

Innovating for Children in an Urbanizing World

a use-case handbook

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a use-case handbook

This handbook seeks to outline opportunities for design, technology, and social impact communities to work together in creating technological innovations that improve the lives of vulnerable children in cities. It highlights the urgent need for innovation on behalf of children in the context of a rapidly urbanizing planet, and also offers guidance on specific approaches and principles--through the lens of UNICEF's innovation priorities.

This handbook is written with a diverse audience in mind, and we hope it will serve as a helpful road-map for all readers on how we can think about designing solutions for children in an urbanizing world. However, we want to note that this is not a UNICEF report, memo or guidance-- it is intended as an external document mainly for technologists, designers, and social impact entrepreneurs in the private sector who are looking to support UNICEF's mission through innovative work.

UNICEF Innovation is an interdisciplinary team of individuals around the world tasked with identifying, prototyping, and scaling technologies and practices that strengthen our work for children.

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Why urbanization?

What challenges do children face in a rapidly urbanizing world, and how can technology-based innovations help to address them?



Why urbanization?

Cities are centers of the greatest human challenges and opportunities. **Today, cities are home to over 55% of the global population and generate more than 80% of our global GDP. The fastest growing cities are in Asia and Africa, and these are largely untapped and growing markets.** Many who move to cities are spending more, but still lack access to the basic services, infrastructure, information, opportunity, and choice required to survive and thrive in the age of urbanization. **By 2050, over 66% of the global population will reside in cities, and 92% of this urban growth is expected to occur in the Global South.**^[1] Amidst this unprecedented and transformational urbanization, there is a growing need to address emerging challenges and tap into new opportunities, especially as they relate to vulnerable children and youth.^[2]

Technology-based solutions can help bridge gaps and open doors--both online and on the ground-- providing greater access to information, faster and more affordable communication, and expanded choices, all of which can directly contribute to safer, healthier, more equitable and inclusive conditions for children. Technology already affords widely accessible advantages ranging from instant access to crowd-sourced information, to participatory engagement platforms, to mobile financial services, to free messaging opportunities (WhatsApp, WeChat, etc.). These new ways of connecting people to information, to decision makers, and to each other has especially huge potential for those at the margins, and particularly for young people. Meanwhile, emerging “higher tech” innovations such as sensor based and Internet of Things (IoT) technologies, can equip cities and their partners with the abilities to measure, alert, understand,



and respond to urban citizens’ needs. When deployed in the right way, emerging and existing technologies can be critical in shaping cities to be centers of liveability, productivity, opportunity and growth for children and their communities. We know that cities are hubs of diversity, growth and innovation, and they should provide boundless opportunities for young people to survive thrive, learn, participate, integrate and reach their full potential.^[2,1]

However, the benefits from technological innovation and urban growth are not yet reaching all of those in greatest need and adding value to their lives. Today, people often require access to technology and an understanding of it to be employable. At the same time, many products and services that are critical to advancing in urban life are designed for the already wealthy and technologically savvy. While vulnerable populations, and children in particular, stand to gain the most from access to emerging tech services and products (online education, youth engagement platforms, transportation access tools, job portals, etc.), these require constant connectivity, and are not designed for, or with, the urban poor.

In the Global South, **digital disparities can deepen poverty and marginalization**^[3]-- and a lack of accurate assessment methodologies for measuring connectivity and access to specific technologies (especially across gender, culture and economic demographics) often prevents us from knowing where this digital divide is most problematic. In addition, many emerging technologies bring up new challenges in terms of protection and privacy, and even introduce new channels and vectors for exploitation and child trafficking. Considering this global reality, we can see a pressing need to make sure technology is used **appropriately** and **safely**.

The yet untapped potential of technology that we seek to explore in this handbook lies mainly in its ability to support efforts that:

1. Improve vulnerable children’s access to **urban infrastructure and services**
2. Connect urban communities with the tools, services and relationships they need to **measure, alert, organize and respond** to specific urban concerns
3. Expand **urban planning and policy processes to include vulnerable populations**, especially youth
4. Improve our sense of **what specific problems exist where, and for whom**
5. Mitigate and prevent the negative impacts of urbanization on vulnerable urban populations

The way urbanization shapes our world will define the chances for individuals, communities, cities and entire regions to either thrive or collapse, making the task of guiding urban growth towards sustainability and equity a global imperative. The lives and futures of children and youth will be critically defined by the shape that cities take. We want to encourage the idea that all of us--makers, engineers, do-gooders, executives, computer scientists, academics/ researchers, inventors, innovators--can come up with technological innovations that are not just nice to have, but that children in the most challenging urban settings *need*.

An opportunity to do good business by doing good in cities

“The interests of children and of business are inextricably linked, as resilient and sustainable societies and business environments will only be possible if the fundamental rights of future generations are protected and promoted.”^[4]

Children in Humanitarian Crises

Current estimates suggest 300 million children live in urban slums, where living conditions are at their worst and opportunities for individual and community growth are severely limited.^[5] Their lives and futures will be defined by the shape that cities take more than anyone’s. While local governments must ultimately provide the essential planning policies, services and infrastructure that form the foundations of livable cities, we see a need and an opportunity to harness the potential of collaborative, cross-sector innovations -- both products and processes-- to meet the emerging needs of children, families, communities, and businesses in rapidly urbanizing contexts. As a majority of “smart city innovations have their origins in the private sector,” it is essential that the private sector take an active part in expanding the focus of such smart city innovations to include challenging urban environments.^[3]

Technology-enabled products and services that address the growing challenges of an urbanizing world can dramatically improve quality of life for the urban poor, especially women and children.

“The informal economy accounts for \$10 trillion per year, which means that if it were its own political structure, it would be the second largest economy in the world.”

Robert Neuwirth

In taking a social impact approach to addressing the challenges facing children in an urbanizing world, we see great potential to do good business while ensuring that:^[6]

Every child survives and thrives

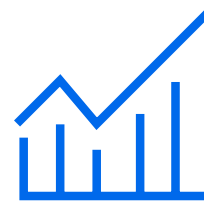
Every child learns

Every child is protected from violence and exploitation

Every child has a fair chance in life (equity)

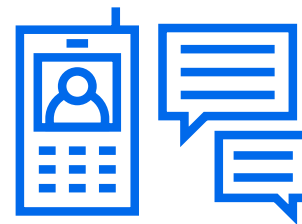
Every child lives in a safe and clean environment

The opportunities to apply technologies to support vulnerable children in urbanizing areas are also opportunities for good business. Emerging markets hold largely unexploited possibilities for technology industries for the following reasons:^[7]



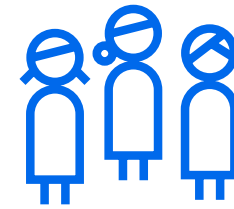
Population Growth

By 2050, almost all of the additional 3.7 billion people on the planet will live in emerging economies. Continuing population growth is projected to add 2.5 billion people by 2050, most in urban areas and with nearly 90% of the increase concentrated in Asia and Africa.^[8]



Information Services

Communication technology is particularly important for emerging markets. Mobile services are already available to a larger portion of the population than many other basic services, including electricity, sanitation and financial services.



Youth Demographics

The early technology adopters (i.e. young people) will live in emerging economies. Today, 2 billion people (out of 7B) on the planet are below the age of 25. 90% of these people live in emerging economies. Africa’s young population is expected to rise 10% by 2040, while the shares of all other regions will decline.



Middle Classes

After Asia, Africa has the fastest growing economies. By 2020, more than ½ of African households are projected to have discretionary income. By 2030, 66% of the world’s middle class will be located in Asia. Most of this growth will be in the consumer product space, especially in the technology sector.



“Today of every 10 urban residents in the world more than seven are found in developing countries”

UN-Habitat State of the World's Cities, 2012

About this handbook

How can we describe the issues that UNICEF, local community members and the technology community are trying to solve, together? How might technologists, urbanists, designers and data scientists join those working in social impact in developing ideas for urban technology that could have an impact on seemingly intractable problems? What are the situations, scenarios and constraints for which urban technologies might be applicable? How can we ensure that our technology-based solutions avoid contributing to digital disparities, and are sensitive to privacy, safety, and security issues?

Sample use cases and design principles should inform these solutions. Building products and services for children in urban environments requires an insight into that environment, the context of need, and an understanding of the end user. There are many considerations in creating technologies for these types of needs. We must ask the questions:

- **What are the potential economic and social opportunities and risks emerging from rapid and unplanned urban growth, and how do they uniquely affect vulnerable children and families?**
- **What do we mean by urban technologies? What developments and applications are emerging in the space of urban technologies today that are relevant for the Global South?**
- **How might we design urban technologies to succeed within the constraints of Global South city settings?**
- **How can we design technologies *for* and *with* urban poor children to augment the chances that they are used?**
- **How can cities be “smart” for all citizens, particularly for the urban poor and children?**

Focus Areas

In order to harness the great opportunity to design technology and enterprise solutions in a rapidly urbanizing world, we need to first understand context and needs, and then frame opportunities, guidelines and strategies for innovative solutions. We hope this handbook provides inspiration and guidance to ask the right questions for the design, technology and social impact communities to lead us to the right solutions and services. After extensive conversations with UNICEF Country Offices, the Division of Research and Planning^[9], external experts and our technology partners, we identified five focus areas where the most pressing challenges for children in urbanizing areas intersect with the greatest opportunities for technology-based solutions.



Technology alone cannot fix any of these complex and layered issues. However, technology-based solutions can and should support broader solutions in the five identified priority areas for children in urbanizing contexts.

FOCUS AREA	PROBLEM	HOW MIGHT WE...?
Infrastructure	The “ urban advantage ” that is meant to deliver access to improved infrastructure , and a higher concentration of goods, opportunities and services, is often the reverse for children living in cities of the Global South, especially in slums. Children in poor urban areas lack access to safe and reliable: shelter, roads, waste management systems, sewage systems, and energy.	<i>How might we design technologies that improve access to adequate infrastructure -- especially that relate to water and sanitation and energy -- and make infrastructure planning processes more inclusive?</i>
Human Mobility	Children lack access to safe and accessible transportation options that connect them with each other, their communities, opportunities and services.	<i>How might we design innovations that connect vulnerable populations with safe, reliable, clean and accessible transportation options to improve human mobility?</i>
Basic Services	In poor urban contexts, health and education services are strained, inaccessible, and inadequate, depriving children of the basic services they need to survive and thrive.	<i>How might we develop technologies that reduce equity gaps that stem from social and economic marginalization, strengthen health and education systems, and extend quality social services to marginalized children in urban settings? How can we innovate for healthy cities?</i>
Violence & Hazards	Children’s safety is compromised in cities in ways unique to the urban context: exploitative labor, trafficking, pollution, structural integrity, vehicular traffic, emotional trauma, safe passage to school, street violence, environmental hazards; Climate change has especially grave environmental/public health implications for children living in cities, and can exacerbate environmental hazards.	<i>How might we design technologies that strengthen urban communities’ capacities to mitigate and prevent violations of personal security, and monitor, respond to, and recover from violent or hazardous events?</i>
Connectivity & Information	Lack of connectivity ^[10] and integration defines the lives of children living in urban slums, informal settlements, and otherwise disadvantaged/ marginalized urban areas; these conditions lend themselves to a self-reinforcing cycle of poverty, immobility and exclusion; Children and young people lack representation in the discussions that shape their physical and political landscapes and define their futures as urban citizens.	<i>How might we design technologies that enhance the visibility, voice, engagement and participation of marginalized youth, and improve access to information and skilling in urban settings?</i>

Implications of Urbanization for Vulnerable Children

framing context and needs

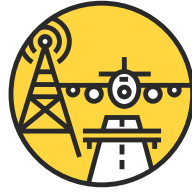


What is a city?

The first step in understanding how we can support vulnerable children in cities is to define what we mean by a “city.” Cities can be defined in many ways; a uniform definition is not always appropriate or helpful, given the diversity of urban realities around the world. However, cities generally share 5 common qualities, which are:^[11]



Significant **population density**



Presence of **services and infrastructure** (public amenities, commerce, roads)



Presence of an **urban economy** that is not based in agriculture



Presence of a **built environment** that provides a foundation for urban extensions, transformations, and upgrades



Intensity of flows of: people, goods, resources and communication

What is urbanization?

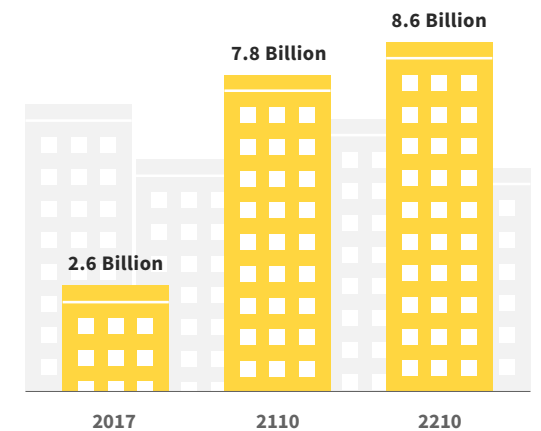
Across the globe, more and more people are migrating to and settling in cities, bringing about an unprecedented wave of urbanization. Historically, waves of urbanization are mainly driven by people seeking out the ‘urban advantage’ offered by a concentration of economic opportunities and the overall promise of a better life. **Well planned cities** can afford this advantage because of their vibrant and dense networks of connections, multiplicity of services, economies of scale, and the higher availability of resources, infrastructure, and amenities. All of these conditions can foster livability, productivity, innovation, and sustainable economic growth. Given these extensive urban benefits, **urbanization can be a promising path forward in securing bright futures for vulnerable populations globally.**

Yet the increasing speed and scale of urbanization--particularly in the Global South--can keep cities from realizing their promise. **More than half of the global population (54%) resided in urban areas as of 2015, in contrast to 34% in 1960, and by 2045, 6 billion people are expected to live in cities.**^[12] Over 66% of the global population is expected to reside in cities by 2050, and over 90% of that urban growth is expected to occur in the Global South.^[13]

This new wave of urbanization is driven not only by the traditional forces, but by emerging environmental and geopolitical trends, ranging from civil wars to mega-droughts, that contribute to displacement and forced migration. This escalating speed and scale of urban growth poses particular challenges in the spaces of: infrastructure, human mobility, basic services, violence and hazards, and connectivity.

Urban growth has already started to stabilize in economically developed countries, where urban populations are projected to swell from 960 million today to just 1.2 billion by 2110. In the Global South, meanwhile, city populations will grow from 2.6 billion today to 7.8 billion by 2110 and 8.6 billion by 2210.^[14] The urban population of the developing world is expected to double between 2000 and 2030, adding 2 billion city dwellers to the global populations [14.1]. This means remarkably fast urban growth for developing cities. Lagos, for example, has been growing by 600,000 people a year, which amounts to nearly 70 people per hour being born or moving into the city.^[15]

Number of people living in cities in the Global South



While much of what we hear about urbanization focuses on ‘Mega-cities’ like Lagos (cities of 10 million+ residents), the fastest urban growth over the next decades will happen in small and mid-size cities, particularly those with less than 1 million inhabitants in Asia and Africa.^[13.1] When rates of urbanization outpace a city’s ability to adapt and meet the needs of a growing population, urban challenges begin to override urban advantages, and the benefits of urban living become unequally distributed.^{[16][17]}

What are the implications of urbanization for the Global South?

Today, there are approximately 1 billion urban poor (roughly 1 in 7 people on the planet)

living in informal urban settlements where they generally lack access to basic needs such as adequate housing, formal housing tenure and citizenship status, water and sanitation, transport systems, basic services, and jobs.^[18] Informal urban settlements take various forms and names; of these, “slums” are defined as the most resource and service deprived, and often face the greatest challenges associated with poverty and exclusion. (See Box 1)^[19]

In addition to the physical, political, and structural constraints, slums are often a victim of spatial injustice: they occupy parts of urban areas that are cut off from urban opportunity and usually ripe with environmental hazards. With these underlying disadvantages in place, the task of integrating growing numbers of urban residents within the social and structural fabric of a city entails new and growing challenges.^[20]



BOX 1:

SLUMS: THE FIVE DEPRIVATIONS^[21]

The United Nations Human Settlements Programme [UN-Habitat] defines a slum household as one that lacks one or more of the following:

1. Access to improved water

An adequate quantity of water that is affordable and available without excessive physical effort and time

2. Access to improved sanitation

Access to a waste management system, either in the form of a private toilet or a public toilet shared with a reasonable number of people

3. Security of tenure

Evidence or documentation that can be used as proof of secure tenure status or for protection from forced evictions

4. Durability of housing

Permanent and adequate structure in a non-hazardous location, protecting its inhabitants from the extremes of climatic conditions such as rain, heat, cold or humidity

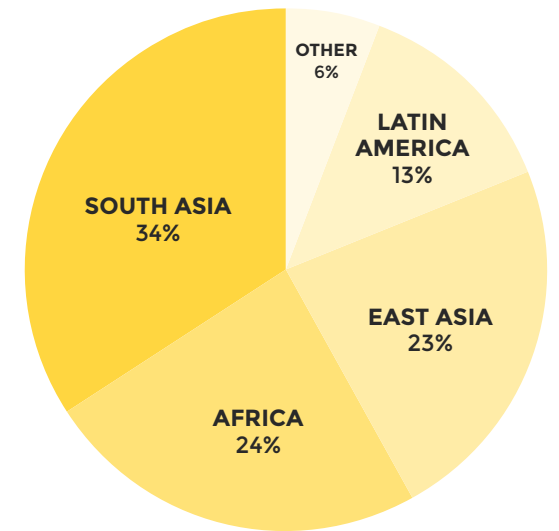
5. Sufficient living area

Not more than three people sharing the same room

About one third of the global urban population lives in slums; in Africa, that figure stands at around 72%. Informal settlements account for 60-70% of urban dwellings in Zambia, 70% in Lima, 80% of new homes in Caracas, and close to 90% in Ghana. As urban populations grow, slums grow.

Current projections estimate that 1.4 billion people will live in slums across the globe by 2020. Meanwhile, the pervasive geopolitical and environmental instabilities that continue to spurn mass migrations and resettlements of refugees into cities add a new and troubling dimension to global urbanization and the proliferation of slums. More than half of the world’s refugees live in urban settings. More often than not, migrants and refugees fleeing from intolerable home environments end up in urban slums. These trends have serious implications for all of us, but especially for women and children in already vulnerable communities across the Global South.

Global slum population by continent



SOUTH ASIA SLUM POPULATION: 280 M

“The underside of urbanization is disproportionately more harmful to children, who often go hungry and become malnourished, drop out of school to work at menial jobs, and forgo needed health care. Poverty and limited access to social services begin to put children at a disadvantage from an early age and can have a lifelong impact.”

Cities and Children: Tanzania

UNICEF Report 2012

How does urbanization uniquely impact vulnerable children and families

In the Global South, children and youth make up more than half of the urban population, and their share is growing rapidly. On the one hand, more people are simply being born into cities: children born in urban areas account for about 60 per cent of urban growth.^[28] At the same time, children and youth (under 25) are the most likely demographic to seek out education and employment opportunities by moving to cities. In fact, youth are 40% more likely than older generations to migrate from rural to urban areas.^[29] Meanwhile, factors related to environmental and geopolitical trends across the Global South increasingly add new pressures on families and young people that further encourage urban migration. With these forces at work, the number of children living in urban areas is only expected to grow, and projections suggest that **by 2050 nearly 70% of the world's children will live in cities.**^[30] Considering that 99% of the total population growth projected for the coming decades is slated to occur in the Global South, it makes sense to take a close look at the specific concerns and challenges likely to arise for children in cities in this context.^[31]

As cities and slums grow, more and more children will find themselves living in informal, poor, and otherwise vulnerable urban areas where they are especially prone to suffer from issues related to urban poverty and exclusion. For every priority challenge facing vulnerable children in rapidly

urbanizing developing city contexts, there are different layers of the problem to consider. **The world's most vulnerable children and families face needs at the most basic level of survival.**

Within the five focus areas of infrastructure, human mobility, basic services, violence and hazards, and connectivity, we've identified some specific challenges facing children, young people and families in a rapidly urbanizing world. We grouped these challenges according to their connection to advancing **survival needs**, creating **opportunity**, or fostering **resilience**, noting that many span all three categories.

Challenges to **survival** threaten a child's fundamental capacity to live out their lives. Only when conditions meet survival needs can we then focus on the next level of urgency: opportunity for a better life. Challenges related to **opportunity** are those that stifle children's abilities and/or potential to improve their quality of life. Meanwhile, **resilience** underlines individual and community capacity to survive and access opportunity.



Resilience in this context refers to an individual or community's ability to withstand threats or shocks, or adapt to new livelihood options in ways that preserve integrity and that do not deepen vulnerability. Resilience provides a lens for understanding how effectively individuals, families, schools, cities, states, and the family can guard against risk and collectively manage threats.^{[32] [33] [33.1]}

For children in developing cities, individual and community resilience depends on many interrelated factors, ranging from adequate housing to psychological well being. Some of the most important dimensions to consider when evaluating resilience include:^[33]

Flexibility: The ability to change, including the speed and the degree of adjustment

Diversity: The variety of actors and approaches that contribute to the performance of a system's essential functions

Adaptive Learning: The integration of new knowledge into planning and execution of essential functions

Collective Action and Cohesion: The mobilization of capacities to jointly decide and work towards common goals

Self-reliance: The capacity to self-organize, using internal resources and assets, with minimal external support



Infrastructure

Urban infrastructure--buildings, roads, water and sanitation systems, energy systems, etc.--forms the basis of economic, social, and physical well being for people living in cities. In urbanizing contexts, cities often fail to safely and sustainably integrate booming populations, leading to congested, unsanitary, insecure, and inadequate infrastructure. This strain is exacerbated as populations continue to grow while investments in services and infrastructure become increasingly costly - financially and socially. ^[34]

The infrastructural challenges in developing cities vary from place to place, but they present the same types of threats to children. Some infrastructural challenges affect children's most basic survival needs--like access to shelter; others prevent them from accessing opportunity--like unsafe roads.

SURVIVAL	OPPORTUNITY
<p>Inadequate housing low structural integrity, poor ventilation (indoor cooking), locational risk, lack of open areas for sports for boys and girls</p> <p>Insufficient housing scarcity and unaffordability leads to homelessness</p> <p>Inadequate sanitation systems and infrastructure lack of access to clean water, poor hygiene, high rates of preventable illness and disease related to sanitation and hygiene (cholera, diarrhoea)</p> <p>Inadequate commercial opportunities (access to markets and growing spaces) food insecurity, undernutrition ^[35] and malnutrition</p>	<p>Inadequate roads burdensome commuting times to schools and work, markets, health clinics, high instance of traffic accidents</p> <p>Absence of streetlights and traffic lights compromised pedestrian and vehicular safety</p> <p>Absence of sidewalks health and safety implications</p> <p>Informal housing insecurity of land tenure (informality, illegality) does not motivate people to invest in their housing</p> <p>Poor access to clean, reliable forms of energy and internet connection lower productivity, higher rates of pollution, lack of access to information, opportunity, and knowledge</p>
RESILIENCE	
<p>Poor access to and quality of green and public spaces low recreational opportunity, threatens children's right to play, negative impact on environmental quality</p>	



Human Mobility

Children and their families depend on reliable, safe, accessible, and integrated transportation options to connect to resources, services, and people that support their fundamental well being. In informal urban areas, which are usually located in a city's periphery, transportation services are especially critical. In urban slums, public transportation services and safe infrastructure for non-motorized transport such as cycling and walking are generally lacking. Existing transportation options for children living in poor and disconnected urban areas are often few, expensive, unsafe, and unreliable. Developing urban contexts also suffer from high levels of traffic congestion, unsafe and inadequate transportation infrastructure, high levels of emissions, and the related side effects. These conditions both directly and indirectly compromise children's wellbeing in cities at every level of urgency.

SURVIVAL	OPPORTUNITY
<p>High risk of vehicular traffic related deaths and injuries</p> <p>Lack of infrastructure/ services to accommodate emergency transport vehicles</p> <p>Poorly maintained vehicles with higher rates of injuries related to accidents, as well as worse emissions</p>	<p>Compromised access to health care and other social services</p> <p>Burdensome commutes to school, barriers to education</p> <p>Lack of access to critical health care services and information</p> <p>Nonexistent or low levels of participation and partnership between the urban poor and government</p>
RESILIENCE	
<p>Diminished recovery capacity in the wake of emergencies and disasters</p> <p>Low levels of data collection monitoring transportation needs</p>	



BOX 2:
FOOD SYSTEMS AND CHILDREN

Today's food systems – defined as the production, marketing, transformation and purchase of food, and the consumer practices, resources and institutions in these processes^[38.1] – are failing to support good nutrition and well-being of today's children. As urban populations grow and urbanize, food insecurity, and malnutrition are increasingly becoming urban problems in all regions of the world. To illustrate, the global share of children with chronic undernutrition (stunting) living in urban settings has risen from 23 to 31 percent in recent decades. Urbanization is also related to alarming increases in childhood obesity, such that urban populations are suffering from parallel burdens of under- and overnutrition. In all, poor diets are now considered to be the main cause of the global burden of disease.

Actions and innovations within the food system are needed to increase access of poor, urban children to affordable, nutritious, and safe diets. These include to support working mothers to enable recommended breastfeeding practices; promote access to nutritious, affordable, and convenient complementary foods; limit the marketing of energy-rich and nutrient-poor processed foods to children; offer healthy foods in public institutions such as schools and restrict access to sugar sweetened beverages; use education curricula to educate children on healthy eating; promote policies to increase physical activity; and target nutrition-sensitive social protection instruments to the poorest.



Basic Services

Rapid and unplanned urbanization poses specific health challenges and undermines children's access to education while also straining cities' basic service providers. As more people move into urban areas, access to basic services that are critical to urban populations' overall health and wellbeing becomes increasingly limited in accessibility and adequacy. The most essential 'basic services' for children in cities are healthcare and education. In cities across the Global South, high levels of congestion, strained resources, marginalization of the peripheries, deepening inequality and poor policy/governance often lead to **inadequate and inaccessible health and education service delivery to the urban poor**. This gap in basic service provision is felt most acutely by poor, vulnerable children, who depend on basic services to survive, thrive, learn and grow and avoid cycles of poverty and poor health.

SURVIVAL	OPPORTUNITY
<p>Strained health clinics low vaccine coverage, especially in slums and informal settlements</p> <p>Inaccessible maternity and emergency services maternal health gaps^[37], high rates of death related to emergencies</p> <p>Inadequate public health/ monitoring mechanisms high rates of indoor and outdoor air pollution, high rates of respiratory illnesses, highest rates of global greenhouse gas emissions, HIV/ infectious diseases^[38]</p>	<p>Low quality educational resources in poor neighborhoods inequitable educational attainment</p> <p>Low availability/affordability of nutritious foods</p> <p>Low quality/ highly strained schools with limited or no digital access low student to teacher ratios</p> <p>Lower school attendance corresponds to higher incidences of child labour</p> <p>Inadequate waste management systems and services dirty streets and highly polluted waste sites, unprotected waste sites in cities, accessed by children and women to pick garbage</p>
RESILIENCE	
<p>Inadequate access to training for 21st century skills</p> <p>Lack of neighborhood institutions to foster community resilience and provide needed resources</p>	



Violence & Hazards

The burdens of unsafe and insecure conditions are concentrated in poor urban areas, and have the gravest implications for children and youth. Without a basic guarantee of a physically safe space where children can live out their lives, they stand little chance of surviving and thriving, and lose out on the opportunities that cities are meant to offer. UNICEF recognizes that all children have the right to be protected from violence, social-exclusion, exploitation and abuse. Yet, millions of children in urban areas worldwide suffer violence, exclusion, exploitation and abuse every day, and millions more are at risk.^[39] In addition to suffering from concentrated risks of violence, children living in cities--especially in developing contexts-- are especially prone to risks related to natural and environmental hazards ranging from flooding to air pollution [see Box 3: **Climate Change in Cities**]. Meanwhile, many hazards are compounded by the spatial and structural conditions present in cities: lack of adequate infrastructure can lead to severe water contamination following floods, epidemics spread especially rapidly in densely populated areas, and so on.

SURVIVAL	OPPORTUNITY
<p>High risk of fires due to density and absence of appropriate protections and services</p> <p>Poor street lighting</p> <p>High rates of car crashes due to lack of safe streets design, poor driving regulations</p> <p>High rates of sexual assault</p> <p>High incidences of violent crime/ street crime</p> <p>Concentrated vulnerability to environmental hazards and disasters</p> <p>High rates of air, water, and ground pollution</p>	<p>High rates of dangerous child labour activity (especially scavenging/ garbage picking)</p> <p>High incidences of child trafficking and exploitation</p> <p>Intensified social isolation of children and youth, higher likelihood of delinquency/ unrest</p> <p>High rates of unemployed youth, common precursor to social unrest</p> <p>Lack of disaggregated data to assist in planning targeted emergency programing responses</p>
RESILIENCE	
<p>Poor disaster preparedness and relief programming</p> <p>low capacity of local authorities to respond to emergencies, inadequate knowledge of the spatial and social structures of urban areas leads to marginalization in humanitarian response</p>	

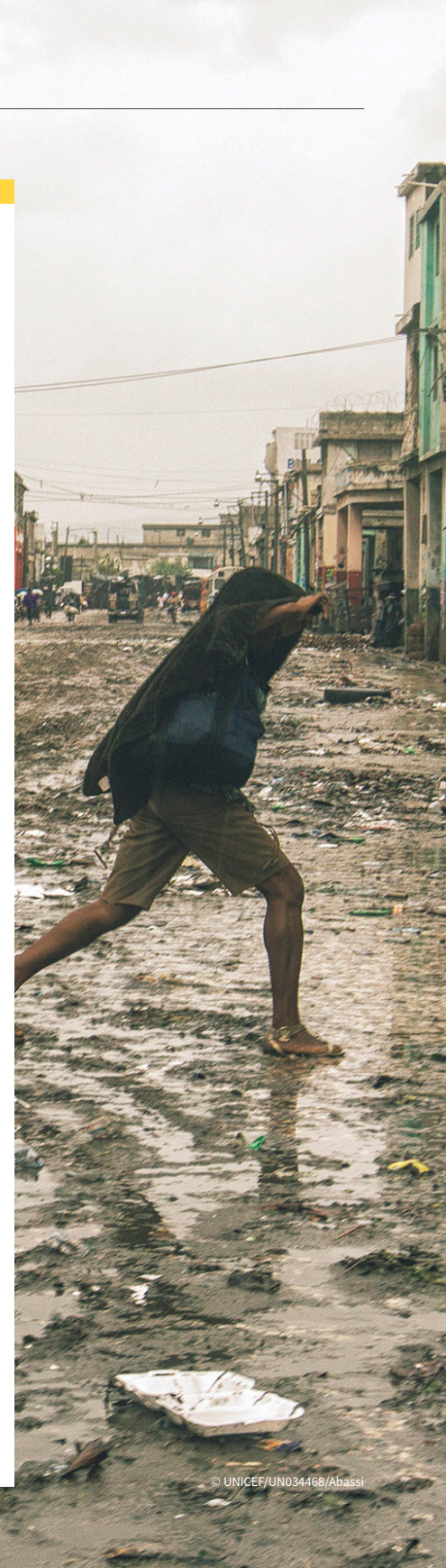
BOX 3: **CHILDREN & CLIMATE CHANGE IN CITIES**

Cities have a vital relationship with climate change in terms of both cause and consequence. Globally, urban areas account for 67% of energy demand, and are responsible for 70% of global greenhouse emissions. Cities also experience the impacts of climate change most acutely, given their concentrated and dense populations, and should be prioritized for climate mitigation and adaptation efforts.

Close to half a billion people live in coastal urban areas that are vulnerable to storms and rising sea levels.^[40] Even outside of coastal areas, cities are especially prone to the indirect impacts of climate change. As temperatures rise, and droughts and floods increase in frequency and severity, millions of people will migrate to cities, adding to the rapid and unplanned proliferation of informal settlements.^[41] **By 2050, some projections expect there to be more than 700 million climate refugees on the move, many of whom will end up in slums.**^[42] Meanwhile, extreme temperatures and water scarcity continue to accelerate repression, regional conflicts, and violence across the world.^[43]

For poor children living in cities, these underlying threats of climate change are multiplied. Environmental hazards related to climate change will continue to impact urban service delivery and infrastructure, exacerbating existing conditions and undermining disaster response and relief efforts. Meanwhile, as escalating droughts, floods, and extreme weather events degrade food production, children are likely to suffer the greatest burdens of hunger, malnutrition, and undernutrition. Home loss and job loss will increase the incidence of child labour, child homelessness, and child exploitation. Increasing temperatures, combined with ongoing water scarcity, water contamination, and air pollution, will drive the spread of waterborne disease and respiratory health risks. In each of these instances, children stand to suffer immediate and ongoing risks to their lives and livelihoods.^[44]

In aspiring for resilience to climate change in cities, we can promote the overall environmental, structural, socio-economic, and political conditions that best support children. As Kailash Satyarthi, Nobel Peace Prize Laureate, put it, *“sustainable societies can only have a prosperous future when their children are safe, educated and healthy.”*^[45] Innovation can and should play a critical role in ushering in a new era of sustainable and resilient urban societies.





Connectivity & Information

Having a connection to the internet, cellular networks, and electricity has become more and more critical to children's quality of life. In developing cities, connectivity can provide marginalized communities and vulnerable children with the means to understand, navigate, and improve their lives. While basic connectivity is often more accessible in cities than in rural areas, at least one-quarter of African city dwellers do not have access to electricity ^[46.1]. Beyond connections to power, internet, and servers, urban residents require fundamental and digital literacy, along with access to devices, content, training, support, and monitoring and evaluation. For the purposes of this handbook, "connectivity" refers to this full suite of digital access. From providing basic health care information, to equipping people with a means of self-advocacy and financial opportunity, connectivity has the potential to improve children's lives at the most fundamental level by increasing chances of survival, whether through mobile maternal health platforms or electricity that powers health clinics that vulnerable urban populations rely on for life saving services.

SURVIVAL	OPPORTUNITY
<p>Inability to access emergency services</p> <p>Inability to receive, understand, respond to, and engage with: notifications, messages, information about impending disaster or crises</p> <p>Inability to be included within emergency preparedness plans, drills, and evacuation procedures</p>	<p>Lack of access to basic educational information and learning platforms</p> <p>Lack of access to critical health care services and information</p> <p>Nonexistent or low levels of participation and partnership between the urban poor and government</p> <p>Low levels of data collection monitoring activities and services that are critical to ensuring children's health and success low rates of birth registration, vaccination, etc.^[46]</p> <p>Lack of access to 21st century skills/development</p> <p>Limited access to identity protection and other privacy measures that are critical to young people's online safety</p>
RESILIENCE	
<p>Lack of visibility of urban slum dwellers and their problems difficult to get attention and buy-in from urban policy makers; cycle of disadvantages</p>	

From providing basic health care information, to equipping people with a means of self-advocacy and financial opportunity, connectivity has the potential to improve children's lives at the most fundamental level by increasing chances of survival...



Empowering Urban Technologies

“Cities are where problems and solutions meet.... the global response to our most pressing challenges—from climate change to rising inequality—will likely succeed or fail in cities.”

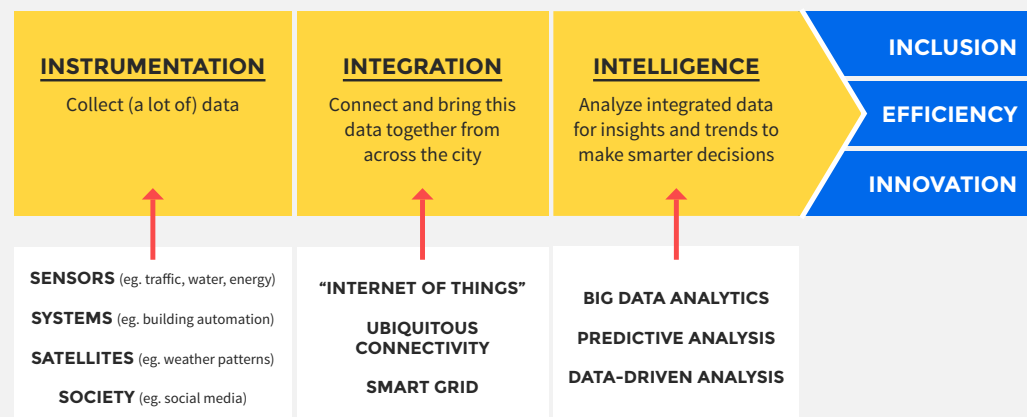
World Bank Development Report 2016,
“Digital Dividends”

What do we mean by urban technologies

While cities can concentrate risk, they can also concentrate and cultivate innovative solutions. “Urban technologies” encompass an enormous diversity of tools, services, platforms and products that make up many of these solutions. What makes a technology ‘urban’ for our purposes is its application in a city, to serve the needs of urban residents. In this handbook, we explore a specific subset of technologies that we feel are most relevant to cities in the Global South context, introduce how they function in their current forms, and explore how we can apply them to serve vulnerable urban populations. **Technology is not meant to replace traditional modes of urban problem solving (planning, policy, economic development, urban design, etc.), but rather to support and strengthen existing pathways to urban development while also opening up new opportunities to meet the needs of urban communities.**



SMART CITIES: FROM DATA TO INTELLIGENCE



Relevant technologies: Expanding the definition of “smart” city tech

Technology has already made its mark in shaping cities and urban life worldwide. Most urban technology-based solutions to date fall under “Smart City” initiatives in the economically developed world. In these Smart Cities, technologies that can sense, measure, monitor and report urban conditions and interactions are embedded into the urban environment through buildings, cars, lighting systems, and so forth to collect data. With this data, we can understand where there are gaps in the efficiency, adequacy, accessibility, and equitability in urban services, infrastructure, and experiences. This insight can then guide a city’s response, creating a feedback loop to improve urban outcomes. This feedback loop is the core architecture of the “smart” city model, and can inform solutions to problems ranging from air quality to traffic jams.

However, the dominant model of the Smart City focuses on high-tech solutions that leverage ICT and IoT technologies to improve the efficiency of city services (schools, transportation systems, power plants, etc.) and has focused almost exclusively on the economically developed world. In this model, “smart” basically equates with “efficient,” with a city’s success largely measured in terms of improved financial, energy, and resource efficiency. Yet we know that the wellbeing of urban residents depends on a city delivering much more than efficiency, and that technology alone cannot fix the complex and layered challenges that arise in urban areas, especially in the Global South context.

For a city to be “smart,” it should understand and serve the needs of all residents.

IoT Based Solutions

There are approximately 8 billion connected devices in use across the world, and this number is expected to reach 25 billion by 2020.^[48] Often called the Internet of Things (IoT), these connected devices actively collect and share data. IoT based solutions can support responsiveness, efficiency, and adaptability in: healthcare, sewers, transport, waste management, crime management, buildings, and infrastructure. IoT solutions can connect urban communities with the tools, services and relationships they need to **measure, alert, organize and respond** to specific urban concerns. Some of the most relevant IoT solutions for urban contexts in the Global South include:

- Smoke and fire sensors in informal Kenyan homes to coordinate alerts for community action in emergencies ^[48.1]
- Sensors that enable water systems to report faulty pumps to authorities and issue early warnings around water sources that are drying up ^[48.2]
- Street lights integrating sensors that collect data on weather, pollution, seismic activity, the movement of traffic and people, and noise and air pollution that provide data for public safety or even street parking planning ^[48.3]
- Sophisticated sensors that can monitor environmental conditions (air quality, water quality, temperature, sound, etc.) ^[50]
- Low-cost environmental sensing kits that measure local environmental data (humidity, noise, air pollution), and stream data to open platforms to create crowd-sourced maps of environmental information ^[49]

ICT Technologies

ICT technologies are critical in providing connections between people and their communities, decision makers, service providers, and information. Through these connections, ICT technologies can meet the needs of vulnerable urban populations by expanding **urban planning and policy processes to be more inclusive**, and provide means for urban communities to **measure, alert, organize and respond** to specific urban concerns. ICT technologies can also be key in measuring and communicating what specific problems exist where, and for whom. Everything that contributes to the poverty, injury, or death of someone living in a city can theoretically be recorded, and serve as evidence to guide policy and implementation, especially for the city or municipal governments that are responsible for providing most risk-reducing infrastructure (such as safe, sufficient, affordable water) and risk-reducing services (such as emergency services, rule of law/policing, and road traffic management).^[51]

Existing applications of ICT technologies in this space for the Global South's urban contexts include:

- Crowdsourced maps that provide critical information on: wheelchair accessibility in a city^[52], environmental hazards^[53], real time flooding, informal transportation routes^[54], and more^[55]
- Mobile apps that empower citizens to report issues like potholes, water leaks, lack of accessibility, and broken traffic lights^[56]
- Portals that make accessing and understanding legal courts easier.^[57] A video game that engages vulnerable populations (children, poor communities) in urban design, and funds the implementation of public space projects all over the world^[58]
- Civic participation platforms for participatory budgeting and for crowd-sourcing identification of highly polluting vehicles in the Philippines^[60]
- **Using Minecraft (video game) as a community participation tool for public space design**^[59]



Data

Data collected by IoT and ICT tech is a cornerstone of the smart city model. Data is critical in **improving our sense of what problems exist where, and for whom** and informing more efficient and targeted solutions. Data is also critical in promoting accountability for city governments. Given the severe gaps in data (especially disaggregated data) on conditions in informal and poor urban environments, the need for data collection and analysis in these areas is especially great, and there are abundant opportunities for both passive and active data collection through sensors, systems, satellites, and society.^[60] However, as noted, data related work brings with it critical privacy and security related concerns. **This handbook does not cover the detailed implications of such concerns, but advises all partners working with data solutions to be particularly mindful of the potential negative impacts of data collection in vulnerable urban contexts.** Some examples of data being used to support smart city solutions in the Global South include:

- Sao Paõlo developing comprehensive geographic database of socioeconomic and physical indicators to inform housing and slum upgrading investments
- Cities across the Philippines using 'local open data' platforms, to share local data with the public, promoting transparency, accountability, and collaborative problem solving
- **In Kibera, using open source mapping software to engage local youth to pinpoint water and sanitation facilities, security problems, health clinics, pollution and community needs to bring attention to city government's oversights and responsibilities**^[61]

Other Urban Technologies

In addition to these "Smart City" solutions, there are other **urban technologies** that improve the natural and built environment, such as: clean emissions transportation options, renewable energy options, air/water filtration systems, and many others. Other important innovations will be in the space of digital finance: for instance, a micro-insurance platform, enabled by digital-finance, could be an impactful and commercially viable way to extend healthcare to those who can't currently afford it. In Nairobi, fully off-grid DFS-enabled solutions allow families to pay for critical services, from home energy to a B2G model for tech that improves the quality of the centralized energy services.

These technologies directly enhance quality of life for all urban residents by mitigating and preventing the negative impacts of urbanization on vulnerable urban populations.

Any technology-based solutions in urban areas require complementary investments (in physical infrastructure, electricity, education), advancement of inclusive planning policies, as well as careful consideration for local contexts.^[62]



Design Considerations and Constraints



Design Considerations

Existing networks, infrastructure, and opportunities for economies of scale can make the delivery of new technologies and services easier in cities. Yet inefficient transportation systems, cultural mistrust, lack of education and many other urban realities can impede access to and use of even the most brilliant and innovative tools. Slum communities are often difficult to penetrate, and without dedicated initiatives adapted to local needs, even the most promising interventions are likely to fail. A sound contextual understanding is imperative to succeed in designing solutions for children in poor urban environments.^[63]

Successful designs will consider an entire system rather than a single point of influence. For example, improving pedestrian safety in a neighborhood depends on behavior change in individual drivers/ pedestrians, which requires the support and participation of their entire community. Meanwhile, behavior change alone cannot guarantee safety; improvements to infrastructure (roads, lighting, sidewalks) are also needed. Solutions must drive systemic change, and so we must design and develop

...data is not an endpoint. It is fluid and dynamic, and can be a force for opening new pathways.

technologies in service of the entire ecosystem around an individual, instead of narrowly focusing on one desired outcome. Designs must also identify behavioral barriers preventing people from using technologies, and seek to work around these barriers or remove them. **Finally, data should not be gathered simply for the sake of information collection, but used as a medium to facilitate collaboration and catalyze change. In other words, data is not an endpoint. It is fluid and dynamic, and can be a force for opening new pathways.**

Design Constraints

When designing technological innovations for cities, attention to contextual constraints is critical. A smart city technology that might have great success in Singapore, where the infrastructure, political climate, cultural tone, and socio-economic reality provide a supportive foundation for high tech interventions, is likely to fail miserably in a **mega-city slum somewhere in the rapidly urbanizing parts of Asia and Africa**. Some of the most common technological constraints to keep in mind while designing for vulnerable populations in rapidly growing cities include but are not limited to:^[64]

Environmental Constraints

- Harsh environmental conditions are the norm in many vulnerable urban areas (extreme heat, extreme wind, highly polluted/ toxic conditions)
- Higher intensity and frequency of natural hazards (mudslides, fires, floods, droughts, etc.)

Social/Cultural Constraints

- Different cultural contexts, need for close attention to existing habits and cultural approaches to technology (How are people using technological devices and services? How are they comfortable integrating technology into their daily lives?)
- Varying degrees of trust in technology + lack of understanding of and appreciation for the potential for technology to do good
- Lack of learning platforms and content that can be replicated across curricula in different languages and contexts
- Critical privacy, security (free from weakness and vulnerability), anonymity (being unknown to others) concerns
- Lack of sufficient, disaggregated data on urban challenges for children^[65]
- Lack of connection between communities and critical facilities and services
- Lack of adequately skilled personnel, especially in highly technical fields
- High linguistic diversity
- Low digital and basic literacy rates
- Low involvement of vulnerable populations in planning and design processes

Economic Constraints

- Competing economic motivations
- Unequal and limited access to financial and banking systems

Political Constraints

- Possibility of prohibitive security concerns
- Abuse of data and targeted surveillance with identity management systems - risk of accessing potentially sensitive info about users and specific demographics, using vulnerable devices to attack local networks and devices
- Complexity of political systems can be hard to manage - need adequately designed policy frameworks
- Potentially corrupt political systems
- Different norms for government's role/ presence in a technology project. At present, most "smart-city" urban technologies are implemented by top-down or government-led initiatives (83%), whereas only 17 percent are bottom-up or citizen-driven.^[66]

Infrastructural + Technical Constraints

- Brittle mobile cellular networks^[67]
- Insufficient ICT infrastructure, systems, platforms, and standards
- Low prevalence of mobile data plans
- Poor cross-sector integration
- Spectrum and bandwidth requirements for adoption of IoT devices/services
- High frequency of power outage events

UNICEF Innovation Design Principles

Design principles can both encourage and constrain technologists, scientists, and designers who are considering solutions to wide-reaching problems. Broadly, we believe that the best solutions are designed according to “human centered design.” See Annex 1 for more on what HCD means and how to apply it while innovating for children.

“Smart cities are human-centered cities. Sensors, networks, data analytics and visualizations, and so on are cutting-edge, 21st century tools. But those tools must serve us, not the other way around. Smart cities technology enables citizens and civil servants alike to achieve the goal of making a city that truly serves the needs and reflects the values of the entire community.”

Aaron Bangor
AT&T Lead Accessible Technology Architect

In this handbook, we refer to UNICEF’s “Principles for Innovation and Technology in Development.” These design principles offer guidelines for operating within highly diverse environments with constraints different from those in the Global North. While not intended as hard and fast rules, they are shared as best practices that inform the design of technology-enabled development programs.



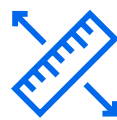
DESIGN WITH THE USER

- Develop context appropriate solutions informed by user needs.
- Include all user groups in planning, development, implementation and assessment.
- Develop projects in an incremental and iterative manner.
- Design solutions that learn from and enhance existing work flows, and plan for organizational adaptation.
- Ensure solutions are sensitive to, and useful for, the most marginalized populations: women, children, those with disabilities, and those affected by conflict and disaster.



UNDERSTAND THE EXISTING ECOSYSTEM

- Participate in networks and communities of like-minded practitioners.
- Align to existing technological, legal, and regulatory policies.



DESIGN FOR SCALE

- Design for scale from the start, and assess and mitigate dependencies that might limit ability to scale.
- Employ a “systems” approach to design, considering implications of design beyond an immediate project.
- Demonstrate impact before scaling a solution.
- Be replicable and customizable in other countries and contexts.
- Analyze all technology choices through the lens of national and regional scale.
- Factor in partnerships from the beginning and start early negotiations.



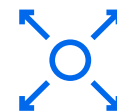
BUILD FOR SUSTAINABILITY

- Plan for sustainability from the start, including planning for long term financial health (e.g. assessing total cost of ownership).
- Utilize and invest in local communities and developers by default and help catalyze their growth.
- Engage with local governments to ensure integration into national strategy and policy, and identify high-level government advocates.



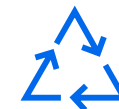
BE DATA DRIVEN

- Design projects so that impact can be measured at discrete milestones, with a focus on outcomes rather than outputs.
- Evaluate innovative solutions and areas where there are gaps in data and evidence.
- Use real-time information to monitor and inform management decisions at all levels.
- When possible, leverage data as a byproduct of user actions and transactions for assessments.



USE OPEN STANDARDS, OPEN DATA, OPEN SOURCE, AND OPEN INNOVATION

- Open data and functionalities and expose them in documented APIs (Application Programming Interfaces) where use by a larger community is possible.
- Invest in software as a public good.
- Develop software to be open source by default with the code made available in public repositories and supported through developer communities.



REUSE AND IMPROVE

- Use, modify and extend existing tools, platforms, and frameworks when possible.
- Develop in modular ways favoring approaches that are inter-operable over those that are monolithic by design.



DO NO HARM

- Consider the context and needs for privacy of personally identifiable information and demographically identifiable information when designing solutions and mitigate accordingly.
- Assess and mitigate risks to the security of users and their data.
- Ensure equity and fairness in co-creation, and protect the human rights and security of the end-users.



BE COLLABORATIVE

- Engage diverse expertise across disciplines and industries at all stages.
- Work across sector silos to create coordinated and more holistic approaches.
- Document work, results, processes and best practices and share them widely.
- Publish materials under a Creative Commons license by default, with strong rationale if another licensing approach is taken.

UNICEF innovation principles have been endorsed or adopted by the following partners: UNICEF, USAID, Gates Foundation, EOSG Global Pulse, WFP, WHO, HRP, OCHA, UNDP, SIDA, IKEA Foundation, UN Foundation, and UNHCR.

When it comes to designing tools, products, and processes for cities, another important set of principles become especially important: those of Universal Design. The principles of universal design operate to ensure that the design of products, environments, programmes and services are usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. It's important to note that this includes assistive devices for particular groups of persons with disabilities where this is needed [UN, 2006]. The universal design principles as outlined by the Center for Universal Design in North Carolina State University include:

- Principle 1: **Equitable Use**
- Principle 2: **Flexibility in Use**
- Principle 3: **Simple and Intuitive Use**
- Principle 4: **Perceptible Information**
- Principle 5: **Tolerance for Error**
- Principle 6: **Low Physical Effort**
- Principle 7: **Size and Space for Approach and Use**

At their core, universal design principles provide guidance on enabling people with disabilities to participate equally in social and economic life. Roughly 15% of the global population, or about 1 billion people, have some sort of impairment or disability that leads them to depend on their physical environment (and the objects within it) being accessible and inclusive. There are strong inherent advantages of designing urban technologies, processes, and environments for persons with disabilities as most of their needs are the same as any other peoples'. In other words, designing for the most vulnerable people leads us to design in a way that addresses a universal set of challenges and constraints, and builds urban environments that work for all people.

The **Smart Cities 4 All** initiative has done incredibly important and accessible work in building out a **toolkit** that promotes universal design and accessibility in urban environments, and can be looked to as a guide for integrating universal design into urban technology.

BOX 4:
ACCESSIBILITY

“Accessibility is a precondition for persons with disabilities to live independently and participate fully and equally in society. Without access to the physical environment, to transportation, to information and communication, including information and communications technologies and systems, and to other facilities and services open or provided to the public, persons with disabilities would not have equal opportunities for participation in their respective societies.”

[General Comment on Article 9 of the Convention on Rights of Persons with Disabilities](#)

To address social good, technology would ultimately need to follow a systematic, communitarian approach. **It must be:**



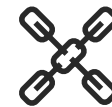
COST-EFFECTIVE

Can be executed en masse in low cost areas, with a demonstrated business case and need



LOW-POWER

Runs off a battery, has long battery life (possibly alternate energy), is power efficient where there is no power



RUGGED + DURABLE

Is waterproof, shockproof, weatherproof, heat resistant, easily stored, and built to last



SCALABLE

Can be applied to varying environments and communities, considers a larger ecosystem, easily produced/developed, easy to use, easy to maintain (fixed/addressed by local skill)

Strategies for Technological Innovation in Cities

With these contextual considerations and design principles in mind, we look towards the types of approaches that can create solutions for children in rapidly growing cities. We can't predict exactly which technologies will be best suited to support children and families in the urbanizing developing world, but we can identify the pathways to innovation. We believe that the best approaches to technological innovation will take shape in four strategic approaches, keeping in mind that the best approaches might employ more than one of the following:

1. **Scaling** existing technologies
2. **Adapting** existing technologies
3. **Inventing** new technologies
4. **Equipping** communities with the tools to create their own technologies

We invite you to read through the set of use cases in the following section, and think about how we might employ each of these strategies to meet the needs of young people worldwide.



Use Cases

For the purpose of this handbook, we outline examples of children's specific needs in rapidly growing cities where we think technology can play an important supporting role. These examples are meant to inspire creative and critical thinking about what a device / tool / system could look like to support communities facing accelerating urbanization. Possibilities abound for technology-based solutions, particularly in the focus areas we have identified: infrastructure, human mobility, basic services, violence and hazards, and connectivity. We hope these examples ground the previous sections in more tangible contexts, while promoting further thinking, ideas and new conversations around how technological innovations can serve children in an urbanizing world.

The use cases in this handbook are particular to the context and environments in which UNICEF works, as part of the 7 pillars within UNICEF's overall strategic plan. These seven pillars are **Child Protection; Education; Health; HIV/ AIDS; Nutrition; Social Inclusion; and Water, Sanitation and Hygiene (WASH).**

Please keep in mind, these prompts are meant to inspire thoughts around some solution areas we think are prime for technological innovation; however, the possibilities to leverage technology extend well beyond these specific prompts, and you should not feel restricted by them.



Infrastructure

THE PROBLEM

Lack of access to clean water and sanitation

Approximately 2 billion people lack access to adequate sanitation facilities, while 1 billion lack access to safe drinking water. Worldwide, some of the highest under-five mortality rates occur in slum settings, where poor water supply and sanitation, overcrowding, and inaccessible health services make pneumonia and diarrhoeal disease some of the leading causes of death for children. A 2000 World Health Organization report estimated that only 43 percent of urban dwellers have access to piped water.^[82.1] In Cape Town, 43% of children in informal settlements lack access to adequate sanitation whereas in urban areas overall it is at 6%.^[68] In Bangladesh (2009), the under-five mortality rate was 79% higher in slums than the overall urban rate, and 44% higher than the rural rate.^[69] Beyond threatening survival, factors related to water, sanitation and hygiene [WASH] can dramatically impact children's overall health and ability to learn. In an atmosphere of poor health, children are unable to fulfill their education potential. Each year, about 400 million school-age children are infected by intestinal worms, which undermine their learning abilities. Each day, approximately 1,400 children die from diarrheal diseases linked to the lack of safe water and adequate sanitation and hygiene.^[70]

Across the Global South, these issues are often caused and exacerbated by poor WASH infrastructural systems, overcrowding, and contamination. In a far too-common case of

UNICEF's Pillars Addressed:

Child Protection; Education; Health; Social Inclusion; Water, Sanitation & Hygiene (WASH)

water-related illness in cities, Kampala experienced a massive typhoid outbreak in 2015. When the government went to investigate the outbreak, it turned out that typhoid had been present in the city of Kampala for 4 years, but the outbreak wasn't identified until it reached/exceeded critical mass. The typhoid outbreak can easily be linked to unsafe drinking water sources, which were found to be contaminated with *Escherichia coli* and fecal matter. These types of contamination are usually related to high incidences of open defecation where there is a lack of publicly accessible toilets (in India, for instance, more than half of children living in slums don't have access to toilets)^[73.1], accumulation of solid waste due to a lack of adequate garbage collection and waste management systems, and presence of point source and non-point source pollutants ranging from animal waste to industrial runoff. Nearly all of these contamination related risks are at their worst in poor urban areas.

In other cases, where clean water does exist within a city, it can be inaccessible for political, economic, and structural reasons. In Mexico City (and in many other cities like it), poor and informal urban neighborhoods have the least access to safe drinking water. These slum communities often depend on water trucks for delivery--which aren't always reliable. Water scarcity, poor infrastructure, government corruption, and other planning related issues contribute to a reality where the average

Mexican family can spend up to 20% of their income on water.^[71] **It is common for the urban poor to pay up to 50 times more for water than their wealthier neighbors who have access to water mains.**^[72] Meanwhile, the opportunity to tap into new water sources through drilling require heavy, expensive rigs that are difficult to operate and very difficult to get to the locations where they are needed most. Sanitation crises and associated disease outbreaks are exacerbated by the difficulty of getting heavy drilling rigs in place to access uncontaminated water under geological barriers or beyond shallower pools of contaminated water. This was a major contributor to the Haiti cholera crisis, since dense bedrock under Port-au-Prince prevented drainage of surface wastewater and spread disease. These scenarios are emblematic of the realities facing families and children in cities across the Global South, where safe and clean water is too-often inaccessible, unfordable, and unreliable.

STATEMENT OF NEED

Children living in cities **need access to clean water to survive, and require access to adequate sanitation infrastructure to stay safe, healthy, and thriving.** Beyond infrastructure and water sources, there is a dire and pervasive need in poor urban communities for awareness and information around: incidents of contamination, threats to water supply (drought, heat waves, power outages), alternative sources, and emergency protocols. Technologies that help improve or strengthen water quality, accessibility, delivery, distribution, and awareness will support the most vulnerable children living in cities from survival through to resilience.

PROMPTS

How might we leverage technology to:^[73]

- Monitor the functionality and quality of water supplies and distribution systems, and map trends in contamination or service failure across urban contexts?
- Increase reliability and efficiency of fresh water delivery systems?
- Create new ways to collect, recycle, and dispose of solid waste?
- Support innovative approaches to fresh water supply (rainwater harvesting, low-fi purification techniques, etc)?
- Connect urban slum populations with reliable and safe water sources?
- Establish awareness programming to improve understanding of water-related risks amongst urban slum dwellers?
- Map out and report on areas where environmental health issues are at their worst?
- Integrate hygiene promotion programs with urban activities (such as market places, schools, etc)
- Monitor sanitation infrastructure construction and conditions (latrines, wells, treatment systems, etc.)

Human Mobility

THE PROBLEM

Unsafe & inaccessible transportation options

In urban areas across the Global South, vehicular traffic poses huge problems to physical and socioeconomic well being. The risk of road traffic injury for children is heightened by a lack of safe play spaces and pedestrian infrastructure such as sidewalks, bike lanes, and crossings that characterizes most developing world cities. The World Health Organization estimates that **road traffic injuries account for 1.3 million deaths annually – the leading single cause of death worldwide among people aged 15–29, and the second for those aged 5–14.**^[74] Even with solutions to improve health for children in cities, many will not survive and have the chance at leading a full life if we fail to find ways to protect children from unsafe streets.

Meanwhile, the congestion caused by poor urban planning and the massive numbers of private vehicles on city streets presents barriers to productivity and connectivity that burden poor urban families and hinder children from living out their fullest, safest lives. Many children in these

UNICEF's Pillars Addressed:

Child Protection; Education; Health; and Social Inclusion

contexts sit in traffic for several hours a day to get to school, often arriving late, and are at a higher risk of falling behind in school or even dropping out.

In areas where public transport is readily available, traffic is generally safer and less congested, and children are better able to survive and thrive; however, for most children living in Global South cities, we see the opposite scenario. In Dar es Salaam, around 80% of informal settlements lack access to public buses.^[75] Combined with prohibitively high transport costs, inadequate roads and the peripheral locations of slums, residents are often completely disconnected from social services, leaving students unlikely or unable to attend school, and visit healthcare facilities. This same transportation and access problem, can be seen in nearly every city in the Global South.

STATEMENT OF NEED

Children and families in urbanizing contexts need solutions that **improve transportation access, safety, efficiency, and reach.** Ultimately, solutions are needed on a city-wide scale that address the fundamental planning challenges that rapidly urbanizing cities face. However, solutions are also needed that directly empower children, youth, and their communities to access better transportation options and advance road safety improvements. In some cities, young people are already employing social networking tools and community websites to set up carpools, which increase accessibility, reduce vehicular traffic, and generally improve urban livability.^[76]

PROMPTS

How might we leverage technology to:

- Create safer transportation options for women and children?
- Improve transportation options that accommodate children and families with disabilities?
- Map transportation routes that are viable in slum settings (i.e. where streets are often vehicle-inaccessible, and violence and topography can be prohibitive)?
- Create interactive or environmentally responsive lighting to promote safe passage, for children in cities while remaining sensitive to energy consumption and light pollution?
- Connect urban children with safer transportation options?
- Integrate warning systems to inform children of dangerous traffic spaces (black spots)?
- Support transportation options that are more energy efficient, less fuel reliant, and “cleaner”?
- Collect, visualize, and report data on modes of transport to inform better policy and planning?

Basic Services

THE PROBLEM

Getting children an adequate education

Children living in poor urban communities, especially those that are “informal”, start out with many fundamental disadvantages: inadequate housing, precarious environmental conditions, crowded and unsanitary learning facilities, and unsafe physical spaces. These conditions can undermine educational foundations. By one estimate, more than 200 million children under 5 years of age in developing countries fail to reach their potential in cognitive development.^[77] These disadvantages are exacerbated greatly when access to formal education is absent, and children are left without the opportunity to learn, grow, and thrive.

For poor children and families living in developing cities, the lack of access to adequate education can be a result of structural, security-based, economic, political, cultural, and systemic conditions. For instance, in Sao Paulo, Brazil (and many cities like it) certain favela areas have such high incidences of gang violence that children often skip school in fear of walking to class. While 25% of children in Egypt’s urban areas attended kindergarten in 2005–2006, compared with 12% in rural areas, only 4% of those from the poorest quintile of urban households could access this service. This gap in access to formal education between vulnerable urban communities and their wealthy counterparts is almost always worse for girls, who account for the majority of out-of-school primary aged children.^[78] Meanwhile, in sub-Saharan Africa and South Asia, about half the

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children in urban areas are unregistered and may be unable to access public education services as a result. This problem is especially prevalent amongst urban migrant populations, whose registration status from their former homes (usually rural) doesn’t translate to city settings.

In Ho Chi Minh City, for instance, hundreds of thousands of people-- a majority of them women-- have moved from the countryside in Vietnam to the city seeking work in the manufacturing industry. Upon arrival, many of these women find that they and their children are unable to transfer their registration status, and their children are left without access to any public formal education opportunities.^[79] In cities as diverse as Tirana and Dar es Salaam, a common thread holds true: many of the schools servicing poor urban children are completely over capacity, with teacher-to-student ratios that prevent teachers from instructing effectively, dissuading children from actively attending and engaging in class. This often leaves parents facing the dilemma of paying to send their children to overcrowded private schools, or withdrawing them all together. Across the Global South, tenure insecurity also compounds these issues. Without secure tenure, the poorest urban children and their families live with the constant threat of eviction. When children are evicted and displaced from their homes, they are unable to continue attending school and may not continue their educations.

STATEMENT OF NEED

The challenges of rapid urbanization demand solutions that remove the barriers in access to adequate basic services for poor families, whether those barriers be rooted in registration issues, overburdened schools, a lack of safe passage between home and school, or deeper systemic challenges. Simultaneously, **children in cities need ways to access traditional and supplementary learning tools and resources under often-restrictive conditions.** Early childhood education contributes to children’s cognitive, social and emotional development, in addition to promoting their health, nutrition and hygiene. Education is also critical for setting young people up for employment. Innovations can support education, learning and training for children in myriad ways. Technology can intervene at different stages in the learning process, from providing ways to collect and map data on where education needs and disconnection from learning tools is greatest, to providing pathways to registration where it is needed to ensure access to public education, to delivering educational tools and material in accessible and sustainable ways. In urban areas, where ethnic minorities, migrants, refugees, and internally displaced populations are common, it is especially important that educational options are available for children who speak different languages, lack official registration, or have had their schooling interrupted.^[80]

PROMPTS

How might we leverage technology to:^[73]

- Improve participatory learning and action tools and make them more accessible?
- Improve data collection and monitoring to understand where needs for education support are greatest?
- Address tenure insecurity for families living in slums by coordinating new means of land registration or reimagining the land ownership model for slum contexts?
- Assess children’s learning needs, and gaps in learning, particularly as they relate to foundational skills (ranging from critical thinking, entrepreneurship, creativity, leadership, to problem solving)?
- Engage teachers with better incentives, connect them to best practices, and create communities of support?
- Invent new technologies designed for children with disabilities to ease their learning, caretaking and social inclusion?
- Engage the voice of students’ communicating needs to be met?

Basic Services

THE PROBLEM

Inadequate immunization & maternal health care services

In 2010, nearly 8 million children died before reaching the age of 5, largely due to pneumonia, diarrhoea and birth complications.^[81] Almost one third of deaths among children under 5 are preventable by vaccine, but in 2015, nearly one in five infants - 19.4 million children - missed out on the basic vaccines they need to stay healthy. Low immunization levels compromise gains in all other areas of health for mothers and children. The poorest, most vulnerable children who need immunization the most continue to be the least likely to get it.^[84.1]

Children living in informal urban settlements are particularly vulnerable to a host of poor health outcomes, including a lack of immunization and maternal health services. Along with peripheral locations and weak health services, lack of education and conflict can prevent children from getting the vaccinations they need to survive and thrive. Many developing countries also have inadequate 'cold chains' – meaning optimal temperature control for the transport, storage and handling of vaccines. Or, they are not able to manage vaccine stocks effectively, leading to insufficient vaccine supply to immunize all children.

New vaccines, like the ones against the viruses that spread pneumonia and severe diarrhea [pneumococcal and rotavirus vaccine] are still too expensive for many countries to afford – even in middle-income countries.

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High child mortality rates are seen in urban places where significant concentrations of extreme poverty combined with inadequate services, space, housing, and infrastructure; slums are home to some of the world's poorest health services, facilities, and outcomes.^[82] Child mortality (under 5) in these contexts is generally triggered by causes that are preventable through cheap and feasible measures. "Everyday" risks of infectious and parasitic diseases are usually the primary causes of premature death in informal settlements, and are related to developmental and cognitive stunting.^[83] **Poor service delivery, lack of information about immunization, and lack of maternal education are key contributors to low immunization coverage.[84] Meanwhile, there is an overall lack of health data, and virtually no local records on many serious health data needed for action.**^[85]

While mothers living in urban areas are often closer to obstetric emergency services than their rural counterparts, access to and quality of these services is low-- health facilities are few and strained, and skilled birth attendants are in short supply.^[86] Under these constraining circumstances, people often resort to unqualified health practitioners or pay a premium for health care.^[87]

A representative 2009 study in Nairobi showed that out of a total of 503 health facilities used by residents of three slum communities (Korogocho,

Viwandani and Kibera), only 6 (1%) were public, 79 (16%) were private not-for-profit, and 418 (83%) were private for-profit. The private for-profit facilities generally consist of unlicensed and ramshackle clinics and maternity homes, with no working guidelines or standard protocols for services. Yet these substandard facilities are exactly where most local women go for maternal and child health care. Only a small proportion of the urban poor has access to more reliable maternal health care services.^[88]

STATEMENT OF NEED

Solutions are needed to **improve the baseline health care options that allow mothers and children to survive and prosper in challenging urban environments.** Technology-based innovations should seek opportunities to connect marginalized urban populations with health services, strengthen existing health services in these communities, and lay the groundwork for improved health. Meanwhile, technologies that can gather accessible, accurate and disaggregated data provide an essential pathway towards recognizing and improving health conditions for children and families in cities. Visualizing this data in innovative ways can help identify gaps, prompting action from local decision-makers.^[89] Technological innovations are also needed to connect vulnerable women, children and youth with essential information and services around immunization, maternal health, nutrition, and basic health care.

PROMPTS

How might we leverage technology to:

- Connect slum dwellers with (online/offline) information on the best available healthcare options and practices?
- Improve youth's adherence and attendance to health clinics?
- Improve monitoring and reporting of health services?
- Improve visibility of the "everyday" risks stemming from infectious and parasitic diseases?
- Support education tools and services for infant feeding practices (breastfeeding and complementary programs)?
- Improve data collection, monitoring, and mapping of health and nutrition risks at the street, ward, district, and citywide scales?
- Increase efficiency of diagnosis, immunization and treatment measures?
- Improve logistics and distribution systems (ex: cold chain for vaccine distribution)?
- Produce and commercialize low-cost alternatives for life-saving and life-changing products/technologies by providing their core function?

Violence & Hazards

THE PROBLEM

Street violence and Exploitation in Urban Slums

Children need safe spaces to grow up in, spaces that are free from urban violence. Violence by armed groups, gangs, crime syndicates, rebels or government forces is common if not constant across poor neighborhoods in developing cities across the globe. **Crime and violence affect hundreds of millions of children in urban areas.** Some are targets and others participate in or witness such acts as assault, mugging, communal conflict and murder. Safety, through security and protection measures, is essential to keeping spaces usable for their intended public purposes. Citizen security and protection measures are important for timely response and prevention of emergencies. These measures are significantly weaker in informal settlements.

This weakness leads to many different types of violence against children, including child trafficking. At any given time, around 2.5 million people are in forced labor as a result of trafficking, with children and young people accounting for up to 50% of this number. Trafficking for sex work, and

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trafficking that targets children who live or work on city streets are some of the most common risks for young people in urban areas. Children without birth certificates or official registration documents, including refugee and internally displaced children, have the highest risk of trafficking and other forms of exploitation, and are among those most difficult for authorities to trace and protect.^[90] Gender violence in urban settings extends beyond trafficking. For girls especially, sexual harassment and violence are a daily reality in public urban spaces. Those living in poverty may be exposed to heightened risk if they walk through insecure areas to reach work or school.^[891]

Meanwhile, the combination of booming adolescent populations with high rates of unemployment and continuing urbanization lends itself to the risk of civil strife. In cities across the world, vulnerable adolescents that are not productively employed or feel disaffected from society are more likely to express their frustrations through violence.^[92]

STATEMENT OF NEED

While urban violence has deep, systemic roots that need to be addressed at a system-wide level, **technology-based solutions can help bring urban violence issues to light, equip communities with response mechanisms, and connect communities with preventative measures.** Dealing with urban violence requires collaboration to address local realities, influence cultural norms and attitudes, promote conflict resolution, and re-establish trust among authorities, institutions and the general public. Successful participatory mapping efforts use technologies to better understand safety risks for children, bringing awareness to what problems exist where and for whom. Social networking tools and ICT can protect and empower young people, build closer community relationships, and expand planning processes and service delivery to include vulnerable populations.^[93] What other technologies can we leverage to prevent violence, while protecting the privacy and human rights of all city residents?

PROMPTS

How might we leverage technology to:

- Promote birth registration tools and platforms, including biometrics, to protect youth from child exploitation?
- Promote virtual educational, recreational and counselling tools for children in difficulty?
- Strengthen community relationships and trust in authorities?
- Create emergency alert and response systems that are integrated into the existing urban fabric?
- Enhance crime reporting and monitoring through sensor-based technologies?
- Promote participatory tools to allow children and their communities to map and track violent activities?
- Create and integrate lighting solutions that make streetscapes safer for children by discouraging violent assault?

Violence & Hazards

THE PROBLEM

Poor disaster preparedness and response capacity

Young people in poor urban areas experience **threat multipliers that exacerbate disasters and emergencies and deepen underlying physical, social, environmental, and health hazards**. Pathways between homes are narrow and often blocked, making evacuations chaotic and dangerous. Meanwhile, sanitation systems in slums--where they exist-- are fragile and overburdened, and prone to break under environmental or other physical stress. When a disaster like the January 2010 earthquake in Haiti strikes an already vulnerable slum context, the combination of existing conditions and disaster led to water contamination, compromised sanitation, and consequently: rampant spread of disease. Epidemics spread fastest in crowded areas where health services and sanitations are absent.

In other contexts, structural vulnerabilities leave slums prone to other disasters, like fires. When fires swept through three Nairobi slums from January

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to March 2011, leaving an estimated 25,000 people homeless, authorities and agencies were slow to respond. Fires are common in slums from Dhaka to Nairobi but urban disasters receive a baffling lack of response from aid agencies, indicating major gaps in urban crisis preparedness. Fires are not the only risk prevalent in low income urban areas. As urban development accelerates, the proliferation of informal settlements, declining ecosystems and failing infrastructure increase the vulnerability of inhabitants to disasters. It is estimated that eight out of 10 of the most populous cities in the world can be severely affected by an earthquake, while six out of 10 are vulnerable to storm surges and tsunamis.

Attention to large scale emergencies is critical. However, the cumulative impacts of smaller scale disasters that are not at the scale of classified disasters are among the main causes of premature death, injury and poverty in informal urban areas.^[94]

STATEMENT OF NEED

Children living in poor urban contexts and their community partners (planners, first responders, etc.) require **tools to mitigate, anticipate, prepare, respond to, and recover from hazards and disasters**. Residents commonly do not know who to call for assistance, and if first responders are available they have a difficult time finding and responding to fires and other disasters quickly. Participatory hazard mapping tools can help communities understand and communicate conditions of risk. Sensor technology, meanwhile, could help with disaster response and also serve as alert and detection for natural disasters and other emergencies such as flooding, earthquakes, social conflicts, and violence.^[95] In the longer term view, appropriate technological innovations could engage children and youth in the policy dialogue on adaptation to climate change, and ensure that measures we take to prevent environmental hazards and our resilience to them reflect the needs and visions of vulnerable urban communities.^[96]

PROMPTS

How might we leverage technology to:

- Engage young people in cities and their communities in collecting critical and disaggregated data on environmental hazards through participatory mapping projects?
- Improve data collection approaches and population sampling frameworks to allow faster aggregation of richer data on affected people at scale?
- Empower national disaster management agencies to more effectively track and respond to the most urgent needs of vulnerable populations in cities in the wake of a natural hazard?
- Create early warning systems for emergencies to alert community members via alarms and mobile alerts?
- Directly notify people who can help (firefighters, responders, residents) to take a specific action in response to an emergency?
- Demonstrate the potential of more dynamic emergency response services to focus more resources on this area?



Violence & Hazards

THE PROBLEM

Indoor and Outdoor Air Pollution

Children are uniquely vulnerable to indoor and outdoor air pollution – due not only to their physiology and to the types and degrees of their relative exposure.^[97] **Outdoor air pollution tends to be worse in lower-income, urban communities, where there is high exposure to environmental pollutants such as solid waste and fuel emissions.** Meanwhile, industrial activity is also more common near lower-income urban areas, where there is often less capacity to manage waste. With these disadvantages in place, poor urban areas often turn to burning their waste, including toxic plastics, rubber and electronics. Burning these wastes creates highly toxic airborne chemicals which are highly detrimental to children. Poorer families living in urban areas are also less likely to have resources for good quality ventilation, filtration and air conditioning to protect themselves from harmful air.^[98]

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For example, a study on public transport in Dar es Salaam found that vehicle emissions expose children to elevated levels of sulphur dioxide, which is known to increase morbidity-especially in children under five years. **Indoor air pollution poses similarly pressing risks to children in cities, especially those in slums.** Coal is a principal fuel employed by the urban poor for cooking and heating. Beyond being a major greenhouse gas emitter, coal's use in congested and poorly ventilated homes often leads to respiratory diseases, which are particularly dangerous in early age.^[99]

STATEMENT OF NEED

Children need clean air to survive and thrive, and clean air is increasingly rare in rapidly urbanizing contexts. Solutions are needed that address causes and consequences of indoor and outdoor air pollution in cities. In the developing urban context, technological innovations that address root problems such as inefficient and “dirty” fuel consumption will be imperative (whether through filtration or other modes). Urban communities will also need interventions and systems that **monitor air quality, predict when pollution will be dangerous, and alert people of unsafe air quality conditions to ensure that children are not exposed to pollution that threatens their lives and livelihoods.** Air quality can fluctuate rapidly in indoor and outdoor environments. For example, cooking or heating with biomass in the home can cause a rapid spike in indoor air pollution. Urban outdoor pollution spikes during rush hour in most cities. Waste-burning tends to be practiced at certain times of the day in many places. Monitoring technologies can help ensure that the worst impacts of air pollution are avoided, and can bring attention to priority causes and areas for pollution mitigation.^[100]

PROMPTS

How might we leverage technology to:

- Measure, report and predict dangerous air pollution levels in the areas where children are most at risk?
- Identify priority intervention sites for air pollution remediation measures?
- Invent clean and affordable cooking, lighting and heating tools and technologies?
- Design filtration systems that improve air quality at different scales?
- Imagine new ways to source, distribute, and employ cleaner fuel options, both for indoor and outdoor uses?
- Install passive thermal cameras and other environmental sensors to detect specific hazardous gasses created by certain industries?

Connectivity

THE PROBLEM

Lack of Youth Citizen Engagement and Representation

Even with expanding access to mobile technologies, poor urban families in the Global South often can't access or afford the internet. In Latin America, fewer than 1 in 10 poor households has an internet connection. In the Central African Republic, a single month of internet access costs more than 1.5 times the annual per capita income.^[102] Without connectivity, pathways to youth engagement and participation for vulnerable urban youth are severely limited.

Young people and their allies are often deprived of the chance to act as active stakeholders and to have a voice in the public debate around how cities are governed, and what shape their cities will take. In addition to expanding public policy and planning conversations to be more inclusive and participatory, improving connectivity can open up opportunities for young people to hold governments accountable for the services they provide, and to improve design and delivery of services to respond better to the public's priorities.

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UNICEF Innovation has worked extensively to empower young people to speak out on issues that they care about in their communities, encourage citizen-led development and create positive change. We recognize that children's input is critical to making products that speak to what children actually need and want – and that draw on children's imagination and creativity to expand the realm of the possible.^[101]

STATEMENT OF NEED

In quickly urbanizing cities, decisions around how cities are planned and run dictate what life will look like for urban residents in the near term and the very long term. Choices on issues ranging from infrastructure to service provision, to environmental regulations have direct bearing on the lives of all city dwellers, and for young people in particular. In these settings, social isolation and exclusionary factors, paired with low connectivity, impede young people from engaging and representing themselves.

Connectivity (as defined in the glossary) is essential to enabling **citizen engagement**, participation, and visibility especially for informal urban residents to advocate for themselves, organize, and work towards restructuring the systemic and policy-based disadvantages they face.

Children and youth in slums need ways to participate and engage with each other, their communities, and their governments.

Participatory learning and action tools can empower children to share ideas, learn from each other's experiences, form and express views and put them into action. Participatory learning approaches can also allow children and youth to assess and report their own levels of risk, vulnerability and response capacity. Other opportunities to engage and represent youth might focus on getting young people to evaluate public policies or planning decisions, and providing feedback on a range of urban issues. Beyond engagement and representation with institutions, connectivity solutions in this space can also provide platforms for conflict resolution, peer-to-peer learning, and entrepreneurial development.

PROMPTS

How might we leverage technology to:

- Develop accurate and effective methodologies to assess gaps and disparities in demographic connectivity across urban areas?
- Advance online protection measures for young people (for privacy and identity protection) while improving connectivity infrastructure and resources in poor urban settings?
- Deploy mobile technologies to allow citizens to voice concerns?
- Use data collection, mapping, and visualizing tools to improve visibility of slum communities and their priority concerns?
- Engage children in participatory learning tools to map and understand their priority concerns, and communicate those with decision makers?
- Create platforms for sharing lessons learned and highlighting issues for use in advocacy and awareness creation with relevant authorities/stakeholder?
- Create technologies-based tools for children to learn about the rights of the child?



Connectivity

THE PROBLEM

Unequal access to opportunity, 21st century skills development

The gap between the rich and the poor is at its highest in the last three decades in most countries (UN WCR). For many children living in urban slums, school can be an exclusionary or very limited learning experience, and on top of lacking access to basic education, **children are left without access quality learning opportunities to develop the skills they need to thrive in the 21st century, including the transferable skills related to learning, leadership, entrepreneurial thinking, creativity, communication, personal empowerment, active citizenship, employability and so on.** ^[103]

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Social Inclusion

The implications of this failure are especially dire in cities, where the promise of better education and increased access to opportunity is left unfulfilled for the majority of poor children and youth. Deprived of these opportunities, children and youth in cities are vulnerable to getting involved in unsafe labour, trafficking, and other forms of exploitation. This vulnerability is especially high for children living in slums, those with disabilities, and children of migrants.



STATEMENT OF NEED

Children in cities need quality learning solutions that prepare them to prosper in the context of a changing, urbanizing world. True learning opportunities need to be available at non-traditional times, and not exclusively linked to a physical location or building. They also need to perform in areas where connectivity, electricity, and maintenance services are not reliably available.^[104] Technological innovations can provide pathways and platforms for delivering 21st skills under these conditions, while also addressing the fundamental limitations (structural, service-based, spatial, etc.) to learning for children in urban slums.

PROMPTS

How might we leverage technology to:

- For the inclusion of vulnerable populations and individuals with disabilities in the productive ecosystem of cities?
- Support us to work with communities to tailor to their needs based on local realities?
- Use waste creatively to produce usable resources such as energy, building materials, that would otherwise be discarded in non-environmental ways?
- Create new markets where there are interests and needs for solutions (such as fintech in Africa creating a market for financial services in an otherwise unserved population)?
- Design mobile, GPS, and sensor technologies for alert systems/warning danger in areas where there is no high-speed wireless, or unreliable internet?
- Connect isolated city dwellers with essential services (such as medicine) in ways that reduce travel time/in-person time and provide accurate and efficient solutions at a low cost?

Where do we go from here?

Our goal for this handbook is to catalyze the identification of groundbreaking opportunities which will accelerate the development of urban technologies to serve communities of need. These could be technologies that already exist or are adaptable, or new ideas that need further development and design mentorship to determine if they can become real solutions for vulnerable children living in urbanizing areas. These technologies should first and foremost be designed to meet the needs of the communities and individuals they will serve, and also be: excitingly innovative, feasible to execute, and display appropriate context.

Across disciplines, we need to reframe our concept of how urban technologies can support solutions for communities as rapid and unplanned urbanization continues to impact lives and landscapes globally. At UNICEF Innovation, we believe that envisioning and advocating for what is possible within the Global South context will direct us to innovation that brings real value to people's lives while affording opportunities for good business.

To realize this vision, we need to follow design guidelines, appreciating the variety of needs unique to local contexts and the importance of designing with users. This work should always anticipate and prevent the potential downsides of technological interventions, and prioritize safety and privacy. Following this model, urban technologies have the potential to impact the lives of thousands of children and transform urbanizing cities into centers of opportunity for all people.

We want to encourage those who use this handbook to look for ideas that can shift universal perspective and improve the world in a meaningful way. Please join us in this effort. We are actively seeking strategic partnerships in order to pursue pilot projects that harness the potential of existing and emerging technologies to meet the needs of vulnerable children. If you are interested in joining us in this work, please contact us.

Email: **Jennie Bernstein**
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Glossary

Children:

All people under 18 years of age.

Connectivity:

Beyond connections to power, internet, and servers, urban residents require fundamental and digital literacy, along with access to devices, content, training, support, and monitoring and evaluation. For the purposes of this handbook, “connectivity” refers to this full suite of digital access.

City:

An area defined by significant population density; the presence of services and infrastructure (public amenities, commerce, roads); an economy not based in agriculture; an extensive built environment and an intensity of flows of: people, goods, resources and communication (see expanded definition on page 16)

Global South:

refers broadly to regions in the Southern Hemisphere, that are mostly low-income and often politically or culturally marginalized.^[105] These regions used to be called “the third world” or “developing countries.”

Informal Settlement:

a residential area where 1) inhabitants have no security of tenure over the land or dwellings they inhabit, with modalities ranging from squatting to informal rental housing, 2) the neighbourhoods usually lack, or are cut off from, basic services and city infrastructure and 3) the housing may not comply with current planning

and building regulations, and is often situated in geographically and environmentally hazardous areas^[106]

Internet of Things (IoT):

is the inter-networking of physical devices, vehicles [also referred to as “connected devices” and “smart devices”], buildings, and other items—embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. “Things” in the IoT sense can refer to a wide variety of devices.

Peri Urban Area:

An area between consolidated urban and rural regions.

Slum:

Commonly understood as the most deprived and excluded form of informal settlements, characterized by poverty and large concentrations of dilapidated housing, often located in the most hazardous urban land. (see box 1 on page 18)

Universal Design:

The design of products, environments, programs and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. Does not exclude assistive devices for particular groups of persons with disabilities where this is needed [UN, 2006].

Urban:

The definition of ‘urban’ varies and can be defined by one or more of the following: administrative criteria or political boundaries (e.g., area within the

jurisdiction of a municipality or town committee), a threshold population size (where the minimum for an urban settlement is typically in the region of 2,000 people, although this varies globally between 200 and 50,000), population density, economic function (e.g., where a significant majority of the population is not primarily engaged in agriculture, or where there is surplus employment) or the presence of urban characteristics (e.g., paved streets, electric lighting, sewerage).^[107]

Urbanization:

The increase in the proportion of urban population over time, calculated as the rate of growth of the urban population minus that of the total population. Positive rates of urbanization result when the urban population grows at a faster rate than the total population.

Urban Technologies:

Technological tools, platforms, and services that are applied to meet the needs of people living in cities/ urban areas.

Youth:

The United Nations defines ‘youth’, as all people between the ages of 15 and 24 years of age. This definition was made during preparations for the International Youth Year (1985), and endorsed by the General Assembly (see A/36/215 and resolution 36/28, 1981).

21st century Skills:

a broad set of knowledge, skills, work habits, and character traits that are critical for success in today’s world and in the future.^[108]

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NOTES

[10] Defined in Glossary

[35] The number of poor and undernourished is increasing faster in urban areas than in rural areas

[39] "Urban settings provide proximity to maternity and emergency services – but access, use and quality are, again, lower in poorer quarters." SOWC 2012

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[65] "Data to understand the magnitude and extent of social exclusion on children remains scarce. Robust evidence is critical to be able to assess the situation of children and women in this area of work. High quality data provide UNICEF with the ability to make sound policy and programme decisions that ensure the best results for children and realization of their rights." ["Social Inclusion for Children"] <https://www.unicef.org/publicpartnerships/files/SocialInclusionTheCaseForSupport.pdf>

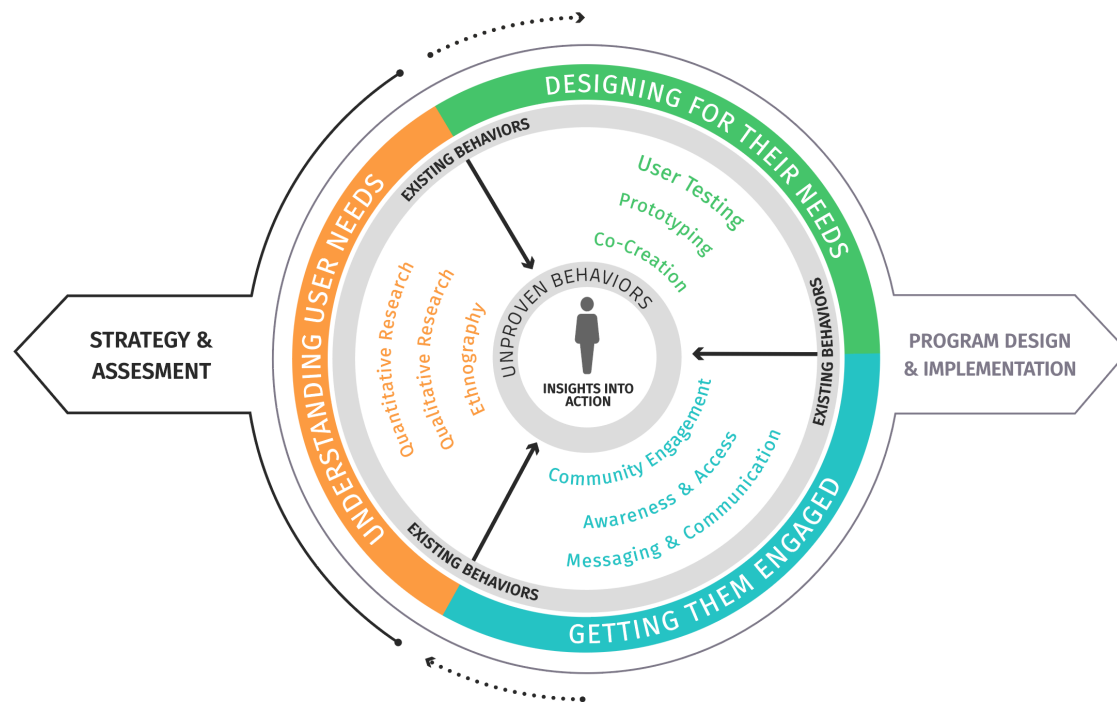
[73] Please keep in mind, these prompts are meant to inspire thoughts around some solution areas we think are prime for technological innovation; however, the possibilities to leverage technology extend well beyond these prompts, and you should not feel restricted by them.

Annex 1: Human Centered Design*

*Taken from “Accelerating Results For Every Child By Design A Case for Scaling Human-Centered Design in UNICEF” May 2017 and informed by Ideo’s [Open Design Kit](#).

While there are myriad definitions and frameworks for understanding HCD and its potential as a strategy for development, the frame offered by Design Impact Group captures the potential of HCD succinctly and in a highly relevant way for UNICEF and its partners in the private sector.

HCD integrates a broad set of practices around a common understanding of user needs that can improve strategic decision-making as well as increase the effectiveness of individual programs.



Design Impact Group, Making the case for design in the development sector

Quantitative research

The collection and analysis of large scale demographic and psychographic data through methods such as surveys and in person interviews to gather representative data on current perceptions and practices

Qualitative research

Direct engagement with target users and influencers through interviews, observational and participatory techniques to gather directional data on emerging needs and behavior

Ethnography

A type of qualitative research based on the social sciences that relies on deep immersion in users' lives and culture in order to minimize bias

User testing

The evaluation of a product or service by directly testing it with users, focusing on the product's ability to meet users needs, and fit into their lives so adoption is easy and natural

Prototyping

The process of building an early sample or model of a product, service or system in order to refine and validate the concept or generate new concepts

In addition to and as part of the quantitative, qualitative, and ethnographic research, one key part of the HCD process involves the development of user personas. User personas offer a way to identify and summarize the needs, thoughts and goals of the target users of a product/system/service/tool. Building user personas can prevent us from generalizing all users into one 'bucket', and allows us to appreciate that even if we're looking at an innovation for a very limited geographical context, the people who will be engaging with the end product will experience it differently. Below we've included a template for how to build user personas, along with two examples that are meant to serve as a roadmap for the reader as they think about how to design for children, young people, and their communities in an urbanizing world.

Co-creation

The process whereby users directly participate in the design of a product or service intended for their use

Messaging and communication

The process of crafting the value proposition of a product or service in a way that is compelling and determining where and when that message is best communicated to different user segments

Awareness and access

Includes any activities to increase the knowledge and reach of a product or service among target user segments, including marketing and sales channels

Community engagement

The process of building long-term relationships with communities to increase trust and the potential to influence behavior and norms

Synthesizing insights into Action: an active, collaborative process for manipulating, organizing, pruning and filtering data to produce knowledge that can be applied directly to active problem-solving



Layla, 15

Location

Cairo, Egypt

Education level

Dropped out of secondary school

Income

~\$100 USD per week

Literacy Level

Only basic literacy from primary school

Technology Usage

Mobile phone, occasional television

How do they receive information?

Mobile phone, social media, some access to internet, and the TV her family shares with the neighboring flat

Daily Reality

Care-taker of her three younger siblings as parents have immigrated to another country in search of employment.

Pain Points

- Heavy familial burdens and limited social opportunities
- Lack of access to adequate social services
- Suffering from physical safety and health burdens linked to obesity and domestic abuse

Motivations

- A desire to help her family
- A desire to be employed and independent
- A desire to have more social interactions, be part of the community
- A desire to be free from abuse
- A desire to be physically healthy



Chanda, 7

Location

Ho Chi Minh City, Vietnam

Education level

Not enrolled in school due to lack of formal registration (parents are migrant workers)

Family Income

~\$35 USD per week

Literacy Level

Illiterate

Technology Usage

No direct access to technology, parents' mobile phone.

How do they receive information?

Word of mouth from parents, neighbours, friends.

Daily Reality

Left unattended at home with his 5 year old brother while both parents work in the garment factories where many of Vietnam's migrant workers work.

Pain Points

- Lack of formal registration, cannot enroll in school
- Lack of literacy/ fluency in local language
- Risk of being subjected to forced labor

Motivations

- A desire to learn
- A desire to play and have friends
- A desire to assimilate in his new home city

Insert Image Here

Insert Image Here

Name, Age (Job Role)

Location

Education level

Income

Literacy Level

Technology Usage

How do they receive information?

Daily Reality

Pain Points

Motivations

Name, Age (Job Role)

Location

Education level

Income

Literacy Level

Technology Usage

How do they receive information?

Daily Reality

Pain Points

Motivations

Contributors

Thank you to the following colleagues, friends and community members who responded to our call to review and provide personal insight to the information and approach contained within this handbook. Following UNICEF's principles of open innovation, together we will keep the conversation going and invite you to do so within your own community, to push the conversation forward where you are able, from whichever domain you operate within.

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Reviewed by UNICEF colleagues in the following programme divisions:

**Child Protection,
Adolescent Development,
Disability Section,
Nutrition, Gender, WASH**

“
Hundreds of millions of children today live in urban slums, many without access to basic services. We must do more to reach all children in need, wherever they are excluded and left behind. Some might ask whether we can afford to do this, especially at a time of austerity. But if we overcome the barriers that have kept these children from the services that they need and that are theirs by right, then millions more will grow up healthy, attend school and live more productive lives. Can we afford not to do this?
”

Anthony Lake
Executive Director,
UNICEF



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