# OPEN BUILDING AS AN INTERNATIONAL APPROACH FOR MULTI-FAMILY HOUSING PRODUCTION

## User-Oriented Housing Practices and Opportunities for Emerging Markets through the SI Housing Perspective

January 2016

MARIANNE COSTA

Graduate School of Engineering

CHIBA UNIVERSITY

(千葉大学審査学位論文)

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Summary of Thesis Presented to
The Faculty of Urban Environment Systems of Chiba University

in Partial Fulfillment of the Requirement for
the Degree of Doctor of Philosophy

Approved By:

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Takeshi Ueno, M. Arch., Committee Member

# Publishing Notes

*Dear reader,*

*The following summary is being published for confidentiality reasons and does not replace my thesis.*

*My doctoral thesis includes floor plans, interior and exterior photos of 169 remodeled apartments. Some remodeling cases include confidential information such as informal and undeclared dwelling expansions. Although the identity of the dwellers is undisclosed, it might be possible to identify them by the dwelling location, or photos of the building facade. The inclusion of this evidence in the thesis body, however, is essential for its complete understanding. Thus, to protect the privacy of the survey participants I prefer not to publish the entire thesis for open access.*

*In order to make it open, I would need the personal acknowledgement of 169 households for showing each of the floor plans and pictures that might show private information. Because these households were surveyed in four different countries during a span of six years, and because I lost contact with the people in charge of recruiting the volunteers it is basically impossible to get everyone's permission. If you wish to read my entire thesis, or talk about it, please contact me by this e-mail (arq.marianne.costa@gmail.com).*

*The apartment surveys presented in this thesis were fully supported by the KAKENHI Project No. 22360247, lead by D. Eng. Hideki Kobayashi. Each of the photos used in this summary are intellectual property of the KAKENHI and of the team leader of their respective locations.*

*Fela Warouw, in Jakarta, Indonesia, 2007~2010;*
*Ji Young Jung, in Seoul, Korea, 2010~2015;*
*Yin Ling Young, in Dalian, China, 2013~2014;*
*and Marianne Costa, in Santos and Sao Paulo, Brazil, 2012~2015.*

# Abstract

This thesis is a following part of a major research on customized apartments, sponsored by the Ministry of Education, Culture, Sports, Science and Technology of Japan, towards the Open Building implementation in emerging markets.

The Open Building concept is a sustainable measure for residential construction proposed by N. J. Habraken, in Netherlands, 1961, which incorporates two basic ideas. The first is about making buildings respond to people and time, by separating decision-making in a residential environment through an approach that distinguishes parts that should adapt according to the user's needs (Infill, I) and parts that should endure (Support, S). The second is about shifting the housing demand from stock production to stock renovation. This concept has been reinterpreted worldwide, remarkably in developed countries, and acquired different purposes according to each national housing demand at the time of its proposal.

In the case of Japan, land of NEXT21, claimed as the most successful application of this concept so far, S and I were disentangled into a hierarchy structure with four sublevels of decision, along with the aim of specifying the building components that compose each level, turning multistory dwellings into long-lasting user-oriented goods. The purpose of this study is to reinterpret this idea and update it to emerging countries in a way they can become able to remove housing shortage from their priority agendas, by improving their housing stock rather than just multiplying it.

In order to achieve that, we carried out a replication study focused on customized apartments in four emerging nations, along with the aim of clarifying the scope of individual decisions, their legislative systems and the development of their house building industries. Therefore, we had to obtain a sample of individuals who had their apartments customized and are disposed to concede us an interview, as well as allow us to visit, photograph and draft floor plans of their homes before and after customization. These duties involve learning a lot about the privacy of the volunteered households, and dealing with language, time and budget constraints. Under these conditions, we opted for non-probabilistic sampling and developed our fieldwork in the metropolitan areas of Jakarta, Seoul, Dalian, Sao Paulo and Santos, guided by native members of our research team. On a time span of six years, we could observe a total of 169 households, in 77 housing complexes.

This study was divided into three major assignments. The first is about clarifying the adaptability demands, in terms of specifying which elements need to be changed, and who controls the decision of changing them, in order to establish the decision making levels for Open Building implementation in each emerging market. Based on the results of the first assignment, the second is about facade individualization. The goal is to clarify the individual perception of these spaces, and the role of local building policies in establishing margins of individual and collective control of decision. Finally, our third assignment is to clarify actual market approaches for user-oriented housing provision, and analyze their differences in terms of product adaptability and affordability, and propose a universal model to deliver user-oriented housing for different market segments.

**Keywords:** SI housing, dwelling customization, decision-making, user-oriented housing production, emerging markets

# FINAL THESIS SUMMARY

## 1. Towards an International Housing Approach

For a long time, the only choice we could give to users of emerging housing markets was the choice of having a shelter with access to the urban opportunities. Due to the housing shortage and to the unsuitability of the existing dwellings, emerging housing policies and market goals have been more focused in multiplying the housing stock, rather than improving its quality (Douglas, 2006). Also, multi-family dwellings have long been dismissed as unable of providing decent dwelling conditions, especially for low-income people (Malard, 1992).

But today, this housing type has become an endorsed solution against housing shortage, and it has been massively applied in urban areas. In fact, multi-family dwellings started to be mass-produced to address housing shortage after World War II. People have lived in mass housing for over two decades, until a group of designers realized that in order to deliver a large amount of dwellings fast, mass production does not offer any place for the user as a decision-maker. As a result, like any other product that stops serving people, dwellings become disposable products, which need replacement.

The group of designers proposed a concept of buildings that could respond to people and time, called Open Building. In order to enable that response, they suggested the separation of building parts into "levels of control" or "controlled hierarchies". Buildings would be divided in two groups of parts: support/skeleton parts that would last longer, responding to decisions of a group of people, and infill parts, with a shorter life, responding to individual decisions.

Developments toward this idea started in Europe and Japan, and turned out into what is known today as the SI System, where "S" stands for Support/Skeleton and "I" stands for Infill. Although support and skeleton refer to similar concepts, the suitability of the use of one or another is controversial. Western theorists defend that: "A Support is not merely a skeleton. It is not neutral, but is rather enabling architecture." And this definition comes often accompanied by the famous sketch of the Domino Skeleton of Le Corbusier, struck with a cross, as if denying their source of inspiration (Leupen, 2006).

Instead, the Japanese theorists embraced the Corbusian inspiration, and preferred to keep calling it Skeleton. Furthermore, they established the Skeleton, after naming the building parts that compose each decision-making level, and setting guidelines to operate each level. In this research, we preferred to adopt the skeleton concept, because its pragmatism is essential for the SI System dissemination in Emerging Economies (Figures 1 and 2).

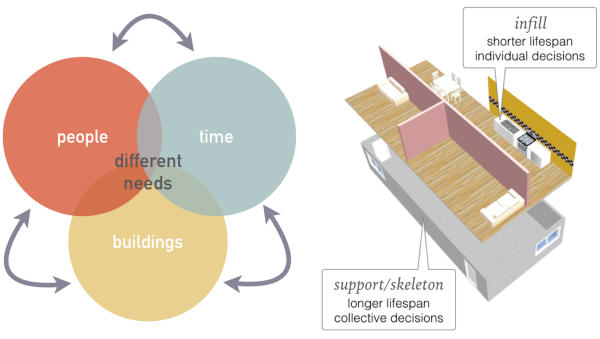



Figure 1 The Open Building Concept

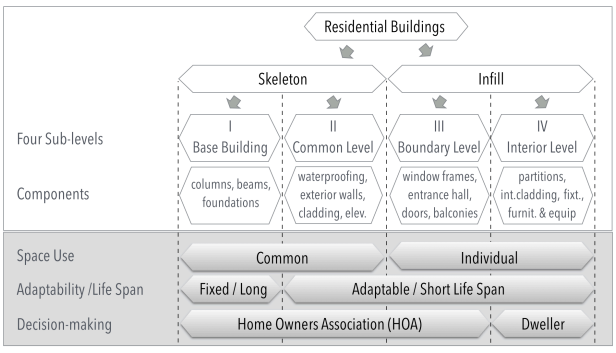



Figure 2 SI Levels (Kobayashi and Fujimoto, 2003)

Previous studies have shown the importance of dwellings as a dominant economic asset, which embodies heritage and family connections, and is used as a means of artistic and status expression. Families are used to design their own concepts of functionality into interior and exterior settings of apartment buildings to their expressive ends. If we don't give a place for that to happen, people will find their ways to do it through the ambiguities of the law.

Thus, the purpose of this research is to reinterpret the Japanese SI theory to eliminate these ambiguities, setting a proper place for user decisions in emerging housing markets. In order to achieve that, we have studied three major issues: 1) How much choice does the user need and in what building levels? 2) How to control individual decisions and what to do when they go into conflict? 3) How to deliver user choice and how to reach everyone?

In order to clarify user choice by observing actual customization practices, our sampling strategy was divided into three stages. First, we chose emerging countries with research staff qualified for field survey and interpret the data. Then, we chose typical cities with meaningful availability of apartment buildings, where we had personal connections that could introduce us to dwellers that had their apartments customized. Finally, we chose information-rich cases, and that depended on how well our connections were situated (Figure 3).

Supported by a Grant-in-Aid for Scientific Research of the MEXT, Japan, fieldwork activities were replicated in a time span of six years, in five cities, each guided by a member of our research team. In total, we have observed 169 households in 77 developments (Figure 4).

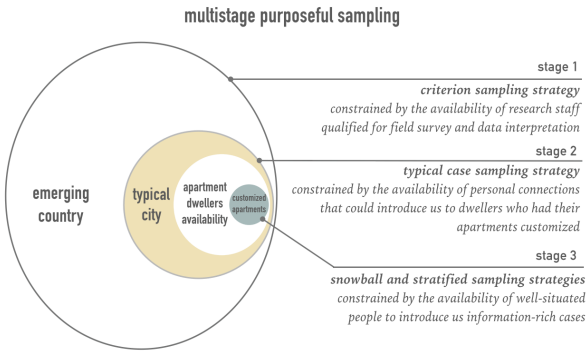



Figure 3 Schematic Diagram of Sampling Strategies


Figure 4 Surveyed Locations

In the emerging markets panorama, our selected markets represent different stages of economic development. South Korea is a high-income market, Brazil and China are upper-middle income market, and Indonesia is a lower-middle income market. The access to housing finance is also different in each country. Comparatively, Korean and Chinese dwellers can borrow more money and rely on installment systems and mortgages to invest in full package purchases. Instead, Brazilian and Indonesian dwellers have less money available to borrow, and might rely on their own saving efforts, using incremental strategies.

As a result of this study, we expect two kinds of findings: (1) high-quality, detailed descriptions of each national case, which are useful for documenting uniqueness, and (2) important shared patterns that transcend cultural barriers and derive their meaning from coming out of heterogeneity. Like the infill and skeleton principles, respectively, these findings can help us to design an open building model for emerging markets. Please notice that our purpose is not to set the "best" housing model for each country. Instead, we aim to provide a roadmap for user-oriented house making that can be tailored and sequenced to each country's condition.

## 2. Household's Profile

Before drafting the profile of our samples, please notice that the group of people who lives in apartment units might not encompass a cluster that represents the whole population residing in a given location. So, our samples could only represent the dwellers of apartment buildings at the selected locations. But, the lack of information about apartment dwellers in our selected cities made impossible to confirm the sample representativeness. Thus, we drew the profiles in contrast to the general population just to illustrate different user standpoints.

For instance, the five cities offer housing supply from public and private sectors, but the samples available at the time of our observation were publicly supplied in Jakarta, and privately supplied in the other cities. Household's tenure is primarily owned, regardless of the location. Although Dalian presents the largest index of homeownership, dwellings in China are sold by the government in purchasing contracts with a length of 70 years; after that, they might be repurchased.

Regarding the head of household age, Jakarta, Seoul and Dalian's samples encompass an age pyramid similar to the national, which could be expected due to the high-density levels of Asian cities. But the same doesn't happen with the Brazilian samples, which rather represent an urban context of gentrification. In Brazil, the stock of apartments is relatively small, both nationwide and in the metropolitan level. Moreover, our stock of apartments is concentrated in the city center in the hands of the upper middle class. The only city where the rate of apartments surpasses the rate of detached units is Santos[1].

Economically, our samples represent an income level slightly higher than the average disposable income of people in most cities, except for Jakarta, which household samples have incomes more representative of the average people (Figure 5).

Lastly, correlating the family size and number of bedrooms within our samples, it was found that the number of bedrooms in Jakarta is miscalculated both compared to the average family size and to the number of actual family members. Relatively, there is a critical gap of dwelling area per capita, varying from 8.3 $m^2$ per person in Jakarta, and 67.5 $m^2$ per person in Santos. This has a substantial impact on how people customize their dwellings, but does not exclude the needs of user choice in one place or another. Though the users' profile is different, many of their needs can be tackled with the same solutions (Figure 6).

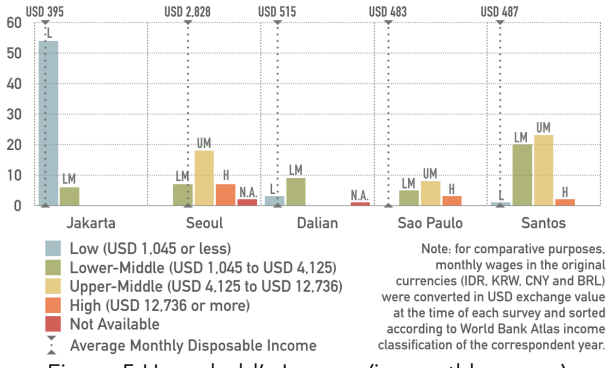



Figure 5 Household's Income (in monthly wages)

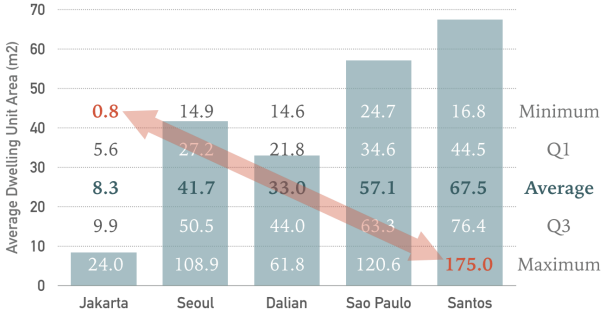



Figure 6 Average Dwelling Area per Capita

[1] Santos is a harbor city at 74 km of Sao Paulo. Because 70% of the land is environmentally preserved, the island portion accumulates densities up to 25,000 people per square km. Thus, the apartment stock accommodates a broader cluster, and also represents the lifestyle at the Brazilian coastline.

## 3. SI Levels and Control in Emerging Societies

Based on the notion that, in human organizations, when the complexity of a social structure demands exceeds the complexity of its control structure, the control structure will be likely to fail, as suggested by Bar-Yam (1997), the purpose of this chapter is to investigate whether the control hierarchies of the Japanese SI System are suitable to control the user decisions of our target group, and if not, propose a way to put them together.

In order to measure the scope of user demands, we first classified the customization works into eight levels of complexity, in terms of ideal decision-making perception. Then, we tried to frame these customizations into the four decision-making levels proposed by the Japanese SI System: base building, common elements, boundary elements, and interior elements. As a result, we found that sometimes the individual decisions bypassed the hierarchic structure, and could not be classified. Bypasses are the result of a customization that started at the individual level, but have some sort of impact in another level (Figures 7 and 8).

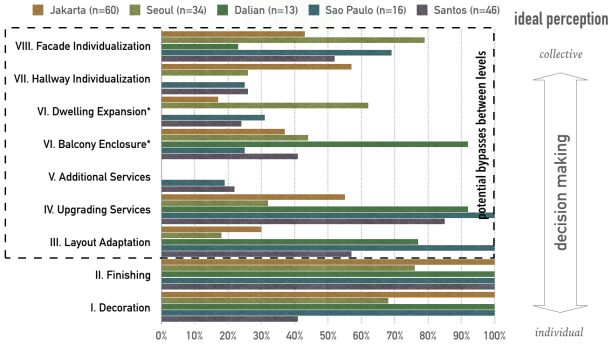



Figure 7 Scope of Individual Decisions

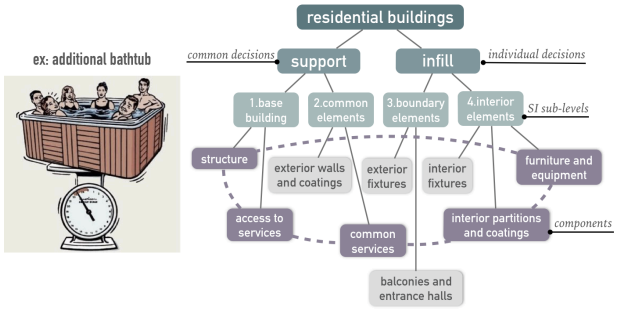



Figure 8 Example of a Hierarchic Bypass

These bypasses make dwelling customizations unsafe, because they can reach any building level. But we could allow individual decisions reach up to the boundary level, as long as we build rules for them to happen. In order to do that, we analyzed each customization type and its potential bypasses, and proposed solutions to eliminate them, as shown in Tables 1 and 2.

Table 1 Customization Analysis: Eliminating Bypasses from Interior Level

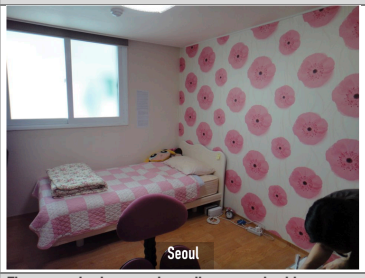
| SI Level | Interior Level | | | | |
|---|---|---|---|---|---|
| Complexity Level | I. Decoration | II. Finishing | III. Layout Adaptation | IV. Upgrading Services | V. Additional Services |
| Customized Content | Interior painting, wallpaper, free-standing furniture | Renovation of interior coatings, openings, built-in furniture | Relocation of interior partitions and openings | Renovation of bathroom/kitchen equipment and service lines | Additional bathroom/kitchen equipment and service lines |
| Example |   | |     Different cases in Sao Paulo accumulation of debris on the rooftop (not one of our samples!) |       |  samples under construction |
| Potential Bypasses | The customized content is totally personal, without potential bypasses, and won't cause any harm to the building or the neighbors | | Potential structural overload and demolition of structural elements. Top example: maid's room bathroom expanded to the void with addition of bathtub. Bottom example: accumulation of remodeling the debris on the rooftop. | Potential structural overload, plumbing relocation through unpredictable pathways, water supply access blocked to neighboring units. Top example: duplicated bathroom. Bottom examples: full remodeling with pipe relocation. | |
| Proposed Rules | None, free choice | | Distinguish partitions from boundary walls and load bearing walls. Keep structural load as original | Detach plumbing from walls. Make autonomous pipe branches, Keep structural load as original | |
| Decision Maker | Dweller | | Interior planners at customization stage (Remodeling standards) | Designers (local building code, Remodeling standards) | |

Table 2 Customization Analysis: Eliminating Bypasses from Boundary Level

| SI Level | Boundary Level | | |
|---|---|---|---|
| Sub Level | Individual Boundaries | Shared Boundaries | |
| Complexity Level | VI. Balcony Enclosure / Expansion | VII. Hallway Individualization | VIII. Facade Individualization |
| Customized Content | Relocation of exterior walls and openings, balcony enclosure* | Exterior painting, wallpaper, free-standing furniture | Renovation of exterior coatings, openings, built-in furniture |
| Example |   |   |   |
| Potential Bypasses | Potential structural overload, facade performance issues, such as leakage, condensation, heat loss, etc. | Individual interests prevailing over common interests | Potential structural overload, facade performance issues, such as leakage, condensation, heat loss, etc. |
| Proposed Rules | Turn the balcony into a buffer zone for expansion | Follow pattern agreed between neighbors who share the space | Enforce pattern agreed in condominium assembly |
| Decision Maker | Developer / HOA (land use policy) | Subcommittee (Condominium convention and bylaws) | HOA (Condominium convention and bylaws) |

By coordinating the hierarchic bypasses in a major frame, which involves policy makers, developers and designers, dwellers of multi-family buildings will be able to fulfill their demands safely. We understand, that in the case of Japan, policies need to be more restrictive for safety reasons. For example, although balconies are parts of exclusive use, they are regarded as parts of collective concern, because they are used as fire escapes, and thus, cannot be adapted. In turn, in the emerging world, the territorial perception allows individual priorities to permeate the dwelling boundaries, sometimes in bias of common priorities.

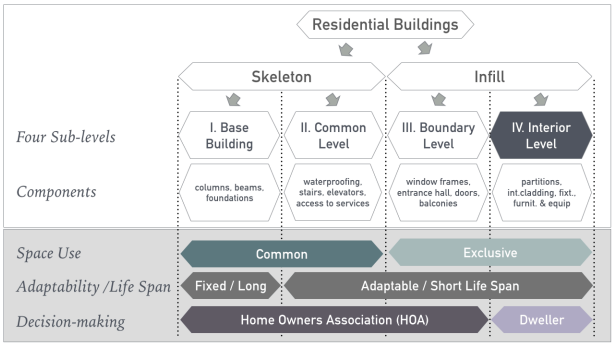



Figure 9 SI Levels in Japan

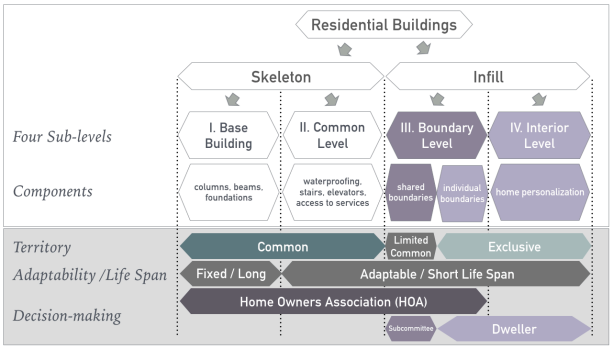



Figure 10 SI Levels in Emerging Markets

Because this is a very sensitive issue, we preferred to discuss it with detail in the next chapter. For now, keeping our discussion on control and SI levels, we proposed the inclusion of an intermediate scale of decision making, to be ruled by subcommittees of dwellers that share that boundary. These subcommittees could be organized by story allocation, facade orientation, or building block, depending on the users perception of a given shared territory.

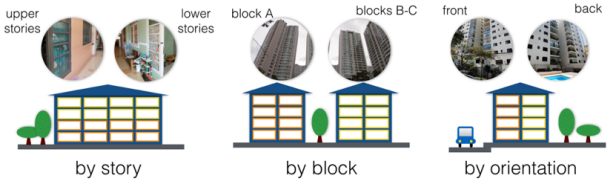
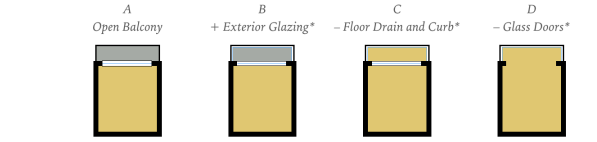



Figure 11 Limited Common: HOA Subcommittees per Shared Area

## 4. Facades as Margins of Territorial Power

Facades are like membranes separate public and private decisions. Some researchers advocate that private decisions should stay inside, and public decisions should stay outside of the membrane. Other researchers believe private decisions can come out of the membrane. This study revealed that even though the local building policies deliberate that individual decisions should stay inside, they tend to come outside anyway. So, the goal of this chapter is to establish guidelines for controlling facade individualization, instead of denying it.

Within our samples, the trendiest strategy for facade individualization is balcony enclosure. Due to its ambiguous character between common and exclusive, some policies account it to the GFA, but others don't. Early policies on balcony enclosure could have allowed only exterior glazing, keeping the floor tiles, floor drain with a curb to keep rainwater out of the suite, and separation from the living space by glass doors. But, in Seoul and Dalian, none of these are longer required. In fact, all samples in those cities had their balconies enclosed.




| | GFA Accountability | Facade Alteration or Expansion? | |
|---|---|---|---|
| Jakarta | unspecified | unspecified | |
| Seoul | accounted | facade alteration | |
| Dalian | accounted | facade alteration | |
| Sao Paulo | accounted if doesn't exceed 10% of FAR | facade alteration (condition: glazing without frames) | facade alteration, if accounted in the GFA expansion, if not accounted in the GFA |
| Santos | | | |

* note that the alterations from B to D are cumulative

Figure 12 Summary of National Policies on Management of Balcony Space

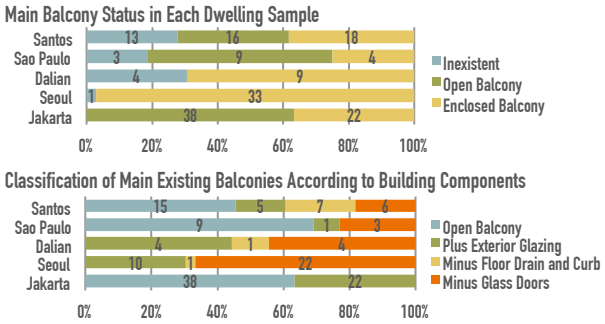
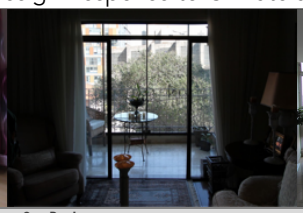
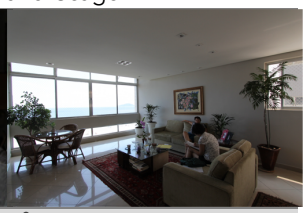



Figure 13 Main Balcony Classification

Another important factor to be considered is that, depending on the location; balconies might suffer climate-related performance problems to overheating, frosting, or excessive rainfall. This makes the space difficult to use. Therefore, because of the lack of enclosure of these unprotected spaces, a clear understanding of the orientation and buffering of these spaces is required to make them more functional. Table 3 summarizes our study results.

Table 3 Summary of Study on Balcony Design Response to Climate and Usage

| | | | | |
|---|---|---|---|---|
| Example |  |  |  |  |
| City | Jakarta | Seoul and Dalian | Sao Paulo | Santos |
| Climatic Type | Tropical Monsoon Climate<br>Wet season covers most of the year | Humid Continental Climate<br>Humid summers, cold, windy, dry winters | Humid Subtropical<br>Temperate, abundant rainfall Climate | Tropical Rainforest Climate<br>No real dry season |
| Balcony Features | Balconies are usually contiguous to the kitchen and serve purposes such as laundry and storage, and if kept always open, would have this use compromised during the wet season. But, mostly, the dwelling units are overly narrow to keep an underutilized space for most of the year. Also, enclosing balconies with glass might be unaffordable to some dwellers, so they use other materials, such as tarpaulin, wooden fences, fiber cement panels, etc. | The main balconies are commonly used as winter gardens, or totally demolished to extend a contiguous room. In Dalian, some balconies may be kept as enclosed laundries/storage rooms, but others might be used to relocate the kitchen out of the edge and open inner space to accommodate an extra bedroom. In Seoul, total balcony areas might occupy over 23% of the GFA, which enclosed, results in equal gain of extra room in cold periods. | The main balconies are usually contiguous to the living room or master bedroom, used as verandas, with seating space and greenery. Compared to the other cities, Sao Paulo's samples had the smallest proportion of enclosed balconies. Considering the issues of intense air and groundwater pollution, high levels of deforestation, and climate change in Sao Paulo, its dwellers could be simply trying to keep the slight amount of green they have. | The main balconies are generally used for seaside contemplation. Since they usually keep the original function, the need for enclosure could be just to keep them dry. Nowadays, Santos is facing a real estate phenomenon in Brazil, called gourmet balcony. It comes with a barbecue place and a whole outdoor set of living, dining and kitchen, requiring enclosure to preserve the furnishings, but those balconies are larger, and thus, accountable to the GFA. |

Therefore, rather than the cultural background or environmental conditions of overheating, frosting, or excessive rainfall, balconies tend to be enclosed as a means of floor space optimization. Moreover, in the locations we visited, facade alterations by the placement of unconventional window frames, glass films, built-in fences, air conditioning equipment, antennas, etc., are commonplace. But none of these alterations are supposed to last forever. Therefore, residential buildings should have their facades prepared for change. Obviously, that depends much on the cultural values and the technologies available in each place, but mostly, on the decision-making process.

Our idea is based on the notion that facades could be individualized before and after key delivery stages. Before key delivery, individualization plans could proposed by developers, by the use of movable panels that would be operated by the dweller after move-in; or by the proposal of option menus to be discussed with potential home buyers. These strategies would coordinate user choices that might include voluminous elements. After move in, we suggest the consent of self-individualization of confined elements, by the use of interchangeable components designated by the HOA (Figure 14).

Finally, the list of elements composing the menu, the movable panels and the interchangeable components should be proposed by local designers, familiar with the local resources, environment, culture, and mainly the consumer. Because the final decision belongs to the consumer, and whatever choice the designer does, if unsuitable to the consumer, it will be replaced by an ideal solution as soon as possible. Similarly, the local authorities should control exclusively the building alterations that may harm the building performance. Only the homeowners association, be it totally strict or chaotic, should be able to deliberate the aesthetical diversity of individual solutions.

In terms of organization, the facade would be separated into two layers, an exterior layer which coordinates the individualization, giving a uniform identity aspect, as proposed by the designers and maintained by the HOA, corresponding the skeleton part, and an interior layer, which is composed by the facade parts subject to individualization, as determined by the HOA and its subcommittees, corresponding the infill part. The Koujak Jaber building, by Victor Bisharat, 1964, exemplifies a practical use of this idea: the circular openings in the facade coordinate individual decisions, and what happens inside those openings might be chosen by the dwellers, according to the HOA's deliberations (Figure 5.9).

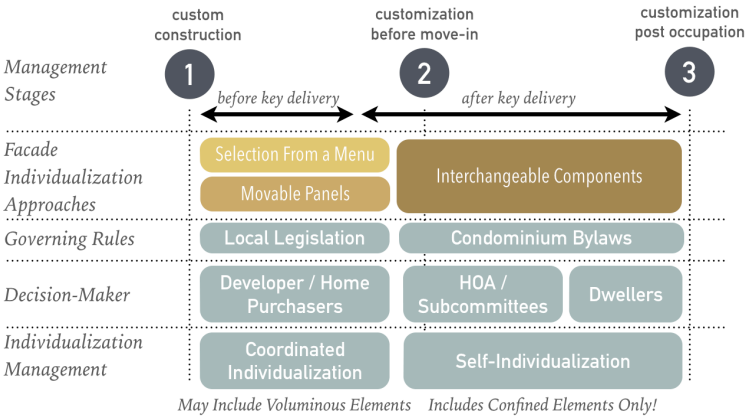



Figure 14 Proposal: Managing User Decisions in Facade Individualization

Figure 15 Coordinating Decisions: Example of Koujak-Jaber, by Victor Bisharat, Beirut, Lebanon, 1964 (Sam Ashley, 2012)

## 5. Delivering User-Choice through Infill Mass Customization

Based on the long tail theory (Anderson, 2006), the mass customization concept (Pine, 1993), and the generic model that translates these ideas to the construction sector by combining order decoupling points, proposed by Thuesen (2013), we developed an analysis of the infill delivery practices in the five cities we visited. The purpose of this chapter is to propose an infill delivery approach that can serve communities of different social and technological backgrounds.

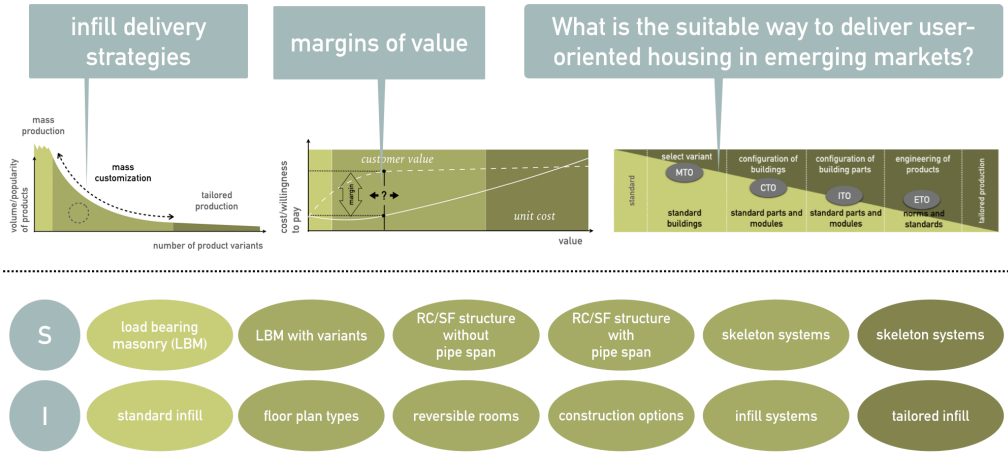



Figure 16 Hypothesis on Infill Choice Delivery through Mass Customization (Anderson, 2006 Pine, 1993 Thuesen, 2013)

Users can choose infill components in three different stages from construction to post occupation. To clarify the infill mass customization process, the first thing we considered is in which of these stages we should deliver user choice. When asked at which stage they had their apartments customized, it was found that most of the dwellers ordered it before move in.

In the cities we visited, infill choice has been delivered in five different ways:

Table 4 Summary on Infill Delivery Practices





| Approaches | Unfinished Plan | Reversible Rooms | Layout Options | Option Menu | Negotiable Options |
|---|---|---|---|---|---|
| Advantages | Interior choice left to the dweller; Reduced price for purchasing. | A third room, placed in center of the layout that can be partly or totally demolished | Enables choice from a menu of layout options pre-defined by the developer | Enables choice from a menu of interior options pre-defined by the developer | Enable choice of elements outside the menu |
| Disadvantages | Must be finished before move-in; No warranties | It is an option only for dwellings with 3 or more bedrooms | Options might suffer restrictions depending on the structural component | Users cannot choose interior components outside the menu | Uncertainty about service cost, quality or warranties |

Placing these choice delivery models into Thuesen's diagram, we have layout options and reversible rooms as MTO strategy, the option menu as a CTO strategy, and the negotiable options, as an ITO strategy. Unfinished dwellings were classified as tailored dwellings, because they eventually received individualized finishing, and those without any infill choice are categorized as ordinary standard dwellings.

Looking each location separately, it could be said that Jakarta and Dalian's samples still follow the mass production model. While Seoul's production is developing a pathway towards mass customization. However, Sao Paulo and Santos' samples are shifting MTO into ITO, and skipping CTO. Therefore, they are just aggregating tailored decisions, instead of developing towards mass customization.

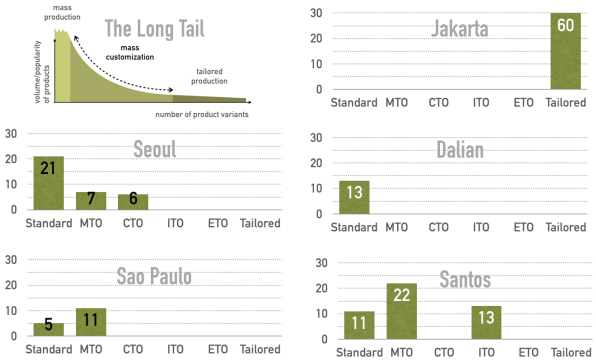



Figure 17 Long-Tail Measurement of Local Infill Industry Development


Figure 18 Professional Involvement in Different Stages per Sample Location

Considering self and professional involvement in the customization stages, we found that in the locations with a larger amount of samples that underwent custom construction, which is by rule professionally managed, there is also a larger rate of samples that underwent customization before move-in managed by professionals. That means that custom construction might not only help reducing the number of customizations before move-in, but it might also improve the dweller's awareness of the role of professionals in making their homes the way they wish it to be.

As the emerging house building industries develop, standard dwellings will be replaced by dwellings with layout options or reversible rooms, those will be replaced by dwellings with construction options, and when the industry assumes full control of assembling individual decisions in multifamily dwellings, possibly there will be even construction agreements allowing the user to choose from outside the option package. But until we build this scenario, we should introduce multifamily dwellings that incorporate the skeleton concept to enable individual decisions, such as it is being experienced in the case of the unfinished plans of Jakarta and Dalian. Moreover, we should streamline tailored customizations by developing building norms and standards for infill customization. Figure 19 summarizes our proposal for a progressive model for delivering user choice through infill mass customization.

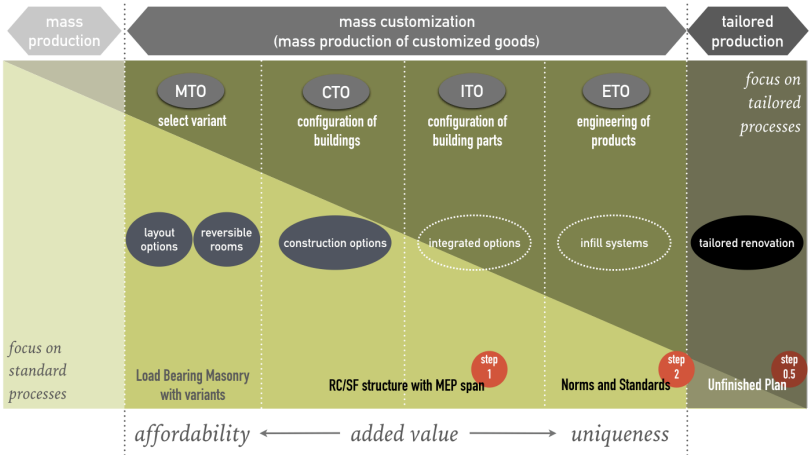



Figure 19 Delivering Choice through Infill Mass Customization

## 6. Discussion and Recommendations

The methodologies used have broaden our knowledge about interaction demands between people and dwellings, and also improved the notion of personal, spatial, and contemporary interdependence of open building applications. The background case studies by my colleagues and the original case studies I carried by myself complemented each other, improving the consistency of our proposal. Finally, in spite of our efforts of combining the information; much of it turns out to be lost in translation, so to speak. The interview sheets were prepared in different languages, addressing different cultures. Some questions were removed, the data processing protocols also changed. But, given the purpose and the time span of our research, we achieved interesting outcomes, and probably, the loss would be much bigger if we had stuck with the same protocols.

This research revealed that if we don't offer user choice, users from the emerging world would demand their needs in their own manner. After clarifying the demands based on the user profile and the stock profile, of each location, we found that individual decisions permeate the boundary level. Then, considering the local policies, and production methods, we discussed ways to attend all the user's demands without bypassing the hierarchy of decisions. Finally, we studied ways to deliver choice at the time the users need it while taking into consideration that it should be affordable to people of any income level.

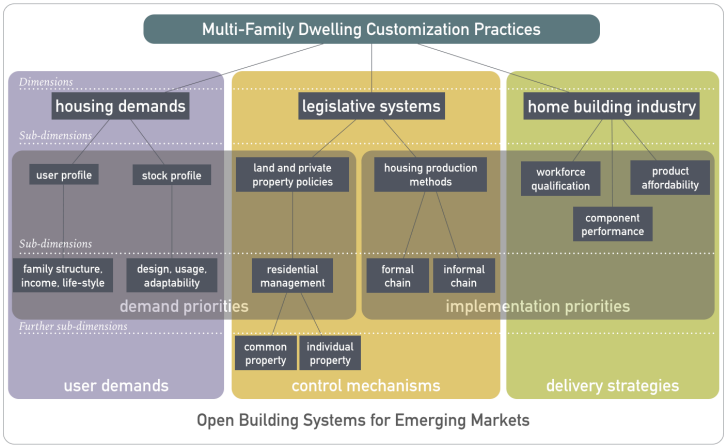



Figure 20 Research Framework

In order to continue this research and widen the scope of its outcomes, future studies should consider:

- Developing a socio-economic profile of apartment dwellers, and renovation activity in emerging countries;
- Verifying the applicability of these results to countries such as India, South Africa, Russia, Pakistan and Philippines;
- Widening these results in the countries we visited with the aim of developing national policies for open building implementation;
- Verifying the feasibility of creating interchangeable modules for self-managed facade individualization;
- Analyzing how much is the cost of custom construction for developers, interior suppliers and consumers;
- Developing strategies for management of user-choice, distinguishing the role of infill suppliers, developers and project coordinators.

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