



Slumming it, better.

Slum living conditions and potential improvement
via participatory design principles and digital
ephemeralization.



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Abstract

The exponential rates of migration from rural areas to urban areas in the last 50 years (United Nations, 2001), has created a pandemic towards the degradation of slum dwellers living conditions.

Architecture is an essential component of how dwellings are designed and constructed for the local environment in which people reside, to a large extent the lack of architecture has dramatically reduced the living conditions of slum dwellers and their conditions have further regressed past the already squallered conditions of which they were perceived. However, regardless of how bad the value of these informal settlements are, people are still choosing to migrate to city peripheries indefinitely in the hopes of a better life (Davis, 2017). The research conducted is based on a literature review on participatory design principles and modern technologies to improve living conditions. Tiwari, et al., (2020) discuss the approaches of both the top down and bottom up methods regarding improving slums, and argue that a middle ground planning approach could be the most effective in improving slums conditions. Further studies have focused on living standards of slum dwellers, in particular the need to improve them not only physically but also socially (Gonzalez R., et al., 2017) and adequate housing is argued by (UN, 2016) to be a basic human right.

From an experiential and analytic perspective, and taking into account the situations in which slum dwellers are subsequently found to live within, the paper explores the existing characteristics of living conditions within these informal settlements, and seeks a solution using participatory design principles via wireless internet in conjunction with smartphone emphermliziation to provide widespread outcomes. Ephemerization is the ability to do more and more with less and less. “More and more with less and less until eventually you can do everything with nothing.” (R.Buckminster Fuller, 1973, p252). It will focus on examples that are linked to street-led developments, and sustainability, these two key aspects are underlyingly deep-rooted challenges that slum dwellers deal with daily.

The paper advocates a holistic and analytical understanding of living conditions within informal settlements, and suggests that architecture and architects can offer a valuable solution when implemented to a wide audience using participatory design approaches that run in parallel with smart phone amelioration. A sustained interplay between those three aspects can shape the environment in which millions of people live and in which billions of people are predicted to live (United Nations, 2018) in the very near future, therefore it is decidedly needed. The paper concludes by proposing solutions to the horrendous and extremely low living standards, that can be easily accessed using open-source information to potentially provide migrators with antecedent information before arriving to cities on how best to improve their living conditions.

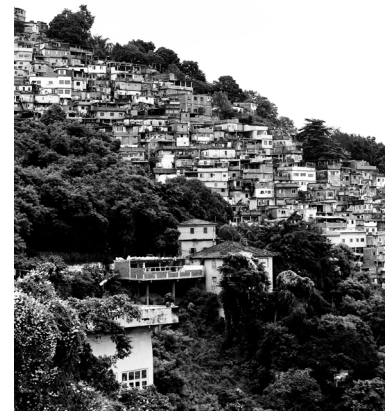
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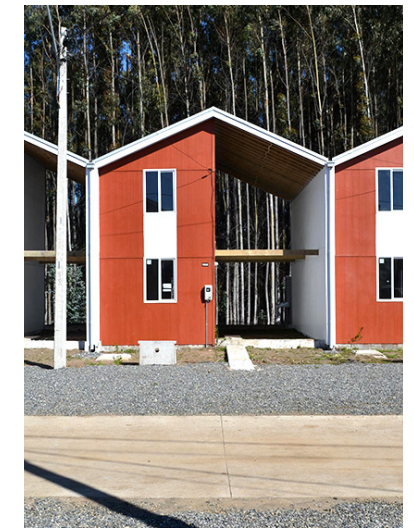
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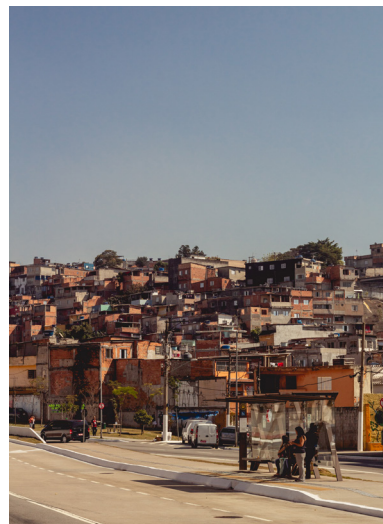
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Introduction

Cities are often seen as the nerve centre of modern ideas, as well as hubs for commercial development, cultural diversity, scientific advancements, social interactions, and economic development. Cities often provide a broad accessibility to information both private and public. 2008 marked the epochal shift in urban areas outpopulating rural areas for the first time in human history. This shift will hugely affect how the inhabitants of the world live and how the future inhabitants are set to live throughout human existence, as it is unlikely to reverse. This transition is called the 'urban millenium' (United Nations, 2001) and in less than a generation of people, by 2050 it is expected that two-thirds of the world's population will be living in urban areas (United Nations, 2018). With more than half of the population living in cities and the number of urban residents growing by nearly 73 million people every year (United Nations, 2018). These staggering numbers will require a monumental shift in how slums are arranged, built and lived within, in the near future.

The idea of a better life is one in which everyone seeks to achieve, however for billions of people the turning point of living within rural areas to urban living sparked this desire. It is often assumed that a good social housing policy encourages movement of people to cities, however this is erroneous. As I will explore with this writing, city peripheries often create slums as social housing is obsolete and one of the main reasons for moving to the city is because of the potential quality of life increase. Access to education, and greater

employment opportunities are often the key points a city can offer that rural areas can not (United Nations, 2018). However due to the enormous influx of people at exponential rates they are forced to live on the outskirts of a city commonly referred to as a slum, which has some of the worst living conditions on the planet.

Normally on the edges of these metropolitan areas, within the slums, a significant lack of sanitation is present and the risk of disaster such as fires become more frequent, further lowering the quality of life overall in these urban areas (Zerbo, et al. 2020). There is a consistent consensus that no single theory can improve slum living conditions alone. However, I will argue that with rapidly growing digital technologies (Piper, 2020), combined with rises in mobile phone ownership (ITU, 2020) and the improved accessibility to wireless internet (Reglitz, 2019), in conjunction with participatory design principles and open sourced information. Living conditions can be drastically improved on a much wider basis, by engaging with millions of people far more effectively.

This dissertation's aim is to explore opportunities to alter the way slums are constructed and how living conditions within them can be improved. I will begin by defining slums and their current characteristics, and will identify the difference among other informal settlements and demonstrate how they are linked to global urban migration phenomenon (Perz, 2000).



Figure 1 - Favela, Medellín Colombia

The research throughout is conducted based on a literature review on participatory design and it's possible applications to improve the living conditions of slum dwellers. This dissertation will focus on examples that are linked to sustainability within slums, firstly regarding materials used for construction and infrastructure, and secondly, the street-led development theory, in which the street becomes a contested space, providing a dynamic living environment and anticipates a multitude of different activities to occur, two key aspects that are inherent to the challenges that slum dwellers currently face.

For this analysis, I will be using examples from, but not limited too; South Asia, Sub-Saharan and South America. Running parallel to participatory design the literature review highlights further opportunities that arise nowadays by technological amelioration and the extended access to wireless internet and smartphone technologies. This last dynamic component not only drastically alters the everyday livelihood of slum dwellers, but also increases their means of communication and their opportunities to participate in the design process, stabilising top-down and bottom-up approaches.

Slums; Characteristics, Perceptions and Definitions

I shall start by analysing slums and their living conditions however, there are three words that are often used as interchangeable terms and phrases to describe or categorise one another, but have different meanings, 'Slum', 'Favela' and 'Ghetto'. Breaking them down and defining them will help in understanding the specific intentions and potential solutions for improving living conditions within slums specifically.

It is best if we set out the definition of what a slum is and what a slum isn't, this can sometimes be dependent on geographical location, but a slum should begin to be explained as an overcrowded urban area, such as a street or district which provides squalid living conditions for its inhabitants (Davis, 2017, p21), who are generally of low economic status (UN. 2016). They are densely populated and usually located on the periphery of a metropolitan area, often described as, run-down, poverty stricken, socially disorganised and tend to be informal or illegal structures in which people live. Generally they are unsafe and unhealthy homes, with a lack of natural light from windows, little to no floor materials, walls that are of poor material quality that leak, and sometimes have no roof. Often crammed areas with very limited and frequently no connection to essential services such as clean water, toilets facilities, electricity and a reliable public transport system (Davis, 2017, p22). A slum is different to a favela although commonly both terms are used interchangeably.

UN-HABITAT (2006) defines a slum household as a group of individuals living under the same roof in an urban area who lack one or more of the following: "Durable housing of a permanent nature that protects against extreme climate conditions. Sufficient living space which means not more than three people sharing the same room. Easy access to safe water in sufficient amounts at an affordable price. Access to adequate sanitation in the form of a private or public toilet shared by a reasonable number of people. Security of tenure that prevents forced evictions."

A favela is often a term used as a synonym for a slum, but there are some small differences. Often a favela is used specifically to describe a slum within South America and more specifically Brazil (Levine, 1991). Some of the largest favela's are located in Brazil's more populated cities, São Paulo and Rio De Janeiro. Typically a favela is started when a large group of squatters occupy vacant land, generally including disused or empty buildings in which to live, that are located at the edge of the cities. Dwellers often make further adaptations to the existing structure (Davis, 2017, p17.). Using salvaged materials and or often stolen materials, which are normally not fit for purpose.

One of the first areas that coined the term favela is now known as "Providência" located in the centre of Rio De Janeiro (see figures 3,4,5), and was started in the late 19th century. It was constructed by soldiers who had nowhere to live following the Canudos War of 1895-1898 (Levine, 1991). Some of the first neighbourhoods were given the name "Bairros Africanos", 'African neighbourhoods' (Radano & Olaniyan, 2016) during the following years, many formerly enslaved Africans moved into the "Barrios Africanos". Pre-dating when favelas came into existence, poor citizens of the former capital of Brazil, were being pushed outwards and forced to live around the edges of the city (Perz, 2000). The late 20th century led to an unprecedented rural exodus, many people living in the rural areas of Brazil transferred to the city in hopes of a better life, similar to the mass migration happening recently from rural areas to urban areas. When they arrived the majority were unable to find a place to live, and many of the migrants found themselves living in favelas. The Brazilian institute of geography and statistics, 'IBGE' showed that in 2010, that within the totality of the country's population, around 6% lived within favelas and slums on the periphery of major metropolitan areas (Censo 2010: IBGE, 2019).



Figure 2 - First Favela in Rio, 1926



Figure 3 - Morro da Providência 1930



Figure 4 - Morro da Providência 1930



Figure 5 - Morro da Providência 1930



Figure 6 - Venetian Square Main Ghetto, Recent

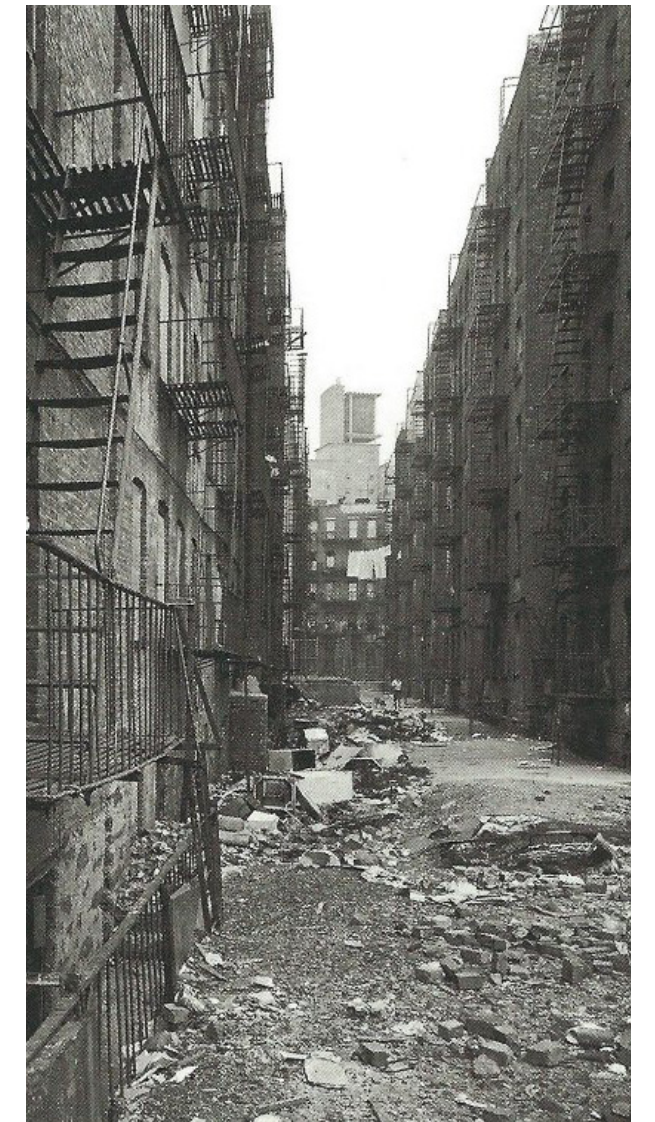


Figure 7 - Harlem NYC Ghetto 1960's

Another frequent word that is commonly confused with slums, and often also used interchangeably with slum and favela is 'ghetto'. A ghetto is often a part of a city whose members are of a particular minority group that live together locally as a result of social, legal and economic pressure. Initially first used to describe the Venetian Ghetto in Venice, Italy as early as 1516 Schwartz, Daniel B. (2019) (see figure 6). It was used to define an urban area of the city in which was predominantly populated by Jewish people who were restricted to live there and gradually became segregated from other demographics within Venice. However, the term has more recently developed to a term used frequently within the United States. 'Ghetto' has developed deep cultural roots within the country, relating to the surroundings

of civil rights and segregation. Leading to being commonly used to describe inner city US neighbourhoods that are mainly populated by low income families of African descent (see figures 7, 9). As defined by the UN- Habitat, a slum dweller is a person or group of persons who; Lacks one or more of the following (UN Habitat, 2007) durability of housing, adequate living space, adequate accessibility to improved sanitation, adequate connection to improved water access and lack of security of tenure (protection against forced eviction).

There are some overlaps between the three words, slum, favela and ghetto (please see figure 8) but within this paper I will be narrowing down the focus to living conditions within slums.

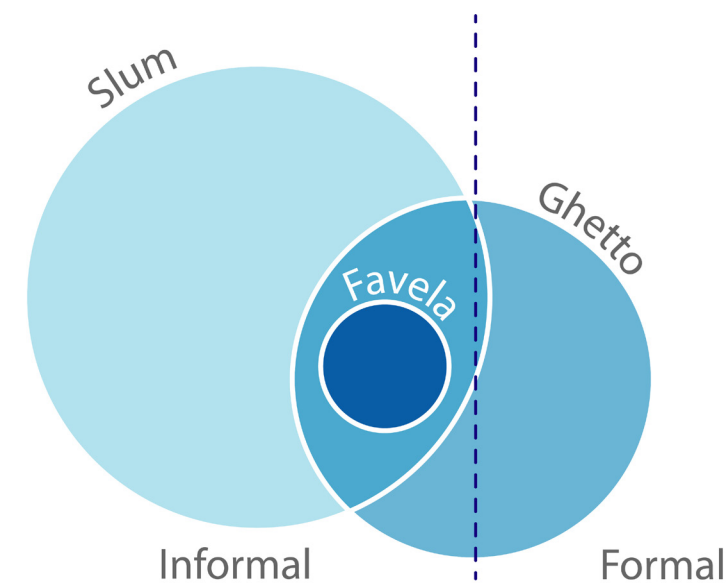


Figure 8 - Slum, Favela, Ghetto Venn Diagram



Figure 9 - Harlem NYC Ghetto 1960's



Figure 10 - UN SDG's 11



Figure 11- UN SDG's 11



Figure 12 - Child labour resulting in health issues, Dhaka, Bangladesh.

Slum living conditions

It is a well documented fact that people are moving towards cities (UN stats, 2021), and a vast majority of evidence shows that people are better off in cities socioeconomically. However, the scale and speed in which people are following this precedent is at such a rapid pace they are forced to live on the periphery of metropolitan areas. (United Nations Sustainable Development, 2021) Out of the 3 billion people that live in metropolitan areas today, 1 billion of them live under the line of poverty, and by 2030, 2 billion out of the 5 billion that are predicted will live under the same conditions. For the first time over a 20 year period the worldwide extreme poverty rate increased. With an estimated 119 million to 124 million people being forced deeper into extreme poverty situations. (United Nations, 2021). This is predicted to cause a generation wide deterioration regarding schooling for millions of children. Over 100 million children have regressed below the minimum reading level, and unimaginably nullifies over two decades worth of educational gains for children of low income backgrounds.

Globally, communities are approaching a critical moment in attempting to achieve the United Nations SDGs. The global pandemic surrounding Covid-19 has affected millions of lives. (United Nations, 2021). Overall the amount of deaths and economic toll is unprecedented since the influenza pandemic of the early 20th century, 100 years ago. Recovery efforts so far have been unbalanced, inequitable and insufficient in trying to achieve the SDG's by 2030. The pandemic will affect decades worth of development gains, further delaying the transition to greener and more sustainable inclusive economies worldwide. Among the 17 sustainable goals set by the UN in 2015, one is dedicated to human settlements and cities. Goal 11 'Sustainable cities and communities' the goal is to "make cities and human settlements inclusive, safe, resilient and sustainable." (UN Habitat, 2021). It set out targets that are challenging to apply to slums

and their inhabitants living conditions. This has worsened due to recent events such as the global pandemic Covid-19.

Sustainable cities and communities will seek out to provide a number of improvements for slum dwellers (See appendix). These categories that have been identified are hoped to increase the living conditions for billions of future people. Unfortunately the progress has been slow and the target goal year has been shifted further into the future due to a variety of factors such as slow uptake and delivery of information, and the global pandemic Covid-19. The initial output of information is generally relayed from NGOs to national government, then to local government, and finally to the people, by increasing the direct information that can be accessed via mobile phones and wireless internet. Slum dwellers and future slum dwellers can more rapidly increase their living standards, superseding the previous slow system.

The pandemic outburst of Covid-19 in 2020, has significantly worsened the plight of slum dwellers (see figure 12) because many of the in progress developments and solutions from the sustainability goals had to be paused for almost 2 years, those who are affected the most reside in the 3 most populous areas for slum dwellers. (United Nations, 2021). More than 1 billion slum dwellers reside in 3 main regions, Eastern and South Eastern Asia totaling 370 million people, Sub-Saharan Africa 238 million people and central and Southern Asia with 226 million people. This equates to almost 10% of the world's total population living in areas with little to no Covid-19 vaccine access, Because of this, cities have become focal points of Covid-19 outbreaks (United Nations, 2021), exposing their current vulnerabilities stemming insufficient sanitation, affordable housing, lack of public health systems, and inadequate urban infrastructure such as water, sanitation and waste services, public transport and open public spaces.

Living within a slum can also seriously affect the lifespan and quality of health for its inhabitants (European Environment Agency, 2021), slums are normally located in areas of high pollution, along major roads, often along major train lines or close to industrial areas of cities. Pollutants from CO₂ emissions such as fine particulate matter suspended in the air and reduce people's life expectancy and perception of well-being. These particles can aggravate many chronic and acute respiratory and cardiovascular diseases (European Environment Agency, 2021). This combined with limited or no access to health care facilities or personnel to identify the problems early, limit the effectiveness of being able to treat and prevent these issues.

The migration to the cities happen regardless of the existence of sufficient housing already prepared for the further influx of people, as the migration will happen regardless (Burdett & Sudjic, 2011). Meaning people will have no choice but to live in already growing slums or favelas or informal settlements in squalled conditions. Within the West, The average family lives relatively well with around 80m² of housing. (Aravena, 2014) However, when migrating from rural areas to urban ones, slum dwellers are found more often being crammed into spaces reduced to 40m² for a family of 4, this 50% reduction in living space is often associated with the lack of money rural populations are able to migrate with, and the rapidly increasing costs to live within a city.

A 0.5 Ha area being used to accommodate 100 families with a liveable space of 40m² resulting in detached housing being able to accommodate only 30 of the families, terraced housing being able to accommodate 30 families (Aravena, 2014). So the most common solution in providing liveable space for all the 100 families is to increase the verticality of proposal, however when using participatory design, this is the most reluctant plan chosen by inhabitants as there will be no room for future expansion. Within developed countries, an acceptable standard of living, in terms of a house, consists of a kitchen, a bedroom, a bathroom and a living room (Minimum space standards, 2020), slum residents rarely have all of these spaces, and often only have 1 room to facilitate all these requirements.

The typical slum dweller lives with drastically significantly lower space than the already reduced 40m², for instance within the slum of Dharavi, Asia's largest slum, it is estimated that around 10-12 people share a slum dwelling of around 9m² to 12m². (C. Gulankar, 2020) They have no separate bathroom or toilet, with the vast majority of them being publicly shared. Shared facilities lead to a greater increased risk of spreading of infectious disease (Davis, 2017 p36), such as typhoid, polio and cholera, and more recently Covid-19, these diseases create enormous life threatening health issues for the slum dwellers.

The traditional process for informal settlements in general is that there are no mortgages but they are seen to be produced on a 'pay-as-you-go' method, where materials are bought daily, weekly or monthly when surplus income allows and over a period of time incremental housing upgrades take place on a vast scale. As they grow many informal settlements gradually become included into the metropolitan area and are granted legal domicile. However, individual projects and interventions can sometimes be seen to hinder citywide approaches and urban connectivity, individuals get used to only pinpoint isolated interventions and are reluctant to take the large-scale approach.

Slums are frequently found on the periphery of a city, but due to the lack of space found within a city centre, they are commonly found along existing railway lines (see figure 12 & 13). This is because of a variety of reasons, initially it provides a route to the city so that they may find work (Totaro, 2016). The routes running parallel to the railway line tend to be the areas where formal housing is not built because of noise, pollution and often where waste material is dumped illegally, creating an undesirable place to live. Therefore it has provided the preferred place for new arrivals to build informal housing. The 5 biggest slums by population are built along existing railway lines (Totaro, 2016); Khayelitsha in Cape Town, South Africa with 400,000 people. Kibera in Nairobi, Kenya with 700,000 people (Figure 13). Dharavi in Mumbai, India with 1,000,000 people (Figure 14). Neza, Mexico with 1,200,000 people. Orangi Town, Karachi, Pakistan with 2,400,000 people.



Figure 13 - Kibera slum trainline in Nairobi, Kenya



Figure 14 - Dharavi slum trainline in Mumbai, India



Figure 15 - Rural amaXhosa village in Zithulele, South Africa



Figure 16 - Rural amaXhosa village in Zithulele, South Africa

Why the move?

1 out of every 3 urban dwellers live in slum conditions, urban expansion has become a simile for slum formation, meaning city dwellers are expanding onto informal land which is not owned by themselves. Therefore, ignoring the basis of urban plans and ordinances (Vidal, 2003), this affects the sustainability of cities and can sometimes lead to slower social housing projects to house those who have moved. Because of the 'Urban millennium' transition in 2008 slums are set to increase. One of the main reasons is of course, economically. The majority of the total world's gross domestic product is estimated to come from urban areas, 70%, contributing enormously to the economic growth and prosperity for millions of people, a further key factor in why people are moving from rural areas to metropolitan ones, even if it reduces living standards and life expectancy

Because of these staggering numbers it is estimated that a city with an inhabitant of 1 million people will need to be designed and built every week until 2030 (United Nations, 2001). And predicting further to 2050, there will be 7 billion people living in cities or its periphery, resulting in an increase of 2 billion people in the 20 year gap (United Nations, 2001). Increasing the need for a 1 million inhabitants city from 1 per week to 2 per week for 20 years, when using the current prediction in population growth.

As a result, 156 out of the 195 countries in the world have developed their own national urban policies (UN stats, 2021). With just over half of the included nations being in the implementation stage of the process, and 40% still being in the early stages of developing theories in how to solve these issues (UN stats, 2021). It is also documented that only half of the world's total population is considered to be in a convenient radius of access to reliable public transport services (UN stats, 2021), this is defined by being within 500m walking distance to a bus stop, or other low capacity transport link, and also be within 1000m of walking distance to a railway station or ferry terminal.

The greatest population growth predictions are expected to be in those countries that already have a high slum population (Burdett & Sudjic, 2011). However they are also the same places where mobile phone ownership and wireless internet access is set to rise rapidly (ITU, 2020). Particularly in the developing world where in 2005 8% of people had internet access increasing to 47% in 2019 (ITU, 2020). When people migrate from rural areas to urban areas and unfortunately find themselves in a slum,

one of the first items they seek is a mobile phone. Ownership of one can provide enormous benefits in the ability to look for work, exchange money without a bank accountant and provide access to information via wireless internet access (Reglitz, 2019). With these increases in population and their subsequent access to more available communication technology (Piper, 2020), participatory design principles can reach the predicted population increase quicker and provide better sustainability within new slum settlements.

Worldwide the percentage of slum dwellers are increasing, Europe, America, Australia, Canada, Japan and New Zealand is currently at around 6%. Northern Africa, South Eastern Asia, Western Asia is currently 25-30%. South America, Eastern Asia is between 30-50 %. Southern Asia is between 50 - 70%. (Acioly, 2014). The worst affected area is Sub-Saharan Africa with 70%+ of the people living in slums. Recently, increased research focuses on resolving those issues exploring top down and bottom up strategies with an increased interest in participatory design models (Ratti & Claudel, 2015 p24).



Figure 17 - Wealth divide, Dharavi slum India.



Figure 18, Top - Incremental housing finished stage. Figure 19, Below - Incremental housing with family development.

What is participatory design ?

Participatory design is where those people that are to be impacted by the design have the opportunity to have a say regarding the outcome. Many urban planners and architects are developing in providing participatory design processes, as it is seen as integral to providing happy and healthy communities. When in contact with the end user, architects and urban planners can contribute in providing results that are often transformative to the region (Ratti & Claudel, 2015 p49). As well as the user, participatory design also requires the input of other stakeholders during the project. Participatory design is something that is founded in the needs and/or wants of the stakeholders, the ones who are going to live within what is being designed.

To be effective it is important to engage the people on their own terms, to discover what is important to them and what their perspective is, which is normally different all over. It is important to ask the right questions, something that is inherently dependent on who is involved, what the issues are, and what the end user thinks they are trying to achieve (Ratti & Claudel, 2015 p51). Some of the most important and critical information gained come from side conversation with the participants for whom you are designing. This leads to the designer making sure all of those resources are respected and catered for equally and that the final outcome is necessary and helpful. There is an element of negotiation regarding participatory design, it is not just a collection of desires from the end users, but a collaboration from all parties involved to provide the best outcome.

Participatory design has struggled to effectively work on larger scales within growing communities of people. These

people interact in thousands of different ways throughout the course of a day, whether visiting the supermarket, cycling to work, walking to and from school or even leisure activities in public green space. The design of the local environment can immensely impact these various areas of social interaction which connect people during their lives, it can become the precursor in seeking a foundation for stronger communities that contribute in co-creating their local environment.

Participatory design normally encompasses two approaches, a top down approach and a bottom up approach, that try to meet in the middle to provide the outcome. (Semeraro et al., 2020). Within a slum the residents would be considered to provide the bottom up approach, and the authorities would be the top down approach. "The aim of participatory design is not to change the rich culture that already exists, but rather to understand it deeply enough to design a space that is useful to and reflective of the community." (Epitunhabitat, 2012)

Within participant designs' bottom up approach, the basic needs are the most common and important things to bring into fruition for the residents (Ratti & Claudel, 2015 p24), the vast majority have no electricity making even the most common daily tasks hard to achieve. Within the top down approach the city authorities try to pre-empt the infrastructure and services that should be in place in order for a basic standard of living to be achieved, plumbing, drainage, waste management and electricity. All in order to avoid the traditional slum environment. Participatory design seeks to provide a middle ground and communicate the limitations of certain projects between all stakeholders.

Many participatory design approaches regarding slums are usually focused towards providing a communal space as designing liveable accommodation is tricky due to local law regarding livability status (Epitunhabitat, 2012). Community centres become the hub of the newly formed community and serve as a space for a variety of activities such as a make-shift school, a place of worship, a library, medical centre, nursery, and a community meeting point.

One of the current issues regarding this process is that designs begin to take place before participatory processes happen, this creates a flawed dynamic in that an idea of a design is implemented before any input has occurred. It would be better to understand where people live, work, play, learn, before ideas take place. Participatory design is often seen as an additional task that delays the process but it should be one that is of common practice and everyday inclusion, the social needs, cultural needs are just as important as their physical needs. (Acioly, 2014) Architects must be able to understand the context not just physically, but the social, political, cultural, historical, demographic factors.

In order to provide participatory design it is important to go where the designs are to be implemented, it is unachievable for a slum resident to venture to an architecture office, therefore the architects and planners must go there (Acioly, 2014). It places the user central to the design process, serving as a bridge between design professionals and the general public. Outcomes work better and are engaged with by the user more often when their input is considered, especially when designing a piece of a city.

Within thousands of informal settlements, the vast majority of residents live with communal toilets, shared water taps. Due to the materiality and proximity of housing there is a huge risk of fire. When implementing construction, they are often built by a variety of 'professionals' and locally employed residents that work together to construct the dwellings (see figures 20, 21). This helps to not only provide crucial education and skills to the residents, but also improve their economic standing, whilst also providing a sense of ownership to the place in which they will reside (Marques et al., 2018).



Figure 20 - Participatory design housing, manufactured vs lived within.



Figure 21, Top - Families adding to participatory housing model, Figure 22, Below - Participatory housing gradual additions.



Figure 23 - Bangkok, Thailand Slum to hi-rise building.



Figure 24 - A Neighborhood from Dominican Republic

Street Led Improvements

Streets within slums are seen as the physical entity for which mobility and accessibility take place, not only is it the normalised pathway for sewage pipes but also the most common route for power lines and drainage systems (Acioly, 2014). The street can also be seen as a public space, where social, cultural and economic activities take place within slums providing an informal economy alongside the informal living. This in turn spurs growth (Latouche & Macey, 2013 p29), and further helps increase the slum living standards.

Something as simple as a street can become a vital element in improving the quality of life in urban peripheries, it helps forge an identity to the area, places names in which outsiders can navigate (Ndugwa, 2019), and also give distinction to where communities and businesses are placed by creating a physical address of people and businesses progressing the legalisation of that slum. This creates a legal definition of the area, and can lead towards property rights and property taxes. Streets also define the urban pattern that will eventually become a future neighbourhood integrated into the city. The street creates the condition for socioeconomic integration (Tiwari, et al. 2020) and also curb the social exclusion from the rest of the city.

As soon as the streets are implemented, residents start investing in the new social domain (see figure 25) creating opportunities for business, allowing for services for the residents and also providing income generation for the area (Acioly, 2014). Allowing for gradual evolution of the slum into a better place to live. Simple acts such as street naming and building numbering greatly improve the area. This is due to providing basic information that can help assist a variety of different aspects, such as legality and

provide accurate descriptions in order to serve the community with health, fire and police services. To enable slums to benefit on a vast scale, many architects and urban planners see avoiding the small and individual project based contributions in favour of a more systematic and programmatic approach such as providing a street first and foremost.

Providing the road first enables accessibility and mobility, increasing the chance of providing better quality materials to the area (Totaro, 2016), and providing residents a more reliable way in which to travel to and from work. This will allow the future of slums that are predicted in the coming generations to be connected to the city in a more cohesive way. If these implementations are successful prior to millions of rural migrations, it will enable interactions to happen quicker, and reduce the need to further disrupt people by moving them after the fact, when they have already made their homes. It could also provide the opportunity to connect the informal settlement to the formal settlement.

Some of the major obstacles regarding upgrading via streets, is the conventional planning systems in these areas. Dealing with existing settlements which involves a completely different variety of issues when compared with dealing with a pre-emptive open piece of land strategy (Goethert, 2014). However pre-empting the move has a downside in which there is a possibility that the anticipated or predicted influx of people does not arrive and that the money is wasted (Totaro, 2016). Whether this would be more or less cost effective than implementing design strategies in order to increase living standards for dwellers after they have moved in.



Figure 25 - Favela in Sao Paulo, Brazil. Street led improvements.

Human resources at a local government level are not sufficiently skilled or necessarily up to date with how best to design citywide programmatic solutions at varying levels of complexity. Local governments don't have the same autonomy, and some cities avoid engaging with slums directly (Goethert, 2014). This could be resolved in the future by increasing and providing better training solutions regarding participatory design principles to varying levels of local authority.

Another huge contributing factor is that the scale in which people are moving to these city peripheries (United Nations, 2001), is vastly greater than the capacity and resources available in order to produce adequate housing and the basic liveable conditions. To provide a solution to this problem architects and planners have proposed dwellings that are partially built, with the main services in place along the street but leave rooms within the dwellings partially unfinished so that they can be completed when the families have secured enough money. Some Architects such as Alejandro Aravena have designed dwellings that provide space for the houses to be expanded in the future. This is considered to be an incremental housing strategy (see figure 21).

Participatory design must involve citizens and stakeholders from the very beginning, plans can be seen as a dynamic process which inevitably evolves, people have been living there for years and generations. The street can be seen as the starting point of the plan, and provides the subsequent development and

integration of slums into the formal city as well as to provide a case for future legal status of the residents (Totaro, 2016). The slums will fundamentally lead to a street pattern which will integrate with the private and public spaces of the city.

When having to deal with the more evident adverse circumstances of life within an informal settlement relating to their physical security and health, families are often unable to think of long term plans for their future (Zerbo et al., 2020), all the homes are considered temporary as they are unsure when the eviction act might come. A participatory approach is generally seen as a good thing as it brings everybody on board from the initial outset. Small interventions eventually lead to the local people embracing the changes and the new activities because of it and very importantly they gain a sense of ownership enabling the maintenance of the project's future.

Enumeration of the properties and mapping the area define the size and scale of the slum problem (Ndugwa, 2019). It is key to define who lives there and what conditions are found in the slums, no two are exactly the same therefore each would need varying levels of implementation in order to make living standards better. Enumeration and mapping also drastically improves the accessibility of the slum (see figure 27), allowing for services to reach residents. Accessibility regarding construction also increases allowing slums to develop over time rather than deteriorate further into undesirable living conditions.



Figure 26 - Dividing line between the Kawangware slum, Nairobi Kenya.



Figure 27 - Slum in Port Blair, Andaman and Nicobar Islands, India

An informal economy is considered to be a key lifeline for many city inhabitants, often providing the only opportunity for the vast majority of urban workers to earn a living, it helps provide flexible services to residents and make enormous improvements economically to city dwellers. (Piper, 2020) However, vast diversity makes the informal economy hard to effectively implement into an urban process policy for slums. Because of the unofficial nature of this employment area, many of the workers are exposed to precarious work, exploitation and harassment, as well as being in constant threat of eviction from the slum where they reside. Noticing the contributions that informal workers make towards the city's economy should force urban planners to provide settlement upgrading.

There is no specifically acknowledged definition for the term 'informal economy' the scale and output of informal economies are huge. Sometimes informal work is considered to be the norm in many countries. In many countries the proportion of informal work is increasing (Harvey et al., 2012). This can be caused by an influx of people, urban migration from urban areas, international migration, and war or climate change circumstances that displaces populous areas of other regions.

The economic output of the informal economy is not well documented. Urban figures are difficult to obtain and there is a lack of surveys and reliable statistics. Many informal jobs use public spaces in order to facilitate their means of livelihood such as people selling food on publicspacefurther reducing publicspace. This in turn reduces means in which maintenance can take place whilst simultaneously providing a greater need for it to happen (Harvey et al., 2012). Informal transportation workers require space to park cars or motorbikes, and also perform maintenance on them at the road or pavement. These by-products of living in tight, cramped conditions further reduce the livability of these slums, further reducing the quality of life, and standards of living conditions, due to waste that is thrown onto the street providing the ideal environment for insects and rodents, whilst noise from vehicles

is abundant and further increases the CO2 in the area promoting urban pollution affecting millions of people.

Not only are slum dwellers living in cramped and uninviting accommodation, many informal workers choose or have no choice to set up home offices within their dwellings such as hairdressers, restaurants, clothes shops and even waste recycling.

Most of these transactions take place via a mobile money service, such as M-Pesa, which is the largest and most successful in Africa (Piper, 2020). 'MPFI' which is the largest in India, and has dramatically increased between 2014 and 2019 (Piper, 2020). These mobile money services are enormously valuable economically, and for informal settlements they are key resources in the way in which they live, furthermore a slum dweller does not even require to own a mobile phone but only the sim card in order to pay and receive money.

A sim card is openly accessible and unlike a bank account does not require a fixed and legal address, this allows slum dwellers to use digital money rather than hold and secure a mass amount of cash (Harvey et al., 2012). Because of this new way in which money is transferred the rate in which mobile phone possession in slums has risen by up to 63% of people, a place in which 34% have no toilet. With no need to hold large amounts of money, the rate of theft has dropped significantly, this has improved the social conditions in which slum dwellers live.

Because of the rise in mobile phone ownership (see figure 28), there is a huge potential increase in productivity of the informal economy and has potential to vastly increase the rate and effectiveness of participatory design to improve living conditions can be achieved on a far more vast approach than in previous years (Piper, 2020). This can increase the access to the amount of people for the bottom up approach to the top down approach is greatly increased (Ratti & Claudel, 2015 p24), in turn the needs and outcomes can be better defined and accommodated for.

Moving from informal to formal for people is not an instant process but one that takes a process of time to achieve (Acioly, 2014). When migration happens to a city, the areas which are built on are normally those which are of low quality, but once the informal city moves in to occupy these areas and the economic output grows, these areas are often deemed as valuable plots of land in the expanding metropolitan area. So inevitably the informal tenants are evicted and moved away in order to build a new infrastructure, historically they have moved them into vertical housing, which in reality have become undesirable formal housing and places that turn into ghettos.

This is currently happening in areas where slums are prominent such as Kowloon, in Hong Kong, and Mumbai in India the extrusion in verticality is seen as a solution to one problem, that is to house as many people in an square area than before, and often the outcomes are still squalled, cramped, with little natural light openings (Acioly, 2014). These are still reminiscent of a slum but with the change to formal legality from informal legality, the

people are the same as before. Poverty only changes the affordability, not the aspirations.

As architects know when building high density vertical housing solutions, they will often lack natural light, this is because the living areas towards the top are acting as a canopy to those along the bottom preventing lower level dwellings the opportunity to have larger amounts of natural light. A further lack of ventilation leads to unhealthy conditions, and the normal process for these are ones in which participants' design is not taken and the needs and/or wants of the users are assumed rather than defined before the design begins. And after being forced to move into a formal society they often start out as a desirable architectural photo, but once the liveability of the people take place they often change the outcome. Creating a cycle of slums to social housing and back to slums again (Acioly, 2017). Participatory design creates a pivotal opportunity to allow for the end user of such design to be involved from the very beginning.



Figure 28 - Slum dwellers in Kolkata, India with mobile phones.

Sustainability within slums.

It is clear that slums develop due to a lack of affordable housing availability (Acioly, 2014), this combined with a lack of appropriate planning have further increased numerous cities' inability to meet the requirements and needs of their local population. Additionally, the city should also uphold a further requirement to the sustainability of their local environment (Totaro, 2016). Slums & Favela's have become places in which sustainability has been quickly forgotten about, even the slum itself can not sustain from ongoing developments and absorption into the city in which it resides on the outskirts of and commonly referred to in the greater metropolitan area of it.

Energy sustainability within slums is almost obsolete, there can be a few reasons as to why this is commonplace, firstly the imminent needs of the populous living there supersede their future needs, meaning that surviving today outweighs the preparations in surviving tomorrow. Secondly their lack of economic sustainability results in little to no funds, which could enable the ability to provide good reasons for environmental sustainability. However, after discussing various aspects relating to economic sustainability and the wide approach to receiving and distributing money via mobile phone technology (Piper, 2020), there can be a new approach in how environmental sustainability can be tackled within these areas.

Material sustainability within slums is something that is hard to quantify, along with where these materials come from and if they are recycled or not, the latter is more commonly assumed. Participatory design should, along with the input from the community at the initial stages, seek to prove that materials are reasonably and sustainably sourced to a degree. This can help solve a number of issues that are already plaguing slums currently. The correct choice of materials can result in better accommodation when used correctly, ultimately leading to a greater quality of life.

Of course, the biggest obstacle for slum dwellers is money, sustainable materials are perceived to cost more, so naturally slum dwellers are forced to use cheaper materials and make do. But due to a lack of skills and knowledge vast amounts of material waste take place when slum dwellers construct their own domicile. If a mobile phone can be used for negotiating payments, then it can be argued that with internet access (Reglitz, 2019) it can aid in the construction of slums so that they become better than they previously were. Many companies are seeking to provide fast and reliable internet access to urban peripheries and some are even seeking to provide internet all over the world (Duffy, 2021). With the ephemeralization of internet technology (Duffy, 2021) and mobile communication (Piper, 2020) many academics argue that free internet access (Reglitz, 2019) should be classed as another basic human right - "Free internet access must be considered as a human right, as people unable to get online... particularly in developing countries... lack meaningful ways to influence the global players shaping their everyday lives" (Reglitz, 2019). Combining this with open source information can vastly widen the audience in which participatory design principles can reach slum dwellers.

Merten Reglitz (2019, p314-331) argues in his paper that "...rather than being a mere luxury. Internet access should be considered a universe entitlement because it is necessary for people to be able to lead minimally decent lives." Providing slum dwellers with free internet access will not only vastly increase their ability to improve their economic standing, it will also allow them to greatly improve their access to educational standards, if desired. These two combined will lead into a further understanding and ability to act upon the area in which they live and potentially allow for the environmental sustainability within slums to take place.

As previously argued, internet access can be influential to accessing a wider audience when contributing to participatory design within slums, but if it is to be implemented, internet access will need to be free or have little cost implications for slum dwellers. Many cities around the world, particularly the larger capitals, are already offering free public wi-fi, with hotspots available at places including restaurants, cafes, shops, airports, and even trains.

Many slum settlements are built in areas of cities that would normally be deemed undesirable, such as train tracks (Totaro, 2016). For example slums are found near the Dahisar railway track in Mumbai, India (see figure 30) and more notably the Kibera slum located on a railway in Nigeria (Totaro, 2016). Therefore, it can be argued that if new infrastructure is being built to provide public transport for the new influx of people in the future generations, by 2030 and 2050. Then it can be a reasonable debate to provide free internet access near or close to their proximity (Ratti, C., & Claudel, M. 2015 p69). Much like providing the street approach as a precursor to slum dwelling being built to enable accessibility routes, pre-installed internet access can be equally as important in being able to educate slum dwellers who have little to no experience in constructing dwellings and accessing open source information to do so. Making dwellings better, firstly in material accessibility, and secondly in construction methods. Ultimately resulting in a better standard of living (Totaro, 2016), reducing

future maintenance and decreasing risks such as fires and building collapses.

Owning a mobile phone has become common even with slum dwellers, it is reported that over 65% of slum dwellers in India own a mobile device (India Gov, 2011). With free internet access available to the widespread ownership of mobile phones in slums, it is reasonable to assume that an open source system can take place in which future slum dwellers that are migrating from rural areas in vast numbers according to the 2030 and 2050 assumptions (Ratti, C., & Claudel, M. 2015 p68). Governments, whether national or regional or even NGOs, can provide basic information regarding slum dwelling material choice and construction methods in order to improve their baseline living standards.

Digital methods have become more popular in recent times in providing education standards to slum dwellers, such as the 'slum2school program' in Africa (Ukomadu & Chile, 2020). So it is reasonable to assume that open sourced information regarding dwelling construction will improve the construction methods of slum housing. A participatory design model can be designed in preparation for the predicted settlements and an open sourced platform can be used to distribute the information to the future residents and gather feedback. It can even be done prior to moving and perhaps further inform the immigrating populace what needs to be done. This system can also be implemented with the previously mentioned



Figure 29 - Slum along traintracks, Thailand.



Figure 30 - Slum along the Bandra Railway Station, Mumbai, India

street first model and the incremental housing approach, in where new slum dwellers that arrive without prior knowledge can be notified by residents, friends or family that currently reside there, providing information on how to source materials, which will hopefully be reasonably sustainably and easy to learn construction methods in order to build it.

Combining mobile phone ownership with free internet access (Reglitz, 2019) available to the widespread and prevalent usage of mobile phones in slums (ITU, 2020), it can be assumed that an open source system can take place in which future slum dwellers that are migrating from rural areas in vast numbers according to the 2030 and 2050 assumptions (United Nations 2001). Governments, whether national or regional or even NGOs can provide basic information regarding slum dwelling material choice and construction methods in order to improve the baseline quality of life. Digital methods have become more popular in recent times in providing education

standards to slum dwellers (Ukomadu & Chile, 2020), by open-sourced information that is readily available over wireless internet.

It is reasonable to argue that open sourced information regarding dwelling construction will improve the construction methods of slum housing as long as it is free (Ratti, C., & Claudel, M. 2015 p68). A participatory design model can be designed in preparation for the predicted settlements and an open sourced platform can be used to distribute the information to the future residents, it can even be done prior to moving and perhaps further inform the immigrating populace what needs to be done. This system can also be implemented with the previously mentioned street first model, and the incremental housing approach, in where new slum dwellers that arrive without prior knowledge can be notified by residents, friends or family that currently reside there, providing information on how to source materials, hopefully reasonably sustainably and construction methods in order to build it.



Figure 31 - Slum Dweller with mobile phone Kenya East, Africa.



Figure 32 - Shimla, Himachal Pradesh, India

Conclusion

Slums facilitate the area in which people occupy when moving to the city for a better life. Although housing was not the predominant reason people move from rural regions to urban ones (United Nations 2001). Housing should be considered a key basic right for people of the 21st century, and slums barely facilitated this need in the most basic sense of 'shelter from the environment'. However, the basic need of housing should go far beyond the current conditions in which people are living.

After concluding what the definition of a slum dweller is and the defined region in which they occupy. It is clear that through participatory design principles and technological advancements, a slum should not fall back into similar outcomes via previous efforts when upgrading living conditions within them. Reducing forced formal change on informal areas too soon creates ghettos (Davis, 2017 p137). Implementing participatory

design principles from bottom up processes (slum dwellers) to balance those from top down processes that come from local and regional governments to define the best outcome, a sense of ownership can be created (Marques et al., 2018). Participatory design interacts with the physical space but also contributes to the social dynamic of the area, creating better environments in which to live, work, play and bring in the next generations after it. By providing the 'street' in which slums are initially built around in the future will go towards preventing a myriad of current problems that happen when new slums are formed. The street or rail line can determine the route in which jobs are accessed. It provides the main link to public transportation and very importantly, allows for the transportation of goods to service and flow into the slums. Without a clear passage network, maintenance is unlikely to happen, replicating the slum-ghetto-slum cycle (Davis, 2017).



Figure 33 - Children Playing Nairobi, Kenya

Due to accessibility issues within and to slums, and without maintenance, slums do not stay as they are but degrade even further over time. By combining participatory design principles with the street-led system, solutions can be achieved, especially when further combining them with mobile communication empowerment. Mobile phone ownership has already become very common with slum dwellers (ITU, 2020), and is only set to increase. It is not only a way to communicate but a further solution to drive economic amelioration (Piper, 2020).

After initially assessing what is considered to be a slum and the conditions that people are subject to living in whilst trying to improve their standard of living. Slums are considered to be compact, dangerous and uninviting areas where families are forced to live on top of one another and share facilities that are traditionally considered for the individual family within more developed regions. Slums and their dwellers are subject to some of the harshest outcomes of the Covid-19 pandemic forcing many of them to fall deeper into poverty (UN Stats, 2021). Due to predominantly working informal jobs no legal requirements where needed to be kept during Covid-19 or be covered by any sort of compensatory scheme, that many dwellers of more developed nations were subject to. Due to the compact nature of them they caused vast spreading of the infectious disease more rapidly than other areas of the city, slum dwellers had little access to medical treatment and due to the tight knit buildings, no dwelling enumeration and limited road access many people were subject to very little medical care. A participatory design and street-led first approach are two intrinsic aspects that can help prevent any unnecessary similar outcomes for future slum sites.

The UN has set out a collection of very ambitious goals with number 11 being a key issue that has been discussed in the slum living conditions section, however it would be untenable to think that without participatory design principles combined with the argued advancements in technology (Reglitz, 2019) that this outcome will

be achievable in the near future, as hoped for. Resulting in millions of future slum dwellers to live with the current standards of living or worse.

Ephemerization of mobile technology and internet access (Reglitz, 2019) will provide a far greater and more broad approach to improvement for slum living conditions via participatory design principles. This will only become greater as the amount of mobile phone ownership is set to further increase in South Asia and South America more rapidly (ITU, 2020). It will play an even larger part in creating an informal economy for the billions of slum dwellers (Piper, 2020) that need to make a living in order to be able to afford the dwelling improvements.

Arguably one of the most important aspects in slum upgrading can be the implementation of free wireless internet access (Reglitz, 2019) as a precursor to future slum settlements. If providing an initial street and allowing dwellings to be built near them, similar to train lines. Wireless internet infrastructure can be installed at the same initial infrastructure implementation and provide enormous quality of life increases. It will serve as the best tool in providing wide spread basic education for children (Ukomadu & Chile, 2020), provide economic relations across social dynamics and provide access to information. Perhaps even open sourced NGOs & government guidelines, in how to select materials, and construct them within future slum settlements can be produced.

A potential next step would be how best to contact and identify the needs of different slums in global areas, and allow people to confidently contribute to the final outcome, further creating a sense of ownership of the place (Marques et al., 2018) ultimately, creating a better slum physically and socially. Large scale demographic efforts to provide information on how to upgrade slum dwelling can begin to be accessed via mobile phones with internet access. Modern accessibility tools provide practical and feasible advantages to those who require them, but they can also change the mindset and attitudes of those who do not.

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Appendix - A

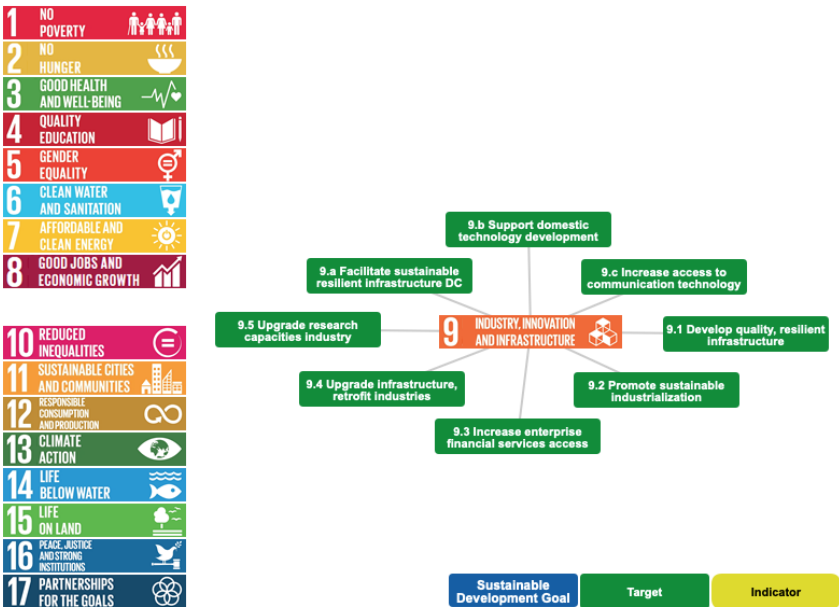
Sustainable cities and communities, will seek out to (UN Habitat, 2021)

- Provide adequate shelter for all.
- Improve human settlements management.
- Promote sustainable land-use planning and management.
- Promote the integrated provision of environmental infrastructure: water, sanitation, drainage and solid waste management.
- Promote sustainable energy and transport systems in human settlements.
- Promote human settlements planning and management in disaster-prone areas.
- Promote sustainable construction industry activities.
- Promote human resource development and capacity-building

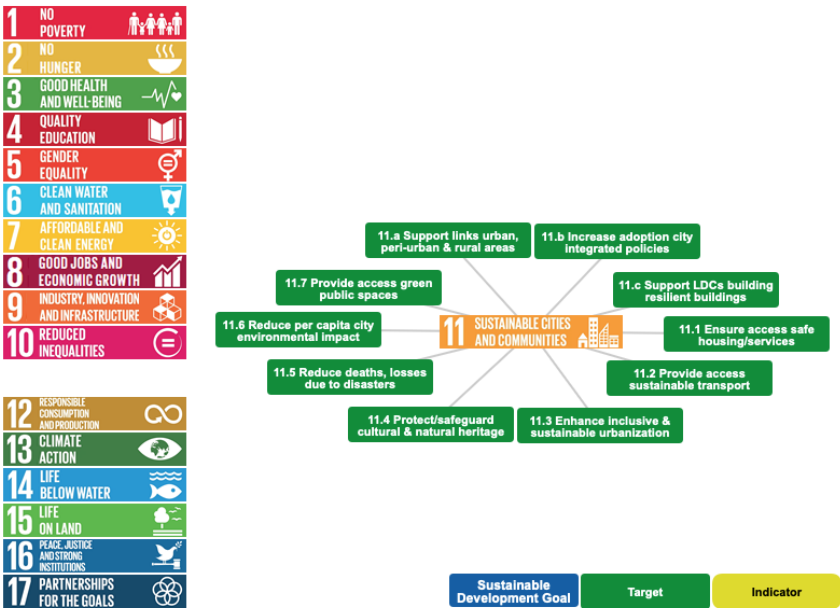
Appendix - B



Appendix - C



Appendix - D



Slumming it, Better.

End
