The Unbearable Lightness of an Open System: The Packaged House 1941–47

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> The system that Wachsmann designed was so open that it was destined to fall apart.
> Alicia Imperiale, 'An American Wartime Dream'[1]

One of the many ways in which architecture is conceptually opened up is by adopting systems theory in building technology. In this context, open systems denote modular design and construction. The holy grail of this line of thinking is modular building systems that induce variety in design within pre-set parameters. They resolve the construction details without designating the final form. A system of standardised, mass-produced parts that can be configured in various ways opens a field of possibilities.

Open building systems position the architect as the designer of the system rather than of singular buildings. They promise to replace construction with assembly that can be handled by unskilled labour. On the professionals' side, this renders 'a completely unified constructed environment, unified by the exercise of professional intelligence, reason, and the scientific method' possible.[2] On the other end, when scaled through industrialisation, manufacturers and consumers see open building systems as high-tech DIY projects that can be produced with low-skill labour. However, there is a significant gap between the high expectations for the implications of the open systems principle and their results.[3]

This essay explores the potentials and consequences of openness in architecture through a historical case study. The Packaged House project (1941–47), designed by Konrad Wachsmann (1901–1980) and Walter Gropius (1883–1969), is a prefabricated housing system devised to meet the housing shortage in the US during and soon after the Second World War. It was an open spatial design system, a modular construction system and a commercial enterprise all in one. During its development, the federal government's investments in public housing proposals resembled a semi-socialist experiment. Although cultivated in the most favourable political and economic landscape for prefabricated building systems, the Packaged House failed to be reproduced in large numbers.[4]

While the existing literature on the project laments its spectacular failure, as Mark Jarzombek asserts in 'Architecture: A Failed Discipline,' failure is the norm in architecture's post-enlightenment status. Hence, we 'celebrate architecture's disciplinary failure … for just because something failed does not mean that it stops being relevant or – just as importantly – stops having a history.'[5] Moreover, open construction systems are hardly a matter confined to history. The sustained proliferation of open systems renders the phenomenon an active technological paradigm.[6] Moving away from the pragmatist position that measures success by the project's materialisation in the manner initially proposed, this essay acknowledges that architecture is as much a field of cultural production as it is of material production, and treats the project as an example of a culturally resonant idea.

Drawing from the conflicting histories of the Packaged House, the discursive formation of the post-war dwelling, changing definitions of

openness, and varied representations that convey mixed messages, I dissect the fantasies of the open building system as well as their practical and symbolic features. The story of the Packaged House reflects the still prevalent ideal of incorporating scientific and technological developments in the design and construction of buildings to increase the financial and spatial benefits for individual users at scale. Although this project was as much shaped by the context as by the intention and skills of its designers, it still offers several lessons to contemporary practitioners. Above all, it demonstrates the risks of responding to architectural problems with solely technological solutions. Moreover, looking at the problem from a critical, temporal distance , and as a historical project rather than a contemporary one with high-stake novelty claims, provides much-needed clarity on the topic.

The entangled histories of the Packaged House
There are two histories of the Packaged House: one a neat intellectual history, the other a messy material history. Both narrate an intellectual transfer from Europe to the US. However, the specifics change depending on which of the Packaged House's two designers the historian is inclined to credit with authorship. Furthermore, the weight given to openness is different in the two stories. In one, openness is the goal. In the other, it is a built-in capacity that may or may not be actualised. The distinct perspectives towards openness also define the rhetoric of these stories. While the first stance only generates neo-platonic accounts of ideal openness that is unattainable with material means, the latter, less interrogated position allows us to see openness in context, as a political and technical capacity.

The neat history places the project as a material reflection of a lengthy intellectual pursuit. It belongs to the trajectory of Walter Gropius's written and built work devoted to industrialised housing. This story starts with a 1910 report Gropius wrote upon Peter Behrens's request on house types and components. Under the title 'Program for the Founding of a

General Housing-Construction Company Following Artistically Uniform Principles,' Gropius wrote the gist of his theory of uniting arts and industry, which he kept advocating for, and restated almost verbatim, as an architect, theorist, and educator over the following decades:

> The idea of industrialising house construction can be realised by the repetition in each building of the same standardized component parts. … The possibility of the varied assembly of these interchangeable parts would enable the Company to satisfy the public desire for a home with an individual appearance.[7]

Between military service in the First World War and his tenure at the Bauhaus, it took Gropius a long time to put the theory to the test. While he incorporated some of the methods and qualities of his theory in the Dessau-Törten Housing Estate (1926–28), Gropius's first entirely fabricated house was one of the two houses he designed for the *Weissenhofsiedlung*, the *Deutscher Werkbund* exhibition that included a model neighbourhood (1926–29) in Stuttgart. The house was a two-story structure with a simple rectangular plan. Gropius described its construction system as *Trockenmontage*, a dry assembly system. It was constructed with a steel frame, clad with asbestos sheeting on the outside, and an industrial cellulose-fibre sheeting on the inside. It had wood floors and a roof made of precast cinder concrete blocks covered with metal.[8] The only exception to the dry assembly rule was the concrete foundation. The project was an exhibition model. It was not replicated. And with so many different materials and components involved, it could not have been replicated easily in another location. However, it was widely publicised and proved that the idea of a prefabricated house system with built-in variability suited reasonable material and spatial applications.

In 1931, Gropius approached the Hirsch Copper Works, which produced prefabricated copper houses, also known as knockdown houses.[9] They

were composed of structural elements made at the factory to fit desired dimensions and specifications, transported to the site, and assembled by joining their edges to produce complete wall sections. The Hirsch houses were much closer to the industrial housing solution Gropius advocated for than anything he had produced thus far. Gropius encountered the system through the Hirsh catalogue published for the Paris International Exhibition of 1931, which included model houses made the same year in Berlin. He found their dry panel system technically promising, but its conservative application and imitative styles aesthetically disappointing. He offered to improve their design, eliminating the peaked roof, and introducing a free plan to include the possibility of expansion. The two models Gropius developed for their catalogue, K and M models, were expanded to the K1, M1, and M2, proving that his theory of variation from standardised components was plausible within industrial production.[10]

When Gropius's earlier experiments with prefabrication and his unwavering intellectual commitment to the unification of art and industry are considered, the Packaged House's development becomes an inevitable consequence in an evolutionary process.[11] The neat history is a hero narrative of Gropius fighting the nineteenth-century fear that industrialisation would bring a cruel monotonous world into existence.[12] It also resonates with the mainstream modernisation myth of shedding the baggage of historical conventions and instrumentalising technology towards the humanist goal of a better future for the masses.

Tracing the history of the Packaged House's material and construction technology provides a less coherent and more contingent narrative. In terms of construction technology, the Package House is a highly developed version of prefabricated kit-of-parts panel houses produced in Europe in the late nineteenth and early twentieth centuries to satisfy the needs for shelter in war encampments and colonies. As an erstwhile chief architect of

Christoph & Unmack, one of the oldest and largest producers of prefab timber construction in the early twentieth century, Wachsmann facilitated the intercontinental technological transfer from Europe to the US.[13] The panel house was one of the three categories of prefabricated timber construction Wachsmann laid out in his 1930 book *Holzbau*.[14] The book partially resulted from Wachsmann's reorganising of the factory's catalogue. While he designed timber buildings, the knowledge and most of the cases in the book were the result of the anonymous labour of the many technicians the company hired or commissioned.

The military and colonial origins of the technical know-how is largely lost in translation from the anonymised labour of various technicians to the emergence of Wachsmann as a master of industrialisation. Architectural historian Itohan Osayimwese, who traces the links between colonialism and modernism, concludes that along with steamboats, rifles, quinine, and the telegraph, prefabrication was among the critical tools that enabled European territorial expansion.[15] As one of the principal developers and providers of these services as evidenced by records of numerous tropical barracks now buried in the archives, Christoph & Unmack was 'an agent of infrastructural imperialism.'[16]

However, it would be hard to cast Wachsman as an intentional agent of the laundering process of the panel house system from a tool of infrastructural imperialism to a neutral technical know-how that will serve middle class Americans by providing them affordable, customised houses that they can build themselves. For Wachsmann, the road that led to the development of the Packaged House was less a wilful evolution than one caused to meander by chance and misfortune. Once a journeyman cabinetmaker, his architectural education was sporadic. He took a course under Heinrich Tessenow at the Academy of Arts in Dresden and studied at the Academy of Arts in Berlin as a master student of Hans Poelzig. Poelzig's influence on Wachsmann's career is one of those manifestations of chance

that contrasts with the neat history cited earlier. Wachsmann met Poelzig when the former was about ten years old. Wachsmann's grandfather had commissioned Poelzig to design a chemical factory in Luban, a small town in western Poland, which was then part of Germany. The volume of correspondence between Wachsmann and the Poelzigs, his teacher and his teacher's son, indicates a lifelong close relationship. When Wachsmann returned destitute from an unfortunate adventure as an unpaid intern at Le Corbusier's office in Paris, Poelzig set him up with a job at the factory of Christoph & Unmack in Niesky, a small town on the eastern edge of the Free State of Saxony, bordering Poland. The family acquaintance Wachsmann had with Poelzig through his grandfather's factory and the connection Wachsmann's expressionist mentor had to the pure pragmatist prefab construction company are chance encounters that shaped Wachsmann's professional career.

Wachsmann's move from Europe to the US is another instance of how chance, or rather misfortune, comes into play. As a German Jew, Wachsmann was one of the many people who were no longer at home in their homeland due to the rise of national socialism. Although he was spared by chance, having been in Italy with a prestigious fellowship at the height of the persecution, the violence caught up with him soon.[17] As a result, his move to the US was more an escape from turmoil that swallowed family and loved ones than a career move.

Wachsmann's ideas regarding standardisation and openness did not have Gropius's panache. Wachsmann's recollection of the time he spent in Niesky, recorded late in his life, is telling when compared with Gropius's remarks on the subject. He describes the orderly streets of Niesky that were lined with prefabricated houses built to the same height with standardised walls and windows as 'delightfully monotonous.'[18] For Wachsmann, uniformity did not register as an inhuman horror. On the contrary, he found it in perfect harmony with nature as 'even trees seemed to be growing in regular order.' He declared that 'in such a self-imposed, universal system, the people seemed to live in remarkable harmony and contentment.'[19] In his autobiography and treatise on the industrialisation of building Wachsmann treats standardisation as a virtue rather than a risk.[20] He considers flexibility, which manifests openness, a capacity rather than a necessity.

The archival material testifies that the truth lies somewhere between these stories.[21] Authorship can only plausibly be assigned to their collaboration. Wachsmann initiated the project, calibrated it from the metric to the imperial system, refined its details multiple times, and found the initial investors to get it going. Yet, without Gropius's theoretical grounding, advocacy, and the support of his robust network, we would probably not know about the project today. One secured the lightness, and the other provided gravitas. However, the project owes its progress as much to the political and economic context as to the individual strengths of its creators.

In February 1942, the National Housing Agency allocated 153 million dollars for the housing of displaced defence workers. The production target was forty-two thousand houses. Seven months later, Wachsmann and Gropius founded the General Panel Corporation. While the initial funding came from private investors, its realisation depended on securing defence commissions. A few months after the company's foundation, Gropius set up a theatrical demonstration for important government officials. The demonstration took place in a warehouse in Somerville, Massachusetts, owned by the US Plywood Corporation. Five men wearing lab coats and bowler hats assembled and disassembled a simple dwelling unit using only hammers and folding ladders. The success of this show, along with a marketing campaign in the professional and standard press, attracted interest and more funding. However, in 1945, when the war – and the need for defence worker housing – ended, the company had not commenced production.

At this critical juncture, federal funding provided a second chance. In 1946, the Veterans Emergency Housing Program was initiated to provide housing for the returning soldiers. The programme was part of a more extensive economic transition from a defence economy to a peace-time economy. Accordingly, the federal government allocated funds for the housing programme and made the armament factories available for alternative production. The General Panel Corporation raised more money, acquired the former Lockheed rocket engine company in Burbank, California, and set up a semi-automatic production line with a planned production rate of ten thousand houses per day.

The factory never accomplished this goal. By the time they completed setting up the factory in mid-1947, the government had withdrawn its support. The Veterans' Housing Program was cancelled. With the loss of purchase guarantees, the production line never achieved the planned rate. At the rate it did achieve, the houses were more expensive than intended. Soon, with both creators out of the picture, the company went bankrupt. But did the Package House fail?

Discursive Presence

Where the material story ends, the discursive presence continues. In Spring 1947, around the time of the decisive end of their commercial enterprise, Gropius and Wachsmann attended a symposium on 'Planning Man's Physical Environment' at Princeton University.[22] Speaking in the session titled 'Limitations and Possibilities', they were the only speakers who unreservedly argued for the possibilities of material and aesthetic quality at effective cost against a choir warning of the limitations arising from financial, logistical, administrative, and planning issues. While they did not mention the Packaged House by name, the promises they espoused using written and graphic promotional material were all associated with it.

The dynamics of this session – Gropius and Wachsmann cast as Pollyannas against a chorus

of Pandoras – echo in most later interpretations. Indeed, the reservations regarding various challenges, especially about the financial limitations, concur with the criticism I have outlined in this essay. However, as the following interpretations of the project's failure also prove, its promises were far too attractive to be eclipsed by practical limitations.

Both Gropius and Wachsmann foreground the economic efficiency prefabrication entails. Under the title 'Prefabrication: Freedom from Limitations,' Gropius frames prefabrication as a democratic solution for the housing shortage, as it creates production volume without prescribing uniformity within affordable means. Gropius believed that this allows for the elimination of housing subsidies and for the issue to be handled within the existing market structure.[23] Wachsmann, on the other hand, concentrates on technological and stylistic aspects. He presents prefabrication as the mode of production and design most in tune with their capacity to control energy at the time. Command of electricity requires machine production. Accordingly, Wachsmann argues, the resulting image of 'lightness' is the expression of the time.[24]

The 'limitations' argued in the same session resurface in the comprehensive, industry-sponsored analysis of the prefabricated housing solutions Burnham Kelly published four years later in *The Prefabrication of Houses*.[25] In addition to the financial, logistical, and administrative issues, Kelly offers two new insights. First, he argues that solutions driven by individuals are not necessarily more democratic, as the maintenance of those new neighbourhoods will still require public funds. Therefore, the efficient use of public resources requires individuals to comply with planning decisions instead of operating in a completely open system. Secondly, as an advantage of hindsight, Kelly can report not only the designers' and producers' perspectives but also the public perception and response. In that sense, Kelly's assessment that in the consumers' minds 'lightness' is associated with weakness is critical. For example, he states that prefabricated houses

are stereotyped as 'dreary shacks.'[26] Despite the high precision and quality of factory production, these houses were perceived as less valuable than conventionally built housing options.

The discursive presence of the Packaged House continues after these mid-century discussions. As histories of and discussions about prefabrication unfold, historians and theorists keep revisiting the Packaged House. Unfortunately, the resulting literature casts it as a spectacular failure. Gilbert Herbert's *The Dream of the Factory House* (1984) records the most comprehensive account of the Packaged House project from pre-conception to the end of production. However, Herbert's interpretation of why the Package House enterprise failed lacks the precision of his assessment of its virtues and advantages. He states that there is no single cause or simple formulation but 'complex interactions of many factors' with cumulative effects.[27] According to Herbert, 'the very high quality of the product contained within it the seeds of failure'.[28] The system was too closed to 'freely incorporate elements from the competitive open market' or to be competitive even at full capacity.[29] Herbert finds the fault in the zeitgeist. The conditions required to fulfil this dream were not only the intellectual capacity of its creators and the proper production tools but also 'a society more amenable to logical discourse, rational decision-making, and creative human interaction.'[30] In other words, this ideal system would require an ideal society ready to embrace such perfection.

Alicia Imperiale, who approaches the Packaged House through a systems theory lens, reasons that the system was too open to succeed. As conceived by Norbert Wiener during World War II, the cybernetic system was a closed system of control to increase artillery targeting. The system required every action to turn into feedback, which made the actions to follow more accurate. With enough repetition, the system would reach perfect accuracy. In other words, Wiener's notion of the closed system specified having 'an end-goal in sight.' As

Imperiale puts it, 'the goal would be determined by the performance of the system. The missile would make its mark, the houses would be determined at the outset by the system of parts.'[31] The Packaged House did not have a perfect application at which to aim. Variation was the goal. Without a destination in mind, it was hard to assess which direction represented progress.

Mixed messages and moving targets

Throughout its development, the advertisements of Packaged House reflect the rhetorical perplexity in the critical literature about it. From the very beginning, the project is presented as a conveyor of conflicting qualities. In 1943, when the National Housing Agency granted the General Panel Corporation's proposal approval as a temporary dwelling unit for the defence housing program, the standards specified by the technical department of the agency were far from challenging. Temporary dwelling unit standards specified simple small units that could be assembled and disassembled quickly, and without material loss. It emphasised mobility and efficiency, but not necessarily flexibility. Yet the subsequent publication campaign presents the system as an infrastructure with which one can build anything. [Fig. 1] The drawings of the project look quite different from the eventual housing kits: it has two stories, a staircase, posts and beams that support a second floor.

The project's potential remained a central figure in General Panel Corporation's visual communication efforts. However, what potential meant for the client was not always clear. In its most mature state, the Packaged House system was marketed as ten types ordered from the company catalogue and customised by the consumer as needed. Did potential mean choice from ten options? Was it alteration upon pre-selected kernel sets? László Moholy Nagy included the Packaged House in his book *Vision in Motion* (1947).[32] He juxtaposes the image of a stacked pile of panels with the plan of a two-bedroom house. The plan shows a third bedroom that

the owner could add later. [Fig. 2] While masterfully done in terms of space and material use, this customisation scheme is far from the level of flexibility Gropius had praised.

The implied growth and shrinkage of the house that the plan communicates is directly related to the housing discourse of the time. In 1942, *Architectural Forum* published a special issue with the title 'The New House of 194X.' The issue argues that the success of prefab houses depends on their adaptation to 'different needs resulting from changes in family composition as a family grows older.'[33] In his analysis of the discursive formation around the post-war dwelling, Carlo Carbone characterises the issue as a call for 'open systems capable of achieving multiple design options based on component standardisation and modularity.'[34]

Although it emphasised production technology, materials, and the assessment of contemporary needs, the discourse of post-war dwelling was emotional and political. By the end of the war, the single-family house had become a symbol of the hopes and aspirations of Americans. It was considered an earned reward for surviving the great depression, fighting the war, and sustaining the production lines at home. It was time for 'the same resourcefulness and ingenuity that had served the country so well at war' to serve its citizens by making 'a modern, convenient, and affordable machine for living.'[35]

Openness, interpreted as flexibility and customisation, plays a vital role in the symbolic construction of the post-war dwelling. In 1944, Charles and Ray Eames authored a provocative manifesto titled 'What is a house?'[36] In carefully composed words and images, this piece calls for an expansion of what the house serves. It argues that the house was no longer a container of living but the stage of various activities the owners may engage in their lives. Domestic life includes work, entertainment, and play, particulars of which cannot be neatly separated. Openness extends to include an open plan which no longer specifies strict functional divisions.

Along with publications, competitions contributed to the discursive formation of the post-war dwelling. In 1945, John Entenza announced the Case Study House Program, calling architects to design a new house.[37] The Eames's 1944 manifesto called for customisable houses, scalable through factory production. Part of the programme's goal was to match 'good architects' and 'good manufacturers' whose sponsorship was critical in building these exemplary houses. The prefab houses were instrumental in the domestication of industrial materials such as plywood, steel, and plastics. While the fundamental values of the programme – innovation, scalability, reproducibility, affordability, and customisation – were not all expressed in each project, '13 out of 36 of the residential prototypes were built on the conviction that architecture could be both mass-produced and fitted to owners' personalities.'[38]

The symbolic character of the post-war house eclipses its practical applications. The cover of the November 1947 issue of *Arts & Architecture* featured 'the connector', a four-way joint designed as part of the Packaged House system, juxtaposed with part of the iconic image of *the Creation of Adam* from the Sistine Chapel. [Fig. 3] In promoting this new system of construction, the article states:
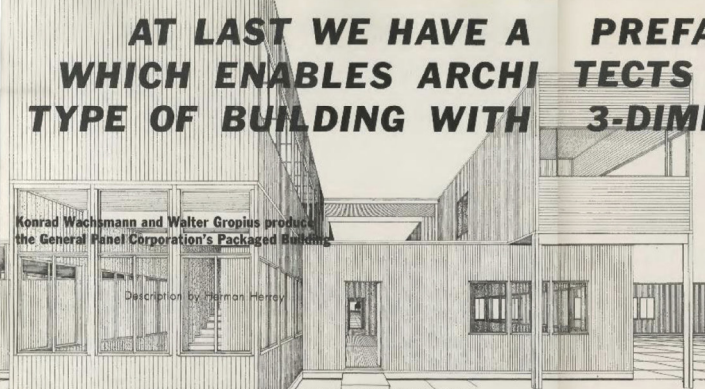
> All detail is integral with the product. A designer confronted with a building project is relieved of the task of having to start all the details from scratch, then see them cut to pieces on the site. He can now devote himself entirely to the best possible layout. On the other hand, great care and thoroughness can be applied to even the smallest detail which, when developed in the shop, will give it an aspect of finality and perfection.[39]

The description suggests that the product is simultaneously complete and unfinished. It is ready to be assembled in a matter of hours yet has space for adjustments for perfection. Earlier in the article, the system is compared to an Erector set with which the designer can build any variation out of prefabricated

Fig. 1: Presentation of the Packaged House as a flexible construction system. Source: Herman Herrey, 'Prefabrication System for Architects: Konrad Wachsmann and Walter Gropius produce The Packaged Building System, which enables architects to design as they please, on a modular basis' *New Pencil Points* (April 1943): 36–37.

Figs. 144 a, b. Konrad Wachsmann and
Walter Gropius, General Panel Corpo-
ration, New York, 1943
The packaged house
Complete parts of external shell; partitions,
floors, ceilings and roof of a four-room
family dwelling, prefabricated and de-
livered in a box, 19' x 8' x 7½'
At right is the ground plan showing the
basic house with the possible additions
when the family is growing

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Fig. 2: The Packaged House System in László Moholy-Nagy, *Vision in Motion* (Chicago: Paul Theobald, 1947), 112.
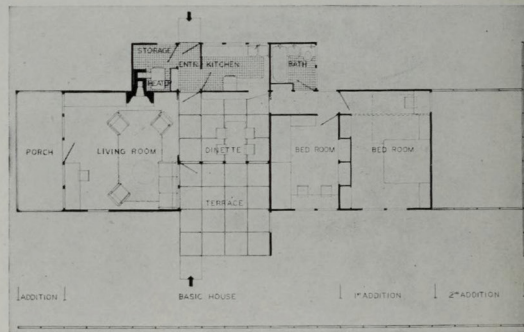
elements. The system is strategically associated, à la Eames, with toys instead of industrial products, to create an illusion of creative agency for the consumer. Unfortunately, at this point, the General Panel Corporation was on borrowed time. For a faster prefabrication process, the connector was 'inserted into panels mechanically and then fixed between layers of finish material.'[40] As a result, the system lost its operability, and 'openness' became a pure symbol.

Financing the open system

In *The Prefabricated Home* (2005), Colin Davies argues that the failure of the Packaged House was the fault of its inventor, Konrad Wachsmann, because he kept tweaking the design even after the production line was up and running. Furthermore, Davies stresses that the Packaged House missed the post-war construction boom due to a tardy production process.[41] Davies values result over ambitions. He suggests that the company could have settled for any one of the progressive patents. Instead of insisting on geometric purity, Wachsmann could have accepted specific accommodations such as using industrial sheet materials for floors and ceilings instead of the patented panels. Then, Davies argues, the company could have been successful, like many that produced prefabricated houses under the same conditions.

Davies accuses Wachsmann of being obsessed with the abstract mathematical system that he keeps polishing towards perfection instead of seeing the Packaged House as a human dwelling. Unfortunately, while he criticises Wachsmann for essentialism, he falls into a similar fallacy. Indeed, the delays made the house substantially more expensive than intended, but the project could have continued with a different marketing strategy targeting another customer group. Thinking along these lines, Wachsmann sought new, better-paid commissions that could keep the production line running until it reached critical mass and became profitable. And he found it too. What failed, however,

was the financial infrastructure serving the construction sector. Wachsmann explained:

> Even after I had left General Panel, I was sent to the Atomic Energy Commission site in Los Alamos. They needed 3 000 houses immediately. They could only issue a letter of intent if the company was able to produce a bank credit. But the bank in turn said that since this was a very unorthodox case, they wanted a letter of intent first. It was a vicious circle which never could be resolved. And thus the 3 000 houses were never produced.[42]

The openness of the project made it an 'unorthodox case' for credit. The financing of construction projects or purchase of buildings, also known as the mortgage system, depends on the financed entity's continued presence. If a borrower cannot make timely payments, within the rules specified in the contract, the creditor has the right to take legal possession of the asset. This system depends on the continuity of asset's use-value, or the value concentrated on the land. With non-existent buildings, without fixed addresses, the system fails as there are no assets to re-possess. There was no way to fund a potential project. From a creditor's perspective, only tried and proven types or a guarantee from the developer aligned with a reasonable calculation. Crediting a 'potential' was akin to gambling.

It is clear that even if the Packaged House could have overcome the difficulty of financing, more challenges would await at insurance or reselling. The General Panel Corporation developed the Packaged House for the expected housing shortage. The federal funds to finance individual projects – in addition to the grants to manufacturers and developers – were going to be low-interest mortgages. Since the variety of zoning codes and land prices would change the value of the assets funded, it is hard to imagine the financial infrastructure supporting the construction of individual Packaged Houses. While many prefabricated houses were produced during

Fig. 3: Graphic depiction of the connector on the cover of *Arts & Architecture*, designed by Herbert Matter. *Arts & Architecture* (November 1947). Source: Travers Family Trust. Used with permission.

this period, it was only possible by the clients having the necessary funds or a third party assuming the developer's position and taking on the risk.

The issue of financing went beyond individual cases and the purchase alone. The term 'housing shortage' is slightly misleading as it primarily refers to lacking reserves. However, as discussed earlier, the shortage was also an outcome of expected demand. The ordinary people that fought the war and manned the armament production deserved their share of the peace-time economy. A house is a shelter, a means for self-expression through its customisation, and an instrument of wealth accumulation. Therefore, housing shortage or housing demand is directly linked with potential housing fetish, making the housing market vulnerable to speculation regardless of how the houses are produced – even more reason for creditors' scrutiny.

Taking stock of the discussions

Modular housing projects that incorporate open systems have a theoretical appeal to architects for offering a systemic solution to the systemic problem of housing shortage. The system typically includes 1) a grid, 2) a set of components or modules that comply with the grid, and 3) a manufacturing scenario that specifies materials, the scale of the components, and the speed of production. Open systems promise the user lower prices, self-representation, and even partial creative authorship. The architect/producer and client/customer engage in a customisation game with pre-drafted rules. In exchange for a product that is overall of higher quality than one-off on-site construction and that is available sooner, consumers choose certain product features and accept the default limits of the system.

The history of Gropius and Wachsmann's Packaged House shows that the literature on open systems in building technology is replete with confusing and contradictory definitions. A system can be deemed both open and closed depending on how we define openness. Unfortunately, there is

no consensus or conventional distinction between open and closed systems in architecture and construction. The partial distinction we have is hard to sustain, because regardless of which definition one follows, openness indicates an ideal state rather than an objective one.

Systems talk suffers from 'a severe limiting of the actual complexity of artifacts.'[43] Open systems' claim of universality eclipses their messy material histories. Technologies collectively produced over long periods appear as unique intellectual feats of genius inventors. In order to make the subject consistent with scientific and testable methods, assessment criteria are limited to the functional attributes reducible to quantitative measures. Praise of abstraction and purity in the name of geometric perfection or mathematical elegance obscure internal contradictions and built-in redundancies.

The eventual commercial failure of the Packaged House demonstrates the consequences of responding to architectural problems with solely technological solutions. Architectural production involves material, cultural, bureaucratic, and financial aspects. Idealising one element can cost the realisation of another. The correlation between the Packaged House projects' level of development and how it was communicated to professional and nonprofessional audiences shows an inverse proportion. When the system qualified for the simple standards specified for temporary dwelling units, it was presented as an infrastructure that would allow one to build any structure. Later, when the universal joint could sustain flexible organisations, its pure potential was reserved for housing and facilitated the addition or subtraction of rooms. The project's potential was presented as an epic quality superimposed on the Biblical creation myth, but it did not have any capacity for flexibility. The joints that provided flexibility were fixed in the panels.

The more resolved the production scenario was, with its semi-automated production line, the more

compromises were made in its flexibility by the addition of specified types and extensions, and the less sense the project made financially. The project was not only incompatible with other products in the competitive open market; it was also inconsistent with the credit system that financed construction projects. The intention to create radical openness produced a highly exclusive closed system. A claim of universal validity based on the promise of flexibility is hard to justify in the politically and culturally charged field of architecture. However, the concept is far from being exhausted.

In a purely technocratic vision, the appeal of modular construction systems reflects the idealised technology that will help us innovate our way out of societal problems and smooth frictions caused by human interaction or human systems such as land zoning. It is this promise that makes prefabricated open system construction an evergreen idea. Whether the housing shortage is due to the reservation of industrial material and facilities for war efforts, increased demands triggered by political investment in the house as a symbol, or current overpopulation in cities where supply cannot keep up with demand, an open system remains a popular solution.

Open systems today

Recent incarnations such as Michelle Kaufmann's Glide House and Charlie Lazor's FlatPak prove that the concept is just as appealing in the twenty-first century as it was in the twentieth.[44] However, these recent examples are distinct from the Packaged House in two regards. First, their origin story, therefore their rhetoric, is substantially different. Instead of the ingenious solution devised by an inventor, both contemporary architects cite personal struggle in finding reasonable housing options, turning to prefabrication, and discovering an answer they would like to share with like-minded people.[45] Their offer is not for everyone. The second distinction is about the assembly. Composed of units much larger than the Packaged House panels,

assembling these houses requires sophisticated equipment to level, join, and seal their components.

The contemporary vigour of the open system concept extends beyond successful applications. If the status of the Packaged House is a measure, the idea is still praised by theorists. In *Architecture and Labor*, Peggy Deamer criticises the phenomenological sensitivity to craft and tectonics that prizes traditional and local building methods, as such labour-intensive practices work 'only for the rich who could afford these indulgences.' She investigates how architects who care for the craft can embrace new and less labour-intensive technologies. In her analysis of the contemporary place architectural detail occupies in the theory and practice of architecture through labour issues, Deamer calls the Packaged House 'the most experimental project of prefabrication.'[46] Contrasting the Packaged House with idealised local crafts practice, Deamer argues that experiments such as the Packaged House system demonstrate 'how far one can go not only in designing the repeatable object (or the repeatable component) but also in making factory labour a thing of both economic and cultural value.'[47]

Like the visible index of the hand in craftwork, details like the universal joint demonstrate a condensation of labour. The universal joint 'indicates precisely how one detail is evidence of and witness to the plethora of procedures that have taken place elsewhere by the factory worker and resolved by the local craft builder in a manner that allows his work to be both repeatable and unique.'[48]

In *Graphic Assembly*: *Montage, Media, and Experimental Architecture in the 1960s,* Craig Buckley makes a slightly different observation regarding specialised joints, such as the one in the Packaged House project. For Buckley, 'redesigning the nature of joints and connections went hand in hand with the redesign of construction labour.'[49] The efficiency gained by more abstract, homogeneous, and simplified forms of assembly also circumvented the trade-protected manual skills. As such, it was not an emancipatory tool for all. Deriving

his assessment from the practice in 1950s Britain, Buckley suggests that the elevation of assembly to the state of an intellectual endeavour carefully curated by architects was, in fact, a response to the reality of practice in a flood of industrially produced materials. Seeing that they do not design most of what is used in a building, architects reformulated their position to protect their disciplinary authority.

Both Deamer and Buckley's ideas are informed by a plethora of other observations than the story of Packaged House alone. Deamer, who has been the leading force of The Architecture Lobby, a Brooklyn-based international organisation, argues that design work is precarious work, and 'architects refuse to acknowledge their role as laborers at their own peril.'[50] Buckley's observations, which rest on the representational practices such as collage, montage, and the industrialisation of building through building systems, assemblies, and discussions of prefabrication, shows that the power struggle Deamer affiches is neither new, nor costs only the expanse of architects. While they both project onto the Packaged House joint these extra layers of interest, their framing of architects' interest in designing building technologies as part of a professional class struggle in the construction sector casts a new light on the ongoing discursive presence of the project. As an architecturally designed industrial object, the system was more than a housing solution. The project's openness, defined as its extreme efficiency, was celebrated as a hallmark of disciplinary exclusivity, adding yet another layer to the inner contradictions of open architecture.

Conclusion

Despite the system's failure to be taken into widespread production within a robust industrial production sector during an exceptionally favourable economic programme, the Packaged House can not be considered a total failure. Neither of its designers suffered reputation damage from their ill-conceived enterprise. On the contrary, it provided

financial and social gain. Wachsmann went so far as to say it was a tremendous opportunity for growth.[51] He implied that the insights the project provided him could only be gained through the experience. To share this valuable lesson, he transitioned to teaching. Moreover, both Wachsmann and Gropius concentrated their efforts separately on the issue of teamwork. While the idea of distributed authorship did not come to fruition in the Packaged House, it fed the imagination of their many students in Chicago and Boston. During the development of the Packaged House, Gropius repeatedly used the Packaged House system in architectural design studios. Variation created from standard units may not have materialised, but it did wonders at the drawing table and the design studios.[52]

Is production, the successful marriage of the idea and material, the sole measure of design success? Is the search for an architecture that is both 'repeatable and unique', mass-produced and customisable, 'complete and unfinished', leaving space for personalisation in vain?[53] For Davies, who mocks the often-cited distinction between architecture and building, architectural concepts that fail to materialise or spatialise are failures.[54] Considering that architecture is as much a field of cultural production as a field of material production, it is hard to claim in good conscience that a project that occupied our imagination and thinking as profoundly as the Packaged House is a failed project. Furthermore, as Jarzombek reminds us, the status of architecture for the last two hundred years has been chasing enlightenment ideals, not catching them.[55] We should not miss the journey over a teleological obsession with the destination.

Despite Herbert's disappointment and Davies's dissatisfaction, we can approach the Packaged House and the open system paradigm not as a concluded story but as a continuous force that kept pushing architects. The inner contradiction of creating architecture that is mass-produced but variable, to express individual identity or address individual needs, is a productive cultural force.

It is not necessarily a bad thing to fall for such contradictions. As Yuval Noah Harari notes, such contradictions are 'culture's engines' that generate 'the creativity and dynamism of our species.'[56] He reaffirms their power with a resonant metaphor: 'Just as when two clashing musical notes played together force a piece of music forward, so discord in our thoughts, ideas and values compels us to think, re-evaluate and criticise. Consistency is the playground of dull minds.'[57]

Deamer's recent praise for the project affirms that the dream of the unison of standardised industrial production and individual expression still has the charge to stir our imagination. As a technological paradigm, open construction systems are here to stay. Like the puzzle that inspired Milan Kundera's novel *The Unbearable Lightness of Being*, the heaviness of the seemingly impossible task may crush us, but when we do not try, the lightness of the insignificance of our actions becomes equally unbearable. [58]

Notes

1. Alicia Imperiale, 'An American Wartime Dream: The Packaged House System of Konrad Wachsmann and Walter Gropius', in *Offsite: Theory and Practice of Architectural Production*, ed. Ryan E. Smith, John Quale, and Rashida Ng, Proceedings of the ACSA Conference (Philadelphia, fall 2012), 39–43.

2. Stephen Kendall, 'Notes on "Open Systems" in Building Technology', *Building and Environment* 22, no. 2 (1987): 93–100, 93.

3. Ibid, 93.

4. Almost seventy American companies produced more than 200 000 prefabricated lodgings during the war. For a brief discussion of mobility, and material choices over some of the other successful projects see Jean-Louis Cohen, *Architecture in Uniform: Designing and Building for the Second World War* (Montréal: CCA, 2011), 266–70.

5. Mark Jarzombek, 'Architecture: A Failed Discipline', *Archis* 19, no. 1 (Jan. 2009): 42–43, http://archis.org/volume/architecture-a-failed-discipline/.

6. The concept of 'technological paradigm' is analogous to Thomas Kuhn's notion of 'scientific paradigm'. It was formulated in 1982 by economist Giovanni Dosi. He defined a technological paradigm as a 'model' and a 'pattern' of solution of selected technological problems. 'Accordingly, a technological paradigm contains a belief system that justifies the relevance of problems and a puzzle-solution that justifies the technical solution(s)'. Giovanni Dosi, 'Technological Paradigms and Technological Trajectories', *Research Policy* 11 (1982): 147–62.

7. Walter Gropius, 'Programm zur Grundung einer allgemeine Hausbaugesellschaft auf kunsterlich einheitliche Grundlage', reprinted in Sigfried Giedion, *Walter Gropius: Work and Teamwork* (New York: Reinhold publishing, 1954 [1910]), 74.

8. Gilbert Herbert, *The Dream of the Factory-Made House: Walter Gropius and Konrad Wachsmann* (Cambridge, MA: MIT Press, 1984), 56.

9. The system was designed by Friedrich Förster, who later developed it further with Robert Krafft.

10. Herbert, *The Dream of the Factory-Made House*, 105–38.

11. Ibid, 87.

12. For the neatest version see Dora Epstein Jones's doctoral dissertation, 'Architecture on the Move: Modernity and Mobility in the Postwar', UCLA, 2004. Jones sees the Packaged House as the last attempt Gropius makes in his search for the factory house that is capable of individual expression. Wachsmann is credited as the engineer who aided Gropius. For a reflective, blended version see Herbert, *The Dream of the Factory-Made House*.

13. In his autobiography Wachsmann describes the Christoph & Unmack factory as the place where he learned his trade. Konrad Wachsmann, *Timebridge 1901–2001: Konrad Wachsmann: An Autobiography* (Graham Foundation, 1981), 52.

14. See Konrad Wachsmann, *Building the Wooden House: Technique and Design* (Basel: Birkhauser, 1995).

15. Itohan Osayimwese, *Colonialism and Modern Architecture in Germany* (Pittsburg: University of Pittsburg Press, 2017), 189.

16. Ibid., 187.

17. In 1932, Wachsmann won the Prix de Rome, along with eleven other promising artists. He left Germany in the early autumn of that year and took a leisurely journey, arriving in Italy around Christmas. Due to Hitler's rise to power and the following the political unrest, he had to leave the German Academy in Rome only a few months into his residency. Except for a short period in Granada, Spain, Wachsmann was based in Rome until 1938, when it became unmistakably clear that he was no longer welcome. Due to Hitler's visit of 3–9 May 1938, Wachsmann was deemed an enemy alien and briefly jailed. Soon after Hitler's return to Germany Wachsmann decisively left Italy. Wachsmann, *Timebridge*, 77–95.

18. Wachsmann, *Timebridge,* 30.

19. Ibid.

20. Konrad Wachsmann, *Turning Point of Building: Structure and Design* (New York: Reinhold, 1961).

21. Wachsmann and Gropius developed a coding system for the drawings. As they developed the project, whoever contributed to the phase, detail, or deliverable had their name first on the label.

22. The symposium took place in spring 1947 as part of Princeton University's bicentennial celebrations. Thomas Creighton, who organized the event, compiled a book that captured in print some of the discussions that took place during the event, as well as those that emerged in preceding meetings and correspondence. Thomas Creighton, ed., *Building for Modern Man* (New Jersey: Princeton University Press, 1949).

23. Ibid., 41–45.

24. Ibid., 46–48.

25. Burnham Kelly, *The Prefabrication of Houses: A Study by the Albert Farwell Bemis Foundation of the Prefabrication Industry in the United States* (New York: The Technology Press of MIT and John Wiley and Sons, 1951).

26. Ibid., 62.

27. Herbert, *The Dream of the Factory-Made House*, 307.

28. Ibid., 309.

29. Ibid., 311.

30. Ibid., 325.

31. Imperiale, 'An American Wartime Dream', 43.

32. László *Moholy-Nagy*, *Vision in Motion* (Chicago: Paul Theobald & Co, 1947), 112.

33. 'The New House of 194X', *Architectural Forum* (September 1942): 66.

34. Carlo Carbone, 'The Kit of Parts as Medium and Message for Developing Post-War Dwellings', *Histories of Postwar Architecture* 2, no. 4 (2019): 54–74, https://doi.org/10.6092/issn.2611-0075/9648.

35. Mathew W. Fisher, 'Prefabrication and the Postwar House: The California Manifesto', in *The Value of Design: Design is at the Core of What We Teach and Practice*, ed. Phoebe Crisman and Mark Gillem (Washington, DC: ACSA Press, 2009), 403.

36. Charles Eames and John Entenza 'What is a House?', *Arts & Architecture* (July 1944): 22–39.

37. John Entenza, 'The Program', *Arts & Architecture* (January 1945): 37–41.

38. Carbone, 'The Kit of Parts as Medium', 63.

39. Konrad Wachsmann and Walter Gropius, '"House" in Industry', *Arts & Architecture* (Nov. 1947): 28–37, 36.

40. Elizabeth Andrzejewski, 'The Wedge Connector: from Function to Symbol', in The Art of Joining: Designing the Universal Connector, *Bauhaus Taschenbuch Volume 23* (Dessau: Spector Books, 2019), 29.

41. Colin Davies, *The Prefabricated Home* (London: Reaktion Books, 2005).

42. Wachsmann, *Timebridge*, 160.

43. Kendall, 'Notes on "Open Systems"', 97.

44. The first Glide house was built in 2002. The first FlatPak House was built in 2006.

45. For Glide House see William Booth, 'House Proud: High Design in a Factory-Made Home? Michelle Kaufmann believes she holds the key', *Smithsonian Magazine,* January 2007, https://www.smithsonianmag.com/energy-innovators/house-proud-142552310/?page=1. For the story of the Flatpack house see: Allison Arieff, 'How to Play FlatPak', *Dwell*, 1 May 2009, https://www.dwell.com/article/how-to-play-flatpak-dd73f653.

46. Peggy Deamer, *Architecture and Labor* (New York: Routledge, 2020), 17.

47. Ibid., 18.

48. Ibid.

49. Craig Buckley, *Graphic Assembly: Montage, Media and Experimental Architecture in the 1960s* (Minneapolis: University of Minnesota Press, 2019), 49.

50. Kate Wagner, 'People Power: In *Architecture and Labor*, Peggy Deamer Recognizes Architects are Workers', *The Architect's Newspaper,* 11 January 2021, https://www.archpaper.com/2021/01/architecture-and-labor-review/.

51. Wachsmann, *Timebridge*, 161.

52. From 1943 to 1947, every semester at least one studio at Harvard GSD was devoted to the panel housing system. According to Dora Epstein Jones, by framing the inquiry as school-wide collaborative assignments presented as 'problems' to exercise 'scientific methods', Gropius used GSD as a research laboratory. Jones, *Architecture on the Move,* 85.

53. The seemingly incompatible characteristics stand out in the Packaged House literature. The emphasis on its capacity to build 'repeatable and unique' works of architecture is in Deamer's description. It is presented as a 'complete and unfinished' kit of parts by its creators in a 1947 article in *Arts & Architecture*. Deamer, *Architecture and Labor,* 18. Wachsmann and Gropius, 'House in "Industry"', *Arts & Architecture* (Nov. 1947): 36.

54. In addition to his criticism of Wachsmann regarding the failure of the Packaged House, Davies also states that 'The early modernists put the prefabricated house at the centre of their programme of reform. Architectural history may pretend otherwise, but the fact is that their prefabricated house projects all failed.' Davies, *The Prefabricated Home*, 9.

55. Jarzombek, 'Architecture: A Failed Discipline'.

56. Yuval Noah Harari, *Sapiens: A Brief History of Humankind* (London: Vintage, 2011), 183–84.

57. Ibid.

58. Milan Kundera, *The Unbearable Lightness of Being* (New York: Harper Perennial Modern Classics, 1999), 5.

Biography

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