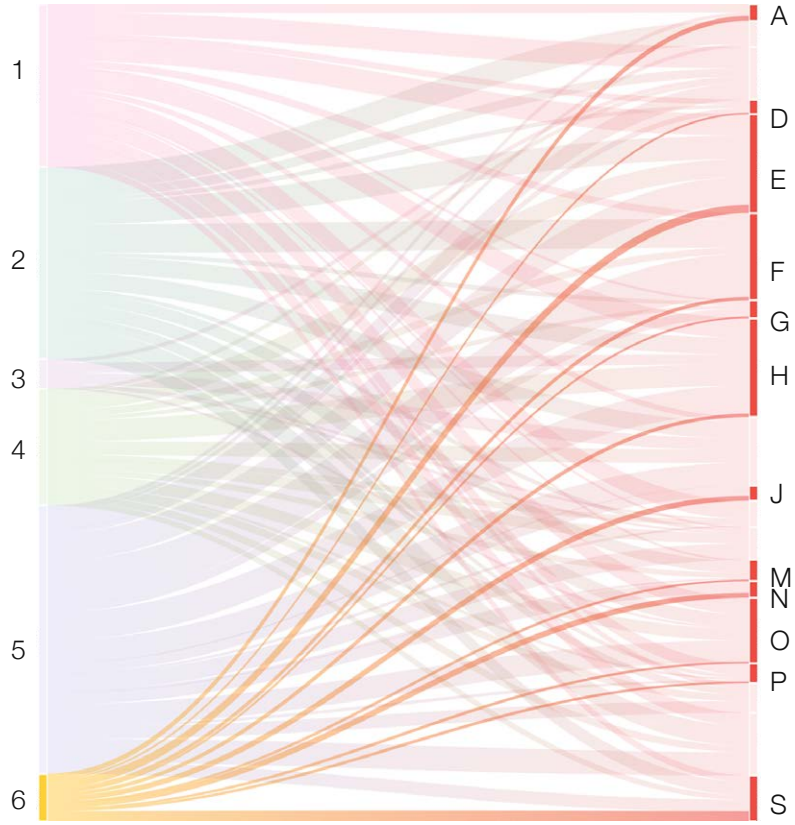
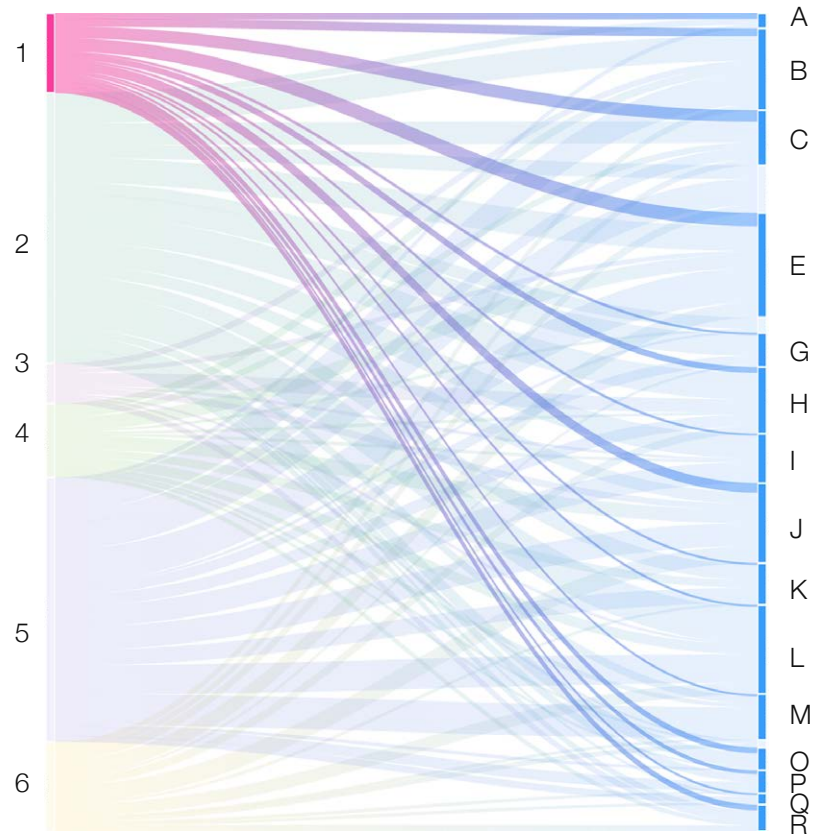


Figure 43. Technical Upskilling Institutions Challenges Indicators.

STAKEHOLDERS OPPORTUNITIES

ARCHITECTURE FIRMS AND BUILDING COMPANIES



KEY

1. Architecture Firms and Building Companies
2. Suppliers of Circular Products
3. Educational Institutions
4. Government Institutions
5. Organisations Advocating Circularity
6. Technical Upskilling Institutions

A. Accesibility & Availability in the Market
B. Community Inclusion & Participation
C. Cost-Effective / Frugal Innovation
D. Create a Good Business Case
E. Creation of Awareness & Change of Behaviour
F. Diversity in Maket Offer
G. Easy to Use
H. Economies of Scale
I. Education
J. Funding
K. Good Communication Strategy
L. Government Support & Action
M. Networks & Partnerships
N. Opportunities with New Building Regulations
O. Research
P. Showcase & Exhibitions
Q. Support New Materials
R. Willingness for New Conversations

Figure 44. Architecture Firms and Building Companies Opportunities Indicators.

SUPPLIERS OF CIRCULAR PRODUCTS

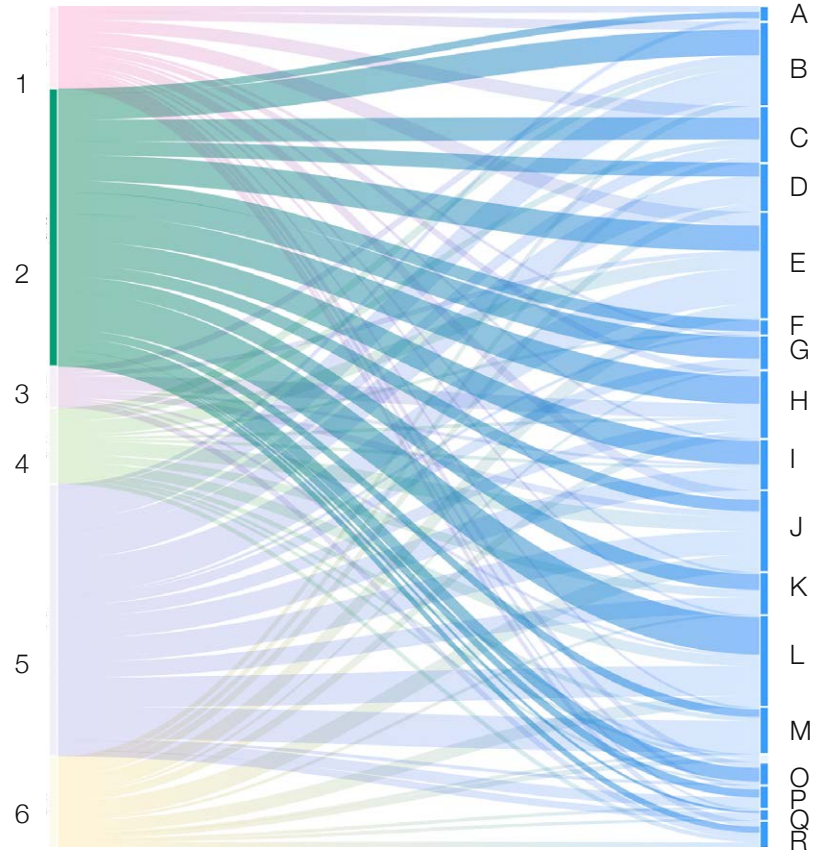


Figure 45. Suppliers of Circular Products Opportunities Indicators.

EDUCATIONAL INSTITUTIONS

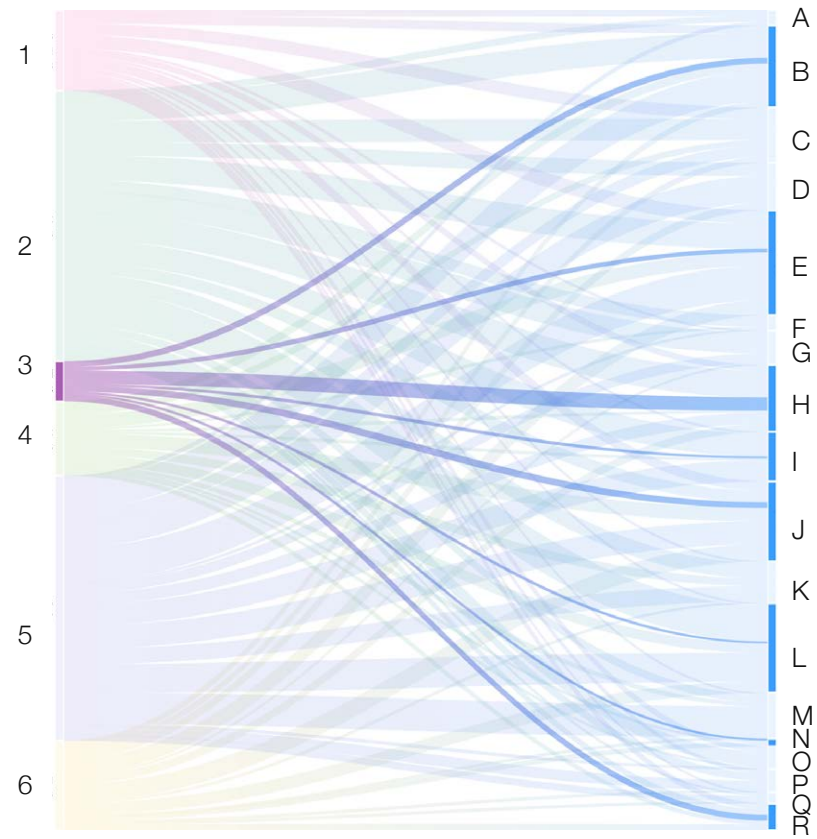


Figure 46. Educational Institutions Opportunities Indicators.

KEY

1. Architecture Firms and Building Companies
2. Suppliers of Circular Products
3. Educational Institutions
4. Government Institutions
5. Organisations Advocating Circularity
6. Technical Upskilling Institutions

A. Accesibility & Availability in the Market
B. Community Inclusion & Participation
C. Cost-Effective / Frugal Innovation
D. Create a Good Business Case
E. Creation of Awareness & Change of Behaviour
F. Diversity in Maket Offer
G. Easy to Use
H. Economies of Scale
I. Education
J. Funding
K. Good Communication Strategy
L. Government Support & Action
M. Networks & Partnerships
N. Opportunities with New Building Regulations
O. Research
P. Showcase & Exhibitions
Q. Support New Materials
R. Willingness for New Conversations

GOVERNMENTAL INSTITUTIONS

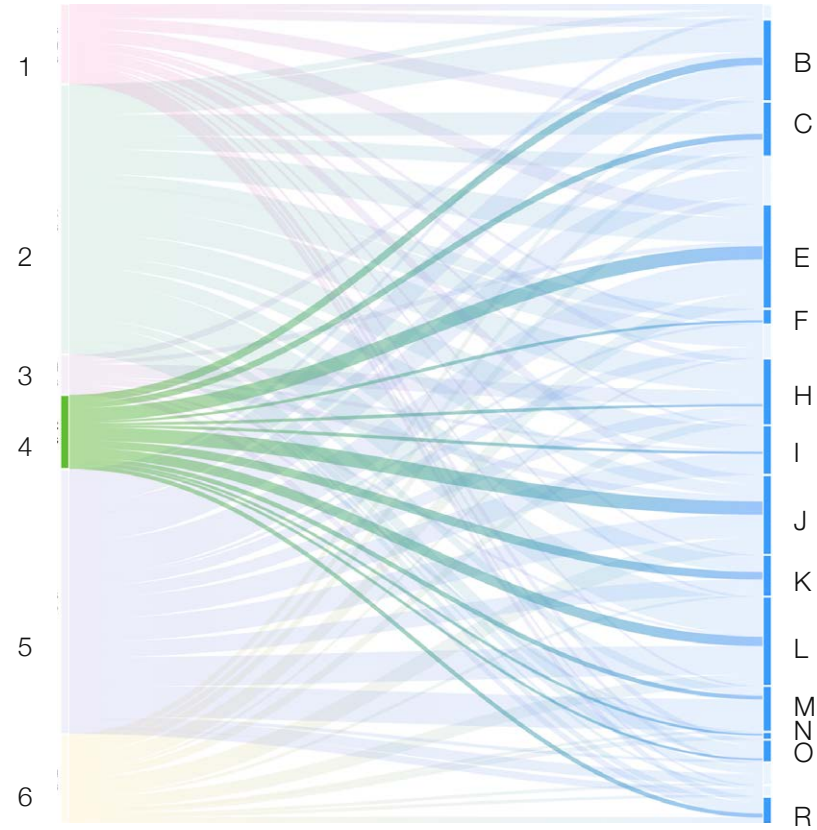


Figure 47. Governmental Institutions Opportunities Indicators.

ORGANISATIONS ADVOCATING CIRCULARITY

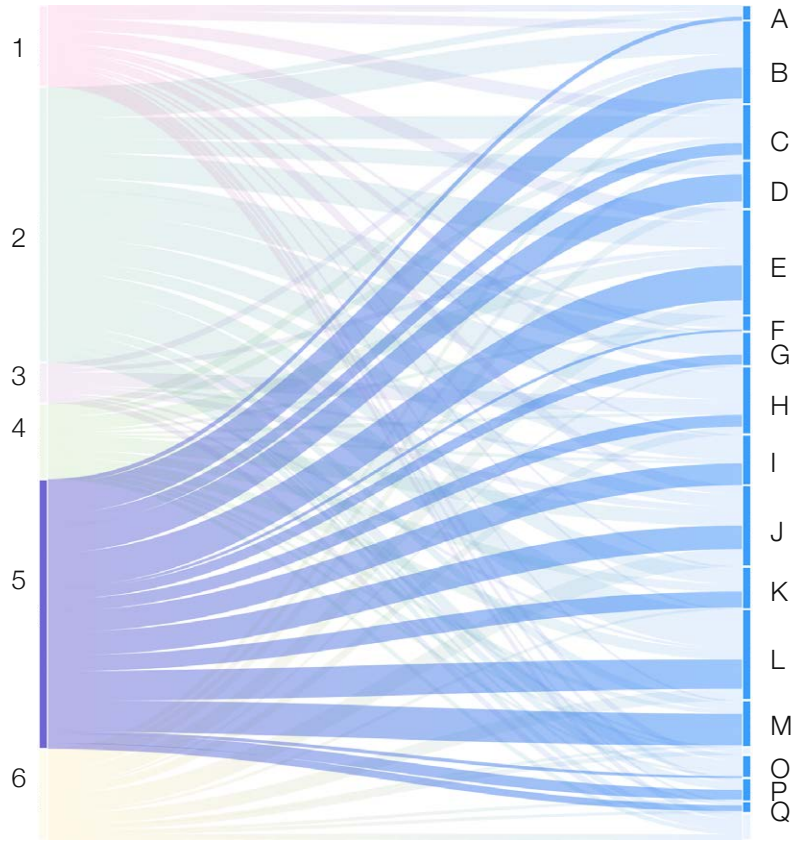


Figure 48. Organisations Advocationg Circularity Indicators

KEY

1. Architecture Firms and Building Companies
2. Suppliers of Circular Products
3. Educational Institutions
4. Government Institutions
5. Organisations Advocating Circularity
6. Technical Upskilling Institutions

A. Accesibility & Availability in the Market
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E. Creation of Awareness & Change of Behaviour
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J. Funding
K. Good Communication Strategy
L. Government Support & Action
M. Networks & Partnerships
N. Opportunities with New Building Regulations
O. Research
P. Showcase & Exhibitions
Q. Support New Materials
R. Willingness for New Conversations

TECHNICAL UPSKILLING INSTITUTIONS

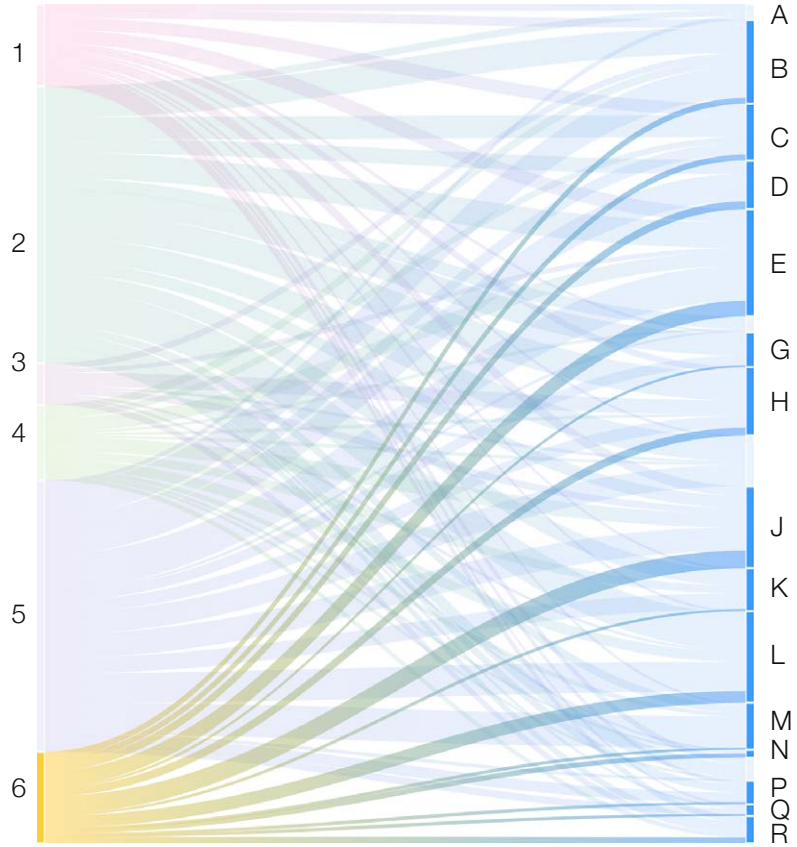

Figure 49. Technical upskilling Insitutions Indicators

APPENDIX E: RECOMMENDATIONS FOR HABITAT FOR HUMANITY

Habitat for Humanity is an organisation that focuses on giving local stakeholders the tools they need to create new opportunities for the built environment and provide adequate housing for the community. As enablers, they manage to influence different stakeholders in the built environment spectrum and facilitate opportunities for those involved in improving the quality of life in the shelter of their communities. After performing this research and understanding the actual situation, the stakeholders' problems, and the opportunities set in the country, the following recommendations could be given to the organisation and, more specifically, to the Kenya Circularity Lab.

As stated in the research, circularity is a new mechanism to approach the built environment. It is a novelty in how materials are processed and used, but its goal remains the same as in conventional construction. The main target of any material or building method is to be a medium to construct any type of ensemble for communities of the country. Therefore, it is important to start seeing circularity as a demand and supply market where new products and services are offered. Hopefully, there will be a demand for these innovations. To implement these new building materials and methods and strengthen their demand, facilitators and influencers need to push towards updating building policies in the country. The goal is to make these materials approved products by the government to work within construction. If the government approves them, they will provide security and assurance to the people who work with them. Kenya is a country used to build with stone, concrete, mortar, iron sheets and burned bricks. Therefore, there needs to be a creation of awareness of the new possibilities of construction the market has to offer and its environmental and socio-economic benefits. Linked to this idea, education is essential in the whole country, explaining what circularity entails and its importance on our planet. Innovation is a challenge because people do not like being taken out of their comfort zone. Especially when housing is at stake, given it is their long-term investment and life dream. However, without innovation there is no development. As an NGO striving to develop a country such as Kenya, the mindset of the local communities needs to be changed; to embrace the idea of helping build sustainably for the future. In this case, as facilitators and as an organisation that has access to diverse places of the country, one of the main goals is to educate and create awareness in every community.

Entering a market that is conservative and led by social expectations and norms is a challenge. Still, a few enterprises are starting to step up and provide cost-effective solutions to the country's building industry. The challenge is to scale up their production to guarantee access and availability to their products. Scaling up is not easy in a country where getting loans is difficult and the profit margin of social enterprises is low. Therefore, as an NGO and enablers of these organisations that are providing new alternatives for the built environment, it is important to help them scale up. This implies monetary funding to grow their supply chain and a good network of investors that can invest in the companies. Partnerships are fundamental to working together as a whole, and Habitat for Humanity has the contacts and means to connect different stakeholders. Providing these opportunities will help these enterprises to grow. Awareness among suppliers about circularity is also important, given that not many know what this new trend is about. As the local community needs to learn what circularity entails, suppliers must gain the same knowledge. This can help organisations involved in the construction industry to seek alternatives to change the products they offer and become circular. The dissemination of information has to be strategic and must tackle demand and supply to become a movement. By those means, incentivising community projects become a good way to make people learn about the new materials and building methods and create security about the strength and properties of circular materials. The knock-test is an examination made by locals to ensure themselves materials are trustworthy and secure. The only way to gain that trust is by seeing ensembles built with these materials. Finally, pressure needs to hap-

pen for organisations that are now supplying conventional materials to change their business models and become environmentally sustainable. Habitat for Humanity can influence the government by providing knowledge on the importance of creating policies restricting the production and use of conventional materials. If pressure is not exerted, no supplier will change, and as an effect, the demand side will stay in its comfort zone. As an NGO with the power of influence, it is important to have a good relationship with policy-makers and help these changes happen.

As John Adams said, “Every problem is an opportunity in disguise”, and it is within the faculties of the organisation to grab this new opportunity, circularity, that is arising in the built environment and enable local stakeholders to strive for change. It could change the future of Kenya and its built environment for good.

APPENDIX F: RESEARCH DATA MANAGEMENT

Table 03. Research Data Management. Following the FAIR principles.

Data creation/collection, organization & documentation	What data will you be collecting, generating or reusing?	Collected data: Qualitative Generating data: Audio, video, textual. Computational model output (e.g. mp4, mp3, jpeg, pdf, .doc) Reusing data: Textual.
	Where will the data be stored during the research project?	Personal hard drive disk.
	How will the data be organised, described and documented?	Data will be organised through folders which will be structured through names and versions and dates of data collection in each file for easy access.
Data Security	What are the main risks to data security?	Loss of data.
	What measures will be taken to mitigate the risks?	Backups of information to prevent any loss of data.
	To whom will access be granted/ restricted?	Information will be allowed to be accessed by mentors of my thesis and the Habitat for Humanity team.
	How often will backups of your data be made and where will they be stored?	Backups will be made weekly and they will be stored in a hard drive.
	If you are using non-digital data, what measures will be taken to assure the safety and usability of these data?	Scanning of paper documents and photography.
Data archival and preservation	At the end of your research project, what data will be archived, for how long and in what format?	Data will be archived for a minimum of 10 year in their original formats. Computational model output (e.g. mp4, mp3, jpeg, pdf, .doc)
	Where will you archive your data?	Data will be archived in personal hard drive, in the external data centre of Habitat for Humanity, and open source repository system of TU Delft.
	What metadata standard will be used?	4 TU Center for Research data.
	What documentation and/or software code must be deposited with the data?	Information on provenance and technical information about files.

Data publication access	What data will be published as outputs from the project and when?	The master thesis document will be published in the open source repository system of TU Delft.
	What (license) conditions will apply to the data you will publish?	Public domain (CC0) and MIT-like
	How will continued access be guaranteed?	Preserved in data archive of TU Delft.
Roles, responsibility and resourcing	Who has specific research data management responsibilities during your research project?	Habitat for Humanity TCIS team. Specifically the applied innovation team and my mentors of thesis.
	Which of the following agreements need to be drawn up?	Legal grounds through consent of data subject, data processing agreement, data exchange agreement, and informed consent to collect, process, archive and/or publish the data
	How will the adherence to this plan be checked and/or demonstrated, when and by whom?	Every week by principal investigator, mentors and Habitat for Humanity team.
	What resources will be required to implement this plan and are these available?	Dedicated staff time for data management.
	Are there any documents related to this plan?	Project plan and ethical commission forms.

For the research management data, the University of Amsterdam (2022) template was used to fill in the information that is presented.

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