DIGITAL TOOLS FOR LOW-INCOME HOUSING IN INDIAN CITIES

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mHS CITY LAB

A self-built Informal settlement in Delhi. Source: mHS CITY LAB

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KEYWORDS

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- INCREMENTAL HOUSING
- URBAN RESILIENCE
- DIGITAL NETWORKS
- SOCIAL DESIGN
- LEAN METHODOLOGY
- USER TESTING
- MICROFINANCE

Through the ongoing work by the team at mHS CITY LAB, a social enterprise based in Delhi, the article looks at the possibilities offered by digital platforms across urban centres of global South in enabling lower income communities to self-build safer and better houses.

INTRODUCTION

mHS CITY LAB was founded in India as a social enterprise to develop innovation housing solutions for the urban poor. The vision has been to enable affordable and safe housing for housing living in informal settlements. mHS successfully implemented pilots with micro-finance agencies on housing and is currently incubating a series of digital tools for improving quality of the built environment. The interdisciplinary team works closely with organisation such as SAATH and SEWA, agencies such as the World Bank, financial institutions, micro-finance agencies and think tanks such as Centre for Policy Research.

DIGITAL ACCESS FOR INCLUSIVE CITIES

Within the current global buzz around 'smart cities', typical discourse on how technology could aid urban environments has centred on glitzy visualisations of high-rises, high speed rail or high speed internet. However, building cities of the global South where large populations lack basic amenities and housing requires a re-imagination of 'smart cities', centred on access for all. Here, the rise of Artificial Intelligence combined with massive digital penetration offers promising avenues to democratize access to knowledge and expertise.

The article explores the role technology can play in improving the resilience of cities in rapidly developing countries by improving the quality of self-built, incremental housing. It presents the insights from an ongoing project at mHS CITY LAB, a Delhi based social enterprise, to empower low-income communities through digital access to construction knowledge. It further evaluates potential of data driven, evidence based approaches and artificial intelligence in solving complex social problems facing the cities of global South.

The rapid penetration of smartphones and internet access in the emerging economies of the world is fast generating flows and stocks of data. This data can be analysed with machine learning algorithms to uncover new prediction and optimization patterns. Digital access has already enabled several African countries such as Tanzania, Uganda, Kenya and Ghana to leapfrog the typical digital development trajectory, skipping the incipient technologies of landlines or pagers. AI and big data here are opening up avenues in terms of financial inclusion, access to healthcare, legal services and other areas of expertise. The use of mobile money services such as MPesa has been hugely successful while other apps in the fields of agriculture, health and education have also had a significant impact on low-income communities (Poushter & Oates, 2015). The recent success of Juan Credit in Philippines demonstrates how deep learning techniques can be used to develop a credit scoring system for the unbanked population (Fintech News, 2017), lowering the barrier of access to capital.

In India, the recent Digital India[1] initiative aims to provide digital access to low income communities and rural areas. Local organisations such as Digital Greens[2] and initiatives such as Khabar Lahariya[3] have been using digital media as a medium to disseminate crucial information and news. Mobile platforms such as *Commcare* developed by the international social enterprise Dimagi are proving successful in reducing maternal and new born deaths in rural areas across India (Halabol, 2013). Like in other domains, machine intelligence leveraging data produced by increasing digital access can be harnessed to improve the quality of self-built housing in urban centres.

ROLE OF TECHNICAL EXPERTS IN SOLVING THE CHALLENGE OF URBAN HOUSING

From Hanoi to Lagos, Caracas to Mumbai, cities of global South are growing rapidly, accounting for most of the urban growth in the world today (UN DESA, 2014). Inadequate resources and planning mechanisms to accommodate for this upsurge in rural-urban migration have led to the proliferation of self-constructed informal settlements, called by different names such as slums, shanties, *barrios, favelas, kampongs, bastis* in different geographic locations. Built incrementally, these settlements provide affordable housing to millions but suffer from lack of basic amenities, overcrowding and poor quality of spaces (Davis, 2006).

This rapid growth of informal settlements in the cities of the global South has a specific impact at the household level: dwelling units are often poorly built and seismically unsafe structures. These neighbourhoods are the most vulnerable and at high risk from natural disasters and climate change induced stresses. The key reasons behind this can be traced to insecurity over land tenure, lack of finance, absence of building regulations and inability to access technical construction information. Even in cases where access to finance has been made possible, communities are seen building unsafe structures due to the lack of access to engineering and architectural expertise (mHS, 2011).

Traditionally, the role of an architect also included that of the contractor, project manager and engineer. With industrialisation, these roles came to be divided into separate professions, with a hyper-specialization of technical professionals in more recent times (Malone, Laubacher, & Johns, 2011). Lower income areas, however, are bereft of these specialized experts, such as architects or engineers. Incremental construction in such a context is directed completely by the local mason who plays the role of the contractor, designer and engineer. Due to the lack of skilled labour and adequate technical know-how, specifically on the concrete frame construction technology rampant in informal settlements across the global South,

"FROM HANOI TO LAGOS, CARACAS TO MUMBAI, CITIES OF GLOBAL SOUTH ARE GROWING RAPIDLY, ACCOUNTING FOR MOST OF THE URBAN GROWTH IN THE WORLD TODAY."

1 See http://www.digitalindia.gov.in/
2 See https://www.digitalgreen.org
3 See http://khabarlahariya.org/

"ACCESS TO CRITICAL CONSTRUCTION INFORMATION THROUGH DIGITAL PLATFORMS HOLDS THE POTENTIAL TO CREATIVELY DISRUPT THE CONSTRUCTION ECOSYSTEM IN EMERGING ECONOMIES TODAY."

DIGITAL TOOLS FOR INCLUSIVE HOUSING

NEED FOR SERVICE:

11%
skilled workers
Source: Government of India, 2008

lack of
professional
assistance

400 million
urban population
of India

76 million
live in dense
informal
settlements
Source: UNDP, 2009

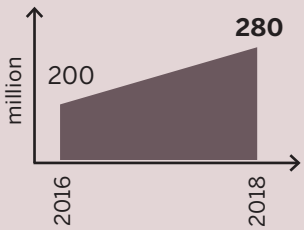
Improving the quality of **INFORMAL HOUSING** in Indian cities through **MOBILE TECHNOLOGY**

960.6
million wireless
subscribers

58% URBAN
42% RURAL

Source:
Telecom Regulatory Authority of India
Annual Report 2013-14.

Projected
smartphone
users in India

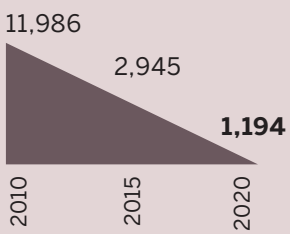


Source:
eMarketer, 2014
2 Billion Consumers Worldwide to
Get Smart(phones) by 2016.

60%
smartphone users
have **android OS**

Source:
Market share held by mobile operating
systems in India from January 2012 to
March 2015.Statista, 2015.

Average cost of a
smartphone (INR)



Source:
PriceBaba.com, 2014
India Android Consumption Report 2014.

typical structural flaws are easy to identify. Many of the construction malpractices could be avoided by access to basic technical inputs. This, however, is prevented by the socio-economic gap that exists between low-income communities and technical experts which in turn, poses one of the biggest challenges in building the resilience of our cities.

Thus, the relevance of technical professions in the cities can only be realised by rethinking their typical roles. It will involve capability-building at the levels of entrepreneurial masons who lie at the centre of the value chain. Technology offers a huge potential to bridge this knowledge gap and deliver construction expertise. Mobile phones have become an essential device in most households and smartphones are becoming increasingly affordable (Poushter, 2016). India had over 1 billion mobile subscriptions in 2016, with 1 in 5 using smartphones (IAMAI, 2016). The cost of android devices is projected at only 20 USD by 2020 and internet access is becoming more affordable with stronger 3G & 4G networks reaching the main cities.

Access to critical construction information through digital platforms holds the potential to creatively disrupt the construction ecosystem in emerging economies today - by providing Building Information Modelling[4] to underserved communities at a grassroots level. This calls for participatory governance and connecting key stakeholders to create impact at scale which the article explores next.

4 Building Information Modelling is an intelligent 3D model-based process that equips architecture, engineering, and construction professionals with the insight and tools to more efficiently plan, design, construct, and manage buildings and infrastructure

Pilot service at Saath's URC in Ahmedabad.
Source: mHS CITY LAB

DEMOCRATISING ACCESS TO HOUSING SOLUTIONS

To improve quality of low-income housing, the right to access technical assistance would need to be viewed as a preamble. Since 2010, the interdisciplinary team at the Delhi based social enterprise mHSCITY LAB have provided customised construction solutions to low-income communities. To scale its outreach, mHS is leveraging the medium of digital platforms to deliver complex technical information. In the form of easy to understand graphics and videos through accessible digital platforms, this information hold the potential to drastically improve the quality of informally built housing. Slum up gradation and resettlement projects in Indian cities have typically overlooked this need for access to information and focused on one-time standardised solutions. With construction in lower income areas largely being incremental and self-built, it is crucial to empower the communities at the household level by providing constant access to information and amenities. While other globally recognised problems in the social sector have been extensively researched and addressed, incremental housing is still an underserved process, mainly due to its invisibility within building plans and regulations. Its relevance in cities of the global South and provision of affordable shelter options to city dwellers, however, call for urgent action.

Informal settlements have attracted much attention from individuals and organisations working in the housing sector. The discourse, however, has focused on insecure land titles, scarce infrastructure, precarious livelihoods and the large number of temporal stakeholders. This has distanced such locations from a solution for improving the quality of informally built housing which could be scalable as well as inclusive. At mHS, it is envisioned that leveraging the proliferation of the digital medium – in the form of a construction toolkit on a digital platform – can overcome the complexities of informal settlements. With the scale and spread of digital tools, the vision is to offer algorithms for construction design and planning through intuitive user interfaces which can self-learn and evolve based on user inputs and experiences over time.

mHS's approach has been to follow a lean methodology with iterative feedback from users collected through multiple prototype tests on field. The digital tools are being developed for the three phases – before, during and after construction. Comprehensive architectural and engineering solutions have been coded into algorithms capable

of processing basic user inputs to generate detailed customized outputs, harnessing the potential of the collective intelligence of experts, communities and machines. The interface for each phase is being designed to be accessible through different digital platforms such as mobile phones and computers for an illiterate to semi-illiterate population who is at the threshold of adopting digital technology today.

Following several field tests and feedback through focus groups over the last year, the first tool for providing construction estimates is currently being tested as a pilot project in the city of Ahmedabad through two Urban Resource Centres (URC) of the community NGO Saath[5].

The centres are enabled by the pilot to provide critical pre-construction information to aid low-income communities in financial planning of their house construction project. Typically, homeowners in the communities where the centres are situated find themselves unprepared for the eventual construction cost of their houses due to incremental procurement of smaller material quantities and daily payment of labour wages. The actual cost always overshoots their initial guesswork or the mason's crude estimates, resulting in last minute loans or incomplete structures. Access to a planning and tracking tool through their local NGO centres is now enabling them to plan their finances and estimate the number of cement bags and bricks, weight of rebars and truckloads of sand they need to buy. Based on simple user inputs such as location, type and size of plot, number of floors, sanitation configuration and quality of finishing, the responsive service generates detailed information on material quantities, costs, labour and project timelines. The pilot is proving critical in developing the application based on user feedback and identifying the most effective channels for dissemination of the service.

5 SAATH URCs provide services such as information support in documentation for Identification cards and awareness on government welfare schemes.

"BASED ON SIMPLE USER INPUTS SUCH AS LOCATION, TYPE AND SIZE OF PLOT, NUMBER OF FLOORS, SANITATION CONFIGURATION AND QUALITY OF FINISHING, THE RESPONSIVE SERVICE GENERATES DETAILED INFORMATION ON MATERIAL QUANTITIES, COSTS, LABOUR AND PROJECT TIMELINES."

User testing by mHS CITY LAB team in Delhi.
Source: mHS CITY LAB

INFLUENCING SOCIAL BEHAVIOUR THROUGH SOCIAL DESIGN

A key challenge to implementing the pilot has been in influencing consumption and investment behaviours in the informal communities in favour of safer and healthier structures. With most households in informal settlements struggling to make ends meet, long term planning and sustainability are not top priorities. Tenure insecurity added to the need to establish their status within the community has been observed in many cases for aspirations by households to invest on larger rooms and facade aesthetics as a higher priority than structural safety. Understanding the aspirations and behaviour behind construction decisions of low-income communities is, hence, a key factor to be able to catalyze the quality and safety of housing.

An important research focus has also been on identifying the most effective distribution channels for dissemination of information in low-income communities. While technology is a great enabler with immense potential to reach millions, it can also act as a barrier to those who have not adopted it yet. Even with rapid penetration of smart phones, given the context in question, reaching everyone today requires leveraging existing networks and more person-to-person interactions. The pilot project has experimented with networks of E-kiosks deployed via grassroots organisations with a large emphasis on door to door awareness, community workshops and service trials.

Delivering high tech solutions in Indian cities also requires an understanding of the prevailing low tech networks and leveraging them as an intermediary technology. mHS plans to employ the technology of Interactive Voice Response as an avenue to reach existing basic mobile phone users while they make the transition to smartphones.

DATA ANALYTICS TO INFORM THE CONSTRUCTION ECOSYSTEM

A substantial incentive of leveraging digital technology is in its potential to generate very large volumes and stocks of data which can then power advanced machine learning algorithms. India undertook the Aadhaar program in 2009 to provide a centralised, mobile and unique identification number to every resident Indian based on algorithmic correlation. Mired in recent controversies over questions of privacy and its mandatory enrolment for certain welfare schemes (Doshi, 2017), it is a mammoth task that brings to light the potential and the challenges in handling data analytics of a billion. While requiring a clear policy for its implementation, it offers immense potential to favour access to basic services in urban environments with the rise of artificial intelligence technologies.

Similarly, monitoring and analysing transactions and behavioural patterns through advanced analytics backed by machine learning algorithms creates manifold opportunities – from connecting key stakeholders involved in informal construction to involving the government in effecting policy changes directed at building resilience in vulnerable settlements. Two such important stakeholders in influencing incremental construction are material suppliers and financial institutions interested in providing micro-finance for housing.

Notwithstanding the set-back to the Microfinance Industry in India in 2011, today there is renewed interest in serving the untapped market of low-income housing. Micro Finance Institutions (MFI) and Housing Finance Companies (HFC) in India have been driven by a tremendous growth of almost 60% in just the last year (PTI, 2016). Material suppliers such as cement companies similarly need to be involved to achieve impact at scale to dramatically improve the incremental construction ecosystem in Indian cities. The Digital Tools project aims to take these stakeholders along as the next step on the successful completion of the pilot project this year. The data generated from user profiles listing their credit worthiness, needs and preferences is invaluable information to the stakeholders looking at serving this lower income segment. Another valuable contribution lies in the tool's potential to map vulnerable settlements to inform resilience building initiatives, especially in pre-disaster preparedness.

"THE ENVISIONED SCALE OF THE COLLECTIVE INTELLIGENCE THAT DIGITAL TOOLS CAN BRING TO THE CONSTRUCTION ECOSYSTEM NEEDS TO BE AS MASSIVE AS THE URBAN CHALLENGES FACING DEVELOPING COUNTRIES."

The envisioned scale of the collective intelligence that digital tools can bring to the construction ecosystem needs to be as massive as the urban challenges facing developing countries, if state agencies can adopt the tools and incorporate the mechanisms at field and policy levels. With user feedback playing a critical role in effecting change, user assistance would need to be furthered by facilitating financial access and tenure security. mHS CITY LAB is hopeful in its vision to inform policy for greater inclusion of low income neighbhourhoods in Indian cities through its Digital Tools project. The next few years will be critical in evaluating the impact of digital technology and data in empowering low-income communities by bridging the knowledge gap.

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