The next wave in housing personalization: Customized residential fit-out

Personalization in housing is not new

Households have always personalized their dwellings, independent of wealth, climate or building culture, bringing in furniture, painting the walls and arranging flowers on their balconies. In owned dwellings, families do more, rearranging spaces, upgrading kitchens and bathrooms, replacing old windows, building extensions, and erecting walls between gardens to establish territorial control and privacy. In a property development of identical detached houses or in a multifamily building of initially uniform dwellings, a visit 20 years later reveals personalization, inside and outside as well.

Individually, these activities are almost invisible. In the aggregate, these acts of inhabitation constitute an important economic reality. Families spend more money each year upgrading and modifying houses, apartments and condominium units than they spend on new housing construction (US Statistical Abstracts 2010).

Given these realities, what lies ahead in the personalization of housing? I hope to show that the next wave in personalization for the individual dwelling lies in new product/ service companies delivering fully coordinated fit-out kits. Such kits will be applied first in newly built or converted multiunit buildings, and will include everything needed to make a demised (legally divided) but empty space habitable. While the details of this next wave will vary from place to place, the basic principles can now be sketched with some confidence, based on observations in Europe, the United States, Japan and China.

Dwellings are not automobiles

The concept that the production of automobiles is an appropriate model for housing personalization has a long history. Yet, while automobile production is moving toward mass-customization (van den Thillart, 2004), it is a poor model for the housing personalization. The reason is not principally because of technical differences, of which there are many, nor with the difference between the top-down supply chains in automobile production and the highly disaggregated supply and d demand constellations in housing, but because automobiles are placeless. Unlike a dwelling, an automobile is known not by its spatial location, but by its detachment from any place. This is part of the automobiles' appeal but makes the analogy with the dwelling and housing personalization processes deeply flawed.

A more helpful analogy is a complete system of automobile transport, including highways and the vehicles using them. The highway is an infrastructure asset with capacity to accommodate a range of vehicles types, is approved in regulatory processes that connect it to a specific geographic and political jurisdiction, and is built by specialists in road construction. Vehicles are produced by an entirely different industry, regulated by other public bodies and subject to change and upgrading. The highway and the vehicle have a symbiotic relationship, but are largely independent.

The social construction of dwelling personalization

In the same way that highways and vehicles need each other to make a complete system of transport, residential "open" buildings are a kind of long-life infrastructure, meeting accepted conventions of design, building regulation and investment. They support further investments (dwellings) meeting personal and evolving preferences.

Analogies all have their limits, but the dialectic between highway infrastructure and vehicles has had its parallel in the real estate industry for more than 50 years in the construction of office buildings and shopping centers Empty "base" buildings (sometimes called core and shell) are successively filled-in by tenants who install preferred fit-out while meeting the standards set by the infrastructure. The fit-out (variously called tenant work or tenant improvements) is subject to frequent change using systems and methods that can be applied in many buildings, ranging from standard partition and ceiling packages to almost complete "slab-to-slab" fit-out supplied by large multi-national companies such as Steelcase.

Residential open buildings are now built in this way around the world, meeting developer or "common" interests, waiting for inhabitation by households. This should not be strange, because we know that no dwelling can exist in contemporary society without action by both the community and the individual (Habraken, 1970). There is always a common physical infrastructure within which each dwelling is situated – a symbiosis as fundamental as the highway and the vehicles using it. In the condominium market in the United States, "common elements," "limited common elements," and "unit elements" are terms that have long been used to describe physical parts and their place in the common – individual spectrum. Yet despite this legal clarity, condominiums are subject to more legal disputes than any other building use type, centering on building facades (who owns the windows?) and the mechanical systems (who controls which part of the plumbing, electrical and heating/air conditioning systems?). There are the households next door, upstairs or downstairs in the same building, exercising control in their territories, and there is always the public space outside your front door.

Clearly, while the distinction of private and shared parts is known, many problems continue to plague the processes of personalization. The reason these problems

persist is confusion about the relationship of territorial boundaries and technical systems. Personalization occurs in a cultural ambiance, but depends on technical systems that cross boundaries in a hierarchy of control, with many public and private parties taking part in its performance.

Technical matters make personalization in housing difficult to accomplish

In large part, the technical – and thus organizational problem in housing personalization stems from the troubled state of technical entanglement in our conventional design and construction processes. The problem is exemplified in the regulated public utility systems to which so many contemporary dwelling functions are attached: electric power, data, water, gas, and sewer. Each utility operates with its own technical standards, its own equipment design, its own pricing and installation rules and its own inspection protocols. The coordination of this work is unnecessarily interdependent, time-consuming, costly and ripe for conflict.

Figure 1: Entangled wiring and piping in a typical US dwelling

For example, a home electrical appliance attaches to an outlet attached to a cable in the wall, which eventually connects to a cable in the building and then to a cable in the street. Similarly, the WC connects to a drain line in the wall or floor, which connects to the building's drain line, which connects to the city sewage system. Crossing these territorial boundaries causes potentially complex and disruptive conditions, both during initial construction and later during episodes of personalization or general upgrading of the common infrastructure.

This entanglement is principally a relic of historical developments and regulatory jurisdiction separation. The public utilities – water and sewer, gas, electricity – each entered the building sector with its own products and standards, at different times, and have not yet seen fit to coordinate or unify their services and technical systems.

A sharp distinction, clear accounting and new processes

The social construction of housing personalization - in which individual and shared control is each recognized - points to the importance of a sharp distinction between these two spheres of responsibility. In housing, this means that a sensible accounting is called for, similar to the accounting that explains and supports the real estate market in office and retail construction and that explains the symbiosis of the highway and the automobile. And with this distinction and its associated accounting, new processes will inevitably – and in fact are – emerging worldwide supporting personalization. The most important process to emerge is kitting.

Kitting - a new kind of ready-to-assemble service

In the newly competitive international market for building products and services, manufacturers and service providers are learning to add value and gain profit by preparing "kits" of RTA (ready-to-assemble) products. Normally, this process occurs at a distance from the site of final installation. Value is thus added off-site (preparing the kit), in its delivery, and on-site (assembling and installing it). For example, electrical contractors often pre-wire all the junction boxes and terminations off-site, put these assemblies and associated parts needed for the buildings' wiring installation into boxes, and bring them to the site for installation. Bar coding is often used to track the parts and sensors are embedded to track long-term performance and access for replacement.

Examples of contemporary "kits" include sunrooms delivered in boxes ready for assembly; kitchens from IKEA (Norman, 1993); or products such as plastic - wrapped toilet bowl valve replacement kits. Often, these products or kits are not made entirely (or at all) by the company providing the product label but may be brought together from a variety of manufacturers or suppliers. Many kits contain hardware enabling the kit to be applied in a variety of situations, with some parts discarded when they are not used. This is not new, just as prefabrication is not new – we have examples of such activities well before industrialization. (Fitchen, 1986)

Kitting and product service systems

Kitting has reached a level of complexity in the housing sector most notably in the "whole house kit." Largely a business concept, some architects have toyed with the idea over the years, many failing to get beyond the prototype stage (Herbert, 1984). The Japanese success with whole house kits, first introduced in the 1960's, (McGrath, 1996) exemplifies a new understanding that design and technology by themselves are not enough. To be sure, this understanding was nascent in earlier, and parallel, whole house kitting companies that emerged in the late 19th century and continue to thrive in the United States and some European countries. Interestingly, most successful businesses providing whole house kits adhere closely to conventional ways of building and architectural design. (Herbert, 1978)

Now it is much clearer that to survive in the global market, manufacturers and suppliers of kits of various levels of complexity must now market a combination of products and services. Many consumers no longer look only for physical products, but focus instead on the benefits offered by value-adding services. By shifting into the provision of benefits rather than simply manufacturing products, companies are gaining competitive advantage over companies that still separate products from services. Companies are aligning their production systems with emergent complex demand. (Morelli, 2002) In doing so, these companies are learning to understand costumers' needs, enabling the provision of knowledge-intensive solutions, or product service systems (PSS). PSS is a service-led competitive strategy and is the basis to differentiate from competitors who simply offer lower priced products (Mont, 2008). Accordingly, by considering product life cycle, companies increase value in use for consumers by taking the risks, responsibilities, and costs traditionally associated with ownership, while (in some cases) retaining asset ownership that can enhance utilization, reliability, design, and protection.

The same new way of thinking has led to the consideration of all stages of products' life cycle, as well as the connections with other products and services. This is the concept of "through-life management" (Koskela et al., 2008). Through-life management encompasses product design and production, producing services through those artifacts, and planning for deconstruction (or disposal). The central idea of introducing through-life management is to create an understanding of all those stages as one unit of analysis and as one integral object of management.

A turning point: personalization of buildings by use of fit-out kits

With this background, it should be possible to imagine how a residential fit-out company would provide housing personalization services using the concept of kitting. In the residential market, part of the business model already exists. The design center, showroom and model dwelling are already familiar. In the showroom of a building company, a prospective buyer can view floor plans, touch materials, open and close kitchen cabinet doors, and become informed about costs and schedules. A trained staff person is available to discuss options and answer questions. Often, the staff person can "build" the dwelling in a computer, giving the customer a virtual tour of their new dwelling space. This process is well known in the best residential development companies around the world. But generally, comprehensive personalization is either impossible or very expensive, and is basically discouraged. The reason is that the conception of the "whole house" or "integrated building" in such business models has not discovered the principle of partitioning the whole in open building terms, the way the office building and its fit-out is distinguished.

A process that supports personalization using fit-out kits also uses show rooms, but what follows, or backs-up, the showroom, is new. The image of personalized

residential fit-out presents a problem of description and explanation. The rest of this chapter makes an attempt at such a description, step-by-step.

Step one

Once decisions are made (by the developer or the future occupant) about the dwelling's layout, specifications, equipment, finishes and other amenities, the cost and the schedule are settled and the order goes to a fabrication facility. Since all of the plumbing, wiring and air conditioning equipment and installation lines for a dwelling's fit-out kit are contained inside the dwelling unit's demising and fire separation walls and floors, the decisions regarding layout, cost or amenity level of each dwelling are independent of other dwelling units. This process is possible because, while quite complex, it is systematic. Being systematic, variations are possible. Some leading companies (e.g. in Finland, the Netherlands and Japan) enable much of this process to occur on-line, each household having an access code to a website where large menus of options and links to suppliers are available. Building information modeling is increasingly employed.

In the fabrication facility, each order for a customized fit-out kit is prepared. Each kit is a "project", with a contract, warrantee, delivery and installation instructions and schedule, and a users manual. Because the facility is highly organized and supported by advanced information management software, it can access catalogues of available products that are delivered just-in-time.

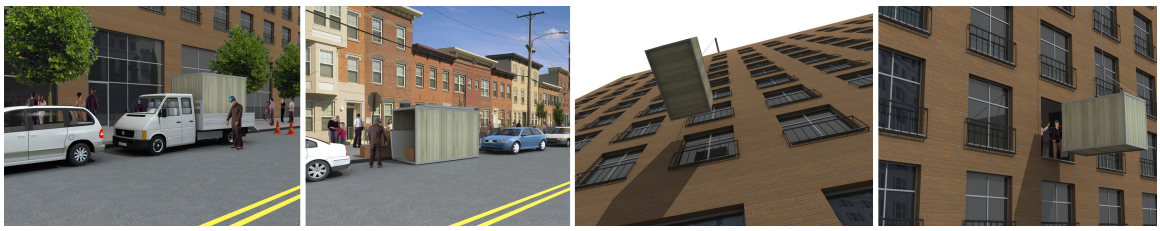
Step two

Following the parts inventory, the bar-coded parts, in their boxes or bundles, are loaded into containers, the number of containers depending on the size of the order. Some products may be off-loaded at the fabrication facility already palletized by the supplier, a process that is already familiar. Along with the parts prepared in the fabrication facility, they are loaded into the delivery containers, in reverse order of their on-site installation.

Step Three

The containers are delivered to the building where the kit will be installed, in the correct sequence. Some few, specialized products may by-pass the fabrication facility and be delivered directly to the site. A trained, multi-skilled work team arrives with the first delivery. The sequencing of these deliveries is planned to match the speed of on-site work.

FIGURES 2-5: Showroom display; fabrication facility and loading/delivering of containers



FIGURES 6-9: Delivery and unloading of contents into the unit to be fitted out.

Step Four

When the truck and its container reach the building, the container is deposited near the front door, near the service elevator or on the ground ready to be lifted up to the balcony. Where elevators are too small, boom trucks are used up to ten floors. Everything must be small enough to go into the empty unit through a door or large window. Once all the parts have been brought in, the container, with packaging debris and other waste products resulting from the installation process, returns to the fabrication facility.

Step five

As soon as the first container is unloaded, the multi-skilled work team, operating as an integrated team, completes the first phase of the fit-out, following detailed installation instructions that come with the kit. Since each fit-out kit is different (but part of the same system), the installation team is never bored and performs like a learning organization, taking full responsibility for completing a dwelling's installation, one at a time, before being assigned to a new "project." When the first container's contents are nearly installed, the next container is delivered, and so on.

Step six

The entire process – from signing the contract to handing over the key to the new occupant – should take three to four weeks for an average sized dwelling. If, sometime later, a dwelling unit must be completely stripped and an entirely new fit-out installed, containers can once again be brought in and the kit of parts unloaded through the doors or window as before and the old parts removed.

IMAGE 10-13: Multi-skilled installers at work; fit-out piping installation; finished dwellings ready for occupancy one month after the fit-out work began.

Conclusions

A key roadblock to further maturation of personalization in housing has been the problem of obsolete classification frameworks in the building sector. The opportunity now is for a new classification to emerge in the construction and real estate sectors (Ekholm, 1996).

Another obstacle for a company entering this market is that the demand for residential fit-out is difficult to measure. During the early years in the evolution of office building fit-out, no one could say with certainty that the market for office fit-out would stabilize and grow to the massive scale it now exhibits. No single event; no single product invention; no single shift in the economics of office building construction; no single change in regulations accompanied the office market evolution to open building. The same is true for residential open building.

Nevertheless, some signs point in the direction indicated in this chapter. While housing projects have steadily become bigger, residential life is tending to become more individualized and is changing. The aging population and decrease in household size in some countries are two examples. For generations, large-scale multi-family residential projects have created tension between the demands of building logistics and economy, and user's individual preferences. We are now beginning to understand how such projects can be well served by the introduction of a fit-out level available to each household. This enables the inhabitant to decide on his own part of the whole (like the automobile), while the base building (like the highway) serves all the occupants and can be applied on an urban scale as an architectural intervention.

While this approach in residential construction has often been considered desirable but not economical, it is important to note that recent projects are commercially driven. Investment in residential base buildings can be amortized over a longer term compared to traditional buildings. In addition, higher user satisfaction translates into higher rental rates or sales prices. Examples include the Plus Home/MOOR projects in Helsinki, promoted by the Sato Development Company; the Solids projects in Amsterdam developed by Stadgenoot; the Warsaw "standard" projects in Poland; a large number of projects in Moscow, and many in Japan. There is evidence of open building in China and the United States, using different names for similar processes.

In Japan, the first formal fit-out companies, targeting the activation of post war residential apartments as well as newly built base buildings, have been launched partly stimulated by a new Japanese law providing incentives for 200-year housing. In the Netherlands there is evidence of continued commercialization efforts to develop marketable fit-out systems. There is some evidence of this in the United States, where "production builders" increasingly think in terms of producing

"volume" (largely empty shells) and many "high-end" developments market largely empty units for sale. In addition, the adaptive reuse of old warehouses and office buildings for residential occupancy, in many countries, often approaches this "open building" process. Many of these projects have won awards for their architectural excellence or their technical innovation, or both. Technical sub-systems and products that can be integrated in full fit-out systems are increasingly available in the international building supply market.

This shift towards a new way of delivering large projects challenges traditional professional design and construction management methods, as well as financing, legal and regulatory tools. It is therefore important that the legal and economical frameworks needed for the emergence of such an industry are put in place by local and national governmental bodies, and by the financial companies that understand the market potential.

In other words, the true challenge posed by this new trend is towards professional habits and conventions that must adjust to new ways of designing, management, and cooperation.

It is well understood that industrial manufacturing as discussed earlier in the chapter has been most effective and dynamic where individual users are directly served. Witness the automotive, electronics and telecommunications industries. As is usually the case, release of tension between conflicting demands on the small and the large-scale can unleash new energies and innovation. Designing base buildings understood as 'infrastructures for living' will stimulate the evolution of a fit-out industry that will itself accelerate innovation and distribution of new domestic fit-out services and systems. We can say that the release of these tensions is the most important aspect of the trend towards a fit-out approach to personalization in contemporary building.

The distinction between the more long-term and the shorter-term in residential construction can also be harnessed for the detached suburban house. Building an architectural shell distinct from the dwellings inside layout and equipment may follow the same separation as in multi-unit buildings. Here we may choose not to think of the base building as infrastructure. But the same fit-out industry that can deliver "ready-to-assemble" product bundles to large buildings can serve the free-standing house. Here also, the large real estate development encompassing many detached units can benefit from the availability of fit-out businesses offering competitive fit-out systems and services.

Residential application of the fit-out concept, although based on the same principles as observed in office buildings, shopping malls and hospitals, is particularly important because it affects a very large market whose potential is not yet understood or exploited. The potential market for residential fit-out is at least as large as that of the automobile industry. Roughly speaking, the cost of a fit-out

system for a dwelling unit is in the order of the cost of the cars its occupants use. This shows the magnitude of the shift identified here - an entirely new industry of impressive scope, based on industrial manufacturing of parts and delivering what is best called a durable consumer good. In this perspective the trends outlined here allow the building industry to effectively come to terms with industrial production in its most creative mode.

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