INCREMENTAL CITY:
AN URBAN CODING STRATEGY TO CREATE LIVABLE FUTURE CO-PRODUCED NEIGHBORHOODS

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INTRODUCTION

Prognoses by the UN assume that by 2050 the number of inhabitants of informal settlements in the global south will increase significantly due to continuous population growth and urbanization.[1] Various experts are demanding to accept the informal sector as the predominant form of future urban space production, anticipate the development of self-built settlements, and incorporate them into formal planning processes.[2]

The concept of the Incremental City described in this paper takes up the above-mentioned approach of anticipation and develops it further into a hybrid urban development model that brings together aspects of top-down planning and bottom-up self-organization as well as giving ample space for informal self-building.[3]

This planning approach depends on good governance and the principles of participation in decision-making processes, collaboration during implementation and joint responsibility for the result. In this context, it is particularly decisive how the interface between the formal and the informal level is designed and how the power of decision and responsibility are allocated, to enable the successful coproduction of future urban extensions.

The urban coding of this model is based on two pillars: the urban plan, a structural concept and the associated key figures for city planning, as well as the urban code, the fundamental rules and obligations for inhabitants and responsible authorities. Through the combination of spatial urban structures and application-oriented regulations, an alternative urban development model is created that may serve as a tool in various planning processes in the context of future co-produced cities.

This paper outlines the key aspects of this planning strategy based on a dissertation published in 2021. In addition, the results of an urban planning master studio at KIT show how these planning principles work in a fictional planning task and how they could be applied in similar planning situations.[4]

„Expansion of Cities is important as long as they are well planned. Well planned doesn´t mean making an instant, perfect city. It means providing the infrastructure of a messy and incremental city.”[5] (Ricky Burdett, *The Quito Papers: Towards an Open City.* LSE Cities, 2016, Min 10:30)

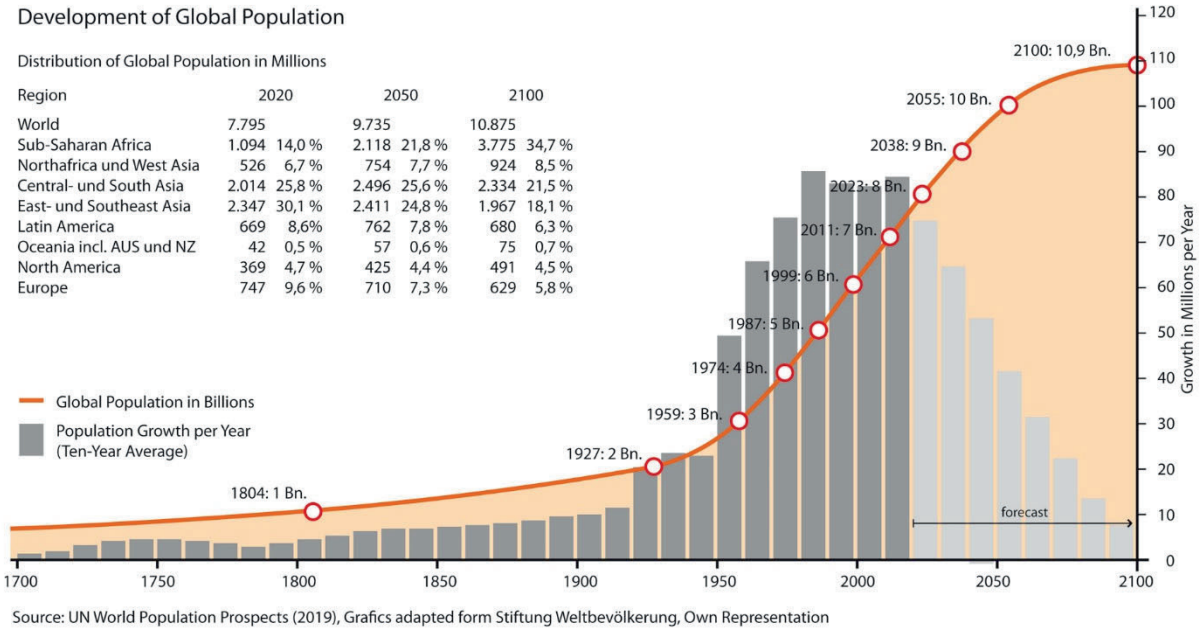

Figure 1: Growth of global population and geographic distribution

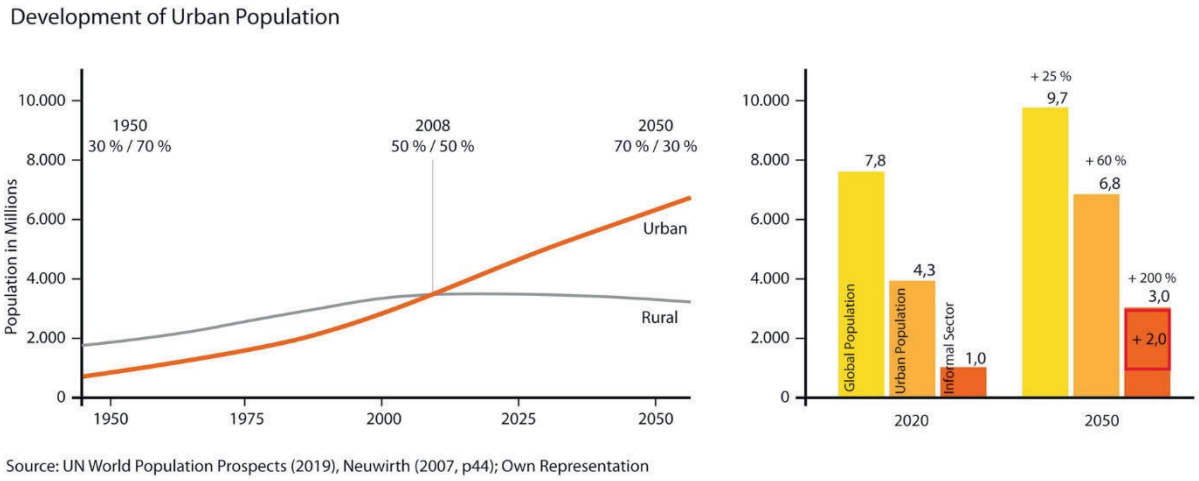

Figure 2: Growth of rural and urban population and share of informal sector

RESEARCH GAP AND METHODOLOGY

Objective

Starting point is the assumption that we have to accept the informal sector as the predominant form of urban space production in the future.[6] Demographics and urban growth are predictable and sufficiently accurate to allow anticipating the extension of self-built settlements. What would planning for the incremental self-build look like in concrete terms?

The objective is to develop a modular and scalable planning approach for a co-produced city using a combination of robust infrastructure[7] and flexible self-built infill.[8]

Hypothesis

A hybrid urban development model can combine the strengths of supportive formal planning (top-down) with the flexibility and efficiency of informal urban production (bottom-up) in future co-produced cities.

Through urban coding, a combination of a structural concept and urban planning metrics (urban plan), as well as appropriate planning requirements, design patterns, and a code of conduct (urban code), dynamic urban growth can be managed.

Research Methodology

This urban coding strategy is divided into three steps.[9] Essentially, the presented approach consists of (i) an analysis part, (ii) a translation of the findings into formalized design patterns, and finally (iii) an application of the developed set of rules for coproduction. To answer the research questions, this work draws on various sources of knowledge between theory and practice. In doing so, it draws on a foundation of personal experience and first-hand observation on the ground in various regions of Asia, Africa and Latin America. Another basis is the professional background in architecture, urban planning and strategic land development.

The research methodology consists of four parts. The first part includes the work with literature sources in the thematic field of informal settlement development and self-building. The second part represents the analyses of case studies, which cover both the structural characteristics and urban development indicators as well as the historical and social framework conditions. The third part represents the coding process, i.e., the development of a planning tool for the co-produced city. The development of such a design toolbox has a significant design component and therefore can be methodologically referred to as research by design. Finally, in the fourth part, test designs are carried out in a workshop and urban planning master studio to test the design patterns for applicability and to ensure that the design results meet the formulated requirements.

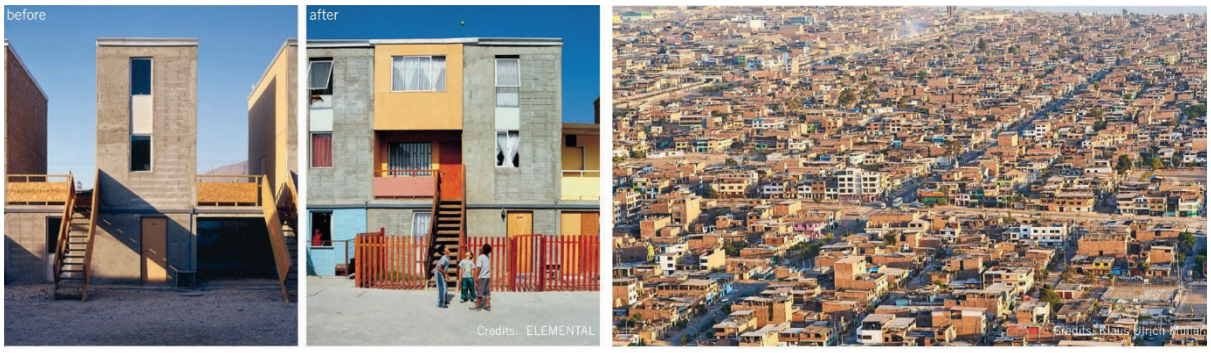

Figure 3: From Incremental Housing to the Incremental City

DE-CODING: ANALYZING THE SELF-BUILT CITY

Case Studies

To analyze and compare the urban qualities of planned self-constructed neighborhoods six case studies have been selected. Criteria for the selection of projects were as follows: A location in the global south, a planned urban structure for low-income residents, and a concept characterized by gradual development in self-building on the plot. As well as an already realized and consolidated structure and

at least 30 years since the beginning of the settlement to derive conclusions about the dynamics of densification and other long-term effects.
The selected projects are Nezahualcóyotl in Mexico City, Mexico; Solanda in Quito, Ecuador; Villa El Salvador in Lima, Peru; Carrières Centrales in Casablanca, Morrocco; Ard el-Lewa in Cairo, Egypt and Aranya in Indore, India.

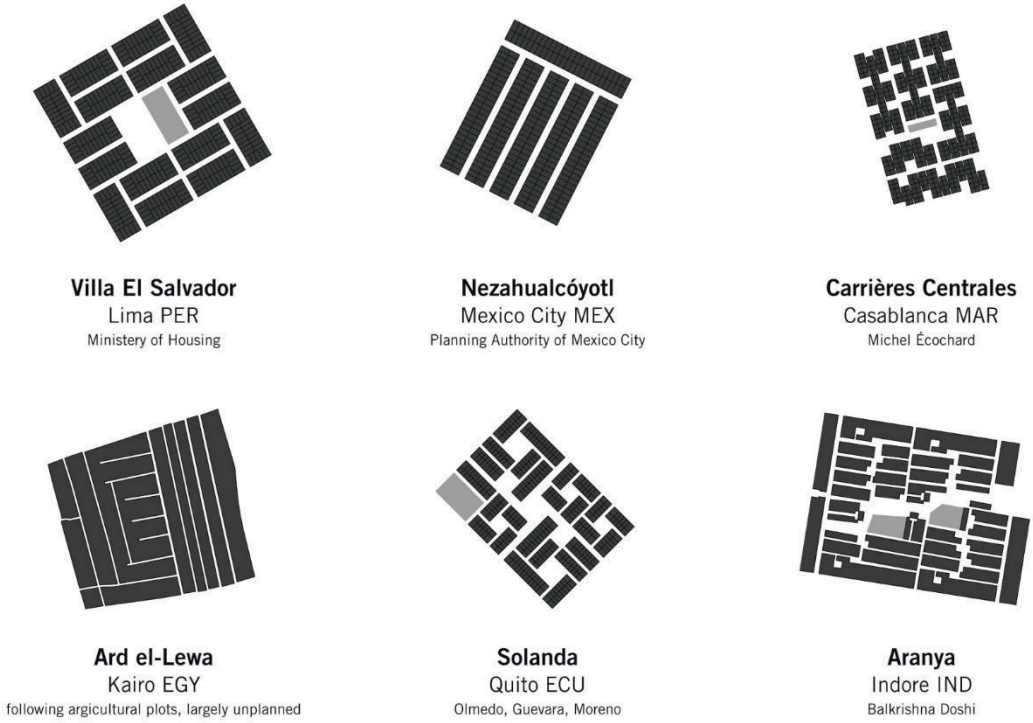

Figure 4: Scale comparison of neighborhood modules of the respective case studies.

First, each case study has been analyzed regarding the individual historic background, the stakeholders involved and its relation to the surrounding city and neighborhoods. Second, all case studies have been drawn to scale as a basis to analyze their urban structure and key figures of urban planning regarding road and transport networks, public space system, structure of plot layouts and distribution of functions and corresponding figure ground plan. This was combined with data regarding building heights, density, plot coverage and number of residents.

Findings and intermediate conclusions

Each of the six projects has a unique history of development and structure of stakeholders. In some analyzed aspects of urban planning, we find similarities, in others, there are substantial differences. The following paragraph summarizes the five key findings:

Structure and Hierarchy: All projects follow a modular-hierarchical structure that ranges from rigid orthogonal grids like in Villa El Salvador or Nezahualcóyotl to complex spatial frameworks like in Solanda or Aranya.
Networks of Streets and Paths: Usually there are three to four levels of access hierarchy. In all projects, at least parts of the street network double up as multifunctional public spaces, mainly close to individual homes.

Open space and social infrastructure: Most projects use public open spaces as an integral part of their urban layout. Especially Solanda with its archipelago of differentiated public green spaces and the interconnected green network of Aranya show successful solutions for livable neighborhoods. Furthermore, all projects combine social infrastructure with public spaces to use the scarce resource of space in the most effective manner.
Plot and block structure: The chosen size and proportion of the plots have a direct influence on the achievable long-term density and height of the buildings. The study shows that families stop extending their homes at a certain level, which causes stagnation of density. This brings us to the conclusion that the optimization of net building land and providing large individual plots above 100 m² are misleading. Small plots and additional public space create more attractive neighborhoods while achieving similar densities over time.
Adaptation to local context: The analyzed examples show a wide array of adaptations to the local context regarding social, cultural and climatic aspects. One example to point out is the strict hierarchical layout of Villa El Salvador, where the urban grid is a direct representation of the local system of self-organization on the block and neighborhood levels.[10] Also interesting is the adaptation to topography and climate, e.g. optimizing cooling wind directions and solar protection in the Aranya project.
These and more findings and best practice examples from the analyzed case studies have been extracted as conclusions which form the basis for the proposed design patterns described in the following paragraph.

Figure 5: Comparison of urban structure in four exemplary case studies

CODING: DESIGNING A CO-PRODUCED CITY

„In essence, coding generates urban order by the generic specification of allowable and necessary components and relationships." [11] (Stephen Marshall, *Urban coding and planning*, 2011, p. 6)

Design patterns of the Incremental City

The following design patterns for co-produced neighborhoods or cities are the result of a research process in literature as well as the findings derived from the case studies combined with the professional experience from practice as an architect and urban planner. The design toolbox for the Incremental City consists of six spatial components.

1) A hierarchical structure forms the basis for any modular and scalable urban system.[12] An urban hierarchy of streets, public spaces, social infrastructure and distribution of functions provides orientation and identity.
2) The access network of streets and paths. It provides a modular structure, which can be repeated and extended to a grid or multi-layered spatial framework. Combined with access to public transport, optimized network lengths and increased walkability it forms the basis of the infrastructure grid.
3) A framework of public spaces works as a powerful tool to structure livable future neighborhoods. These public spaces are multifunctional and cater for a wide range of uses and users. Multiple uses in the same space are staggered over time to maximize the use of the rare resource of public (green) space. This framework could be extended beyond the settlement limit and may include protected areas like waterbodies or important landscape features.
4) Social infrastructure serve as gravitational centers in the urban system. Strategically located social infrastructure guides incremental growth into desired directions and works as a protector of public or ecologically important spaces. Especially within the realm of social infrastructure, certain institutions may be used to create destinations of city-wide or regional importance within new co-produced neighborhoods and therefore contribute to a more equal city.
5) The plots and block structure in which the principles of informal modernism serve as a blueprint of the urban design.[13] Moderate height and full use of the plot create the basis for a low-rise and high-density urban development model. The gradual expansion and incremental growth of the neighborhood and on individual plots are some of the most visible characteristics of the Incremental City.
6) The adaptation to the local context. All of the above-mentioned spatial components need to be adapted to topography, climate and natural environment and for example include solutions for shading, ventilation and precipitation. Finally yet importantly, the urban framework not only needs to be adapted to the social, cultural and historical context. Preferably, it should also use the specific context as a source of inspiration to create a unique livable neighborhood with a strong identity.

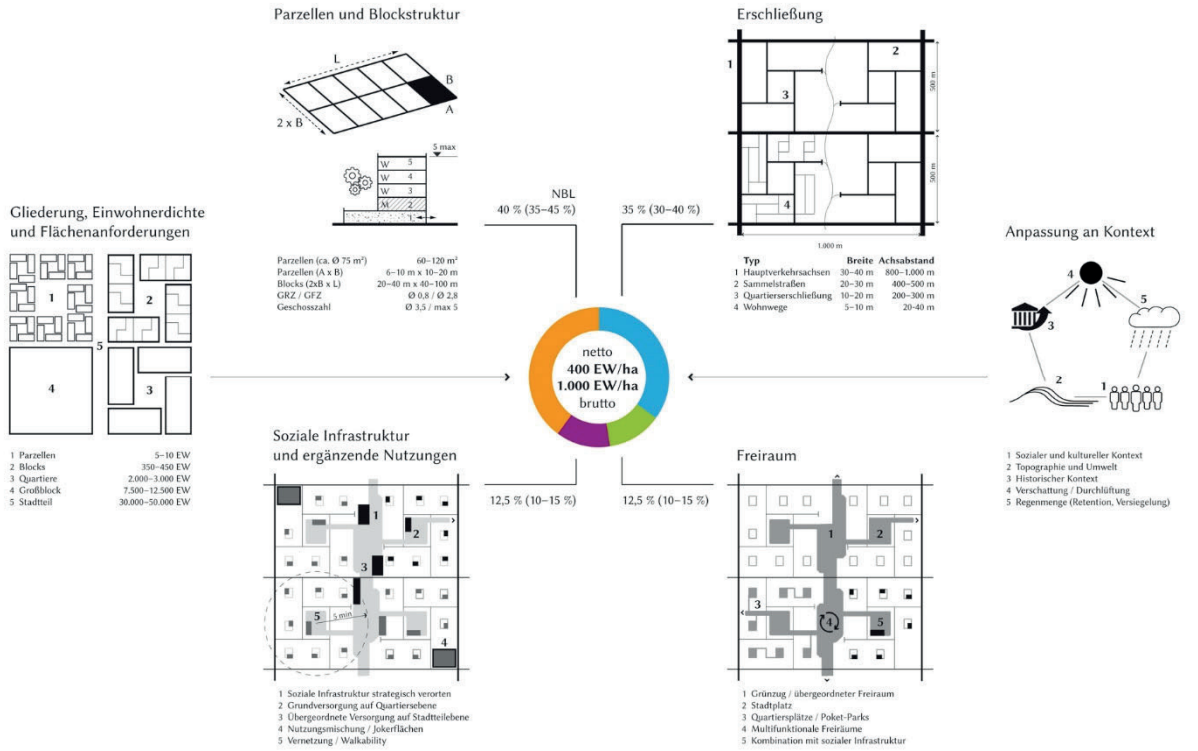

Figure 6: Urban Design Toolbox of the Incremental City

Test design with professional architects and urban planners

Based on the patterns described above, a design workshop has been conducted to test the methodology as well as the proposed design urban design guidelines. The objective for three teams of professional architects and urban planners was to work on a fictional planning task in Qaha, a small agricultural town 25 km north of Cairo. The 75-hectare site provides enough space to cater for the projected doubling of inhabitants over the next decades. Its urban design based on the Incremental City principles. The results after two workshop days were encouraging. Not only were the participants able to provide three structurally and conceptually different solutions, but they also provided important feedback to improve the preliminary guidelines in some aspects and increase the clarity of its structure.

Test designs in urban planning master studio at KIT

These refined urban planning guidelines were used as a basis for an urban planning master studio at Karlsruhe Institute of Technology (KIT).[14] Seven teams set out to search their individual planning territory in the global south. The criteria for the country and site selection were a high population growth and urbanization rate, a moderate human development index, preferably a small or mid-sized city and a site of 50 – 75 hectares. Five teams chose locations in Africa, ranging from Cairo, Egypt; Ouagadougou, Burkina Faso and Sebeta, Ethiopia to Athi River, Kenya and Kigali in Rwanda. With Tenggarong, Borneo and Jayapura, Papua two teams chose sites in Indonesia.

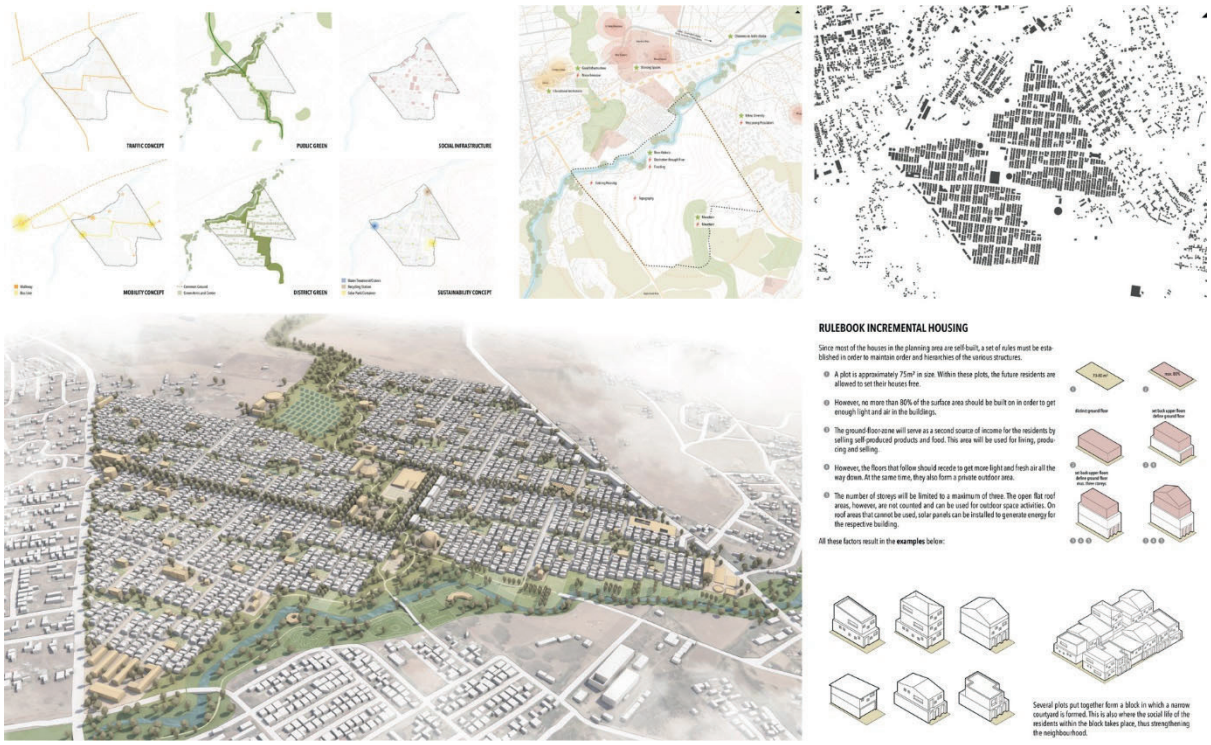

Figure 7: KIT Urban Design Master Studio, Sebeta, Ethiopia. By Lukas Benz, Xiang-Ru Zhu

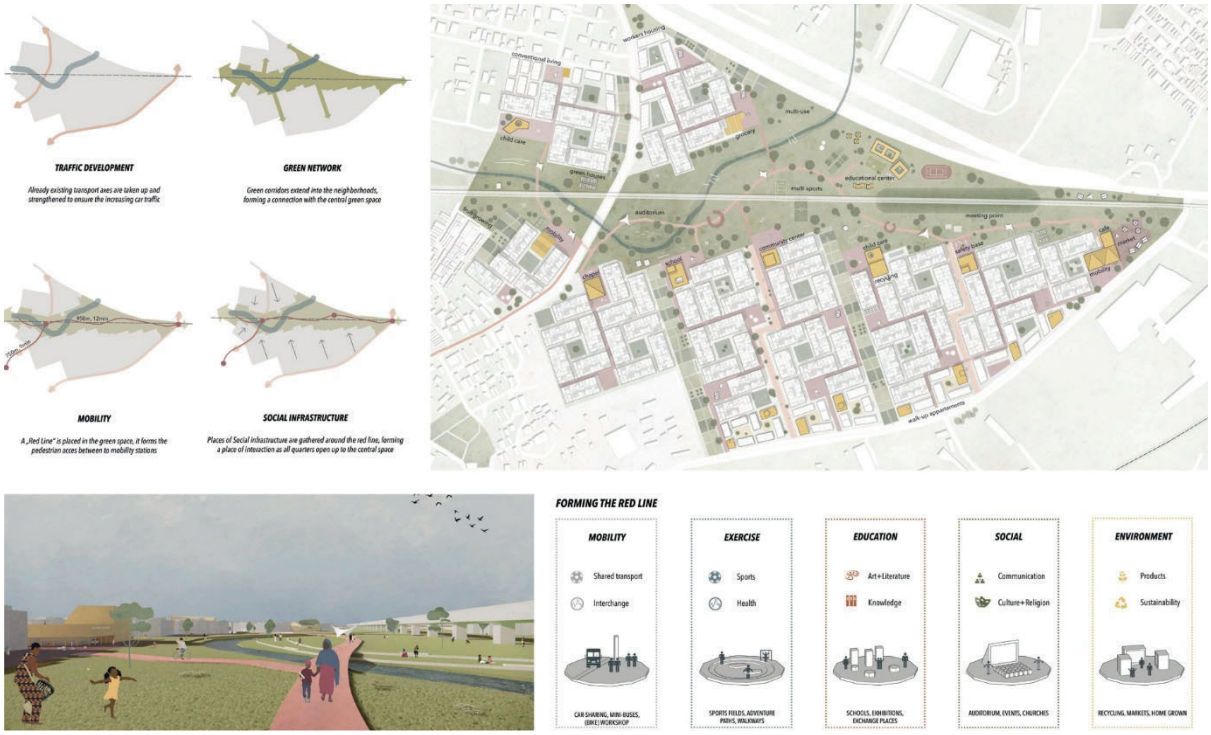

Figure 8: KIT Urban Design Master Studio, Athi River, Kenya. By Julia Henschel, Johanna Olfen

Findings and Intermediate Conclusions

As a result of the case studies, combined with the findings of the urban planning workshop and master studio some general findings can be formulated. General requirements for a co-produced city are a robust infrastructure framework of hierarchically organized access streets combined with a balanced network of public open spaces and social infrastructure. At the same time, the layout should provide ample space for individual construction within the blocks and plots. It should be easy to construct, modular and scalable.

The design guidelines should be communicated as an application-oriented planning tool. The complexity of these guidelines is consciously reduced to six interlocked spatial components to make the design patterns clear and easy to understand. In contrast to early critiques towards a seemingly reduced repertoire of design patterns, an interesting finding is the great variety of urban design solutions that resulted especially in the master studio in geographically, culturally and climatically very different contexts. In fact, the professional urban planners as well as the participants in the master studio mentioned, that the design toolbox provided great help and greatly accelerated the design process.

IMPLEMENTATION

Preconditions for the Co-Produced City

While developing the concept of a co-produced city a set of necessary preconditions has been identified. The following paragraph outlines five of these aspects.

1) Availability of land is one of the core issues.[15] Often there is no physical scarcity but rather historically developed concentrated ownership, which contrasts with the claimed right to the city movement and raises questions on how to provide a fair distribution of land.

2) Innovative solutions in financing are needed.[16] Apart from optimizing costs of the developed area, infrastructure networks and building structures, land banking and value capture are strategies that help authorities to provide affordable conditions. A flexible mix of savings, institutional funding and loans tailored to those in need, further enhances the circle of beneficiaries.[17]

3) Good governance is necessary to support transformation of politics, administration and legal frameworks to integrate successful informal practices into formal processes.

4) Capacity building is needed. This happens directly through education, knowledge transfer and cooperation, but also by providing open-source knowledge of basic planning and construction principles supported by new technologies like web-based solutions or smartphone applications.[18]

5) The need for innovative government frameworks that create ample space for participation, collaborative processes and self-governance.[19] Especially on the neighborhood level an active engagement of different stakeholders is necessary to maintain continuous exchange, guidance and consultation to provide long-term success.

Depending on the context, all of these issues are challenging, but not impossible to solve. Solutions to each of these sectoral issues have been documented in literature. Ultimately, it boils down to the presence or absence of political will to change.

„In current planning theory and activism, urban coding is discussed as a bottom-up approach to understanding, formalizing, and thereby manifesting sociospatial qualities of urban neighbourhoods.“[20] (Ahlert et al. *Moravia manifesto. Coding strategies for informal neighborhoods*, 2018, p. 73)

Integration of the informal into formal frameworks

First, it is necessary to accept the informal sector as an existing reality. The informal sector caters for the needs of millions in a very efficient way and should therefore not be considered as part of the problem, but rather as a part of the solution. This is not limited to the building sector alone but extends to the fields of transport, business, finance, law and others.

To create successful hybrid solutions it seems necessary to adapt existing formal frameworks to the existing informal practice, not the other way around. In concrete terms, this means simplifying formal regulations and access to formal processes while at the same time integrating informal practices in existing frameworks. For example, this principle could be applied in the sectors of planning and building regulations, registration of land ownership, transactions and finance of real estate.

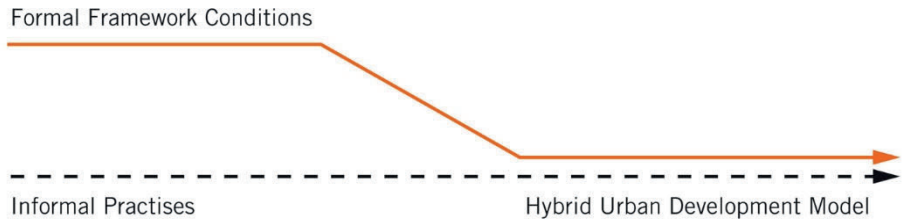

Figure 9: Adaptation of formal frameworks to hybrid urban development model

Responsibilities and Code of Conduct

Within the context of a hybrid urban development, the areas of responsibility and their interfaces need to be defined. In simple terms, it can be summarized that in the early stages of the process and in large-scale tasks, the responsibility usually lies in the formal sector and with the authorities. The later in the process and the smaller the task, the more responsibility can be assumed by future inhabitants. Depending on the context, certain concessions of all actors are necessary and the areas of responsibility should be negotiated carefully. Examples show that reasonable interfaces are located on the scale of neighborhoods, quarters or blocks and at the transition from specific urban infrastructure and definition of plot layouts to the realization of first buildings.

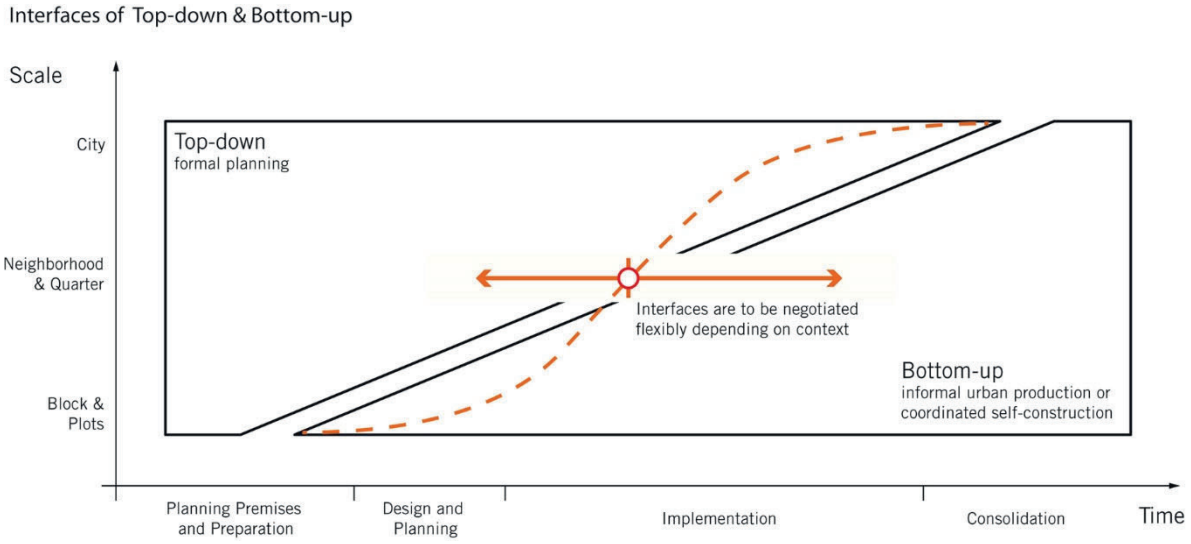

Figure 10: Sectors of responsibility and interface between top-down and bottom-up

CONCLUSION

The analyzed case studies show that planning for self-construction can create successful results in the sense of livable neighborhoods. Key features of the co-produced city are summarized in simple sets of rules. These guidelines form an effective starting point for urban planning tasks in the context of rapidly expanding cities, especially in cases with high proportions of self-built construction.

The experimental application in test designs with professional architects and urban designers demonstrates the functionality, agility and flexibility of the toolbox. Moreover, the 2021 urban planning master studio at KIT shows that the guidelines of the Incremental City can be easily understood and implemented by professionals and students alike. The wide range of urban patterns and the variety of locally adapted planning solutions developed within the urban planning studio are proof of the versatility of this concept.

These results indicate that a hybrid urban development model - described as the Incremental City - is able to combine the strengths of supportive formal planning (top-down) with the flexibility and efficiency of informal urban production (bottom-up) in co-produced cities. To achieve this combination of formal planning and informal urban production several prerequisites have to be met: First, a flexible yet robust urban plan including the expected key figures for city planning. Second, an urban code outlining the fundamental rules and obligations for future inhabitants and responsible authorities alike. It is expected, that negotiating and following an alternative urban code is one of the most challenging aspects, partly because it also means that authorities need to accept the realities of informal building production and therefore need to adapt existing building regulations. One way to achieve this goal might be to create special development zones for coproduced neighborhoods, as it allows maintaining existing regulations in the existing and future formal parts of the city while allowing fewer restrictions and special rules in designated areas.

Yet urban planning alone is not enough. The preconditions for a successful co-produced city are manifold, where availability of land, financing, law, personnel capacities, good governance and participation could be identified as the key topics.[21]

Sectoral strategies for these issues have been documented and there are tested solutions for each of these thematic fields, yet there is a need for more in-depth work to bring them together into a combined interdisciplinary strategy. The greatest challenges lie in creating favorable framework conditions and embedding planning in an effective overall strategy.

NOTES

[1] United Nations *World Population Prospects* (New York, United Nations, 2019), 1.
[2] Christian Werthmann *Metropolis Non-Formal, 10 things designers need to work on* (accessed June 3, 2020), https://www.youtube.com/watch?v=hJiLiMlFotw, Min 5:30–7:45.
[3] John Turner *Housing by people. Towards autonomy in building environments* (New York, Pantheon Books, 1977) and Horacio Caminos and Reinhard Goethert, *Urbanization primer. Project assessment, site analysis, design criteria for site and services or similar dwell-ing environments in developing areas, with a documentary collection of photographs on urbanization* (Cambridge, MA, MIT Press, 1978) and Alejandro Aravena and Andrés Iacobelli (eds.) *Elemental. Manual de vivienda incremental y diseño participativo/incremental housing and participatory design manual.* (Ostfildern, Hatje Cantz, 2016)
[4] KIT, Institute for Urban and Landscape Design, Master Studio: *Incremental City – Planen einer koproduzierten Stadt*, (Karlsruhe, KIT, 2021) accessed March 15, 2023, https://stqp.iesl.kit.edu/1156.php
[5] Ricky Burdett *The Quito Papers: Towards an Open City* (UN Habitat, NYU, Theatrum Mundi, 2016) accessed December 10, 2019, https://www.youtube.com/watch?v=B4sJzJxXmNw, Min 10:30.
[6] David Gouverneur *Planning and Design for Future Informal Settlements* (London, Routledge, 2015), 3.
[7] Shlomo Angel *Making room for a planet of cities.* (Cambridge, MA, Lincoln Institute of Land Policy (Policy focus report / Lincoln Institute of Land Policy)), 57
[8] David Gouverneur *Planning and Design for Future Informal Settlements* (London, Routledge, 2015), XXIV.
[9] Moritz Ahlert et al. *Moravia manifesto. Estrategias de codificación para barrios populares: coding strategies for informal neighborhoods* (Berlin, Jovis, 2018), 75.
[10] Vila El salvador: Organisation und Hierarchie
[11]Stephen Marshall (ed.) Urban coding and planning (London, Routledge, Planning, history and environment series, 2011), 6.
[12] See: Christopher Alexander et al. *A pattern language. Towns, buildings, construction.* (New York, NY, Oxford University Press, 1977)
[13] Eckhart Ribbeck, Sergio Padilla and Fatima Dahman *Die informelle Moderne - spontanes Bauen in Mexiko-Stadt* (Heidelberg, awf-Verlag, 2002), 14-15.
[14] KIT, Institute for Urban and Landscape Design, Master Studio: *Incremental City – Planen einer koproduzierten Stadt*, (Karlsruhe, KIT, 2021) accessed March 15, 2023, https://stqp.iesl.kit.edu/1156.php
[15] Mark Napier *Trading places. Accessing land in African cities* (Somerset West, African Minds for Urban LandMark, 2013), 50.
[16] Laura Sara Wainer, Billy Ndengeingoma and Sally Murray *Incremental housing, and other principles for low-cost housing*, (International Growth Centre / RHCI MIT, 2016, C-38400-RWA-1) accessed November 15, 2019, https://www.theigc.org/sites/default/files/2016/11/Wainer-et-al-2016-final-report.pdf
[17] John F.C. Turner *Uncontrolled Urban Settlements: Problems and Policies* In: International social development review No. 1 (New York, United Nations, 1968) 126.
[18] Marco Ferrario, Rakhi Mehra and Swati Janu Digital Tools for Low-Income Housing in Indian Cities. (mHS CITY LAB, in Field Actions Science reports, 2017), 54-59
[19] Mark Napier *Trading places. Accessing land in African cities* (Somerset West, African Minds for Urban LandMark, 2013), 107.
[20] Moritz Ahlert et al. *Moravia manifesto. Estrategias de codificación para barrios populares: coding strategies for informal neighborhoods* (Berlin, Jovis, 2018), 73.
[21] UN-Habitat Our City Plans - An Incremental and Participatory Toolbox for Urban Planning (Nairobi, United Nations Human Settlements Programme, 2022) accessed March 15, 2023, accessed https://ourcityplans.unhabitat.org/

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