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THE PREFABRICATED KITCHEN: SUBSTANCE AND SURFACE

DEBORAH SCHNEIDERMAN IS THE THESIS COORDINATOR FOR THE INTERIOR DESIGN MFA AT PARSONS THE NEW SCHOOL FOR DESIGN. PROFESSOR SCHNEIDERMAN'S RESEARCH AND WRITING EXPLORE SUSTAINABLE BUILT ENVIRONMENTS, THE INTEGRATION OF SUSTAINABILITY INTO THE DESIGN CURRICULUM, AND SUSTAINABILITY AND PREFABRICATION. HER BOOK *INSIDE PREFAB* IS SCHEDULED FOR RELEASE IN 2012 BY PRINCETON ARCHITECTURAL PRESS.

ABSTRACT **Though much attention has been given to the architecture of the prefabricated house, little has been devoted to the discussion of the prefabricated interior environment. Many discussions have centered on the notion of the house as a "machine for living," but it is the kitchen, a room that epitomizes the profession of interior design, that stakes the greatest claim to such automation. The prefabrication of the kitchen arose from the ever-present desire to attain efficiency and accommodate individual user needs, requirements, and preferences. Driven by the need for efficiency and within the context of continued industrialized invention—including every conceivable element for making the processing of food easier, such as, for example, computerization—the kitchen historically has served as an ideal laboratory for the investigation into interior prefabrication.**

KEYWORDS: prefabrication, architecture, design, sustainable design, kitchen, interior design

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INTRODUCTION

With the discussion of prefabrication in architecture receiving significant attention in the literature, particularly in the past century, I questioned how so little historical attention could be devoted to the prefabrication of the interior environments. A review of the literature revealed that whereas there is a paucity of categorical research focused on this subject, there is an abundance of evidence regarding the prefabrication of the interior environment, most significantly from the late nineteenth century to the present. As such, the historical topic of prefabricated interior design does in fact exist and merits directed exploration.

The prefabrication of the kitchen arose from the ever-present desire to attain efficiency and accommodate individual user needs, requirements, and preferences. Driven by the need for efficiency and within the context of continued industrialized invention—including every conceivable element for making the processing of food easier, such as, for example, computerization—the kitchen historically has served as an ideal laboratory for the investigation of interior prefabrication. The American kitchen is also a symbol of modernity and technology. Though efficiency has been a driving force in the advancement of kitchen design, the iconic role of the kitchen as a signifier of modernity and technological advancement in the home cannot be ignored, neither on the local level of the neighborhood, nor within international debates (Carbone 2009). The prefabricated kitchen has enjoyed a mass-market acceptance that no other prefabricated architectural unit has even approached. In fact, it has historically been coveted as a definitive symbol of success and technological achievement.

PURPOSE AND METHOD

The purpose of this article is to survey and establish this history of prefabricated kitchen environments, and to define their success as a prefabricated prototype. It thus aims to begin an investigation into the previously unexplored topic of prefabricated interior design. As has been considered in the field of architecture, the reduction of construction waste, increasing efficiency and flexibility, and remaking the way we construct the built environment (Kieran and Timberlake 2004: 43) by means of offsite fabrication and mass production are part of a critical strategy toward a more sustainable future (Mau Institute without Boundaries 2004: 33). The requirements of the prefabricated kitchen are unique and necessitate a paradigm of efficiency in both construction and user experience. In domestic design, the kitchen serves as a prototype for consumer acceptance of the prefabricated modular fitted kitchen, not only as the standard but as a typology, routinely embraced by the consumer (Freeman 2004: 49–50). A better understanding of the successful mass-market acceptance of the prefabricated kitchen could also inform the market

for prefabricated homes and help establish that technology as a broadly accepted norm.

The analysis is based on a literature review. In the article, I investigate scholarly discourse in architecture, interior design, and technology as well as material from the popular press. The sources incorporate both primary and secondary texts. The investigation into popular secondary sources facilitates a parallel exploration of the elements of the interior as they relate to architecture. For the most current investigations, the review incorporates investigation into the World Wide Web to examine current examples in the contemporary exploration of the prefabricated kitchen.

PREFABRICATING THE KITCHEN

For over a century, studies in the design of the kitchen have included not only a focus on efficiency and ergonomics but also other contemporary sustainable notions, such as prefabrication, natural light, ventilation, and view. Traditionally, the kitchen, though a domestic interior, has been approached as functional space and the kitchen user, historically the housewife, has been functionally likened to a factory worker. The systematic design of the kitchen was first pursued by home economists, usually female, in the USA as an academic and scientific endeavor incorporating a multitude of studies in efficiency and workspace organization. Later, architects, predominantly male, also laid claim to kitchen design, and while there was some evidence of synergy between architects and home economists their relationship often proved to be competitive in nature. The architects' approach embraced rationalist-functionalist principles and machine aesthetics (Oldenziel 2009: 319–20). As such, it is not surprising that the kitchen has been a vehicle for exploration in the mechanics of prefabrication in architecture and design.

Prefabricated kitchen environments follow two basic configuration types:

- The unit: a self-contained object that comprises all functions required by the (office) worker in one single piece of furniture.
- The module: a building block of customizable prefabricated space.

THE PREFABRICATED KITCHEN: A HISTORY

The centrality of the kitchen stems from its historical role as the place where the housewife spent most of her time (Caudenberg and Heynen 2004: 25), making the study of its operations and efficiency central to many investigations and a primary subject of the early university education of women. Land grant institutions[1] and the development of home economics as a degree course fostered the professionalization of women, with notable programs at Cornell University and Iowa State University. Departments of home economics were centers of technical training for women, often modeled on science and engineering

programs. Iowa State College in Ames, Iowa, housed one of the country's first programs in home economics and offered courses as early as 1871, prior to the establishment of it as a majors subject. To facilitate the understanding and operating of kitchen equipment was a primary aim of the fully established program (Bix 2002: 729–30).

The kitchen as a prototype for prefabrication has its roots in the earlier notion that "a well-run kitchen is a well organized kitchen"—extending to the idea that such efficiency would lead to a professionalization of the American woman (Henderson 1996). Explorations into the efficiency of the kitchen may be found as early as the 1860s in Catherine Beecher and Harriet Beecher Stowe's book *The American Woman's Home*. Here, the authors proposed the introduction of "the sink and cooking form" (see Figure 1), a design solution for greater efficiency, given that in the typical kitchen of a large home of that era "half the time and strength is employed in walking back and forth to collect and return articles used" (Beecher and Beecher Stowe 1975[1869]: 24). The "sink and cooking form" is credited as a predecessor to the twentieth-century kitchen, driven in large part by the necessity for organized storage. The "sink and cooking form" should not be regarded as merely a piece of furniture, since its design already foreshadows the prefabricated packaged kitchen of the

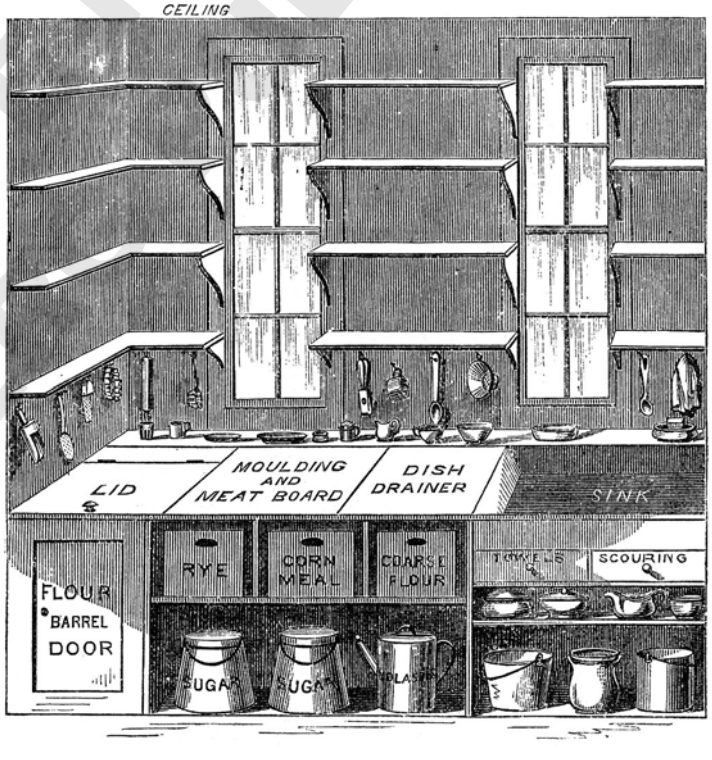


Figure 1
Catherine Beecher and Harriet Beecher-Stowe's "Sink and Cooking Form" (Harriet Beecher Stowe Center, Hartford, CT).

mid-twentieth century with an integrated mechanical core, including water heating and ventilation systems (Hayden 1981: 58–60). The "sink and cooking form" was not itself prefabricated nor did it really gain wide acceptance, but it is credited with inspiring the designers that followed (Beecher 2001: 27–8; Lupton *et al*. 1992: 43).

EARLY MASS-PRODUCED PREFABRICATED KITCHENS

As early as the 1890s, the USA witnessed the first prefabricated kitchen furniture elements in the form of factory-produced freestanding "dressers" (Beecher 2001: 28). These dressers or wardrobes foreshadowed the prefabricated packaged unit kitchens of the mid-twentieth century as they were originally designed as large all-inclusive elements. The kitchen dressers proved to be problematic and inflexible as they did not fit into all kitchens, and they required not only a large room but also needed to occupy a wall uninterrupted by windows or doors. Among the manufacturers of this early kitchen furniture was the Hoosier Manufacturing Company (see Figure 2) which, influenced by Beecher, produced the "portable pantry." The failure of the portable pantry to fit properly into many existing kitchens led to the design of the "pantryette." This large modularized cabinet could be assembled from several smaller units, allowed for a better fit into any given space, and permitted the users to customize and select

Figure 2
Hoosier Company kitchen cabinets advertisement (courtesy of Henry County Historical Society).

the option(s) most useful for their needs and wishes (Beecher 2001: 28–32). The notion of choice and flexibility is one that permeates the design of kitchens until today and it has been essential to successful prefabrication. This concept of systematizing the dimension of cabinets addressed issues of both standardization and flexibility in the combination of units (*American Builder* 1927: 314).

Around the turn of the twentieth century, another two women influenced the development of the kitchen as a prefabricated prototype. Lillian Gilbreth conceived of the idea of the Continuous Kitchen, an efficient layout well ahead of its time, when she recognized that for a kitchen to work efficiently it must allow for flexibility. She noted that the most practical layout would vary from house to house, largely because people of different body height would require different work counters (Bell and Kaye 2002: 49). Gilbreth worked together with another influential designer, Christine Frederick, on several projects. However, it was Frederick who, in the 1910s, took the next step of equating the kitchen with the machine in a more literal manner through her analogy of the kitchen to the assembly line of the modern factory (Lupton *et al*. 1992: 43). In her book, *Household Engineering: Scientific Management in the Home* (1919), Frederick firmly connects home-making with modernization and mechanization, even to the point of visiting factories to better understand efficiency in the course of writing her book. Frederick became influential in both the USA and Europe and, most significantly, her concepts influenced the Frankfurt Kitchen, the first prefabricated kitchen "machine" (Frederick 1919: 8–17).

THE WERKBUND, WEIMAR, AND THE DESIGN OF THE EFFICIENT KITCHEN

One of the main criticisms of the kitchen of today is that after the selection of its elements, the kitchen becomes inherently inflexible. For example, the height of the work counters is usually unchangeable due to the design of base cabinets; hence, there is no place for the user to sit comfortably and work. The 1929 *Werkbund* exhibition in Stuttgart, Germany, featured kitchens by the designer Erna Meyer, one of which had been constructed by herself, the other in collaboration with the architect J. J. P. Oud. The collaborative iteration, though traditionally only attributed to Oud, became the basis for many of the kitchens designed in Germany at that time and boosted the prefabrication of the mechanized kitchen (Henderson 1996: 231). Meyer's conviction that the kitchen user should be provided with the option of a seat was likely derived from Frederick and is included in the design of her own kitchen and her collaboration with Oud (Lupton *et al*. 1992: 39).

Although Le Corbusier has been credited with the notion that the home is a machine for living, Grete Schütte-Lihotzky realized a prefabricated domestic "machine" in her 1926 Frankfurt kitchen design (see Figure 3). Though the influence of her predecessors is clear, Lihotzky is credited as the designer of the modern kitchen (Parr 2002:

Figure 3
Grete Schütte-Lihotzky's "Frankfurt Kitchen" (Institut für Stadtgeschichte, Frankfurt am Main).

661). An Austrian architect, Lihotzky (while employed by architect Ernst May) designed the first mass-produced prefabricated kitchen, now commonly termed the "Frankfurt Kitchen." Like Erna Meyer, Lihotzky designed within the philosophy and influence of the socialist system. Originally, the Frankfurt Kitchen was designed for the Weimar housing program. In this particular design approach, the role of the housewife was seen as analogous to that of an industrialized worker. The design is closely related to the tight and efficient commercial kitchens that could be found on trains or ships. With more than 10,000 of these units being installed in Germany, these kitchens foreshadowed contemporary prefabrication techniques in home building and even the construction of skyscrapers (Henderson 1996: 235–7). The Frankfurt Kitchen was acclaimed by architects for its foundation in rationality and scientific planning (Llewellyn 2004: 45).

THE RATIONAL KITCHEN AND CUBEX: FUNCTIONALISM AND MASS PRODUCTION

The third *Congrès International d'Architecture Moderne* (CIAM) conference in Brussels, in 1930, witnessed Belgium's entry into the realm of the rationalized kitchen. Reiterating the gender specificity of the kitchen, its qualities reminiscent of the machine and the

assembly line, the Cubex called for unit design to be aligned to the dimensions of the female body. This demand is firmly connected to the professionalization of women in the home as evidenced by L. H. De Koninck's statement that women should be educated in proper kitchen operation or housewives would be unable to realize the full potential of the rational kitchen. The Cubex system, designed by L. H. De Koninck of the Belgian CIAM branch (CIAMB), is notable for integrating the concept of customization into prefabricated standardized design. The system comprises four cupboard types that can be arranged in ten different ways, allowing for an array of two hundred unique kitchen layouts. It is essential to note that although the system was based on design flexibility, it did not achieve genuine customization by the user. The elements were designed to correspond to an idealized body and did not take into account the wide range of variations in individual body height. Ultimately, the kitchen modules were installed as a fixed, fully integrated set. Reconfiguration by the user, which in the designer's eyes might compromise the proper arrangement, was not possible. As a consequence, the housewife remained subjugated to the designers' judgment and predetermined thinking.

BRITAIN AND THE PREFABRICATED KITCHEN

Elizabeth Denby, a British housing reformer of the early twentieth century, also advanced the notion of the kitchen as an efficient machine and hence a prefabricated prototype (Denby 1941: 22). Well respected by both policy makers and architects for her expertise in housing and domesticity, Denby argued for the importance of recognizing the functional relationship among the elements within a kitchen. Although not trained as a designer, Denby was given the opportunity to design the layout for the kitchen in Kensal House, a British mass-housing project. She envisaged her layouts as an "efficient machine," comparable to the operation of a factory (Llewellyn 2004: 46–8).

Also influential in Britain and following in the path of Denby in designing efficient prefabricated kitchens was Jane Drew, who authored the 1944 book *Kitchen Planning*. Drew, an architect, was married to Maxwell Fry and worked with such important individuals as Le Corbusier. She espoused the belief that the kitchen was central to the design of the house and, as such, its location and relationship to the rest of the house had to be carefully considered in the design process (Llewellyn 2004: 48–51). The notion of "the view" proved to be critical in Drew's positioning of the kitchen within the house, based upon her belief that one should be able to see through the kitchen to the front of the house (Drew 1944: 6–23). Drew did not believe that there was a single ideal typology for the kitchen. Hence, she conceived of five plans based on the same standard modular unit and enabled all five plans to be easily mass-produced (see Figure 4).

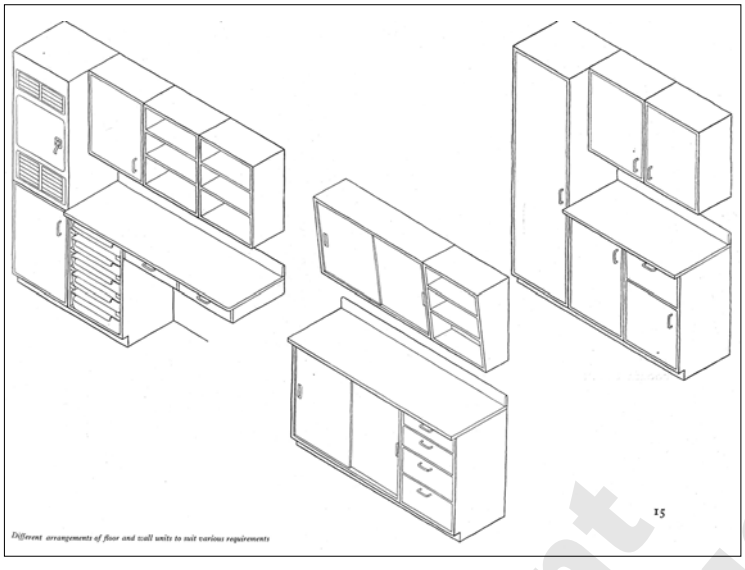


Figure 4
Jane Drew: Different arrangements of floor and wall units to suit various requirements (Drew and London Gas Company).

THE MID-CENTURY KITCHEN: INTEGRATED EQUIPMENT, THE UNIT KITCHEN, AND THE PACKAGED KITCHEN

Approaching mid-century, the prefabrication of the kitchen was truly linked to the prefabrication of architecture—with little exception, the investigations had more to do with efficiencies in construction than with efficiencies in function. Although a concept often attributed to postwar America, the notion of "integrated equipment" was introduced in 1937 when *Architectural Forum* first published the construct of integrated equipment (without attribution to the "sink and cooking form"). *Architectural Forum* advanced the idea that the unit (here referring to a "module," which differs from a "unit kitchen," which is a single element kitchen) in the design and construction of the kitchen had become commonplace. As such, the time had arrived for a new approach to the investigation of integration. An "integrated equipment" kitchen, is one in which cabinetry, sink, range, and refrigerator are designed to work together, constituting a fully prefabricated element. Also included in the integrated equipment in some instances is the structural support necessary for the construction of the kitchen, providing further autonomy from the construction of the house and greater flexibility for installation. A direct connection between kitchen and hygiene is made in the discussion of integrated equipment: the elements are all designed to interlock, thus minimizing gaps between elements. This approach therefore makes the kitchen easier to clean and keep clean, while also having the benefit of being more attractive (*Architectural Forum* 1937a).

The 1937 "Integrated House" issue of *Architectural Forum* proposed several designs conceptualizing the mechanical core, in which the core equipment is described as being "in tune with the machine

age." In the same issue, *Architectural Forum* proposed its own solution to the integrated mechanical core, termed the "power plant," a prefabricated element incorporating all the fixtures and mechanical equipment necessary for the bathroom and kitchen of a small house (*Architectural Forum* 1937b). The Utility Unit (a mechanical core system produced and sold in the USA in 1947 by Ingersoll Steel and Disc Division of Borg-Warner Corp) is not conceived for a particular prefabricated house but instead intended to be incorporated into any developer's prefabricated or traditionally built house. The entire unit is 9.5 square feet and incorporates all equipment essential to the kitchen, bathroom, laundry, and house HVAC (heating, ventilating, air conditioning), much like its Canadian predecessor, the Unitility. The Unitility had to be assembled into a complete element, measuring 7.5 square feet and, unlike the Utility Unit, was delivered in pieces, each of which could fit through a standard doorway making it useful when employed in renovations as well (*Architectural Forum* 1946: 81–3).

The investigations into prefabricated kitchens in the first half of the twentieth century were interconnected with the simultaneous investigations into prefabrication in housing. The terminology of "packaged," popular in the description of prefabricated kitchens, arose out of the explorations into prefabricated houses, indicating that all parts necessary to construct the house arrived in a package ready for assembly at the site. Of note is Walter Gropius' prefabricated endeavor called the "Packaged House," a collaboration with a European refugee, Konrad Wachsmann, who first conceived of the modular system and brought it to Walter Gropius. The packaged house system was patented in 1942, and the General Panel Corporation formed to manufacture the house. A few prototypes were produced, but the house never achieved mass production (Herbert 1984: xi–xii; see also Abercrombie and Nelson 1995: 76). Buckminster Fuller, an early proponent of prefabrication, explored its technologies in his visionary Dymaxion House of 1928 (Marks 1960: 80–3) and the prototype Dymaxion Dwelling Machine (Wichata House) of 1944 (Marks 1960: 120–3). Fuller's investigations included those more specific to the kitchen as evidenced by the stand-alone mechanical core of the Mechanical Wing (1940). The Mechanical Wing incorporated a Dymaxion Bathroom, a kitchen, and a laundry into a portable or permanent prefabricated construction, essentially a "packaged" prototype (Marks 1960: 108–9).

In the mid-1940s, the first packaged kitchens went to market. McCullough differentiates the packaged kitchen from the unit kitchen, defining the packaged kitchen as one in which the manufacturer markets all necessary equipment in one package and the unit kitchen as a cast element that includes all equipment and cabinetry (McCullough 1945: 8–10). The thing these systems all have in common is that they rely on prefabricated structures and not on the construction of the house for their support (Beecher 2008: 150). Further, they address

the ongoing discussion of prefabricated kitchen furniture versus modularization.

The Charles C. White Kitchen is an example of the prefabricated packaged typology. White reconceived the cabinet as a cylindrical form to allow for the door to slide in a hidden area behind the cabinet. The system incorporates all major appliances with the same cylindrical form as the cabinets. Integrated into the system is a steel frame from which to hang the pieces so that they are not dependent on the strength of the wall. Another model, representative of the unit typology, attained definition by a freestanding "cast unit" designed by J. J. Little. Its main concept places emphasis upon the primary kitchen functions, as they are consolidated into a central "island," with meal preparation on one side and a clean-up area on the other. A raised retractable bar houses controls and small appliances to assist with such common kitchen functions such as vegetable cleaning, glass washing, and stirring (*Architectural Forum* 1946: 81–3). The prefabricated qualities of both kitchens are enhanced by their structural independence. Both kitchens achieve efficiency in construction through prefabrication, and the Little Kitchen also makes preparations more efficient, yet they do not address functionality for a specific, individual user.

In the 1950s, designer George Nelson introduced a particularly interesting prefabricated packaged kitchen through General Electric. Nelson's kitchen concept was the Mechanized Storage Unit (MSU). Not only was the MSU driven by the notion that the kitchen should be a packaged product inclusive of all elements essential to its core functions, including cabinetry and appliances as components or modules in the system, but Nelson also attentively addressed issues of ergonomics. Nelson's MSU kitchen mechanized the upper cabinetry, so it could be raised or lowered to typical upper cabinet height, making it accessible to the average kitchen user, as well as to users of varying heights (Abercrombie and Nelson 1995: 72–4).

THE CORNELL KITCHEN

The design of the Cornell Kitchen is (in its own terms) product design through research, culminating in a prefabricated kitchen prototype (see Figure 5). In this exploration, the history of the development of the kitchen is given as much consideration as social and psychological aspects and as its technical details. The design of the kitchen was executed through Cornell University's Housing Research Center as a collaborative effort among the students, home economics professor Mary Koll Heiner, and Professor Glen Beyer, Director of the Center and Professor of Housing and Design. The Cornell Kitchen research culminated in two studies, "Farm House Storage Facilities for Food Commodities and Related Equipment" and "Study of Space, Facility and Structural Requirements for Farm Houses in the Eastern Region." The kitchen's concept evolved though a combination of field study and laboratory research (Beyer 1953: preface). The full-scale Cornell

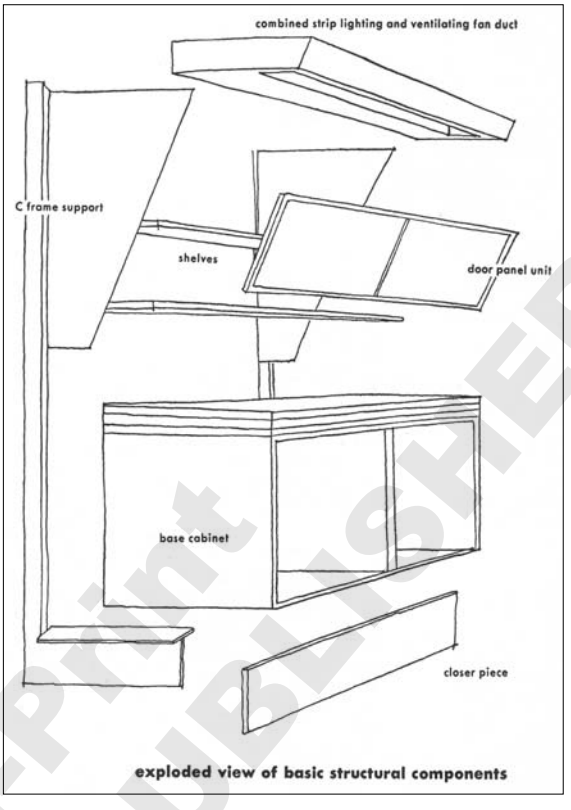


Figure 5
Cornell Kitchen: parts diagram (courtesy of the Division of Rare and Manuscript Collections, Cornell University Libraries).

Kitchen prototype was presented in 1952 at the University's Farm and Home Week where the elements were constructed and further tested by farmwomen whose responses to the design proved to be overwhelmingly positive (Riglin 1952: 92). Although the response was positive, the researchers acknowledged that their kitchen design was not the final or ideal typology but rather constituted a mere step forward in realizing a broadly useful kitchen design (Beyer 1953: preface).

The design of the Cornell Kitchen revisits some critical ideas addressed in earlier research that were still not routinely included in standard kitchens. The prefabricated Cornell kitchen units provided for a wide range of counters of adjustable height, from thirty-two to thirty-eight inches (*American Builder* 1952: 46–7) and also a seated work area for the kitchen user. The design of this kitchen revisits the constructions of modularity and flexibility. The basic kitchen functions were grouped into five prefabricated "centers": mix, serve, range, sink, and refrigerator/oven. The centers could be arranged in any configuration and comprised a self-supporting structural system. They had identical base cabinets, with the exception of the sink center, so that inner organizational components were interchangeable between

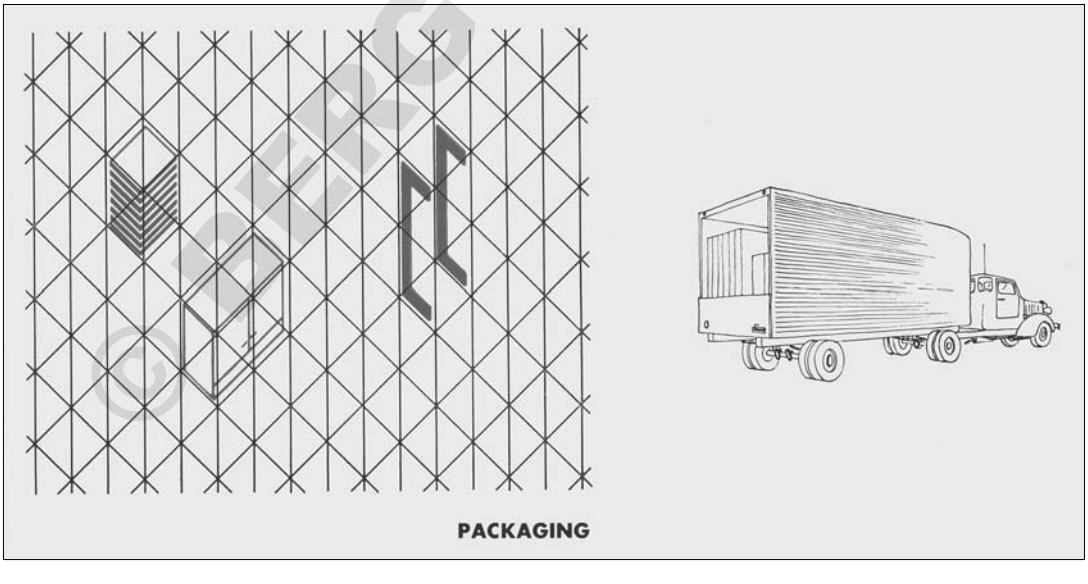
the centers (Beyer 1953: 62–8). That way, the user had the choice to determine which inner organizational elements went into the center and also to determine the height of such elements.

The centers were designed as a flat pack system, a decision the researchers attributed to what would now be considered a sustainable concept, reducing warehouse and shipping space (see Figure 6). This design stands as a true precursor to the typical prefabricated cabinet of today as the researchers designed the kitchen so that it could be readily done by the purchaser/user. The inclusive design is typical of the prefabricated packaged typology, as previously discussed, with lighting, ventilating fan, outlets, sink, dishwasher (optional), and refrigerator all comprising part of the package (Beyer 1953: 56–72).

THE KHRUSHCHEV KITCHEN

In 1959, kitchen design became an issue of debate between socialism and capitalism at the US Trade and Cultural Fair held in Moscow (*Universal News Reels* 1959). The exhibition made kitchens a showcase of the high standard of living in the USA, casting them as a signifier of modernity, contemporary society, and technological achievement. It encountered critical deliberation in the infamous "kitchen debate" confrontation between Richard M. Nixon and Nikita S. Khrushchev. Although the Soviet Union had proved its technological prowess with the launch of Sputnik in 1957, the kitchen could still serve as the symbol of a successful and civilized society and as evidence of a high standard of living. The Prefabricated Packaged Kitchens were exhibited as consumer-driven technological advancements and included the automated RCA "Miracle Kitchen," which could be operated with the push of a button, the General Mills Kitchen inspired

Figure 6
Cornell Kitchen: packaging and delivery concept diagram (courtesy of the Division of Rare and Manuscript Collections, Cornell University Libraries).



by frozen food technology, and the iconic site of the kitchen debate photographs, the General Electric Kitchen (Carbone 2009: 59–70). The exhibited state of the art modularized prefabricated kitchens were utilized by Nixon to challenge the success of Soviet socialism (Reid 2005: 289–91).

The new kitchen discourse was particularly critical in the Khrushchev era as the intensive housing drive strove to provide housing for individual families rather than multigenerational living, causing a boom in domestic construction. Also promoted was a new cultured way of life that was hygienic. This period in the Soviet Union witnessed a professionalization of women, as seen earlier in the USA, supported by directed literature and a formal home economics education in the newly established College of Housekeeping. The design of the Soviet kitchen proposed by the architect A. Cherepakhina, popularized though periodicals, followed the home economist model that recognized the necessity for an efficiently designed kitchen in proportion to the user or housewife. The Cherepakhina proposal unfortunately regularized the average height of the Moscow woman, at 158 cm, and proposed a fixed height design rather than an adjustable iteration that could meet the needs of many (Reid 2005: 301–5).

Though the Khrushchev era fostered principles of an efficient kitchen, inspired by the dream American kitchens of the era as well as the earlier, socialist Frankfurt Kitchen, the Khrushchev Kitchen was not in fact a factory-built installable element. It was ultimately merely a set of design advisements for the homeowners on how to install or fabricate this nonexistent kitchen themselves, and, as such, the fully fitted kittens were only rarely installed.

FULL CIRCLE: KITCHEN FURNITURE REVISITED

Joe Colombo: The Kitchen as Object

Joe Colombo began his career as an artist within a movement that disconnected from history and believed in the free play of the imagination (Favata 1988: 7–10). In his career, he contributed significantly to the areas of interior design and furniture. His contributions have been critical in the development of the module as place-maker and in particular in the inception of furniture as environment. In his 1963 "mini-kitchen," he reconceived the portable pantry typology of the late nineteenth century into a prefabricated package even more compact, mobile, and utilitarian. The unit includes everything necessary to the function of the kitchen, except for the sink, in a space of less than eleven square feet, including a stove, refrigerator, and storage for tableware and cooking. Boffi, an Italian producer of kitchen and bathroom design, revamped and relaunched the mini-kitchen in 2008 (Kaiser 2008).

In addition to the "mini-kitchen," Colombo designed two additional significant prefabricated kitchen elements. The 1966 Central Block

Kitchen is of the "unit" kitchen concept, incorporating all equipment necessary for a functioning full-size kitchen within a self-contained and fixed block. Looking beyond just the kitchen, the 1971 Total Furnishing Unit turns the concept of house inside out, with all elements of living prefabricated and contained within one interconnected centralized block. In a later iteration, he divided the element into four detached and movable units: kitchen, cupboard, bed privacy, and bathroom (Favata 1988: 110–3). Though Colombo's work is pivotal in the discussion of the prefabricated interior environment, addressing efficiency in building and lifestyle, his exploration does not extend to considerations of ergonomic user efficiency.

The Universal Kitchen

The design of the Universal Kitchen represents a return to such consideration (see Figure 7). In collaboration between the Departments of Interior Architecture and Industrial Design begun at the Rhode Island School of Design (RISD) in 1993, the "Universal Kitchen" was studied in design studios over the course of several years. This approach again advanced the idea of the kitchen as prefabricated and flexible. The Universal Kitchen is reminiscent of Lillian Gilbreth's Continuous Kitchen; indeed, it was the notion that the American kitchen had not changed since Gilbreth that had prompted their investigation. The basis of the research is the discovery of a "comfort zone" void in the design of kitchens, referring to the vertical heights at which items are stored (Bell and Kaye 2002: 54). The collaborators'

Figure 7
RISD Universal Kitchen (courtesy of Rhode Island School of Design).

discovery is not dissimilar to that of the researchers of the Cornell Kitchen (almost fifty years earlier) regarding the fact that different people are more comfortable working at variant heights and that kitchen tasks are more comfortably performed at different heights, depending on the nature of each individual task. The RISD kitchen study came to similar conclusions through time/motion studies of the preparation of a simple pasta dinner. The project resulted in two distinct prefabricated prototype kitchens, the "Min" and the "Max," which are each essentially kits of interchangeable modular components. Each element is chosen by the user and can be installed at varying heights and depths (RISD "Sponsored Research" n.d.). The outcomes were presented in 1998 at the Cooper Hewitt National Design Museum show *Unlimited by Design* and again at the RISD Museum in 1999. The design of the Universal Kitchen incorporates earlier ideas that included notions of sustainability and realizes them with greater specificity. The overall design of the prototypes takes into account "the conservation of human energy and natural resources" and it aims to "make a kitchen to accommodate people of all ages and physical abilities" (RISD "Museum: Exhibitions" n.d.). Although much investigation, particularly into the prefabricated prototype kitchens, has shown the clear necessity of a flexible and adjustable kitchen, ergonomically, the kitchen has remained inflexible in design despite appreciable design research to the contrary.

Oma's Rache: Grandma's Revenge

Melanie Olle and Ilja Oelschlägel designed this concept kitchen as part of the "compact kitchen project" with Professor Klaus Michel of the Department of Interior Design at the University of Art and Design in Halle, Germany. The concept behind *Oma's Rache* comes full circle, returning to the off-site manufacture of the kitchen wardrobe, the original prefabricated kitchen investigation. The twenty-first-century version is a departure from the storage function of the Hoosier cabinet as it further includes the functions of cooking and dining. The element is only four square meters (or forty-three square feet) when closed and houses provisions for cooking, dishwashing, dining, refrigeration, food preparation, and storage (Designboom n.d.). *Oma's Rache* is one of many investigations that return to the topology of movable kitchen furniture (see Figure 8).

CONCLUSION

The design and fabrication of the modern kitchen has enjoyed considerable attention and investigation and serves as the only example within the architectonic environment where the popularity of a prefabricated design has gained widespread mass-market appeal, achieving a status which arguably exceeds that of its site-built counterpart. The prefabricated kitchen does not appear to suffer the stigma of prefabricated housing as something cheap and substandard. Rather, the

Figure 8
Oma's Rache: twenty-first-century kitchen furniture (courtesy of Melanie Olle and Ilja Oelschlägel).

prefabricated kitchen historically has been appreciated for the basic tenets of prefabrication—efficiency and accuracy of construction in a controlled off-site environment. The notion of flexible kitchen prefabrication arose from home economists' systematic investigations into efficiency coupled with architectural investigations in rationalization and technological advancement. Such technological considerations, in addition to the repetitive nature of tasks performed within the kitchen, have drawn the logical comparison to the machine and have primed it as an investigational site critical to the architecture of prefabrication. Explorations and research have centered on creating kitchens that are flexible and maximize efficiencies for both "housewives" and working women and men. The conclusion is readily drawn that the kitchen is the most successful prefabricated architectonic element—though the conclusion can equally be drawn that the endeavor was not, in fact, a success. Overwhelmingly, commercially available prefabricated kitchens are fixed in height and location and do not meet the well-researched requirement for flexibility. The academic investigation in kitchen efficiency, for example the Cornell Kitchen and RISD Universal Kitchen, have consistently shown that flexibility, particularly in regard

to the height of the cabinets, is essential for maximum comfort and efficiency, yet installations typically remain immovable. The kitchens that have been generated from the architectural field, more concerned with rationalization than user experience, repeatedly and purposefully fix the elements of the kitchen, as evidenced in the Cubex kitchen, the designer of which did not want his design compromised, and the Cherepakhina kitchen which assumed a standard female body size for reasons of economy. While they have become the norm and are free from the stigma of prefabricated buildings, commercially available prefabricated kitchens unfortunately still neither meet the requirement nor the potential for flexibility.

NOTE

1. Institutions of higher education in the USA funded through federal land grants to each state, focusing on applied subjects rather than classical studies.

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