



# AFFORDABLE HOMES

## BUILDING MASS HOUSING IN INDIA

January 2014

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# Executive Summary

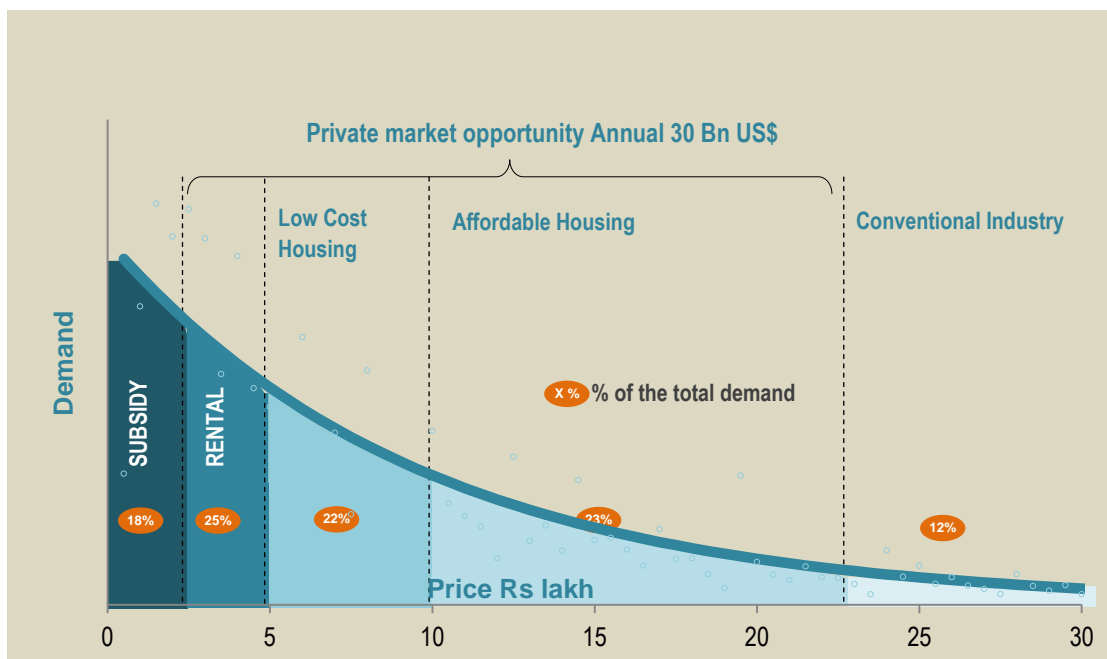
## Turning deficit into an opportunity

India has a deficit of 18 million houses in the urban areas. About 70% of which is accounted by the bottom two quintile of the income pyramid, households with income less than 5,000 Rs a month. Close to 800 households get added every day to the 14 million families forced to live in the slums of urban India. 80% of the housing deficit is accounted by congestion; large families are forced to live in small tenements. On a business as usual scenario the housing deficit will rise annually by half a million to about 40 million in 2051.

This report estimates that low cost housing has a business potential of 600 Bn US\$ over the next two decades. However, unlocking this value requires surmounting several constraints. Primary component, land is a scarce resource in Indian cities, as a consequence of both topography and policy. Delay in getting approval for construction can inflate the price of the land by 50% – 100%. Consequently the mainstay industry has chosen to focus on the top quintile of the income pyramid.

### Exhibit 1 Demand Curve

Source: IHDS, Clytics research



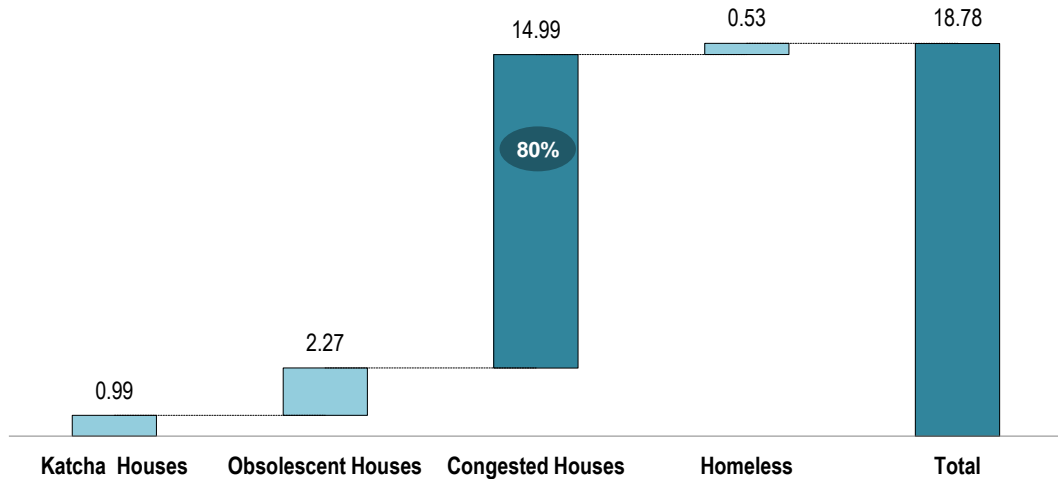
The government has always accorded the importance of priority sector to housing. Its role has shifted from a supplier to an enabler. In the mid 80's it became clear that the pace of the housing supply is unable to match that of population growth. National housing Board was formed in 1988. However, private sector interest in the low cost housing space remains muted till mid 2005. In an inefficient market



## Exhibit 2 Nature of the Deficit

Number of units (million)

Source: Report of Technical Group on Urban Housing Shortage



developers held on to the land banks to allow price appreciation and released the supply into the market as premium units. Post financial crisis; crunch on the money supply led to a correction in the industry. Speculative land assets, stressed balance sheets and forced a rewiring in the operating model. Notwithstanding a small start, a few successful projects in the low cost housing space and a huge pent up demand, evokes curiosity in the industry.

Most of the low cost housing projects have come up in peri and suburban regions on account of high land prices within the city precinct. Developers have financed the land using equity. Close to 100,000 units, sized 25 – 60 m<sup>2</sup> built up area priced between 5 – 20 lakh, have been delivered till date. The sales off take has been promising and construction was initiated post a sale deed had been signed, leading to a low working capital requirement.

### Mass Manufacturing

Context of operations in the low cost housing is different compared to the conventional industry. Low operating margins, faster turnaround, low asset base and a lean organization is the philosophy behind affordable housing.

Developers have followed three approaches for designing a low cost home. First, they have adopted a smaller format 1 BHK and studio. Second projects carried basic amenities, finishes and fittings. Lastly configurations, layouts and process were standardized across the project.

Streamlining project management, which typically accounts for 75% of the low cost project value and about 80% of the project duration, becomes a key challenge for low cost housing. Period costs can comprise upwards of 25% of a projects topline. While conventional construction is carried using large batches (*see Box Manufacturing Houses*) we can re-engineer it to create a pull based process.



### Box Manufacturing Houses

There are striking similarities between the mass market automobile and the affordable housing sector. The paradigm extends into the operations as well. Standardizing the product over the last century has enabled vehicle manufacturers to reduce cost, reach a wider consumer base, and achieve consistent quality benchmarks. On the shop floor production managers migrated to a single piece flow. It gave insight into hidden wastage within the system and allowed repeated course correction of the process. In the next five decades many approaches of mass manufacturing would find their way into low cost housing segment.

The conventional construction is carried out in large batches. Entire floor of a wing (set of blocks) is casted together covering an area over 20,000 sft. The duration to complete activities at each stage (floor) consequently is stretched out to weeks. Identifying constraints in a large jobsite becomes challenging and as a parade of workmen of a related trade move in and then out, production delays get piled up. Incomplete activities create a multiplying whipping effect at delivery and throw the entire schedule out for a toss.

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#### Exhibit 3 Batch Production

Huge work spaces make identification and monitoring difficult  
Source: Clytics Research

ILLUSTRATION



## Box 3 Manufacturing Houses

Increasing the throughput, in the conventional process faces a physical constraint: construction for the next level cannot be initiated until the slab can bear its own load. Typically there is a ten day delay, for the concrete to cure, before the next level is placed on the one below. Concrete casting sets the precedence and the duration of each of the activities downstream. When apportioning for an activity over a longer duration is not possible the gang is either rested, reassigned to another location, or trade.

The first step in adopting workstation into a construction process requires restructuring the work sequence to use smaller elements. In case of housing these elements are a set of flats. Next the sequence has to overcome the physical constraint set by the curing of concrete. Instead of shifting vertically up after every casting the construction process has to move horizontally for few castings before making a jump to the next level. As a consequence the duration between castings can come down drastically by a factor of 10 when compared to the conventional industry. Low cycle times and batch size result in the workforce getting a continuous work-front. We estimate that most projects can haircut 40-70% off the project duration by removing uncertainties involved in managing a large batch size and instead chosen to be executed with workstations.

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### Exhibit 4 Getting to flow

Sequential flow process with segregated and smaller work centres leading to a faster pouring cycles.

Source: Clytics Research

ILLUSTRATION



The work flow can be designed to be repetitive as an assembly line giving visibility into the hidden wastages in the system. The productivity increases as the workforce becomes accountable for a specific work on a specific location. Just as preassembled components prefabricated kits can reduce the complexity in managing the logistics

The biggest challenge in implementing the framework in the field is to evolve shared benchmarks for execution. Process parameters productivity, quality has to be defined and the underlying preconditions required to achieve the same consistently have to be understood.

**Exhibit 5 Constructing an assembly line**

**A. Reduce the batch size, the number of units executing a particular activity.**

**B. Create workstations sequential work flow while optimizing the flow of materials and ensuring physical constraints are met.**

**C. Kanban: use visual communication for benchmarks and control the flow of work materials and workmen**

| Code        | Material            | Qty | W     | Net |
|-------------|---------------------|-----|-------|-----|
| 09 01 01    | Painters Putty      | Kg  | 0.27  | 5%  |
| 09 04 32 01 | Sand Paper Grit 150 | #   | 0.01  | 1%  |
| 09 04 32 41 | Sand Paper Grit 100 | #   | 0.01  | 0%  |
| 09 04 32 03 | Sand Paper Grit 80  | #   | 0.025 | 1%  |

**Measuring up**

As the biggest stakeholder government has the opportunity to facilitate this sector by cutting down the project approval timeline of one month, creating rational densification norms in cities, and by evaluating the bylaws with a perspective on the price.

Developers can participate in this opportunity by leveraging their scale in operations to create subsidiaries focused on low cost housing. HFC as a senior participant in the industry can catalyze and guide outcomes, while the supporting



industry of Equipment manufacturers and raw material providers could use this opportunity to create new products for a new operating model.

# Turning Deficit into an Opportunity

Housing, one of the primary necessities, opens the doorway of access to other services including sanitation, security, financial inclusion, education, and public health care.

India has a deficit of 18 million houses in the urban areas. About 70% of the current deficit is accounted by the bottom two quintile of the income pyramid: households with income less than 5,000 Rs a month.

To contain the backlog and balance the demand which is posed to be generated over the next 20 years India has to produce on an average 8500 low cost houses every day over the next two decades. Over 1.2 million highly skilled masons, carpenters, welders; about half a million semi skilled workers, besides over a lakh foreman, 25,000 engineers and project managers will be will be directly involved and about twice the number supporting the execution.

Affordable housing will require ambitious investments to the tune of 30 Bn US\$ annually. It has a potential to increase the mortgage to GDP ratio from 10% currently, to 20% at the end of the decade. It can raise the national income by a percentage point.

1.1. In this section we take a stock of the levers driving the demand and supply of affordable housing. We take an overview of the housing finance sector and evaluate its robustness to scale up in the next decade. We try to provide answers where the future urban growth is likely to take place. Finally, we take a stock of the affordable housing supply from a nascent industry.

Definitions:

1 lakh = 100,000  
1 Crore = 10 Million  
1US\$ = 62 Rs  
1 m<sup>2</sup> = 10.76 sft

1.2. In the next section we make a case for industrialization of construction and its implication in affordable housing. We analyze how organizational structure and core capabilities are changing as a response. We evaluate the approach taken to design and to construct low cost homes. The final section of this report explores the gaps in the market and presents a roadmap for scaling up.

## Sizing the demand side

1.3. Every day about 800 households migrate and end up living in a slum in urban India. More than a fifth of the population of Indian cities is unable to participate in the formal housing markets. The price of the cheapest home in the market today is still unaffordable for 18% of the urban households. However the opportunity represented by households which may not be affluent and are not



### Exhibit 6 Low cost Housing opportunity

Demand plotted against capacity to afford

Source: IHDS, Clytics research



deprived either is about twice of what is being catered to by the mainstay industry<sup>1</sup>. The size of this segment will rise for about 45% of the total demand currently to 64% in 2025.

14. Over the next four decades the forces driving this demand will interact amongst themselves across the country. Northern India will undergo a spell of rapid population increase, while the southern and western India will undergo a period of rapid urbanization. Population of Uttar Pradesh will increase by 90% in a span of four decades, while the population of Bihar will double. Kerala and Karnataka will experience a spell of rapid urbanization and will be more the 60% urban by 2051. While the demand for housing remains strong the supply side has not been able to measure up. In the last decade the housing stock in West Bengal has increased close to 25%, Kerala 20%, which is significantly below the national average of 33% increase during the same period. With a business as usual scenario we find the deficit will rise annually by half a million to about 40 million in 2050. 13 of the 20 bigger states will have to initiate strong

<sup>1</sup> Computed using data from Indian Human Development Survey; refer to Note on Methodology for further details.

institutional intervention to contain the deficit and control the price rise (see Exhibit 7 Annual Demand supply gap).

Affordable Housing is a 600 Bn \$ opportunity over the next two decades

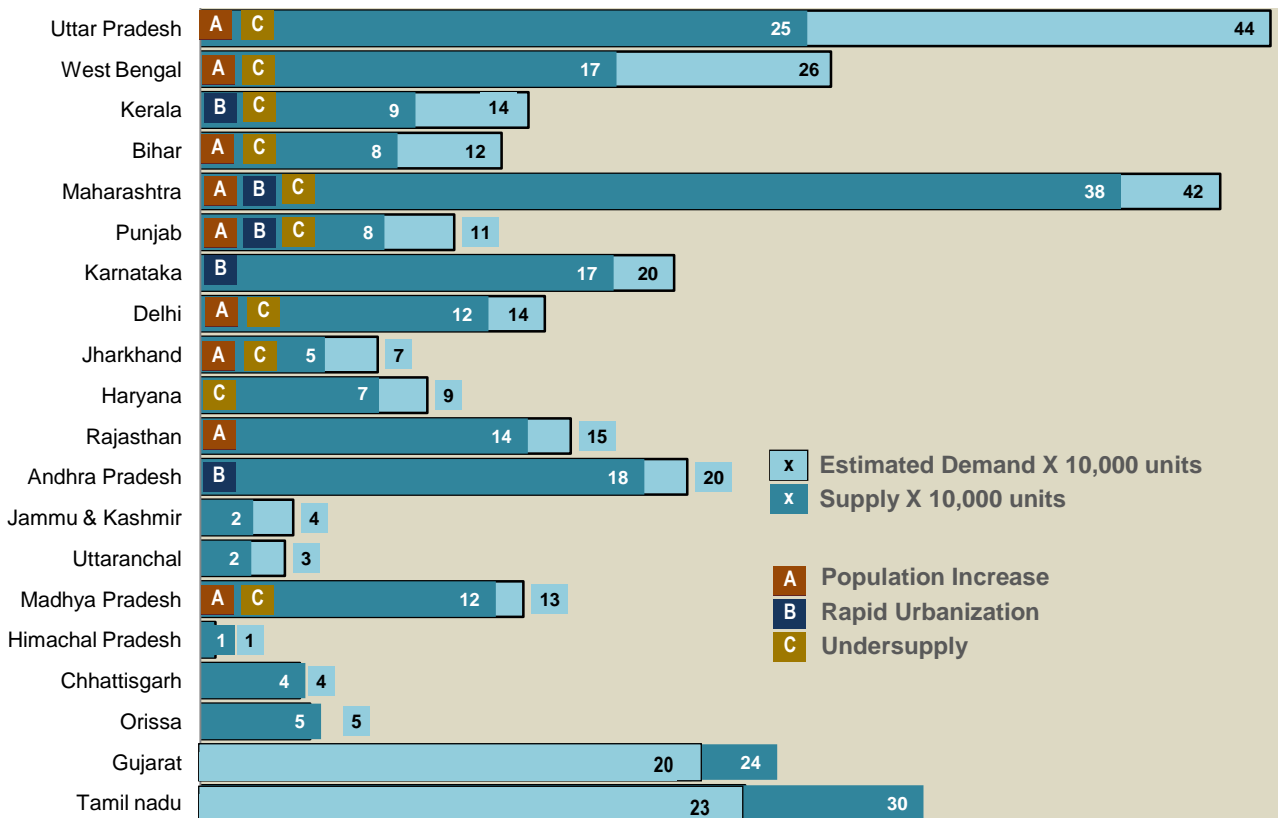
1.5. We estimate that affordable housing has a potential to unlock 600Bn US\$ of business, opportunity over the next two decades. Larger states, Maharashtra and Uttar Pradesh will account for close to a third of the estimated annual demand of 3 million housing units in India. Rapidly urbanizing but aging south India will account for about 25% of the tally while a more populous eastern India will account for less than 16% of the total demand. Low cost housing can generate direct and indirect employment to the tune of 4 million and induce a further job creation across the sectors for 17 million more<sup>2</sup>.

1.6. Of the 18 million deficit in housing obsolescence and temporary construction *katcha* accounts for 15%, while household forced to live in congested dwellings account for 80% of the deficit. Congestion results from large families forces to share small tenement without privacy. Homeless households, generally single member destitute account for the balance 3%.

**Exhibit 7 Annual Demand supply gap**

At current trend line projections Uttar Pradesh and West Bengal are most likely to account for half of deficit across the country if we continue along business as usual.

Source: Census 2001, 2011, Demographic model Clytics Research



<sup>2</sup> We considered a marginal income to demand multiplier of 2 for direct & indirect and 4.7 for induced. Similarly we accounted an employment multiplier of 2 and 7.8 respectively

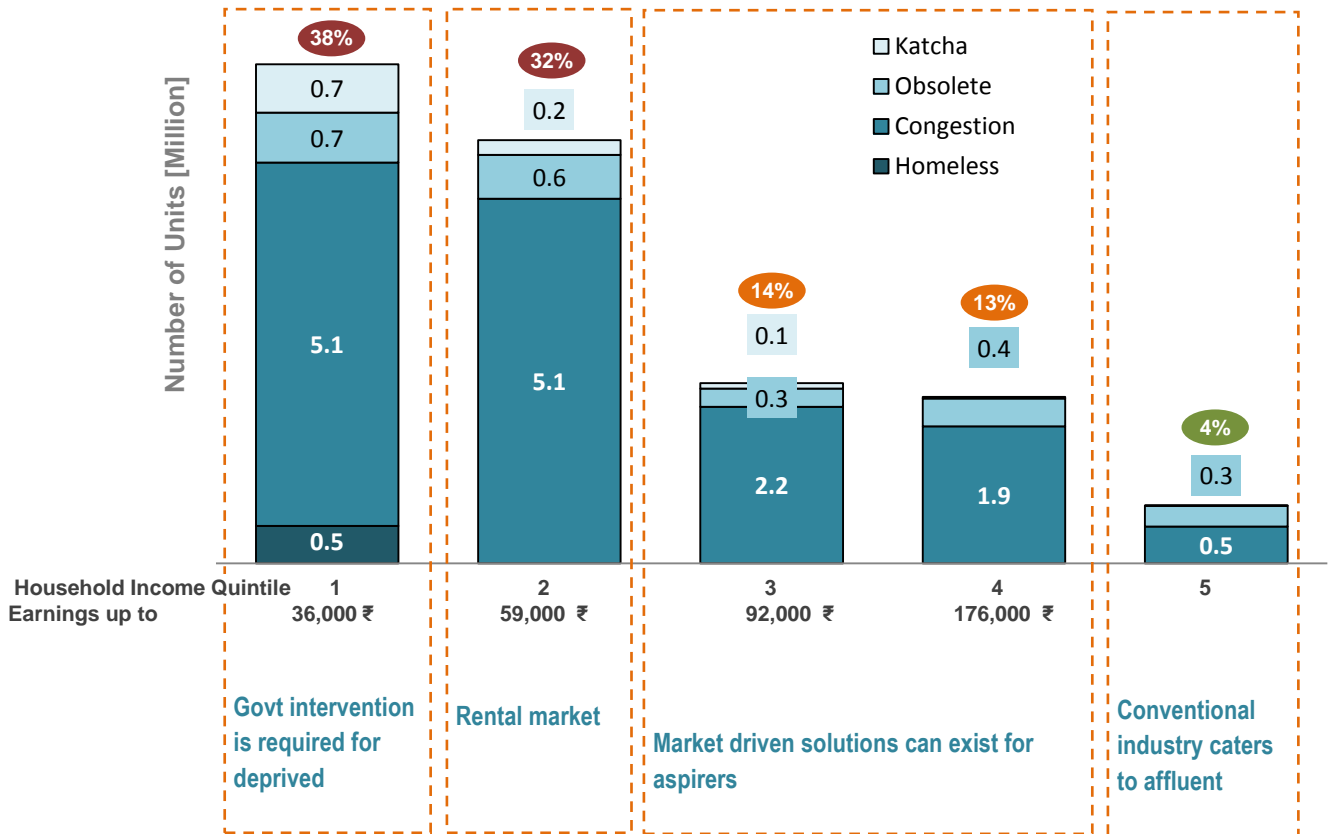
Majority of the deficit is accumulated in the bottom two quintile of the income pyramid

17. Unlocking this value requires resolve of steel. Slightly less than 70% of the current deficit is accounted by the bottom two quintiles on the urban income pyramid, a household with an annual income under 75,000 Rs. Half of the households in the first quintile have negative savings. The majority of such families is left out of the formal housing market, unable to afford even the lowest priced unit. Catering to the future demand will require innovation since 45% of the total demand shall arise out of low income states<sup>3</sup>.

**Exhibit 8 Distribution of deficit across income class**

70% of the deficit is in the bottom two quintiles while most of the supply is skewed to the top of the pyramid

Source: Report of Technical Group on Urban Housing Shortage, NCAER How India Earns Spends and Saves, Clytics Research



<sup>3</sup> **Low income states:** Assam, Bihar, Madhya Pradesh, Meghalaya, Orissa, Rajasthan, Uttar Pradesh, Chhattisgarh, Uttaranchal and Jharkhand; **Middle income states:** Andhra Pradesh, Himachal Pradesh, Karnataka, Kerala, Tamil Nadu and West Bengal; and **High income states:** Goa, Gujarat, Haryana, Maharashtra, Punjab, Delhi.



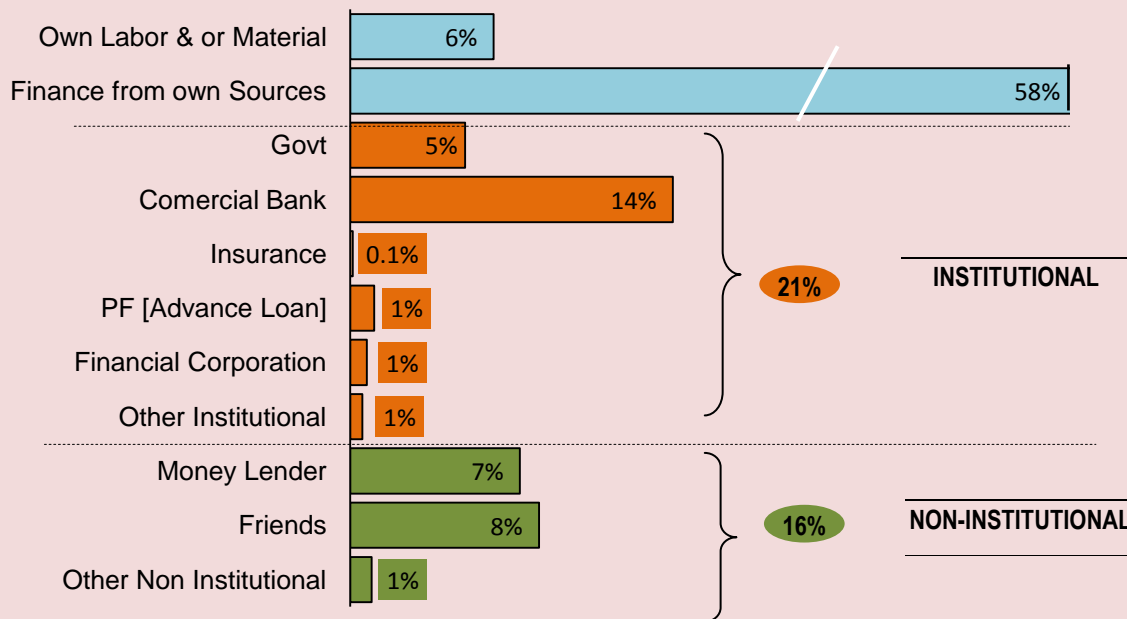
**Box 1 Delivery and access to finance**

Formal financial sector is yet to penetrate perceptively into the housing segment of India. Most households finance the construction of their homes out of their own pocket. Non-institutional informal sector accounts for a further 16% while the formal sector accounts for 21%. This is both a constraint and an opportunity for the low cost housing industry. As a reflection housing loan portfolios have been growing at 16% CAGR in between FY 06-12. Over the next two decades this trend is likely to continue. The industry is posed to double itself over the next five years as it percolates deeper into the segment and the market itself expands with time. The long duration growth is estimated at 8-9% in proportion with the demand for housing.

**Exhibit 9 Sources of Finance for construction of a ‘Pukka’ house**

Majority of the funding for construction of houses comes from ‘own’ sources. Institutional finance has low penetration levels in India.

Source: National Sample Survey, Clytics Research



Compared to Scheduled Commercial Banks (SCB), Housing Finance Companies (HFC) are better posed to capture the growth. Lower operating costs and targeted business structure have enabled HFC to grow at 24% annually over the past five years. Housing portfolio of SCB has grown at half the pace during the same period. The market share of HFC is likely to increase from 30% currently to 50% in the span of a decade.

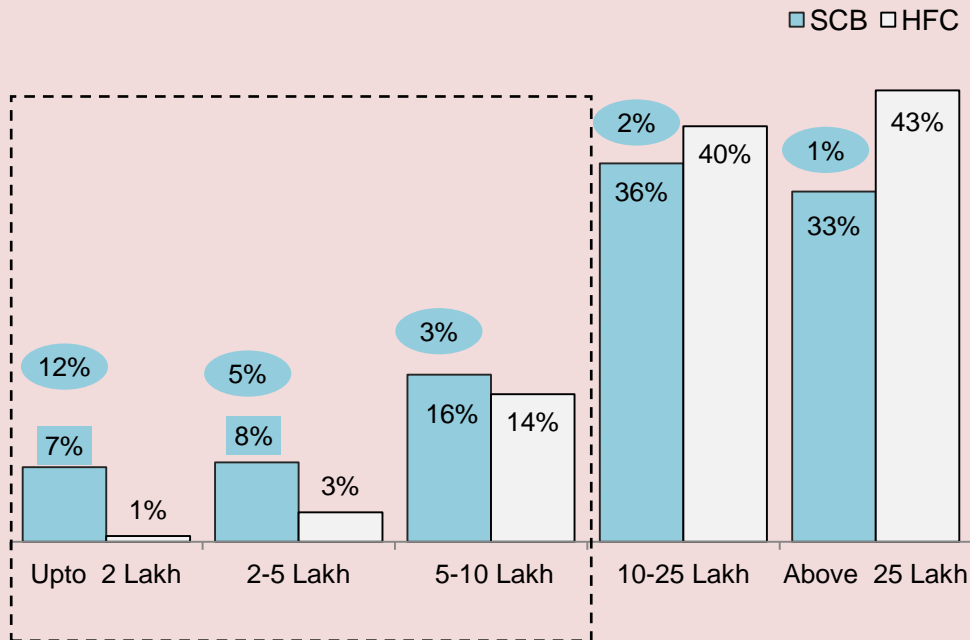
### Box 1 Delivery and access to finance

Despite a high growth rate, Non Paying Asset (NPA) levels have limited the disbursal of loans at low ticket size. More than three quarters of the loan disbursals are pegged over 10 lakh. SCB have a bigger presence in the affordable segment both on the account of their size and the priority sector lending targets set by the Reserve Bank of India. HFC have been testing the affordable segment. However, high cost of funds and a risky asset class have forced them to position towards mid-income consumers. In future as the pooled security market deepens and credit insurance products mature the affordable segment will start lending its weight in the housing finance industry.

#### Exhibit 10 Disbursements to the Affordable segment 2011-12

40% of housing loan disbursals of SCB was for loans below 10 lakh, the same figure for HFC was 18%. Higher NPA levels have prevented further penetration into this market segment.

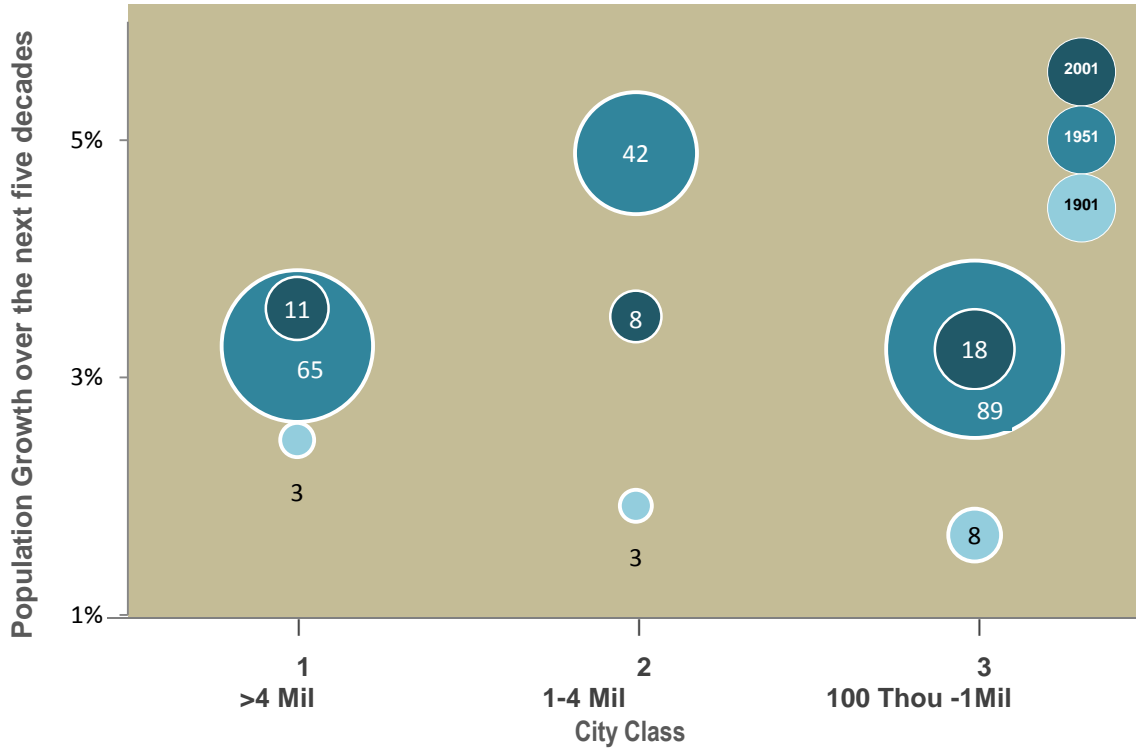
Source: National Housing Board Trend and Progress of Housing in India, Clytics Research



**Exhibit 11 Where will the urban growth take place**

Average annual increase in population by class of cities. A higher proportion of growth will come from the smaller tier II cities. Size of the Bubble indicates the population in the corresponding year.

Source: Respective Census, 2001-51 forecasted. Clytics research



**Locating growth**

1.8. In between the last two censuses 2001 and 2011 the total population in the seven metro grew by about 20%, while that in the tier two cities has grown close to 40% in the same period. If the same trend continues over the next four decades the demand for new houses in tier II cities will be more than double than that in tier I cities (*see Box 2 Growth beyond super-cities*) over the next four decades. Organized housing market is slowly waking up to the reality presented by tier II cities.

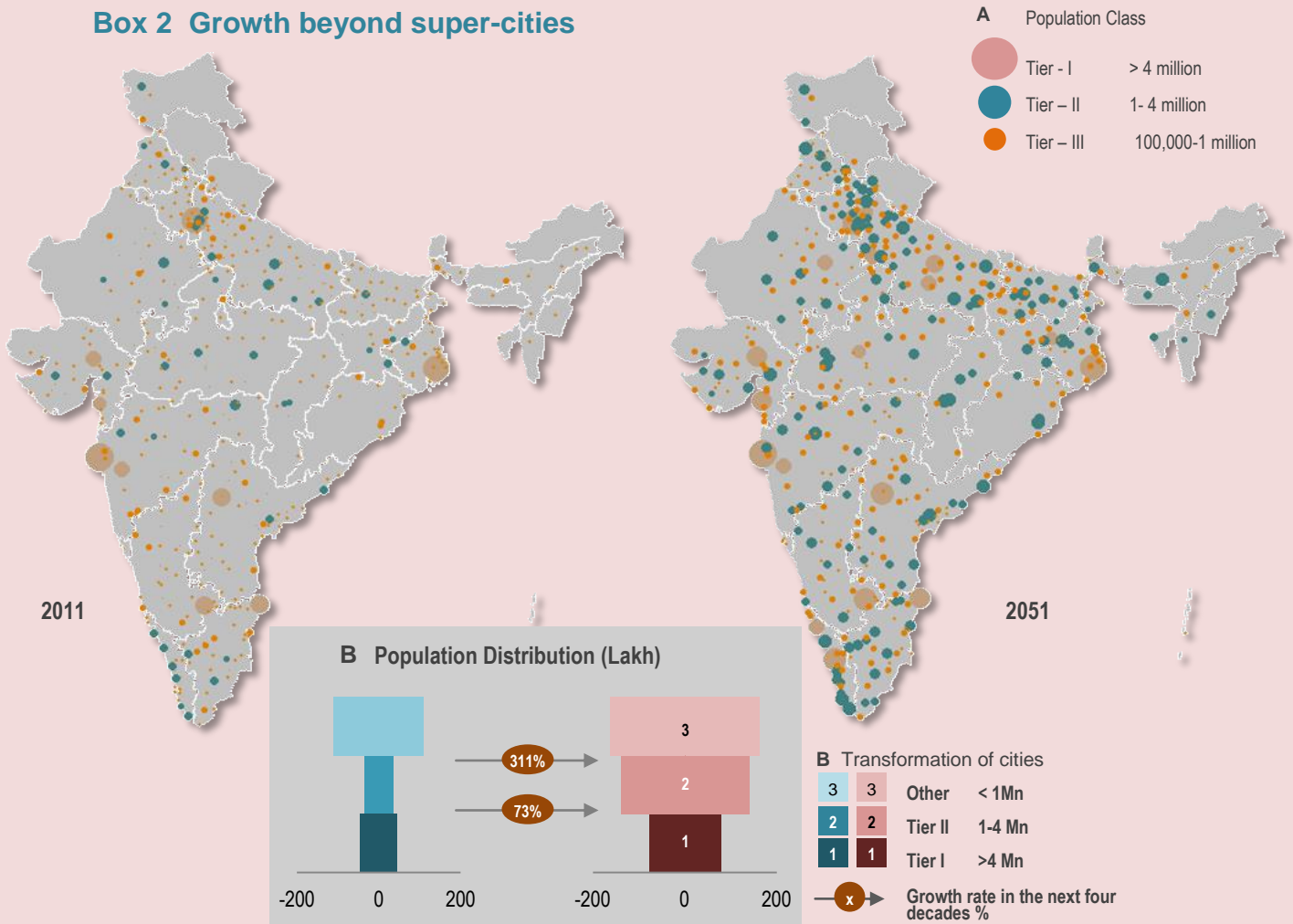
Future Urban growth lies in Tier II cities

1.9. While the future remains discrete, a third of the Indian cities have come up within 50 km from a major metropolitan<sup>4</sup>. Almost all the cities with a population above a lakh have a neighboring city which also has a population above a lakh. There are about 130 twin cities spread across the country separated from each other by a couple of hours drive. Notwithstanding the expanse of the country we find strong linkages resulting in the agglomeration of Indian cities. The growth in future will take place within these agglomerations and on the routes linking them. Peri urban regions will become hot spots for the housing sector.

Peri Urban hotspots

<sup>4</sup> World Bank. 2013. Urbanization beyond Municipal Boundaries : Nurturing Metropolitan Economies and Connecting Peri-Urban Areas in India. Washington, DC: World Bank. © World Bank.

### Box 2 Growth beyond super-cities



### Exhibit 12 Evolution of Indian cities

Size of the bubble indicate the population  
Source: Census, Clytics Research

About 24% of the urban population lives in nine Tier I cities, with more than 4 million residents. In 2051 the number of such cities will increase to 20 with about the same 20% of the urban population living there. However about 37% of the urban residents will live in Tier -2 Cities with a population between 1-4 million up from about 18% residing currently.

Across the world as the population of the city increased, its growth rate in population has decelerated. We find similar trend in India as well. Land acquisition delays, poor access to infrastructure, slow pace in decision making; impact a city of 4 million much more significantly than they do a city with a population of 500,000.

However, we find strong inter-linkages between the cities. At present 96% of the urban population lives within 500 km of a major metro. As non-agricultural employment opportunities get concentrated we are likely to have discrete but connected urban agglomerations across the country.

## Overview of the supply side

1.10. Government of India has held low cost housing as a priority sector since independence. Initially, the five year plans were crafted to give financial assistance. Consequently, state housing boards were set up to modulate the supply. From the late 70's it became clear that the pace of addition of housing stock was not measuring up to the demand generated by population growth. HUDCO and HDFC were established to provide retail and commercial loan to the sector. In the mid 80's, policy reverted and the government stepped out of the role as a supplier to assume the responsibility of an enabler with the formation of the National Housing Bank in 1988. Private sector participation in the low cost housing remained muted till 2005. Developers had acquired speculative land assets and positioned themselves in the premium segment. In the aftermath of the financial crisis speculative assets strained balance sheets. Facing a liquidity crisis the industry looked has started looking at alternatives.

Role of the Government changed from a supplier to a facilitator

1.11. Market driven Low Cost Housing is a fledgling industry; close to 100,000 families have moved into 'affordable' homes delivered over the last decade. We did an indicative study<sup>5</sup> on the supply side and analyzed organizations on three

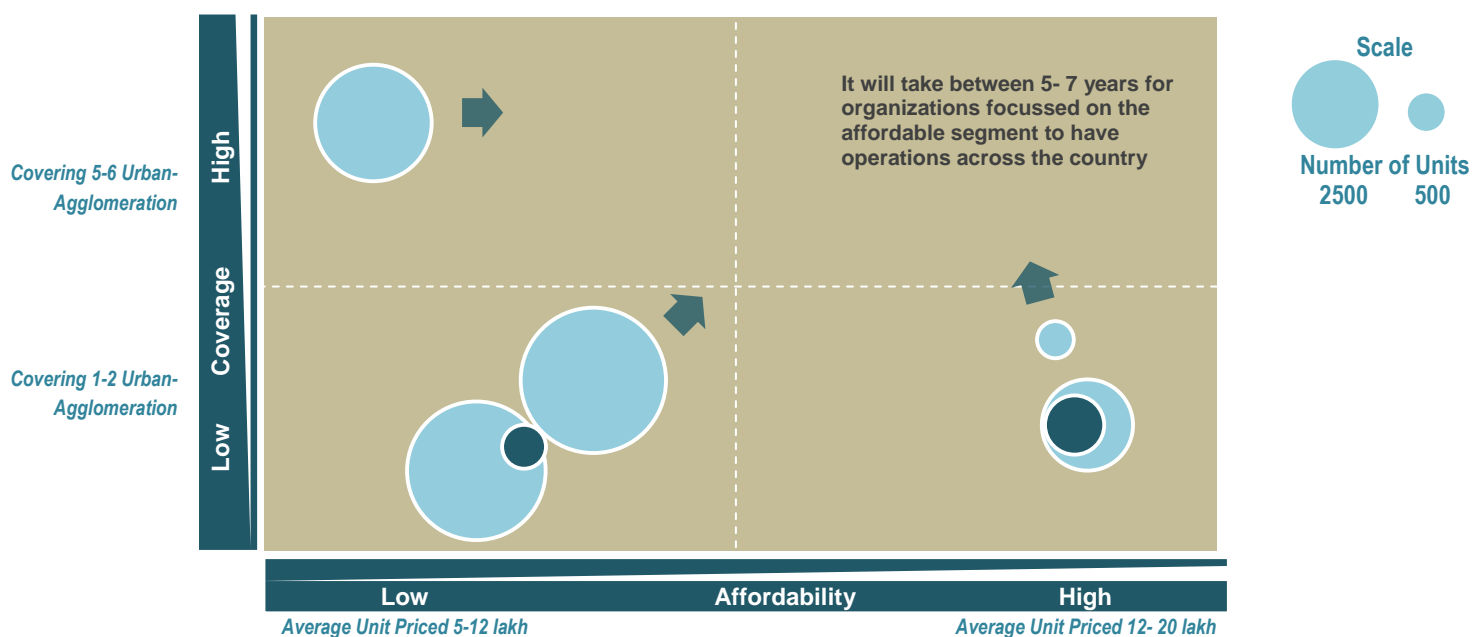
Opportunity is clear but constraints remain

### Exhibit 13 Affordable Market

Dynamics of players<sup>5</sup> in the Affordable housing space.

Sources: Interviews, Annual Reports, Corporate Websites, clytics research

INDICATIVE NOT EXHAUSTIVE

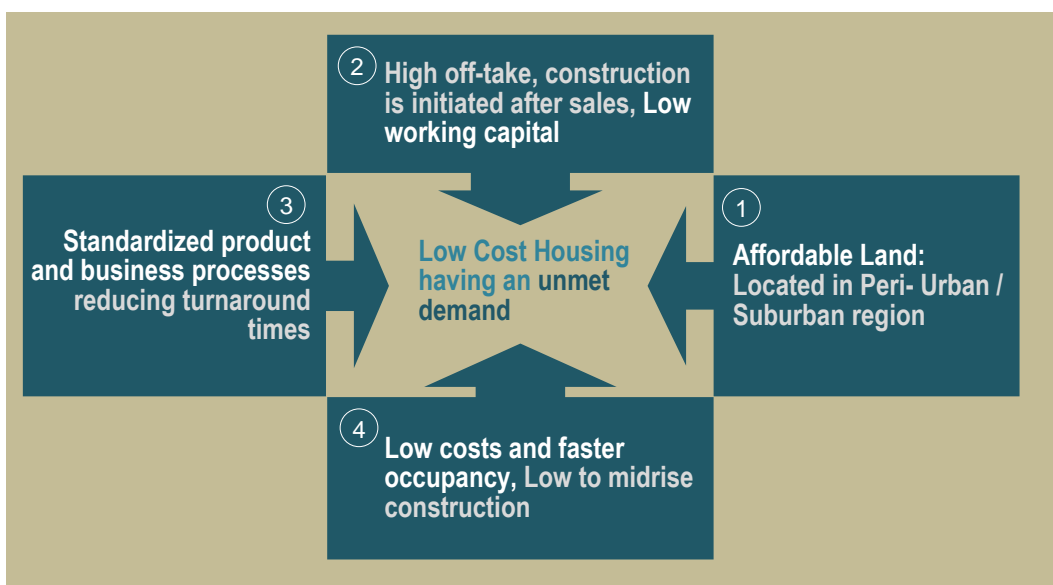


<sup>5</sup> We analyzed seven organizations: Tata Subh Griha, Xrbia, DBS communities, Value Budget Housing Corporation, Navjivan Foliage, Janadhar and Ashray to compute an indicative index in the affordable housing space. Refer to Note on Methodology for further details on the index.

fronts: First their focus on the affordable segment, which draws from the average cost of the product offering. Second, how well these organizations are placed to grow by measuring their outreach within the urban population. Finally, we looked at the experience of evaluating the number of units which have been delivered or are under construction till date. We find that developers, who have been able to grow or have spread across regions, have found it difficult to keep the focus on affordability while pursuing growth. Delays in land acquisition and obtaining approvals after entering into a new location has forced some of them to realign a part of the offerings towards the mid income segment. However, sales off take for small format units remain strong. Some projects have been able to sell of an entire phase in two days. Construction is initiated after sales deed has been signed, leading to lower working capital compared to the conventional industry (see Exhibit 14 Evolving Business Model).

1.12. Most of the low cost housing projects are located in the peri and suburban regions which are in between 60-100 km from the city center. This has limited the cost of land within 150 – 300 Rs apportioned on salable area. Financing of land on most projects has been through equity. A joint venture with landowners has been difficult since the objectives of owners and developers are difficult to converge. The landowners want to maximize the FSI and the returns, while the developer wants to build small units and get out of the project fast.

#### Exhibit 14 Evolving Business Model



## Turning Deficit into an Opportunity



# Mass Manufacturing

The opportunity has been sensed; however the constraints still look daunting. In this section we evaluate some of the best practices. We try to look for answers: How should a low income house look like? What approaches can be taken to execute profitable projects in this segment? How do we create organizations that deliver? How do different construction platform pit against each other? Finally, we analyze into how we can scale the model over the next decade and create the capacity to execute over 8000 houses a day catering to the affordable segment in urban India.

- 2.1. Conventional industry courted the affluent segment of the population. Developer cherry picked land strategically located to allow for appreciation in future. The construction and sales were initiated only when the city precincts expanded and the services: roads, drains and electricity reached these areas. Profitability arose out of from speculative skills. The business levers had been marketing to pooled set of investors, and liaising with the local government body. Most of the construction and project management is outsourced. The cost of delay was transferred to the customers or accommodated within the appreciated land prices. The operating model has made it difficult for the industry to look beyond the top 20% of the population strata.
- 2.2. A low cost housing, consumer has several requirements similar to that of an affluent consumer. As with the affluent, buying a house has strong emotional connect. It is linked to the household's social standing. As with the affluent low cost housing customer view their home as a long term investment. Consumers are comparatively more risk averse to try out new product innovation without the presence of a strong brand or a financial incentive. Rather than making a single investment in affordable housing, consumer makes incremental additions to his home over a long duration of time to reflect his aspiration and pressing need. Families strike a balance between the size of the unit, location, number of rooms and affordability. Households can trade off smaller room size and accommodate in a 2BHK which has the same size as that of a 1BHK. Customers prefer faster delivery since servicing a home loan while paying rent becomes strenuous.
- 2.3. Operating within this context is different compared to the conventional industry. Unit priced below 10 lakh can be viable only if projects are turned over faster. Operating in this segment does not allow room to accommodate speculative risks. Wafer thin margins, low asset accumulation, high utilization

First time home buyers view home as a long term investment



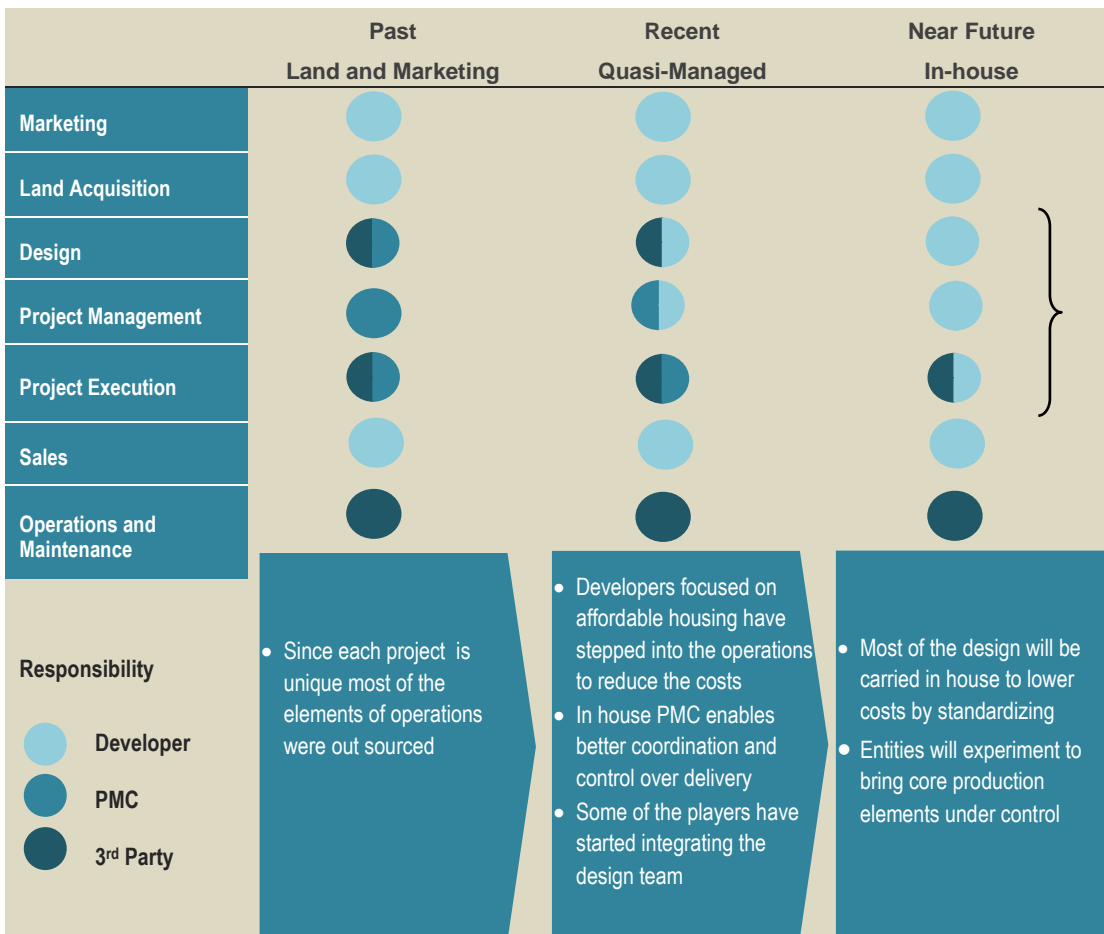
rate and a lean organization set up are the philosophy of in designing the operational and revenue model.

2.4. A business imperative to turn over fast has made low cost housing developers to dig deeper into the operations. Project execution and engineering contractors lack both scale and an incentive to overcome the inherent inefficiencies in the sector. Consequently, developers have internalized several workflows which conventionally have been outsourced. Cropping out contractor margins has enabled developers to shave off 100- 150 Rs psft from the project bill. The greater impact results from more control and visibility of the project schedule. As the industry prunes and streamlines the processes in execution, developers are likely to assume direct responsibility of key value added activities at the site in an effort to tone down fluctuation even further.

Affordable Housing developers are getting hands on with project management and design

**Exhibit 15 Transformation of the Operating Model**

Restructuring core engineering capabilities is underway. Mature affordable housing industry will be self managed, offering a standard product





### Exhibit 16 Overcoming the incumbent inertia

Challenge lies in creating an organization to rework the thumb rules from first principles.

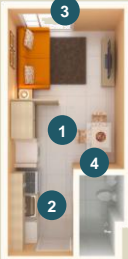
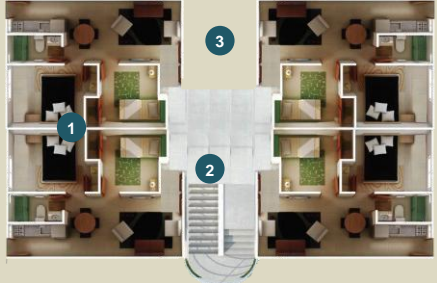
|                    | Design   | Project Management   | Execution   |
|--------------------|--|--|---|
| Resistance         | <ul style="list-style-type: none"> <li>• Reluctance to collaborate in creating standards and protocols</li> <li>• Resistance to document design protocols</li> <li>• Opposition to standardization</li> </ul>  | <ul style="list-style-type: none"> <li>• Disinclination to move from managing with a span of weeks to a day</li> <li>• Conflict to accept standard process and change.</li> </ul>  | <ul style="list-style-type: none"> <li>• Refusal to log and share production and quality statistics</li> <li>• Failure to ensure prerequisites for the next activity is met.</li> <li>• Resistance to increase productivity and accepting ownership</li> </ul>  |
| Source of Conflict | <ul style="list-style-type: none"> <li>• Relinquishing control</li> <li>• Lack of time for fulfilling multiple projects.</li> <li>• Too much complexity in input parameters</li> </ul>   | <ul style="list-style-type: none"> <li>• Lack of time and expertise to manage change</li> <li>• Inability to understand and identify constraints</li> <li>• Common processes and benchmarks not evolved and developed</li> <li>• Lack of hands on knowledge</li> </ul>   | <ul style="list-style-type: none"> <li>• Fear of bringing out constraints in the open.</li> <li>• Process benchmarks are not available or recognized.</li> <li>• Frequent reallocation in between job locations</li> <li>• Lack of communication of a shared vision</li> </ul>  |
| Mitigation         | <ul style="list-style-type: none"> <li>• Create cross functional teams working on specific standardization projects</li> <li>• Refrain from scaling operation till a maturity has set in</li> <li>• Have clarity in business plan before initiating design. Focus on a particular segment</li> </ul> | <ul style="list-style-type: none"> <li>• Use a participative process to create benchmarks.</li> <li>• Hands on training facility</li> <li>• Allocate adequate buffer at the initial stages of the project to establish the process</li> <li>• Mix youth and experience while drawing the organization structure</li> </ul> | <ul style="list-style-type: none"> <li>• Top management involvement in the change process on ground</li> <li>• Enable transparency visually communicate benchmarks</li> <li>• Peg the flow of information, <i>drawings, material resources, finance, workforce</i> in the process</li> <li>• Communicate the larger goal</li> </ul> |

25. The approach of internalizing workflows in project management has started encompassing other engineering and design functions. Internal teams work

with standard templates of prototype units rather than outsource a design contract to a third party who will then make a fresh start on every project. Multiple disciplines architecture, services, structure interact and are able to iterate to a decision faster, based on the past history of the prototype.

### Tightrope between affordability and aspiration

**Exhibit 17 Designing the affordable house**

|               | Prototypes  | Remarks  |
|---------------|---|--|
| Unit Level    |   | <ul style="list-style-type: none"> <li>1 Smaller sized unit of 1RK / 1BHK covering an area 270-450 sft. Minimal specification for dry finishes: flooring, wall painting</li> <li>2 Avoiding Idle spaces and using passages intelligently</li> <li>3 No external overhangs: balcony, eaves</li> <li>4 Low wall to floor area ratio: more common walls.</li> </ul> |
| Block Level   |  | <ul style="list-style-type: none"> <li>1 Standardization of unit level design across the project</li> <li>2 Optimization of the common area / corridor footprint</li> <li>3 Low to midrise (2-4 floors) precluding the need for a lift machine room</li> </ul>   |
| Project Level |   | <ul style="list-style-type: none"> <li>1 Economies of scale justifying the use of machinery and equipment over the project duration</li> <li>2 Open space parking minimizing construction costs</li> <li>3 Finding a balance between standardization and consumption of the Legal FSI available</li> </ul>   |

2.6. While creating the product it becomes difficult to strike a balance between aspirations and affordability. A ceramic tiled floor costs about three times a red cement coated floor, however, it is very difficult to market. In some markets selling of a cheaper studio is more difficult than a comparatively costly 1BHK.

2.7. First approach towards affordability has been densification. Small format units bordering on the legal requirement from the bylaws have ushered several families into the formal housing market. Architects have sought to spread out the cost of the land both by building densely and by reaching out vertically.

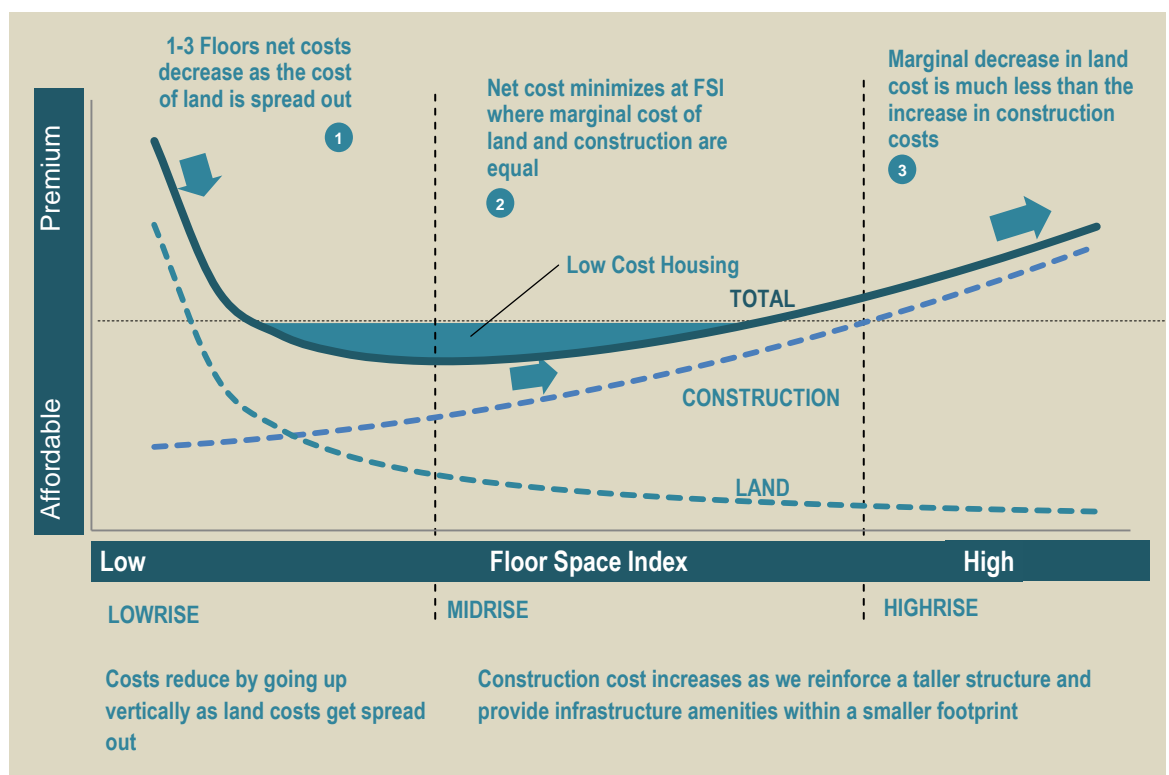
Dense small format and standardized

However, construction costs increase exponentially as the height of the building increases. Deeper foundations for support, sturdier reinforcement in the lower floors, and higher costs to provide parking and other services for a greater number of units within a small footprint inflate the cost of construction more than the reduction in the cost of land. Typically affordable segment makes sense with mid rise configurations rising 2-5 floors above ground level.

### Exhibit 18 Balancing FSI and construction costs

Building vertically does not always reduce costs . Net costs even out at mid rise structures.

INDICATIVE



2.8. The second approach has been to provide adequate, but basic amenities. Walls and roof are distempred instead of using epoxy paint. Lifts are avoided by limiting the height of the building. Most of the parking in affordable projects is provided in open space. Basic tiling and dado works are executed instead of granite (see *Exhibit 17 Designing the affordable house*).

2.9. The biggest impact on affordability is being brought by standardization. Instead of repeating the design process across multiple project engineers reuse standard configuration of units and combine them to cater to multiple

Reduce the number of input parameters

projects. Standardization has enabled teams to, work autonomously, process information faster and provide greater details for the execution. Initial business plan, drawing on the depth of information about a standard unit, can be created without requiring assistance from designers. The focus of engineering shifts from coming up with creative inputs on every project to fine-tuning design assets to streamline execution while cutting down costs. Typically, standardization exercise has enabled teams to operate at one or two levels of detail, deeper than the mainstay industry, reduce life cycle duration of projects by 40% and cut costs by 30%. The impact on execution and project management is even greater because of the resulting economies of scale.

### Building fast and building right

- 2.10. Hiding within the disorganized sector is a significant value which we believe can be unlocked by streamlining the project management. Period costs, comprising of cost of finance, the salary head and administration can account for 20-30% of the affordable projects topline. Frequent rescheduling in response to multiple inputs and lack in business clarity limited the productive output of the workforce. Business requirements will mandate the construction industry to adopt several concepts from success of manufacturing and technology sector in the country.
- 2.11. Working within a workstation a worker on an assembly performs the same task in the same location. The flow of raw materials into his workstation, controlled by bins and visual signals 'Kanban', triggers a just in time response from the supply chain to ensure he gets the right component at the right time. Some of the components are sub assembled before being delivered to his assembly line, cutting short the number of activities and allowing his co-workers to produce one unit every minute. An 'Andon' switch on the assembly line can be triggered by any technician facing a problem, bringing the entire line to a stop after which the entire floor tries to fix the problem. Process and quality benchmarks are clearly defined and transparently displayed, enabling a newcomer to be easily assimilated. Maintenance is autonomously managed by everyone, which limits downtime of the production line. The culture promotes small incremental continuous improvement.



Replicate an assembly line

2.12

In construction along with the product, the assembly line itself keeps moving. As each unit gets constructed the workstation moves a step ahead. Despite the differing concepts employed in manufacturing can be applied to construction. While the conventional approach has been to employ huge batch size (see Box 3 Manufacturing Houses) we can re-engineer to create a pull based process and replicate the workstation of manufacturing. Smaller batches allow accountability and every person has a responsibility for a specific job at a specific location. For example a tiling mason is responsible for the same set of tiles in the kitchen. At the end of the day after finishing laying tiles in his 'workstation' he supplies a Kanban card to the store which triggers the supply of predefined quantity of material for the next day's activity in the 'workstation' The card also logs the schedule and the line jumps to the next unit. Each day the same cycle repeats itself

Exhibit 19 Constructing an assembly line

**A**

**B**

**19 PUTTY APPLICATION 2ND COAT**  
F1313  
09 98 05 21 Manual Putty Application Walls and Ceiling Qty: 37 m2

**20 LAYING FLOOR TILES**  
F1314  
09 98 13 19 Ceramic Vitrified Thin Set Filling (Full and Bedding) Qty: 40 m2  
09 98 13 19 Ceramic Vitrified Thin Set Filling (Bedding and Grout) Qty: 13.3 m2

**21 LAYING DADO WALL TILES**  
F1315  
09 98 13 22 Ceramic Vitrified Thin Set Grout Qty: 13.4 m2

**22 INSTALLING SKIRTING AND MAIN DOOR**  
F1316  
09 98 13 22 Ceramic Vitrified Thin Set Bedding (Full and Bedding) Qty: 17 m2  
09 98 13 22 Ceramic Vitrified Thin Set Bedding (Grout) Qty: 19 m2  
09 98 12 19 Insulating Foam Door Shutter Qty: 2 #

**24 INSTALLING DOOR SHUTTER**  
F1411  
09 98 13 10 Insulating Wooden Door Shutter Qty: 4 #

**C**

**19 APPLYING PUTTY 1ST COAT**

| Code                  | Material Description                       | Q          | W     | Net     |
|-----------------------|--|------------|-------|---------|
| 09 98 05 21           | Manual Putty Application Walls and Ceiling | Qty        | 485   | m2      |
| PT_A                  | Painter Assistant                          | m2/day     | 45.00 | 8.00 10 |
| 09 91 51              | Painters Putty                             | Kg         | 0.27  | 5% 115  |
| 09 94 32 51           | Sand Paper Grit 100                        | #          | 0.01  | 1% 5    |
| 09 94 32 41           | Sand Paper Grit 100                        | #          | 0.01  | 0% 5    |
| 09 94 32 31           | Sand Paper Grit 60                         | #          | 0.025 | 1% 10   |
| <b>Code Equipment</b> |  | <b>Net</b> |       |         |
| 49 51 11 19           | Standard Safety Helmet Magenta             | #          |       | 20      |
| 49 51 15 10           | Standard Leather Safety shoe               | #          |       | 20      |
| 49 51 18 10           | Disposable Cloth Mask                      | #          |       | 20      |
| 49 51 17 34           | Nitrile Lined hand Gloves                  | #          |       | 20      |
| 09 99 11 10           | Machine Mounted Paddle Mixer               | #          |       | 2       |
| 14 09 13 10           | MS Stool [1m] Int x 0.5 x 0.5              | #          |       | 5       |
| 09 99 15 14           | Std Roller Frame 9"                        | #          |       | 10      |

**A. Reduce the batch size, the number of units executing a particular activity.**

**B. Create workstations sequential work flow while optimizing the flow of materials and ensuring physical constraints are met.**

**C. Kanban: use visual communication for benchmarks and control the flow of work materials and workmen**

## Box 3 Manufacturing Houses

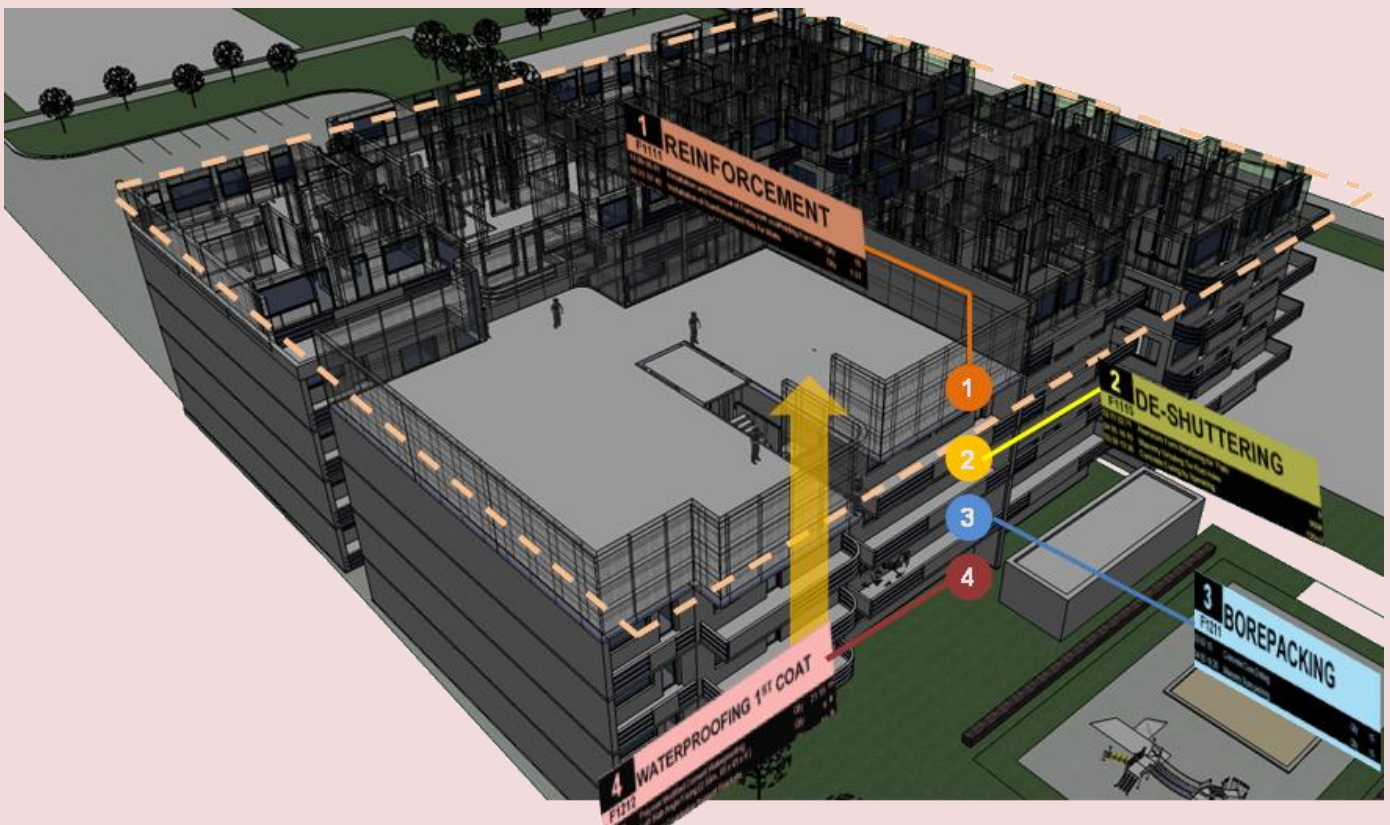
There are striking similarities between the mass market automobile and the affordable housing sector. The paradigm extends into the operations as well. Standardizing the product over the last century has enabled vehicle manufacturers to reduce cost, reach a wider consumer base, and achieve consistent quality benchmarks. On the shop floor production managers migrated to a single piece flow. It gave insight into hidden wastage within the system and allowed repeated course correction of the process. In the next five decades many approaches of mass manufacturing would find their way into low cost housing segment.

The conventional construction is carried out in large batches. Entire floor of a wing (set of blocks) is casted together covering an area over 20,000 sft. The duration to complete activities at each stage (floor) consequently is stretched out to weeks. Identifying constraints in a large jobsite becomes challenging and as a parade of workmen of a related trade move in and then out, production delays get piled up. As the delivery approaches, incomplete activities hiding within multiple locations make resolution with the schedule extremely difficult.

### Exhibit 20 Batch Production

Huge work spaces makes identification and monitoring difficult  
 Source: Clytics Research

ILLUSTRATION



## Box 3 Manufacturing Houses

Increasing the throughput, in the conventional process faces a physical constraint: construction for the next level cannot be initiated until the slab can bear its own load. Typically there is a ten day delay, for the concrete to cure, before the next level is placed on the one below. Concrete casting sets the precedence and the duration of each of the activities on the schedule stretches out to weeks. When apportioning, workforce is not possible the gang is either rested, reassigned to another location, or trade.

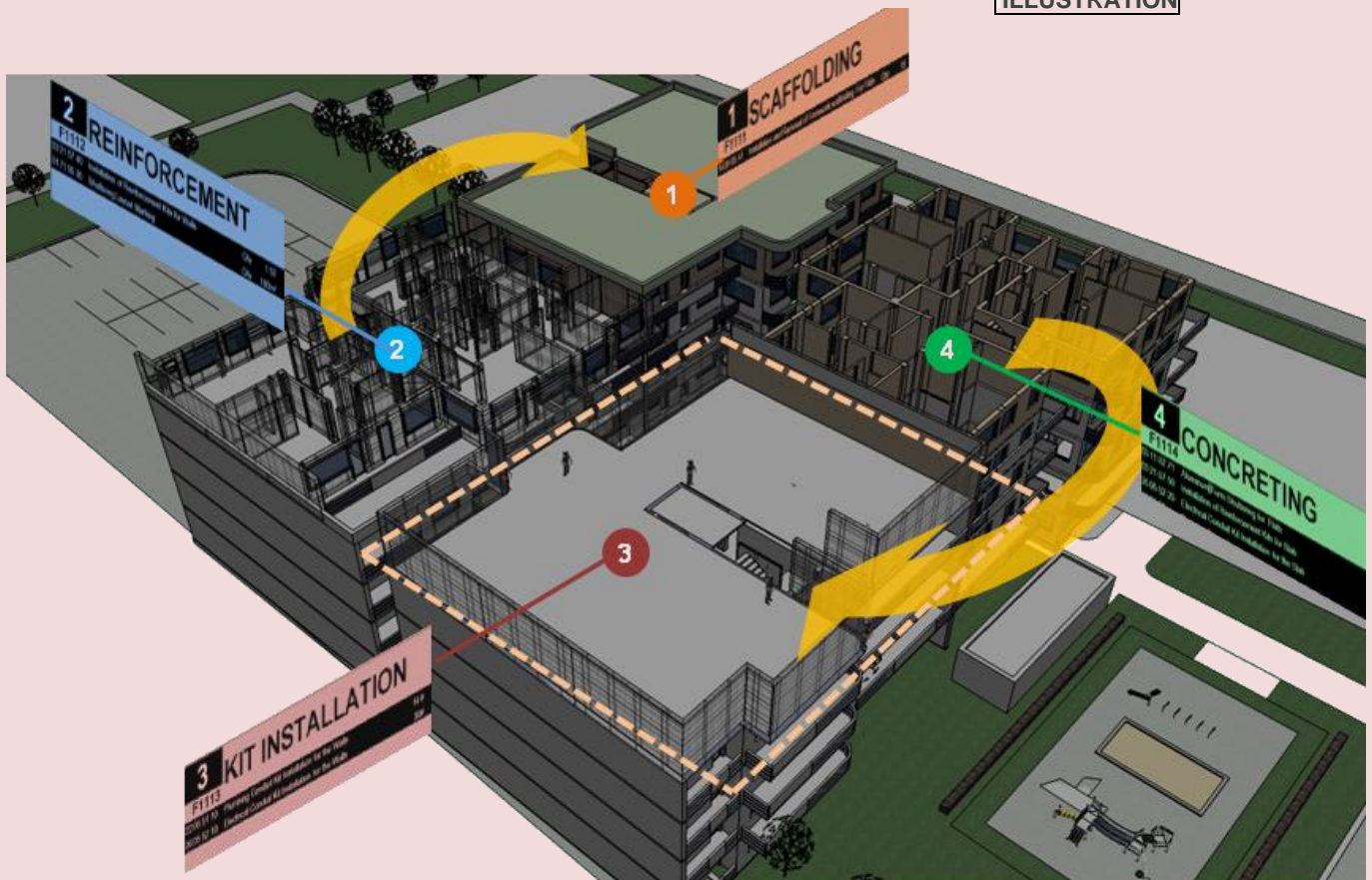
The first step in adopting workstation into a construction process requires restructuring the work sequence to use smaller elements. In case of housing these elements are a set of flats. Next the sequence has to overcome the physical constraint set by the curing of concrete. Instead of shifting vertically up after every casting the construction process has to move horizontally for few castings before making a jump to the next level. As a consequence the duration between castings can come down drastically by a factor of 10 when compared to the conventional industry. Low cycle times and batch size result in the workforce getting a continuous work-front. We estimate that most projects can haircut 40-70% off the project duration by removing uncertainties involved in managing a large batch size and instead chosen to be executed with workstations.

### Exhibit 21 Flow with Spiral

Sequential flow process with segregated and smaller work centres leading to a faster pouring cycles.

Source: Clytics Research

ILLUSTRATION





Similar to an assembly line, partial completion of activities is not accounted and mobilization of resource controls and enforces discipline

2.13. Like sub assemblies in a manufacturing assembly line, pre constructed elements: welded wire mesh, pre-fabricated plumbing and electrical kits, pre-cast partition walls, water tanks reduce the complexity at the site and move the construction to a controlled environment. Prefabrication streamlines the logistics, instead of over 40 components in a plumbing kit project management and execution have to deal with a single item. As operations scale to multiple sites in an urban agglomeration, each individual project can be fed by a central facility which will be able to schedule and reroute based on real time demand similar to a central machine shop feeding to multiple assembly lines.

Preconstruction reduces complexity

2.14. The biggest challenge in implementing this framework in the field is to evolve shared benchmarks for execution. Process parameters productivity, quality has to be defined and the underlying preconditions required to achieve the same consistently have to be understood. Similarly clarity is required in the material consumption, movement plan and other physical constraints. If sufficient groundwork has been done, creating an on demand system as responsive as a manufacturing assembly line is much simpler.

Clarity required before implementation

### Banking on the right platform

2.15. Over the last five years, several construction platforms found their way to the project site. Industrial systems have reduced the proportion of skilled workforce requirement, compressed multiple activities into a single process, moved activities out of the construction site and reduced rework. Even though adoption has been slow, most construction continues to use RCC frame structure, this report finds that standardization will lead to a gradual switchover to industrial mass construction platforms (see Exhibit 22 Choosing the platform). During the last five years, both modular framework and precast are getting acceptance in the mainstay industry. Some low cost housing projects have also been constructed using industrial systems. Technology transfer has brought crossovers between the cast in situ and pre-fabricated into the country. Pilot scale projects for light weight pre-fabricated structural panels have been implemented and commercial scale operations are underway. In the next couple of years as the size of the industry doubles the scale of operations of affordable developers will allow them to make capital investments into an industrial system which they can depreciate over multiple projects. The industry itself will mature and develop expertise with industrial systems, reducing the cost of pioneering in this field.

Industrialization is the way forward



## Exhibit 22 Choosing the platform

Industry has started adopting new platforms to support faster turnover. Apart from precast and cast in situ cross-over approaches embodying attributes of both are being tested.

|                                      |   | RCC Frame  | System Formwork   | Precast  |
|--------------------------------------|---|--|---|--|
|                                      |   | Conventional   | Industrial  | Industrial   |
| Capital Investment                   | <ul style="list-style-type: none"> <li>Capital Intensive platforms pose a significant risk in the early stages of a project</li> </ul>  |  |   |  |
| Site Operations                      | <ul style="list-style-type: none"> <li>Lowering the number of operations at the worksite reduces the potential for variation and makes scheduling more predictable</li> </ul> |  |   |  |
| Manpower Required                    | <ul style="list-style-type: none"> <li>The greater the workforce required at the work site greater is the effort in coordinating and lower is the throughput.</li> </ul>      |  |   |  |
| Product Quality                      | <ul style="list-style-type: none"> <li>Stricter tolerances in initial wet masonry / castings reduce the rework and costs at the later dry finishes</li> </ul>                 |  |   |  |
| Availability of Expertise            | <ul style="list-style-type: none"> <li>Adoption of new processes is curtailed by availability of expertise in design, execution and managing the same</li> </ul>              |  |   |  |
| Flexibility at site                  | <ul style="list-style-type: none"> <li>Low business maturity requires higher flexibility on site to accommodate changes</li> </ul>  |  |   |  |
| Project Duration                     | <ul style="list-style-type: none"> <li>Shorter Project duration cuts through the indirect costs</li> </ul>  |  |   |  |
| <p><b>High</b></p> <p><b>Low</b></p> |   | <ul style="list-style-type: none"> <li>Prevalent construction method in India, good understanding of the process and resources is present with the contractors.</li> <li>For Low and medium rise RCC frame structure units do not require significant capital outlay: Tools and Equipments are leased. This lowers the barrier to entry.</li> <li>RCC frame entails handling multiple materials and equipments: Concrete, Brickwork / Blocks, Cement Mortar as against Cast <i>in Situ</i>.</li> </ul> | <ul style="list-style-type: none"> <li>Cast in situ merges multiple processes into a single operation resulting in about 60% of the value added in a single step.</li> <li>It removes masonry process and reduces the skill required in finishing.</li> <li>Projects can cut down costs up to 30% on account of faster cash flows.</li> </ul> | <ul style="list-style-type: none"> <li>Precast needs scale to be affordable.</li> <li>It needs to be located under 60 km from the construction and adequate road infrastructure</li> <li>Precast requires a higher skill set, to ensure compatibility with the tolerances, ensures watertight fitment.</li> <li>In India, execution capability needs to be developed before this technology platform can be explored.</li> </ul> |



# Measuring up

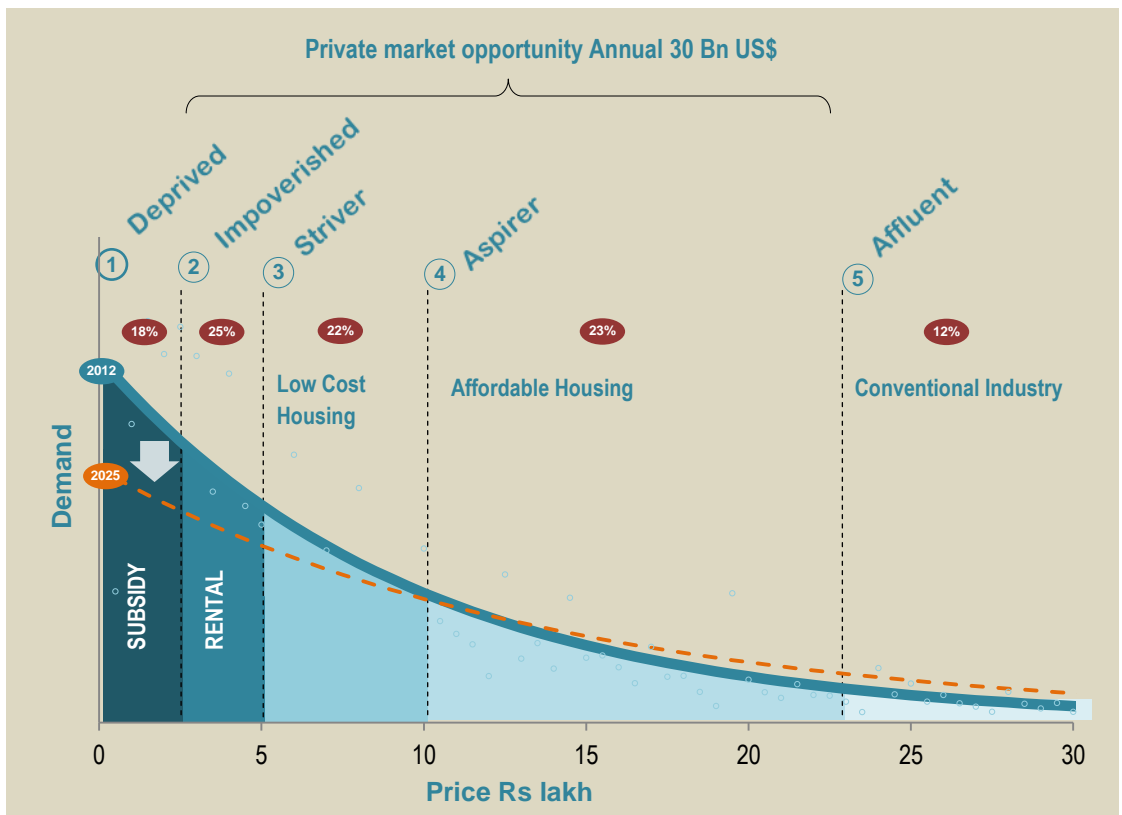
18% of the urban households cannot afford the cheapest unit offered by the market<sup>6</sup>. It will be impossible to provide access to the deprived without cross subsidy and strong government support. The deprivation gap measured as the total amount required to bring all such families within the fold of the formal market stands slightly under 8000 Cr Rs annually. As the real income rises the gap will reduce. In 2025 the gap will stand at 2800 Cr Rs.

The next segment of impoverished families comprising 28% of the demand requires both financial inclusion and a robust rental market. Strivers and Aspirers comprise 45% of the market demand and represent a business opportunity of 8 and 19 Bn US\$ respectively.

## Exhibit 23 Shifting Demand

Even after a span of a decade Low cost housing demand will remain strong  
Annual demand plotted with capacity to pay

Source: IHDS, Clytics research

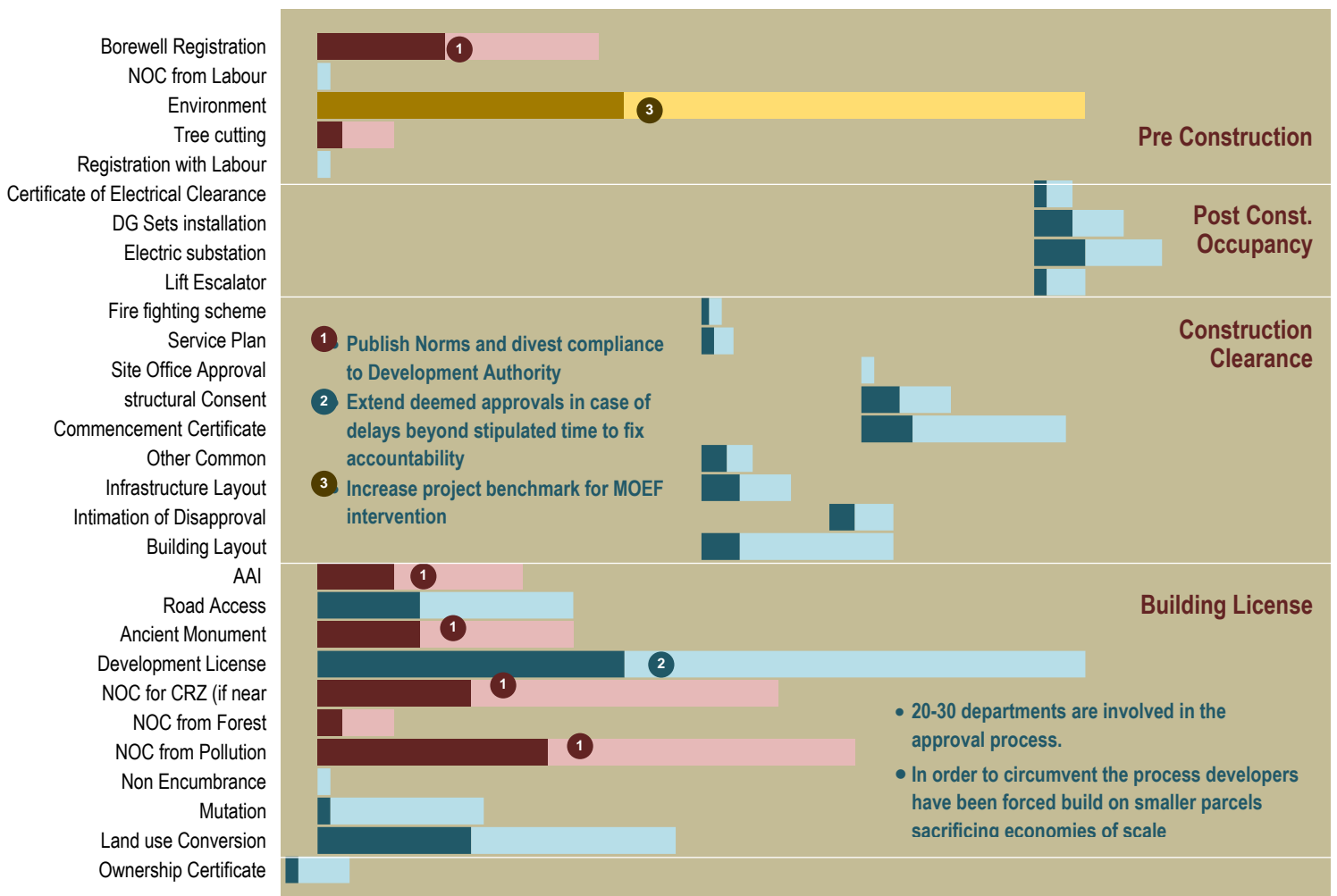


<sup>6</sup> Computed using data from Indian Human Development Survey; refer to Note on Methodology for further details.

A nascent industry, affordable housing has till date produced close to 100,000 units, about 30% of which is priced below 10 lakh. This pales in comparison to the deficit of 18 million units and an estimated annual unmet demand for 3.5 million units. The last five years have been spent testing the waters. The next five years will be to scale the system across the country. In this section we evaluate several systemic obstacles which still lay in the way and analyze measures to overcome them.

**Exhibit 24 Approval Timelines**

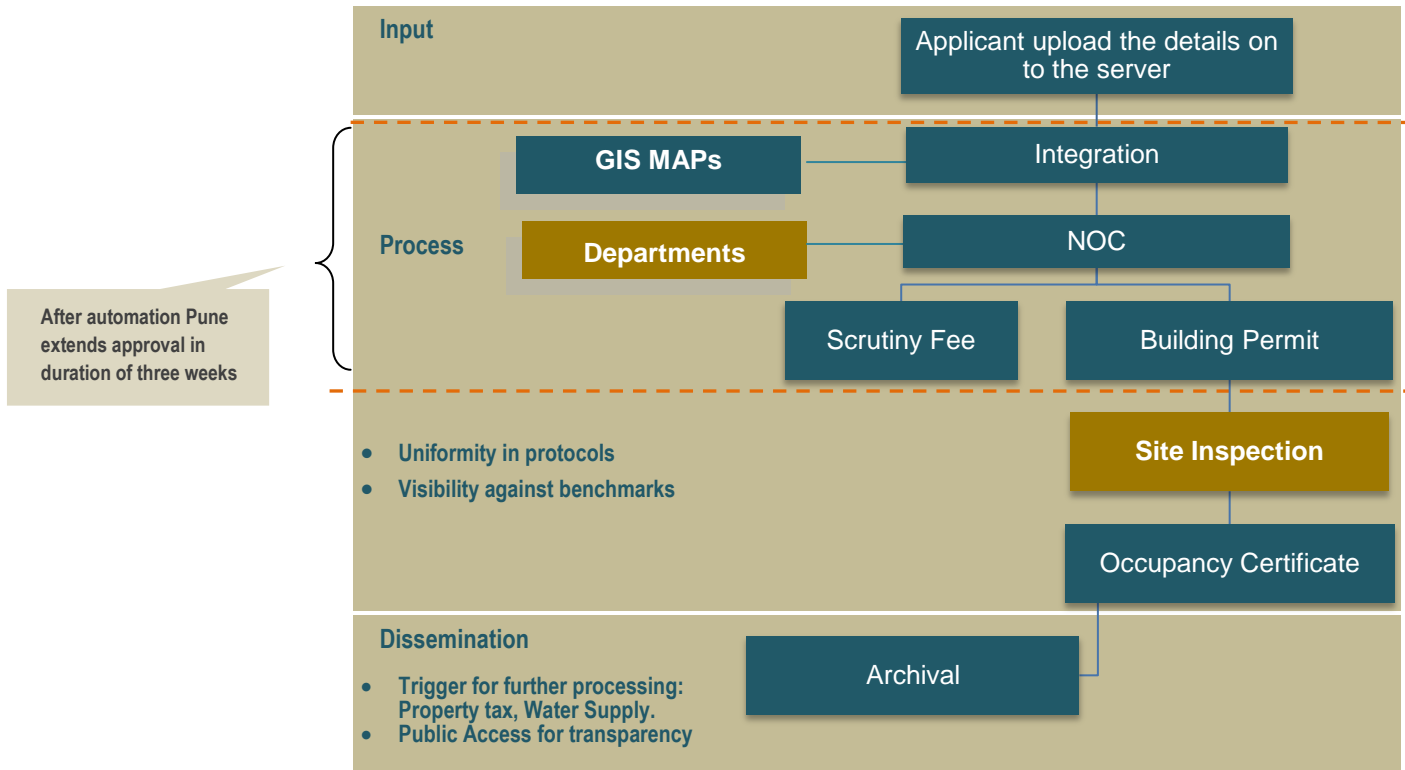
Cost of land can inflate by 30 – 100 % on account of delay in obtaining approvals  
 Source: Interviews, Streamlining approvals for real estate projects NAREDCO





### Exhibit 25 Automating the workflow

Source: Detailed Project Report Pune Municipal Corporation, Clytics Research



## Handholding a nascent market

3.1. India ranks at the bottom of the Doing Business Construction Index. Involving over 30 departments, construction permits in India take over 15- 24 months. Delay in getting approvals can escalate the cost of the land by a factor of two making smaller format affordable homes unviable for developers to pursue (*see Exhibit 24 Approval Timelines*).

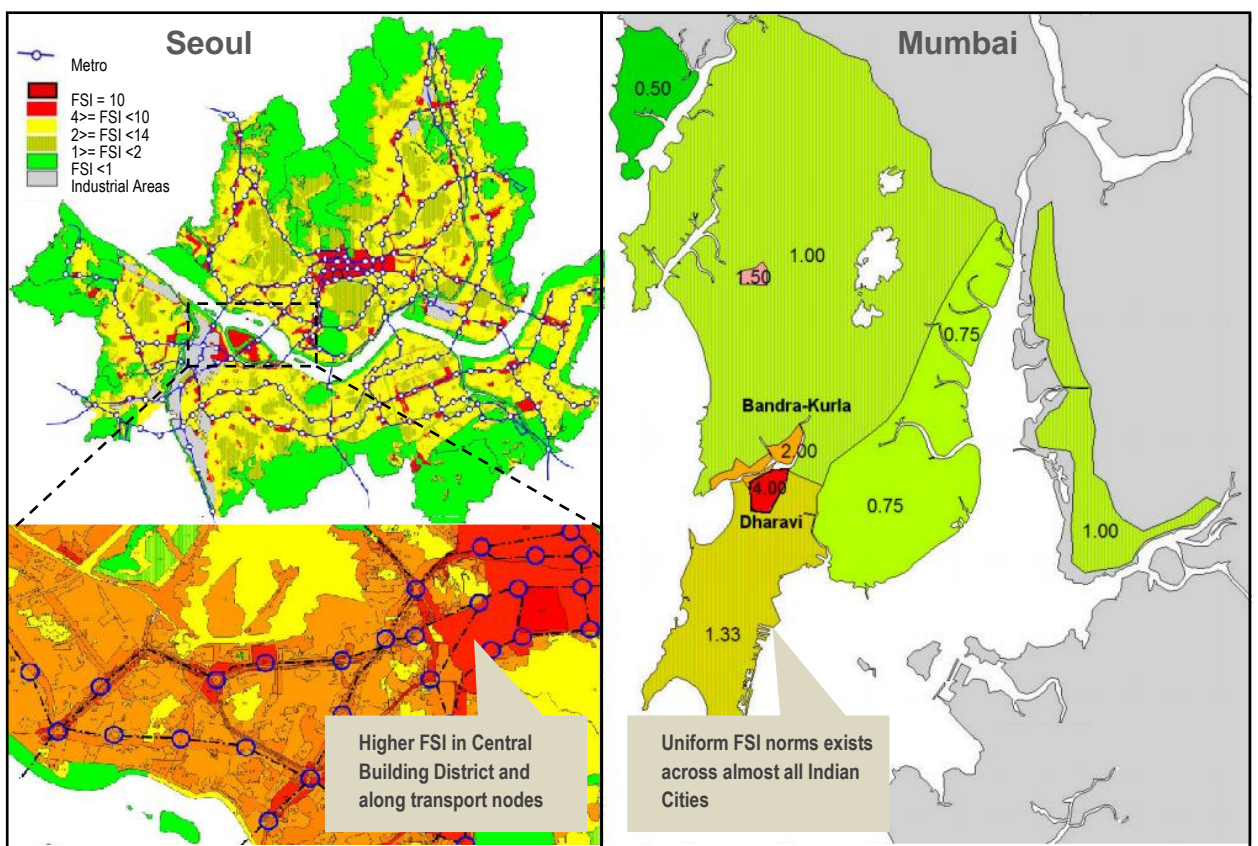
- Institute a 60 day approval window for affordable housing project. In case of indecision beyond the stipulated time projects will be deemed as approved.
- Create a single window for approval. Transfer the responsibility of compliance to the development authority while the norms are set by multimodal organizations: AAI, ASI etc. which are incorporated into the master plan.
- Create a repository for archival of approvals to create transparency both for the developer and the consumer.

3.2 Rather than controlling, allow the market more room to determine the density of settlements. Indian cities use a flat density: using the same FSI in the central business district and in the suburb. Urban bodies while trying to limit the external costs imposed by high rises in the neighborhood and the infrastructure<sup>7</sup> have created scarcity of land in the core of the city and pushed the city outward into the suburbs.

- Make redevelopment of the core feasible by increasing FSI up to 15 in certain parcels. Hyderabad stopped using FSI in March 2006 and has instead allowed setbacks, width of the road and the market to determine the vertical density. Compared to benchmark 2007 prices National Housing Bank's *'Residex'* finds Hyderabad housing prices have decreased by 12 % at the end of 2013.

**Exhibit 26 Rational FSI densification**

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<sup>7</sup> Alain Bertaud, "Mumbai: why reform the current FSI system?, experience in other cities"



- Support the infrastructure development costs by levying a development fee for approval. A 60% premium for an extra unit of FSI levied on the 10% area of Mumbai covering rail link and transport nodes can generate over 60,000 Cr revenue.
  - 80% of the 225 cities which will have over a million residents by 2051 are yet to make a master plan or have initiated urban planning recently. While it is difficult to make significant changes in existing tier I cities, adopting a spatially determined FSI policy will be easier in tier II and tier III if it is backed by a central policy.
- 3.3. Reduce the idle inventory. Housing census of 2011 found over 10% of the urban housing stock lying vacant. This is about 60% of the current housing deficit.
- Marginal reduction in the vacancy status brought by tax adjustments can lead to significant mitigation in the housing deficit. However, given the sensitive nature, it will require political hegemony to implement.
  - An easier measure will be to introduce a mutation fee on land lying vacant for more than five years or every time the master plan of a city is redrawn to curb land hoarding.
- 3.4. Target subsidies without distorting the market. It is amply evident that the bottom quintile will not be able to participate in a free market without government intervention and cross subsidy. However, unless the sops are targeted they will distort a legitimate market.
- 3.5. Create savings linked subsidy products. Accumulating 20% equity component of a home is daunting for the population in the bottom two quintiles. The second challenge is to service the loan while waiting for occupancy along with a rental burden. In both the cases, local government can provide gap funding to a targeted consumer base contingent on the accumulation of a savings pool.
- 3.6. Taxes ranging from stamp duties to service tax inflate the basic sale price of a home by 10%. There is no distinction between a product aimed at the affordable segment and that aimed at the affluent.
- Extend tax rebate on capital invested for all affordable housing projects, providing incentive to developers to transit towards industrial construction platform focusing on shorter turnaround time.
  - Provide relief on stamp duty, land use conversion and other taxes levied by urban bodies for affordable housing project.
- 3.7. Create uniform by laws within an urban agglomeration



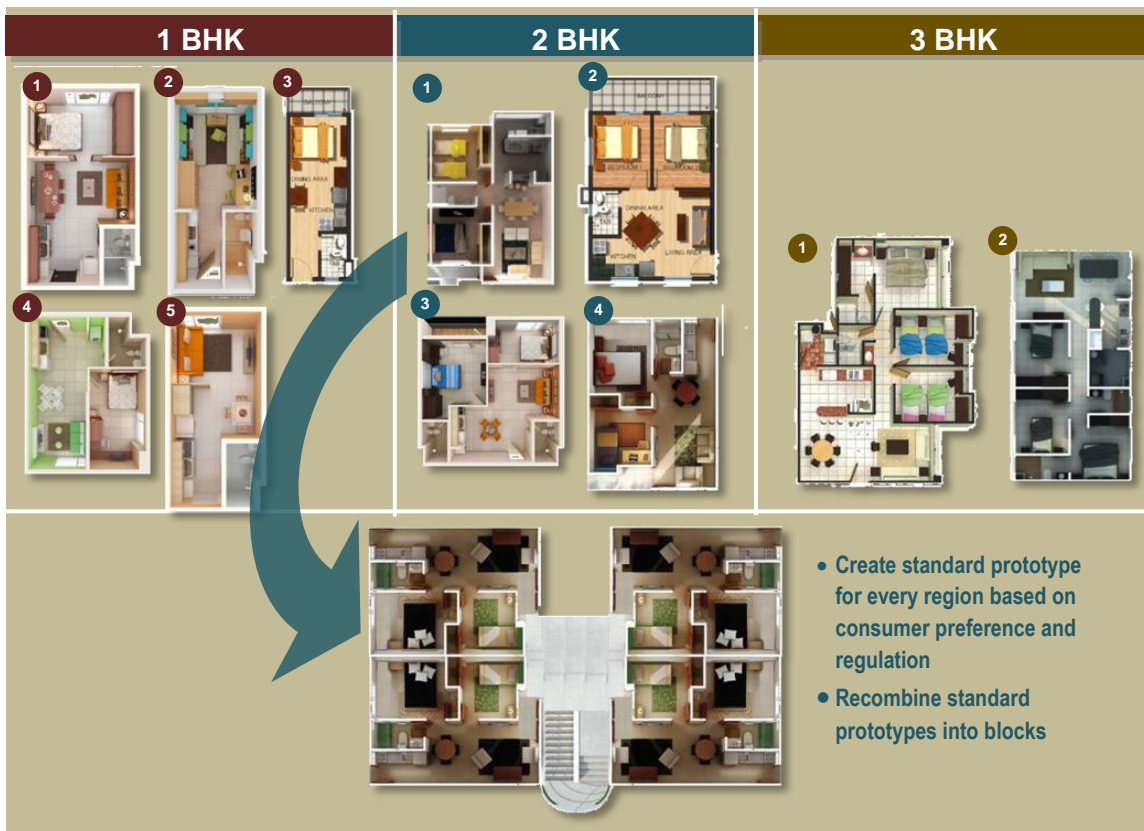
- Overarching uniform templates to act as a guide for the project within a zone, allowing developers to standardize their offerings based on market requirements within a region.
- Evaluate impact of housing standards imposed on the unit cost. For example, reducing the requirements of a car parking 1 for every 2 units in Bangalore to 1 for every 35 units as in Hong Kong will enable developers to create smaller units for the same land parcel size. Similarly, reducing the minimum dwelling size from 27m<sup>2</sup> of 21 m<sup>2</sup> will result in 5% additional household to enter into the formal market.

## Rebooting an Industry

3.8 The demand for branded standardized products offering value at an inexpensive price far surpasses the supply of such units.

- Climb down the ladder to deliver to a pent up demand. Existing brand catering to the affluent segment can be isolated by creating a subsidiary to cater to the affordable sector, with a separate organization set up and business model.
- Step out from the metro into the Tier II and Tier III. Market growth will remain robust, and competition is absent at present.

Exhibit 27 Standardization of the Prototypes





- Smaller format sell faster, giving faster turnaround and higher return on equity.

3.9. Reduce the number of parameters involved in design and execution. Create a standard design configuration for unit layouts and use them across multiple projects.

- Integrate multiple disciplines and create intelligence for different prototypes: marketing to understand the consumer preference for different combinations, operational details to understand the process for each unit and subunit level product costing. Detailed manuals which business development, land acquisition, project execution and procurement teams can use to arrive at a decision faster.

3.10. Streamline project management and cut down the batch size: Period cost adds up to 20-30 % of the bill. Cutting off project duration by half can cut down 100-200 Rs per sft in large projects.

- Subdivide the project schedule into a workstation. Manage by tracking the buffer *the number of flats lying 'idle' between two workstations*. Raise an alarm whenever the buffer exceeds a benchmark ideally zero.
- Cycle workforce with the same type of work and through the same location to allow the workers to get specialized. For example, instead of applying tile workers will specialize in fixing tiles only for the kitchen.

3.11. Invest in people. Productivity in the construction sector is a fifth of global benchmarks. Creating capacity to construct 8500 houses every day will require the direct involvement of close to 2 million workforces. While it may not be feasible for developers to invest directly, they have to work with partners to create a pipeline for future human capital.

## Housing finance: enabling Aspirations

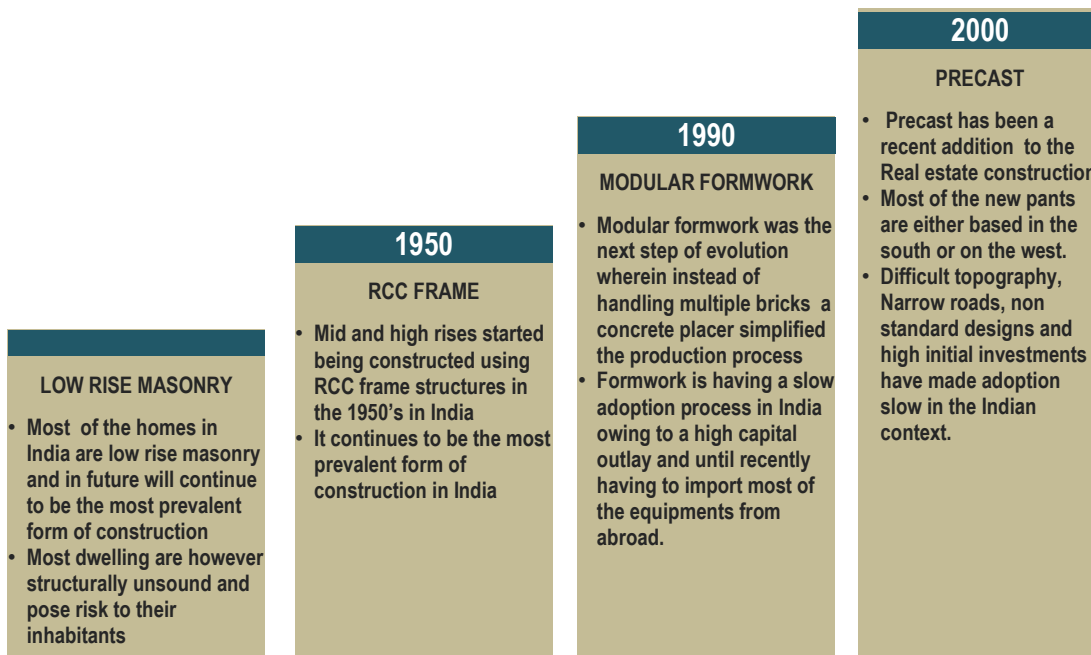
3.12. In a nascent market where the developers are yet to mark their presence HFC has much greater brand awareness. In this context, housing finance companies can play a catalytic role in this Industry. First, leveraging with their wide network they can encourage existing developers to enter into this segment. Second, they can work with existing developers to co-brand projects in this space. Finally, they can work with the developers to reduce the processing time and help develop a team to prescreen applications.

## The Supporting Industry

3.13.

In the absence of a business driver the process of evolution of the construction platform has been slow in India. Most construction equipments were imported and sold off in the market. The government insisted equipment providers to set up a base in India and adopted a tariff structure to promote the local manufacturing. Imported second was similarly discouraged. Manufacturers were reluctant since they lacked the scale to set up a business development outpost in the country, moving entire fleet of operations seemed difficult. However, over the last five years, a relatively robust construction sector in the country has started to court renewed interest as most of the developed housing and infrastructure markets collapsed post the financial crisis. The gap in the Indian market is not just access to technology but also an understanding of its application and a capacity to absorb the same.

### Exhibit 28 Evolution of Construction Platform in India



- Build a strong portfolio of engineering services along with the product. While markets Europe and America are mature, products such as concrete foaming agents, floor accents, concrete fasteners, etc. which can have mass application in affordable housing need several pilots to introduce the concept to the construction Industry in the country. Business development will need a strong engineering support.
- Invest directly or with a partner to create a training infrastructure. Developers are reluctant to adopt precast out of apprehension to find adequate manpower to erect the panels at the jobsite despite having an engineering infrastructure redesign their project with precast elements.



- Intervene in the lease buy back market to combine financial products along with the service. The Market for leaseholds for construction equipment is disorganized. Typical contracts, price the cost of the equipment over two to three fiscal which makes it difficult for developers to adopt.
- Leverage on the low cost manufacturing base in India to create a base for further expansion into South East Asia.

□□□□



# Note on Methodology

## Forecasting Population

- 4.1. We used regional fertility and mortality indicators to estimate the future regional demographic trends. Using the past fertility data from the sample research surveys we forecasted future trends based on a sigmoid relationship. Life expectancy indicators were modeled similarly, and were used to determine the age specific fertility rates from the life tables. Using both the information we prepared the population profile with a five year interval for the next four decades across all regions.

## Estimating Urbanization

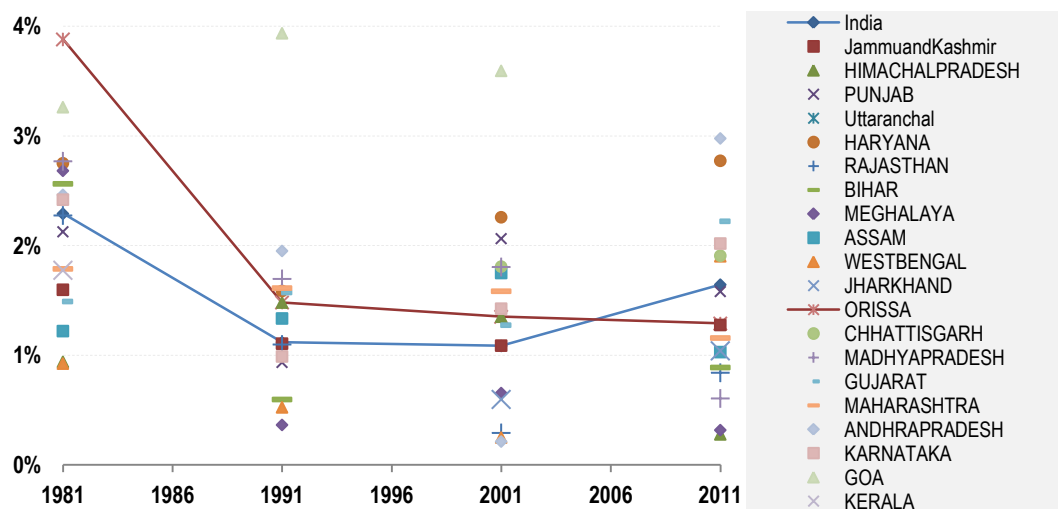
- 4.2. Urbanization is a complex phenomenon to both measure and model. Notified census towns like Yenaguda in Karnataka with a population close to 5000 are but an extension of the nearby Tier II city Udupi. Boisar in northern Maharashtra has increased from 14000 to over a lakh in the last decade, although it is still classified as a census town governed by a Gram Panchayat with limited state funding and without a property tax base to fall into. There are neither any public transports available, nor are there any waste collection or planned drainage systems. The urban population in Kerala has nearly doubled in the last decade, but the majority of this has been a result of dwindling productivity and climate change turning agriculturists into migrant workers. These cases illustrate the difficulty in defining and measuring urbanization.

### Exhibit 29 Urban Rural Growth Rate Difference India and Major States

Plot for the period 1971-81 to 2001-11.

During 2001-11 except for Uttar Pradesh (-1.9 %) all major states had a positive differential between Urban and Rural Growth rates. The decadal URGD lies in between 1-3 %.

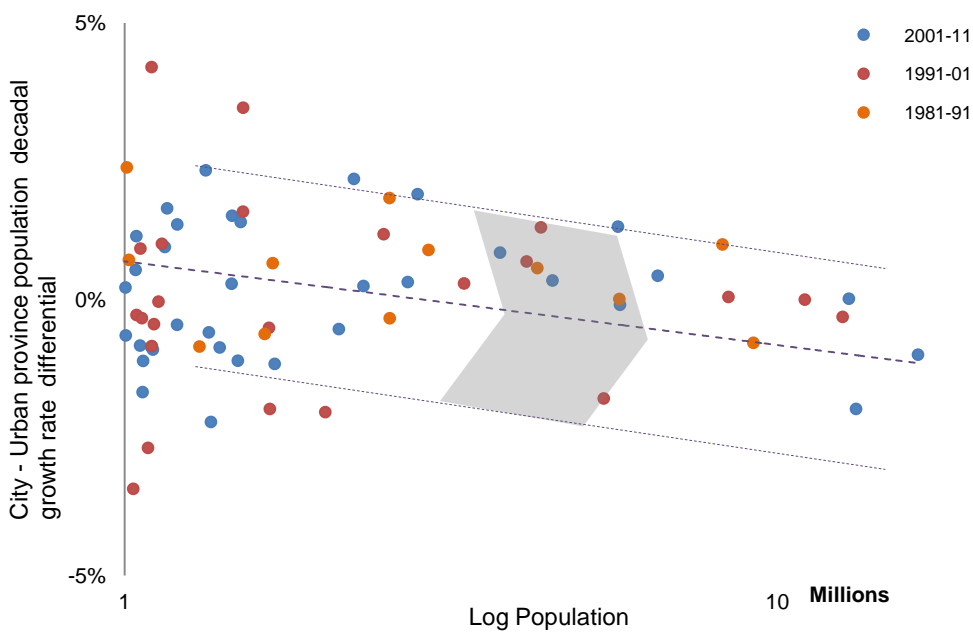
Selected trajectories have been rendered.



There are, however, limited variables through which, access to urban amenities and services can be defined and compared across an entire region. The census of India uses three criteria: i) a minimum population of 5,000, ii) at least 75 % of the male main working population engaged in non-agricultural pursuits and iii) a density of population of at least 400 persons per sq. km. For the purpose of this study, we used the methodology laid by the census for our forecasts.

**Exhibit 30 Forecasting city level population using differential growth rates**

Large population in mega cities dampen its growth relative to the urban population of the province in which it is located. For smaller cities with population under a million the effect is more diffuse. Differential average decadal growth rates of million plus cities [2011 census] and their parent province's increase in urban population have been plotted against respective cities population. The damping trend is found similarly across the world.



4.3. Urbanization is closely related to the structure of the economy, the growth rate of the economic engine and access to infrastructure facilities. We modeled rural, urban ratio on the pattern observed throughout the world. We adjusted the forecasted values based on rural, urban growth rates with historical observations. Rural, urban growth rate differential have been wavering around 1-3 % of the major states as per the trend observed in between 1981-2011. We used the forecasted urbanization, the current cohort population distribution of rural and urban areas and the future net cohort population to determine the future cohort population of rural and urban areas.



4.4. Since district and state level indicators are not available, we used differential growth rates between cities (or districts) and the states to estimate the future population. For large cities we modeled the differential growth rates of the population based on past trends observed both in the region and across the world. In most cases the growth rate of a city is dampened as its population increases. (Exhibit 30 Forecasting city level population using differential growth rates). For other cities, we have used historical averages to estimate the growth. We have considered census figures for computation and adjusted them post computation to reflect agglomerations.

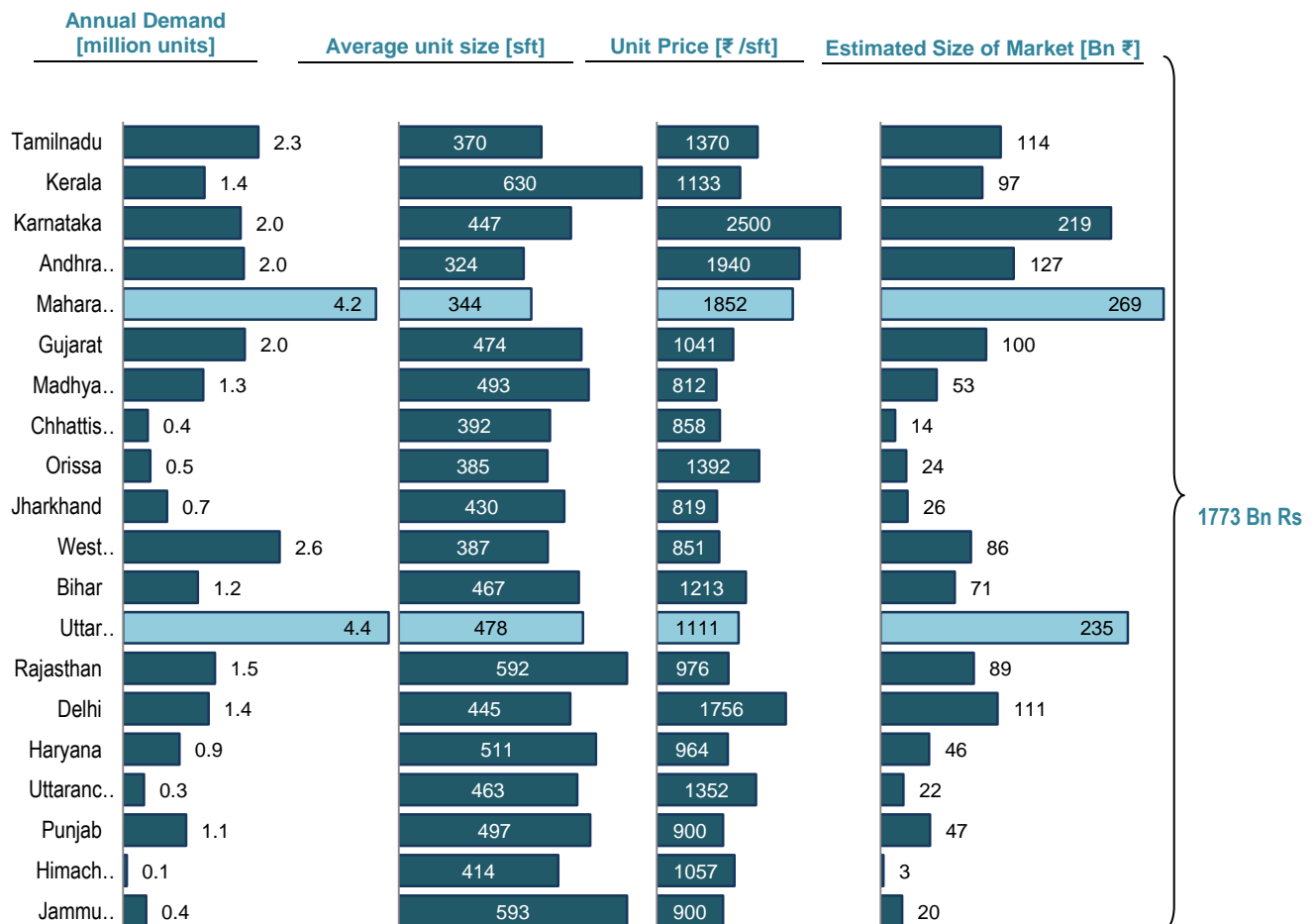
### Explaining the housing supply

4.5. We estimated the addition to the housing stock using disaggregated figures from the two housing census in the last decade. We estimated the addition to the urban housing stock (new construction) by apportioning addition over an

### Exhibit 31 Size of Affordable Housing opportunity

Larger states Uttar Pradesh, Maharashtra Andhra Pradesh account for the bulk of the deficit

Source: Housing Condition and Amenities in India, NSS 65<sup>th</sup> round, Report of Technical Group on Urban Housing Shortage, Clytics Research





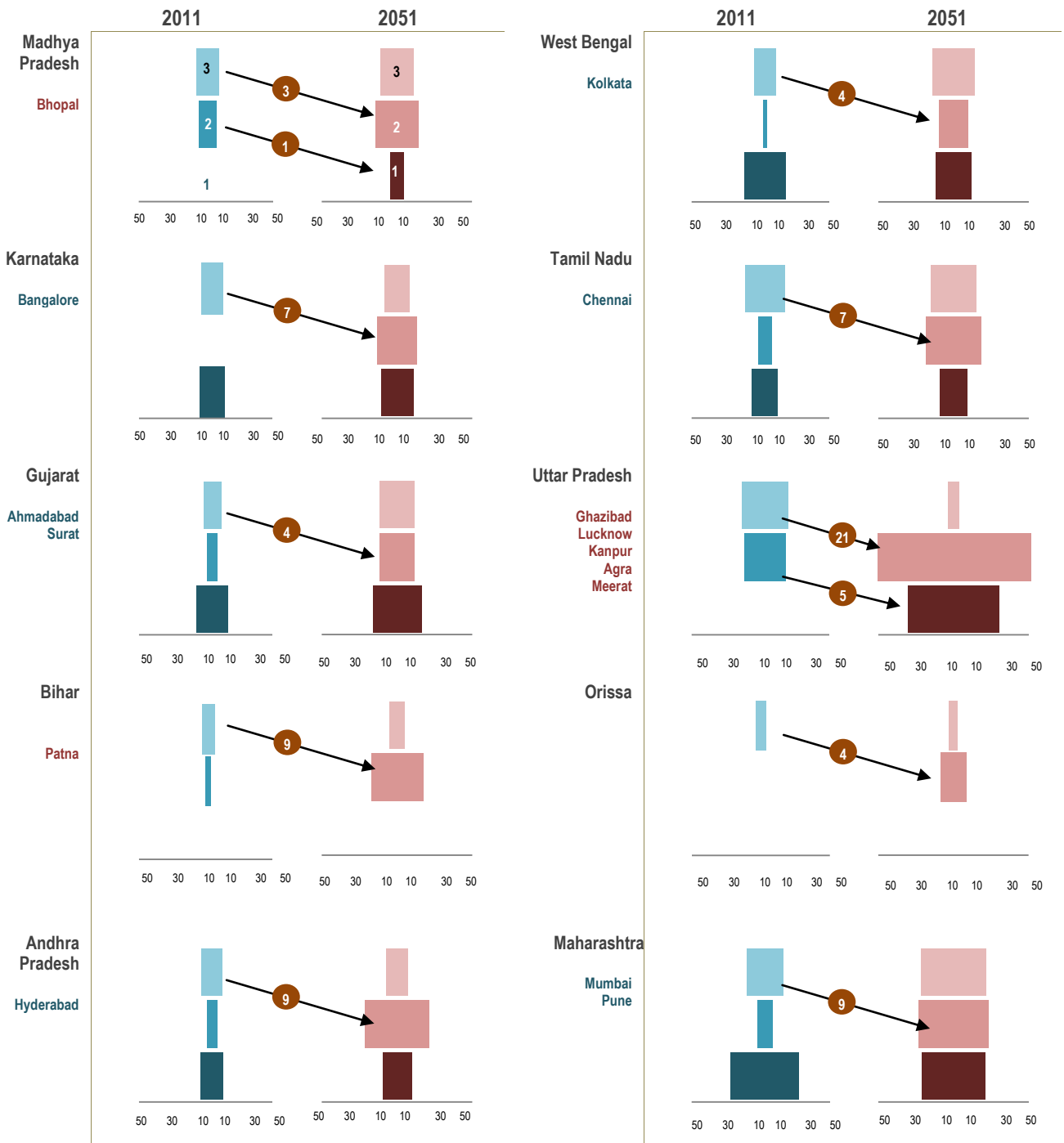
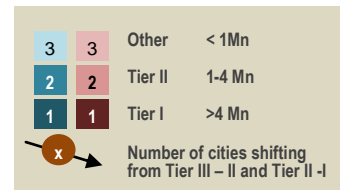
entire region to the percentage urban population in the last census. We revisited the estimation using the National sample survey estimates for fresh construction and readjusted the estimates. Our estimates of urbanization and forecast of the household size and the demography gave a sense of the future housing demand over urban regions. While the trends from the last two censuses gave an indication to the supply. We combined both the information to get a sense of the future deficit in a business as usual scenario.

- 4.6. To estimate the size of the opportunity of Affordable housing we had to first figure out the average dwelling size in different regions. We plugged NSS estimates for the same. To bring out differences in price in different regions we used average monthly rentals in different regions and adjusted a mean price point across India to reflect the difference. On the lower side, we used a cutoff of 950 Rs shift to reflect the cost of construction Combining unit size , price point and the future demand gave a sense to the business potential.
- 4.7. To cross check the estimates we used Indian Human development survey findings to prepare a model of the demand curve. We adjusted the survey data from 2005 to 2013 to reflect the household economic growth and inflation. We used pooled estimates from the survey for the ratio of savings to income for different income quintiles and used the result to prepare a potential demand for houses across the demographic profile. We then applied this demand curve to our estimates of household growth to bring out the demand. The estimates from both the methods were found to be in close agreement.
- 4.8. While evaluating the industry, we chose to analyze the supply of affordable housing along three dimensions: Affordability, Coverage and Scale. Affordability of the units measuring the price point of the average unit sold till date. We accounted any past unit / projects sold using the most recent price of similar units offered in a similar location, to eliminate price inflation. On the second dimension we measure coverage indicated by out of the total urban population how many are being targeted. We accounted the entire population of an urban agglomeration in which the project has been launched as a target population. Finally, we accounted for the experience by the number of units which are committed to customer or have been delivered till date.



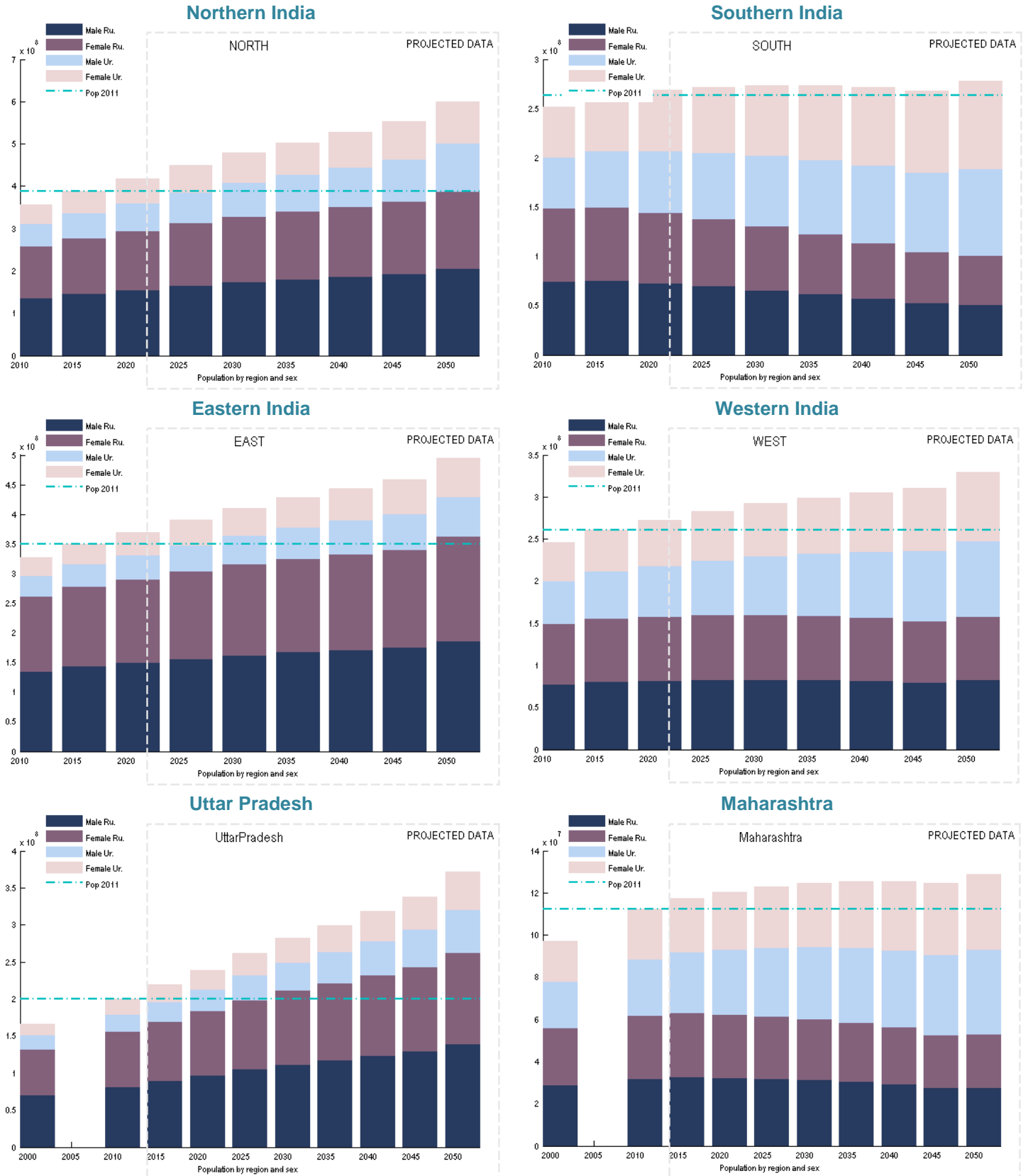
### Appendix A: Shifting power centers

Distribution of population by different class of cities 2011 and 2051 [projected] in major states.





## Appendix B: Rural Urban Population Distribution



## Appendix C: Glossary of terms

**Group Housing** means a building unit constructed or to be constructed with one or more floors having more than two dwelling units having common service facilities. Land ownership is shared between the residents.

**Carpet area** is the area enclosed within the walls, which is required to lay the carpet. This area does not include the thickness of the inner walls. It refers to the actual usable area in a unit.

**Build up area** is the unit footprint. It includes the area of all internal and external walls balconies, cupboard space over the carpet area.

**Super Built up area** is the built up area plus proportionate area of common areas such as the lobby, lifts shaft, stairs, etc. The plinth area along with a share of all common areas proportionately divided amongst all unit owners makes up the super built-up area

**Floor Space Index FSI** is the ratio of the build up area to the total plot area. FSI is used by urban bodies to control the density of development in different zones. For example a FSI of 2 over a 5 Acre plot will allow a build up area of approximately 8000 m<sup>2</sup>

**Ground Coverage** is the footprint of the build-up area less exclusions dictated by different by laws. Ground coverage is used as a tool for controlling the amount of open space in a project. However restrictive ground coverage ratio forces developers to reach out vertically which renders a project less affordable.

**Tier I,II,III cities** refer to classes of cities based on population A tier I metro has a population over 4 million, while a tier II has a population between 1 – 4 million while a tier III ranges from a lakh up to a million.

**Kanban** is a tool employed to control the work in process inventory in a supply chain. Kanban card is a visual communication exchanged between work centers to trigger the supply of a predefined quantity of materials.

**Andon** is a system to notify a problem in a workstation. Andon empowers the bottom line worker to take a decision to stop the production of the line if he encounters a defect. The entire shop floor focuses to fix the problem before the line is restarted.



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Appendix C: Glossary of terms

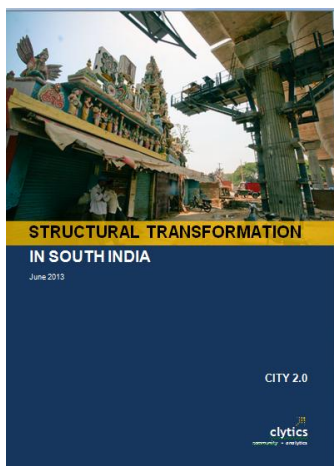


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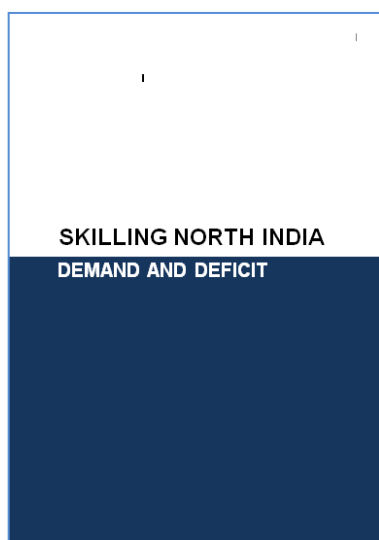
## Previous publications



### **Structural Transformation In South India**

This paper presents the momentum of changes taking place in the demography and the economy of South India. It analyzes and explores the conflicts and problems that will arise as an implication of these changes.

## Forthcoming publications in the next Quarter



### **Skilling North India Demand and Deficit**

In the next four decades the working age population in North India shall increase by 60%. The demographic headwind can result in profound changes in the economies of the Northern states. At the same time it will be a challenge to construct inclusive growth and create jobs.

January 2014

## CITY 2.0