Prefabricated Interiors: Through the Lens of an Interior Systems Theoretical Framework

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Figure 1: Embedded Portrait | Deborah Schneiderman

PhD by Published Work in Prefabricated Interiors

Deborah Schneiderman

Supervisors: Dr. William McLean, Dr. Ro Spankie

April 2025

Acknowledgments

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Finally, I extend my heartfelt appreciation to my husband, Scott and children Chloe and Eli, whose unwavering support and encouragement have been a constant source of strength and inspiration.

Declaration

I confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Deborah Schneiderman, April 2025

01 Table of Contents

02: Abstract

The submitted publications and commentary demonstrate my founding literature on the topic of prefabricated interiors. Prefabricated interiors are fabricated off-site, typically customizanble, transformable, transportable, and place-making within both architecturally defined and non-architectural settings. They foster user attachment, promote regenerative design, and have significantly advanced the evolution of prefabrication across the built environment. I am the first scholar to discuss prefabricated interiors as a stand-alone design practice, theoretical approach, and pedagogical subject. As such, I have received global recognition as an authority on the subject.

This commentary analyses the source materials that introduce the topic of prefabricated interiors through a theoretical framework and introduces a novel methodology for classifying them, distinguishing them from prefabricated architecture. Using my interior systems theoretical framework—combining systems thinking and emotional design—the scholarship examines how strategies of modularisation and mass-customization differentiate prefabricated interiors from prefabricated architecture. The research fills a gap in the literature by introducing the role of interior design in prefabricated technology. The research underscores systems thinking in interior design, viewing interiors as interconnected systems that optimise materials, minimise waste, and enhance user attachment. These strategies support sustainability efforts globally. From screens to modular elements to complete units, prefabricated interiors serve as place-makers, shaping undefined spaces into transformable, transportable, cohesive environments that catalyse an emotional connection between the user and the environment.

The research contributes to modern prefabrication techniques across the built environment by articulating the role of prefabricated interiors. Prefabricated interiors hold transformative potential in shaping future architectural practices, fostering adaptability, emotional attachment, and regenerative design in the built environment.

03: Introduction

Interior prefabrication is defined as the off-site fabrication of interior environments that are place-making within both architecturally defined and non-architectural settings. Unlike prefabricated architecture, prefabricated interiors possess the capacity to foster emotional attachment due to their typically inherent customizability, adaptability, and transportability. These characteristics enable the relocation of place, allowing for a dynamic and personalised spatial experience.

The techniques and applications of prefabrication of the interior have been evident for thousands of years, and prefabrication in the built environment owes much of its advancement to concepts investigated in terms of interior elements and components. As a design topic and construction technique, prefabrication has enjoyed continued attention from prominent architects and designers, predominantly for efficiency and affordability. More recent prefabricated investigations recognise the inherently sustainable qualities and further regenerative design by including materiality and prefabrication processes.

Innovations in the prefabricated interior have ranged from individual elements to complete assemblages. The constructs of walls, furniture, kitchens, bathrooms, and cubicles have defined space, either as complete prefabricated assemblages or through the repetition and fabrication of the module, essentially becoming place-makers within the built environment. Elements of the interior effectively become place-makers when they are situated or assembled in such a manner to organise an undefined area into a cohesive, defined, and programmed space. Explorations of prefabricated interior elements have informed investigations and inventions in prefabrication on greater scales within the built environment.

Innovations in prefabricated interiors range from individual components to fully integrated assemblages. These elements, whether as complete prefabricated systems or through the repetition and fabrication of modular elements and/or screens, serve as critical place-making devices within the built environment. When strategically positioned or

assembled, prefabricated interior elements function as place-makers to transform undefined spaces into cohesive, structured, and purpose-driven environments. The study of prefabricated interior elements has significantly contributed to advancements in prefabrication at larger architectural and urban scales, demonstrating their pivotal role in shaping spatial configurations and informing broader developments within the built environment.

04: Thesis

Through the lens of my interior systems theoretical framework, which integrates systems thinking with emotional design, it is evident that prefabricated interiors—through the application of standardisation and modularisation strategies—not only foster user attachment but also promote regenerative design, and have significantly advanced the evolution of prefabricated architecture.

05: Research Questions

- Can prefabricated interiors have the ability to customise and transport place, establishing a user connection that increases their useful life and distinguishing them from prefabricated architecture?
- How has the development of prefabricated interiors positively affected the development of prefabricated buildings?
- To what extent have prefabricated interiors forwarded the development of regenerative design?
- How do prefabricated interiors create and instigate a greater emotional attachment to their inhabitants?

06: Methodology

In this research, I argue that prefabricated interiors, employing strategies such as standardisation and modularisation, generate user attachment, support regenerative

design, and have positively impacted the development of prefabricated architecture. The research methodology for this scholarship on prefabricated interiors consists of a thorough literature review that integrates both primary and secondary sources. This approach is augmented by a systematic analysis of visual materials, including both physical objects and photographic documentation. Further, the methodology involves the experimental application of theoretical concepts within my own design projects. These concepts are evaluated through collaborative studio design work with students, encompassing both realized and conceptual projects.

07: Submitted Publications

The submitted publications and this commentary demonstrate a novel approach to a subject that had not been examined sufficiently until my research. I have been studying prefabricated interiors as a scholarly endeavour since 2008. This commentary will highlight my innovative methodology of classifying the typologies and territories of the prefabricated interior. It will also consider how my research has cast light on the impact of prefabricated interiors on the evolution of prefabricated technologies in the built environment. At the centre of this work is my finding that the successes of prefabricated interiors, a regenerative design strategy that employs standardisation and modularisation, have positively impacted the development of prefabricated architecture. Through an intersection of systems thinking and emotional design, prefabricated interiors have the ability to customise and transport place, establishing a user connection that increases their useful life and distinguishing them from prefabricated architecture. Two books, three book chapters, and one conference proceeding publication combine to discuss prefabricated interiors in terms of their success as a construction typology in the built environment. While my earlier research primarily concentrated on works from the United States, Europe, and Japan, my publication, “The Prefabricated Interior”, adopts a more global perspective.

07.I [Book]
Schneiderman, D. (2025). The Prefabricated Interior. Abingdon and New York: Routledge.

This book is significant for establishing and defining my interior systems theoretical framework through a comprehensive investigation of the primary typologies (screen, module, unit) and territories (soft structure, furniture, bathrooms, kitchens, offices, prefab house interiors, mobile, digital realm, and mobile interiors) of the prefabricated interior. The text identifies and theorises the significance of prefabricated interiors within the broader context of architecture and design. I articulate how these elements have been crucial in driving prefabrication technologies and shaping interior environments throughout history. I argue that prefabricated interiors align with my interior systems theoretical framework, which posits that these living spaces are integral system components, enabling adaptability, transportability, and emotional connection for inhabitants through customisation.

One key point is the systemisation of prefabricated interior typologies from screens to modules and units, demonstrating their historical importance in architectural development. A critical aspect of the volume is my discussion of how prefabricated interiors, particularly kitchens, have overcome the stigma associated with prefabrication by focusing on efficiency and accuracy. Examining various case studies, such as the Total Furnishing Unit and the Dymaxion Bathroom, further emphasises the role of prefabricated interior design in addressing cultural, functional, and technological challenges.

My position also raises important questions about the success and limitations of prefabricated interior elements. Despite advancements, issues like adjustability and user comfort remain significant, as seen in academic investigations like the Cornell Kitchen and RISD Universal Kitchen.[1] Moreover, the discussion extends to the modern office

[1] The Cornell Kitchen, presented in 1952, developed by Cornell University's Housing Research Center, featured five prefabricated movable "centers" (mix, serve, range, sink, and refrigerator/oven) that could be configured in various ways, as a modular set, with sub-module interior components, and adjusted for user comfort. A 1998 Rohde Island School of Design (RISD) project resulted in the "Min" and "Max" kitchens, customizable kits of interchangeable modules.# Modern kitchens typically consist of off-site constructed modular pieces installed at standard heights.

environment, where prefabricated elements like cubicles have become deeply ingrained but are now being reconsidered for more adaptable solutions (see Figure 2). This reflects a broader focus towards regenerative design, where prefabrication offers benefits such as reduced waste and increased lifespan of elements. The text introduces the concept of the mobile interior as mass-produced and capable of reconfiguration. Lastly, the text introduces the concept of wearable interiors, introducing an approach to spatial design that emphasises mobility and adaptability.

Figure 2: Kruikantoor Mobile Office | Tim Vinke | 2010

This book is a seminal contribution to establishing and elucidating my interior systems theoretical framework, establishing principal typologies and territories within prefabricated interior design. It elucidates the significance of such interiors within the broader architectural and design milieu, delineating their instrumental role in propelling technological progress and moulding interior landscapes across epochs. Through a methodical examination of typologies and illustrative case studies, I articulate the alignment of prefabricated interiors with the tenets of my interior systems theoretical framework, facilitating adaptability, portability, and emotional resonance for occupants.

Key tenets encompass the historical trajectory of prefabricated interior typologies and the surmounting of societal apprehensions through efficacious design paradigms. The narrative also provokes inquiries regarding the efficacy and constraints of prefabricated interior solutions, accentuating an ongoing pursuit of regenerative design imperatives. Moreover,

my conceptual introduction of mobile and wearable interior constructs provides innovative approaches to spatial organisation, accentuating mobility and versatility within contemporary living environments (see Figure 3). This volume furnishes invaluable insights into the historical, present, and future trajectories of prefabricated interior design, thereby influencing discourse and innovation within the discipline.

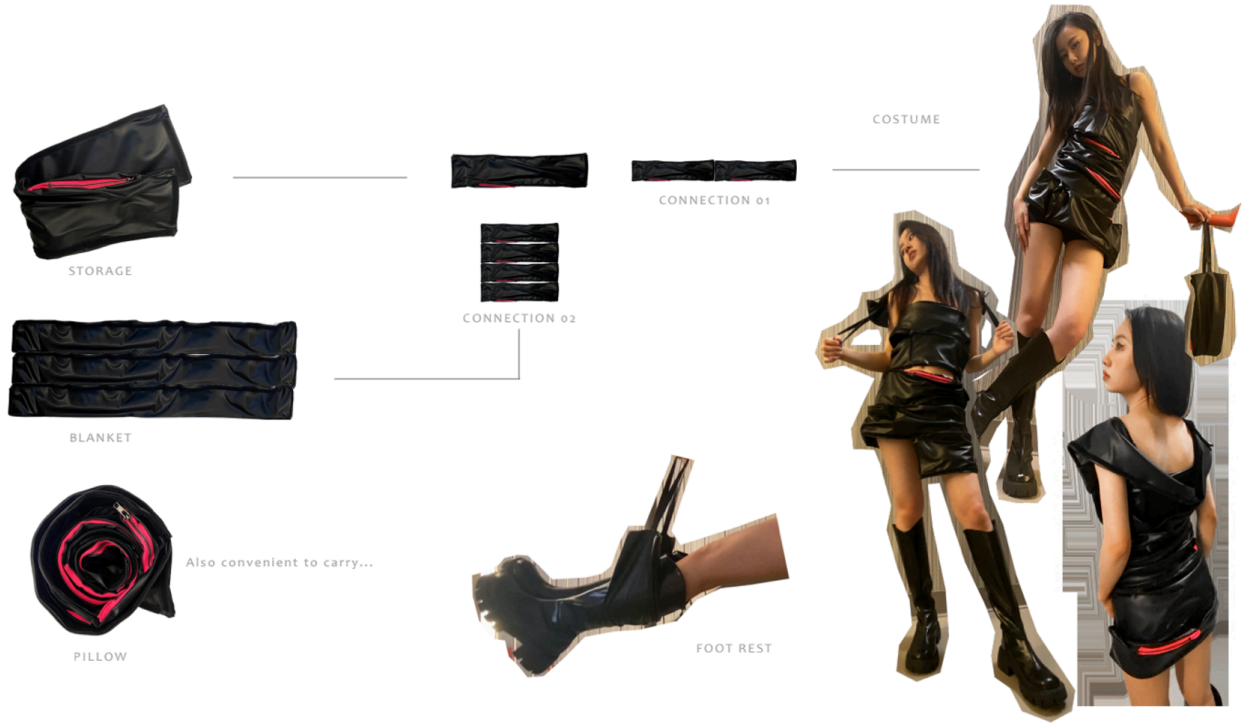

Figure 3: Wearable apparatus to make the experience of riding on a train in coach more comfortable developed for the Prefabricated Interior Studio: Mobile Interior at Pratt Institute by | Yuxi Wang | MFA Interior Design Candidate | In my Prefabricated Interior Studio, centred on the Amtrak Train, students were assigned a charrette project at the beginning of the course. This exercise aimed to establish design strategies and programmatic elements for their train interior proposals. The wearables were fabricated at full scale | 2022

07.II [Book Chapter]
Schneiderman, D. (2019). Ornamental Futures. In G. Brooker & H. Harris (Eds.), Interior Futures (pp. 74-81). Swindon: Crucible Publishers.

This book chapter proposes a modularised system of digitally mass-customized mouldings, evidencing the applicability of my interior systems theoretical framework at the scale of interior detail. With the advancement in parametric design and digital fabrication of interior components, the concept of ornamentation can undergo a significant shift, becoming customisable interventions specific to the site and occupants. Traditionally, mouldings were influenced by proportion and allegory, but contemporary mass-produced versions lack personal connection. In this chapter, I advocate for integrating advanced computational techniques into the mass production of prefabricated customisable moulding elements, arguing that they promote an emotional connection that prolongs their use.

Historically, architectural details have mirrored human or natural forms, as seen in Vitruvius' mathematical proportions and Francesco di Giorgio's analysis of cornice profiles in relation to facial features. Similarly, Le Corbusier's Modulor system and Jacques François Blondel's observations highlight this connection. Allegory has also played a significant role in ornamentation, as seen in Marie Antoinette's private chamber at Versailles and the Worsham-Rockefeller Dressing Room. These spaces were adorned with symbols and motifs reflecting personal narratives and aspirations.

The Embedded Portrait series reimagines decorative ornamentation as digitally designed and prefabricated mouldings reflecting the inhabitants of a space (see Figure 4). These dynamic mouldings, made from recycled paper, visually resemble traditional mouldings while embodying contemporary customisation and fabrication techniques. The mouldings can capture snapshots of multiple inhabitants or evolve over time. The design process involves simplifying desired inhabitant profiles into curves using Rhino, which are then lofted and transformed into modular moulding elements through parametric scripts. These modules can be combined in various permutations to create unique installations. Parametric design enables the mass customisation of these mouldings, aligning with

individual preferences and spatial requirements. Modularity, prefabrication, and parametric design align with interior prefabrication principles focused on emotional connection, efficiency, sustainability, and adaptability. They represent a forward-thinking approach to interior ornamentation, where customisation and relocation converge to personalise architectural spaces' aesthetic and functional qualities. The prototyped test mouldings were derived from the profiles of my own family.

I argue that the Embedded Portrait mouldings exemplify the future of digitally induced, industrially produced, customisable products tailored to individual tastes and architectural needs. They blend historical ornamentation traditions with modern computational methods, offering mass-produced yet unique ornamental forms that can be prefabricated and readily tailored to specific spaces and inhabitants. I assert that the resultant interior product is aligned with interior systems framework; through its ability for specificity, it generates a greater connection to its inhabitant, extending its useful life and adding to its material sustainability.

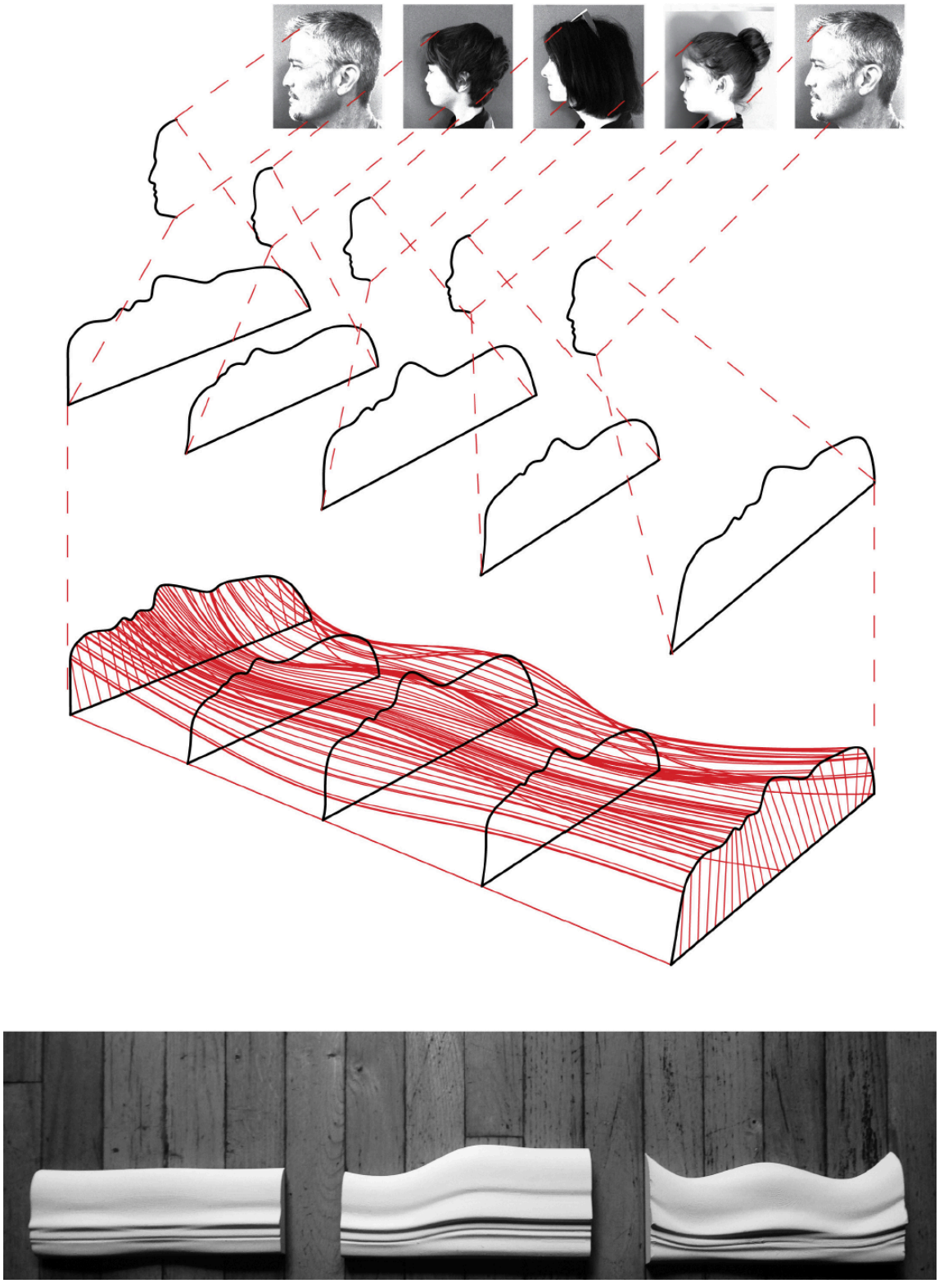

Figure 4: Embedded Portrait | Deborah Schneiderman | The embedded portrait prototype was developed by creating profile drawings of my family members. Multiple profiles were then lofted in Rhino to form modules. By utilising Grasshopper scripting, the modular system has the potential for mass customisation, allowing for diverse configurations through algorithmic design | 2016

07.III [Conference Proceeding]
Schneiderman, D., & Coggan, A. (2019). Productive Draping: The Making of and Research behind the Performative Curtaining Project. In Textile Intersections. London. Retrieved from https://doi.org/10.17028/rd.lboro.9724706.v1.

The conference proceeding paper evidences the implementation of my interior systems theoretical framework as The Productive Draping Project, a series of prototyped curtains, three of which I designed and fabricated. I argue that the modular, adaptable, and transportable textile-based prefabricated interior elements are inherently place-making. The project represents a collaborative effort intended to refine architectural spaces and enhance interior functionality.

Traditionally, drapery has served practical purposes such as light filtration, privacy provision, and draft minimisation. In historical contexts, the emergence of picture windows in mid-century American homes led to the use of drapery to rectify architectural imbalances caused by exterior symmetry prioritisation. Moreover, contemporary urban structures featuring expansive glass facades have compounded these challenges. Unlike Petra Blaisse's focus on site-specific spatial solutions, Productive Draping addresses commonplace interior issues, including those arising from extensive glass surfaces and obstructive HVAC elements. The issues can be readily solved by the modular and adaptable design of the productive draping.

By designing, fabricating, and testing multiple curtain prototypes, the project explores the practical applications of curtains in addressing architectural and interior challenges, such as lighting, ventilation, and spatial adaptation. Productive Draping prototypes were developed through a comprehensive taxonomy that explored the practical aspects of drapery using both traditional and digital techniques (see Figure 5). This praxis research extends theoretical inquiries in interior design, aiming to reimagine domestic environments. Employing diverse fabrication methods and materials, including hand and machine sewing, smocking, folding, and smart textiles, the prototypes showcase the versatility of drapery in adapting to various spatial and climatic conditions.

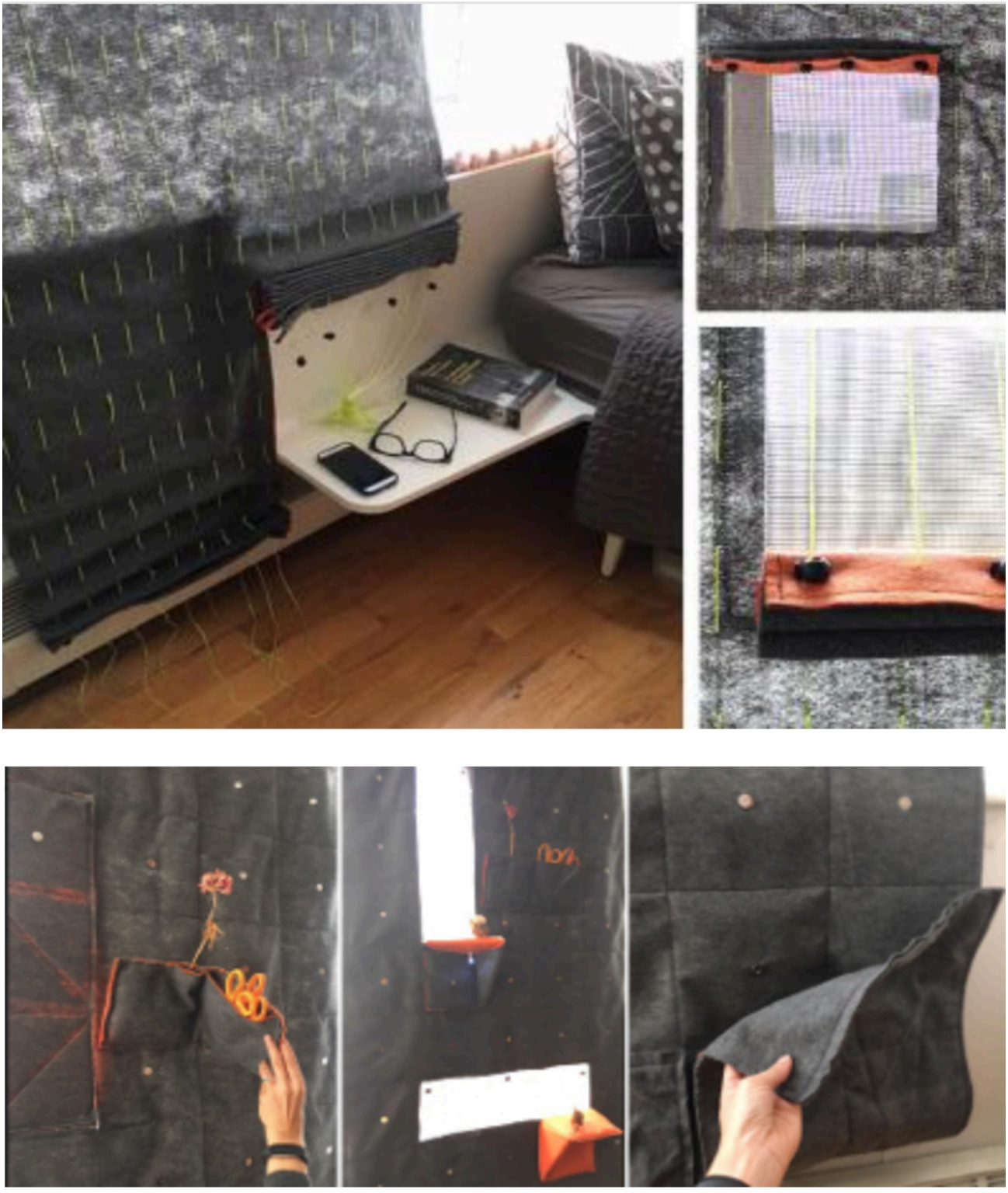

Figure 5: Productive Draping | Retractable Curtaining and Snap Switch Curtaining | Deborah Schneiderman | I designed Retractable and Snap Switch curtaining systems to address personal challenges related to window treatments. These systems are capable of being readily reconfigured to provide both privacy and views, adapt to existing conditions, and be modified according to seasonal changes | 2018

The prototypes developed through the Productive Draping project transcend mere decoration, offering solutions that dynamically frame views and adjust to changing environments. By questioning conventional consumption patterns, particularly in the realm of home goods, the prototypes underscore the potential for multifunctional objects to redefine interior spaces. Retractable Curtaining and Snap Switch Curtaining address issues related to HVAC systems and window configurations, as they can be readily lengthened or shortened to adapt to multiple interior conditions. View/Furniture Curtaining integrates decor and furnishing functionalities. All are developed as a modular system and hence can be readily adapted by their users.

By merging decorative and practical functions, such as lighting and framing, these prototypes contribute to a cohesive and redefined concept of interior living. Due to their adjustable height and modular nature, users can tailor these draperies, enhancing their functionality, adaptability, and portability. I argue that The Productive Draping Project fosters versatility by involving users in the design process. It establishes an emotional connection with the product, aligning with my interior systems theoretical framework principles.

07.IV [Book Chapter]
Schneiderman, D. (2018). Inside the Prefab House. In G. Marinec (Ed.), The Interior Architecture Theory Reader (pp. 116-124). Abingdon and New York: Routledge.

In this book chapter, I establish that the interiors of prefabricated houses can be hierarchically more significant than the exterior. Some of the analysed prefabricated interiors align well with my interior systems theoretical framework as they invite inhabitant participation in their arrangement; others are predetermined and fixed. However, fixed ones still align with systems thinking in their design and manufacture and are often set because they are incorporated into the house's structure.

Historically, the development of prefabricated houses has been closely intertwined with prefabricated interior components. The Manning Portable Cottage, dating to 1830, marked the inception of prefabricated housing. Subsequent innovations, such as the Sears and Roebuck kit homes, introduced early forms of interior prefabrication, like drywall interior linings, streamlining construction processes. One notable example is Buckminster Fuller's Dymaxion Bathroom (1936), a complete interior prefabricated unit designed for efficiency and compactness. This innovative concept influenced later developments in prefabrication, including modern pod bathrooms.

I argue that several typologies exemplify the integration of prefabricated interiors within prefabricated housing. The Lustron House, introduced in 1946, exemplifies a conceptual harmony between structure, interior, and exterior through material and finish. Similarly, Joe Colombo's Total Furnishing Unit (1971) is a unit-based prefabricated interior incorporating all essential home elements. Shigeru Ban's Furniture House systematically elevates interior elements to multifunctional structural components, blurring boundaries between interior and exterior. The Composite House proposed by su 11 Architects conceptualises large-scale programmed modules which are simultaneously interior and exterior components as a user-defined system (see Figures 6 and 7).

Figures 6 and 7: Composite House | SU11 architects | 2003

I articulate that the Lustron House revolutionised prefabricated housing design by integrating modular interior elements, serving functional and spatial purposes. While earlier prefab houses focused on steel exteriors with traditional interiors, the Lustron House utilised porcelain-enamelled steel panels for interior and exterior surfaces, creating a visual connection. The Lustron House also incorporated prefabricated interior furniture. Arguably, a failing of the house was the redundancy in structural design. Had the interior components (dressing tables, storage room dividers, etc.) been structurally integrated, the redundancy could have been reduced, and the interior elements could have achieved a greater hierarchical significance. However, its impact on the evolution of prefabricated interior design is undeniable (see Figures 8 and 9).

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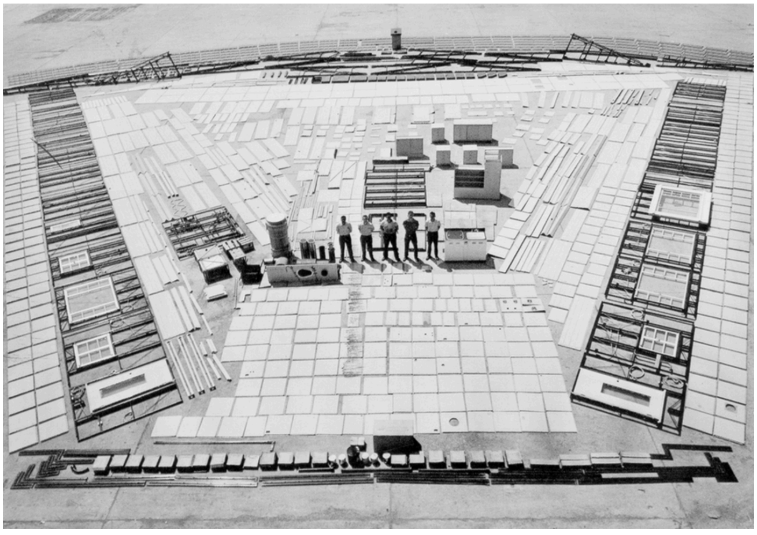
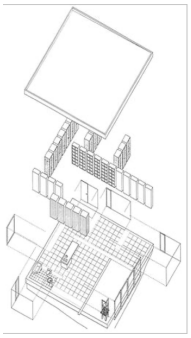


Figures 8 and 9: Lustron House Advertisement | 1948 | Lustron House Parts| 1949

Joe Colombo's prefabricated Total Furnishing Unit redefines the concept of interior space by treating furniture as the primary architectural element. Through visionary designs like the Cabriolet Bed and Roto-Living Unit, Colombo integrates essential living functions into unit-based environmental furniture pieces, blurring the distinction between objects and architecture. His exploration culminates in the Total Furnishing Unit, a prefabricated system that encapsulates all aspects of domestic living within furniture modules, challenging traditional notions of habitat and architecture (see Figures 10 and 11). The unit-environments, while integrated wholes that are not customisable, do have the capacity to be relocated, making transference of place possible.

Figures 10 and 11: Total Furnishing Unit | Joe Colombo | 1971

Shigeru Ban's Furniture House transforms furniture into integral structural elements, merging functionality with architectural design (see Figures 12, 13 and 14). Ban creates a flexible and regenerative design aligned housing system by utilising prefabricated furniture components as load-bearing elements. Each module of the Furniture House is prefabricated off-site, reducing construction time, waste, and environmental impact.


Figures 12, 13, and 14: Furniture House | Construction view | Axonometric | Interior View | Shigeru Ban | 1995

My research demonstrates that each of these projects that address prefabricated interiors emphasises the importance of interior elements within the context of prefabricated housing. The Lustron House, Furniture House, and Composite House all demonstrate a systematic integration of interior and exterior components, marking a progression towards incorporating prefabricated interior elements within the overall prefabricated structure. In all four projects, the prefabricated assemblage serves as programmable interior elements that contribute to establishing place. While two of the examples do not follow the ruleset of my interior systems theoretical framework, the Lustron House and Furniture House are composed with a permanence of the interior prefabricated elements; it is possible to design prefabricated house interiors that are adaptable and customisable. su11's Composite House (where the programmed units are selected and located by the end user and can be relocated in alternated configuration), and Joe Colombo's Total Furnishing Unit and other living environments (the user can personalise units by being relocated within the same site or relocated to a new site) align with my interior systems theoretical framework methodologies. Ideally, prefabricated house interiors would allow inhabitants to customise at least parts of the interior in conjunction with interior elements that might be structural to benefit from positive outcomes evidenced in the application of my interior systems theoretical framework.

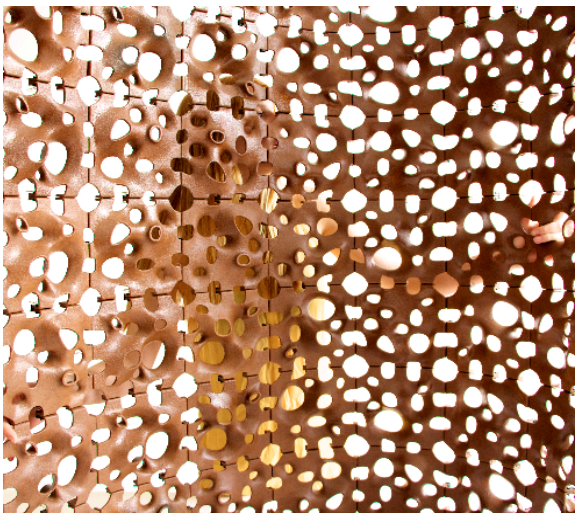
07.V [Book Chapter]
Schneiderman, D. (2016). Bespoke: Tailoring the Mass Produced Prefabricated Interior Environment. In D. Schneiderman & A. G. Winton (Eds.), Textile Technology and Design: From Interior Space to Outer Space (pp. 95-107). London: Bloomsbury.

This book chapter was critical to establishing my interior systems theoretical framework thinking as advanced computational design, and digital fabrication have made a more individually articulated prefabricated interior possible. Merging systems thinking with emotional design theory enables prefabricated interiors to possess the capacity to redefine space and evoke a profound connection with users, thereby enhancing their longevity and setting them apart from conventional prefabricated architecture. I argue that the transient and customisable nature of interior space distinguishes it significantly from permanent structures, enabling inhabitants to personalise their environment in ways that resonate with their preferences and needs. Historically, handcrafted interior elements offered a personal connection, but the advent of industrial production brought about mass-produced goods that lacked uniqueness. However, interior design has continued the tradition of curating collections, even from industrially manufactured components, to create a distinct gestalt that transforms spaces into personalised environments.

Traditionally, prefabricated modular kits allowed some degree of customisation, but their formal outcomes were often limited, and precise fitting was a challenge. The concept of modular design as a form of customisable interior prefabrication has been a consistent focus in the realm of the prefabricated interior. The exploration of modular design in interior prefabrication, pioneered by visionaries like Le Corbusier with Maison Domino and Cassiers Standard (designed with Charlotte Perriand), Charles and Ray Eames with their Case Study House and ESUs (see Figure 15), and Robert Probst with Action Office, laid the groundwork for the immense potential for inhabitants to customise their interiors with prefabricated modular kits of parts. The appeal of mass-customized interior products lies not only in their practicality but also in their capacity for self-expression. As individuals increasingly define their identities through possessions, the uniqueness and personalisation of interior elements become paramount, fostering deeper emotional connections.

Figure 15. ESUs | Charles and Ray Eames | 1950

Recent advancements in digital fabrication technologies have revolutionised the customisation of serially produced interiors. The parametrically derived digital fabrication of interior products and environments is a subset of prefabricated interiors. One can view the production of the elements as existing within the digital realm, ready for tailoring to a specific user or space and a direct fabrication from computational model to product on or off-site. Similar to bespoke tailoring, digitally fabricated interior products cater to individual preferences, instilling emotional responses tied to culture, exclusivity, and personal taste. Parametrically derived prefabricated interior elements and environments are increasingly being developed with significant prototypes and products from Rael San Fratello (see Figures 16 and 17) and Nervous System.



Figures 16 and 17: Sawdust Screen |2014 | Saltygoo | Rael San Fratello | 2013

The eponymous design firm Rael San Fratello, founded by partners Ronal Rael and Virginia San Fratello, has been at the forefront of experimentation with 3D printing since its inception. Their research involves not only material formulation but also the design of elements to be printed, resulting in transformative applications such as high-performance site-specific and parametrically derived 3D printed curtains that offer passive solar benefits and energy savings. Nervous System, founded by Jessica Rosenkrantz and Jesse Louis-Rosenberg, specialises in product design driven by computer simulation and digital fabrication. Inspired by patterns found in nature, their designs are created through scripting programs, enabling mass customisation and serial production. Through web-based applications Radilara, and Cell Cycle, customers can customise pieces within specified parameters, allowing individualised products that reflect user preferences and fit with specifity into interior spaces (see Figure 18).

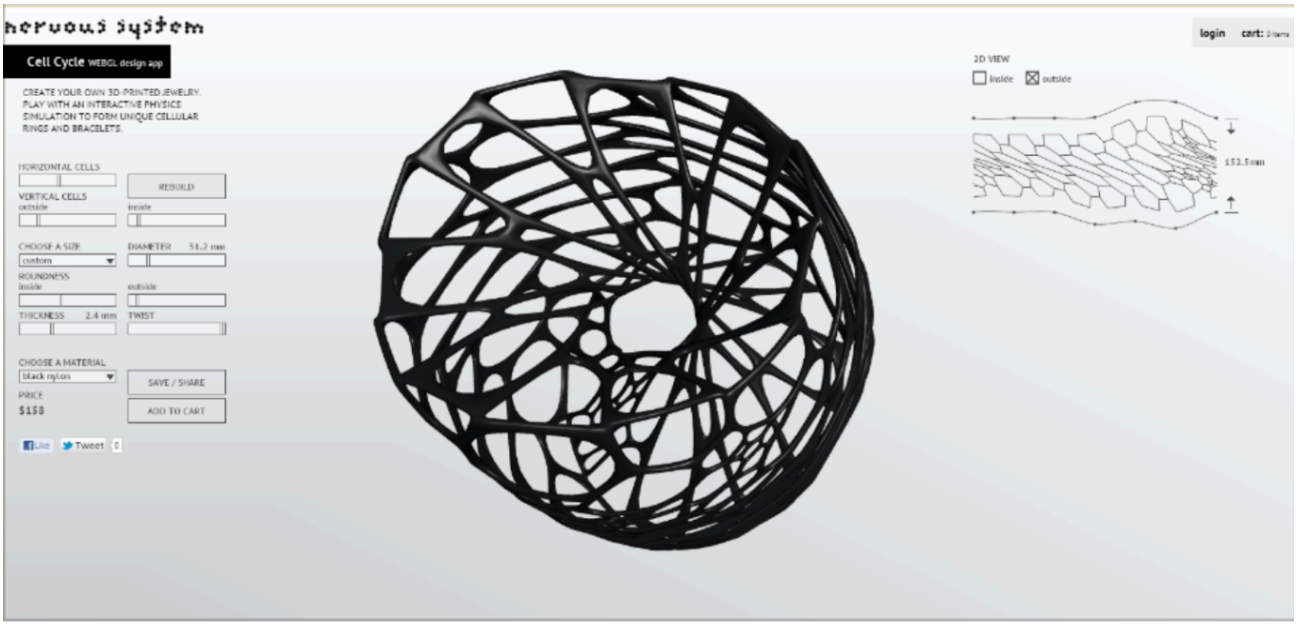


Figure 18: Cell Cycle Parametric Software Generator | Nervous System | 2009

While some argue that true emotional attachment requires historical memories, I argue that mass customisation can bridge practical and emotional needs for interior products. By digitally fabricating parametrically designed one-of-a-kind pieces, users obtain aesthetically and functionally tailored products and establish a deeper connection through their involvement in the creation process, such as Cell Cycle products. This democratisation of

consumption addresses the aspirational nature of bespoke goods while fulfilling the desire for distinction and individuality. The potential of digitally fabricated interiors goes beyond mere functionality, offering greater adaptability to individual tastes and fostering emotional attachment. My research evidences that user involvement in creation could lead to products aligned with regenerative design principles, as enhanced connection and functionality reduce disposability, thereby decreasing consumption and waste. Thus, the introduction of digitally prefabricated interiors enhances customisation through parametrically generated systems capabilities and holds promise for longevity through emotional resonance in interior spaces.

07.VI [Book]
Schneiderman, D., & Som, B. (Illustrator). (2014). The Prefab Bathroom: An Architectural History. Jefferson: McFarland Publishing.

In this book, I argue that the evolution of the bathroom as a prototype for architectural prefabrication evidences the capability of a plug-in systems approach to fabricating built environments. Examining prefabricated bathrooms spanning a century reveals that while unit-based pod systems are most commonly recognised, modular and screen-based types also hold significant importance. The book traces bathroom history from ancient communal baths to current prefab designs. It emphasises the complexities of bathroom construction, which require coordination among various trades and precision to avoid poor quality. This complexity has driven designers to explore modularisation and prefabrication.

Buckminster Fuller's Dymaxion Bathroom was a critical instigator of prefabrication technology. Designed in the 1930s, it aimed to streamline bathroom construction by treating it as a machine-like unit. Although never mass-produced, the Dymaxion Bathroom's influence extended beyond bathrooms, shaping design theory and technology in architecture and the built environment. The 1940s saw various prefab bathroom prototypes featured in publications like Architectural Forum, demonstrating a growing interest in modular and integrated bathroom designs, including George Sakier's Unit Bathroom Panels, In the 1960s, the introduction of moldable plastic led to a resurgence in prefab bathroom design. Plastic's versatility allowed for complex forms and integrated functionalities, but durability concerns eventually led designers back to ceramic fixtures. Alexander Kira's 1968 book “The Bathroom” emphasised function over materiality, focusing on anthropometric studies and the ritual aspect of bathing. His proposal, the Experimental relaxing/washing facility, aimed to incorporate cleansing and relaxing functions while ensuring proper fixture placement for optimal functionality. The influence of bathroom pods extended beyond interiors to inspire a new form of architecture, including plug-in or pod architectures like Peter Cook's Plug-In City and Kisho Kurokawa's Nakagin Capsule Tower (see Figure 19). These structures prioritised adaptability, allowing for easy replacement of outdated components.

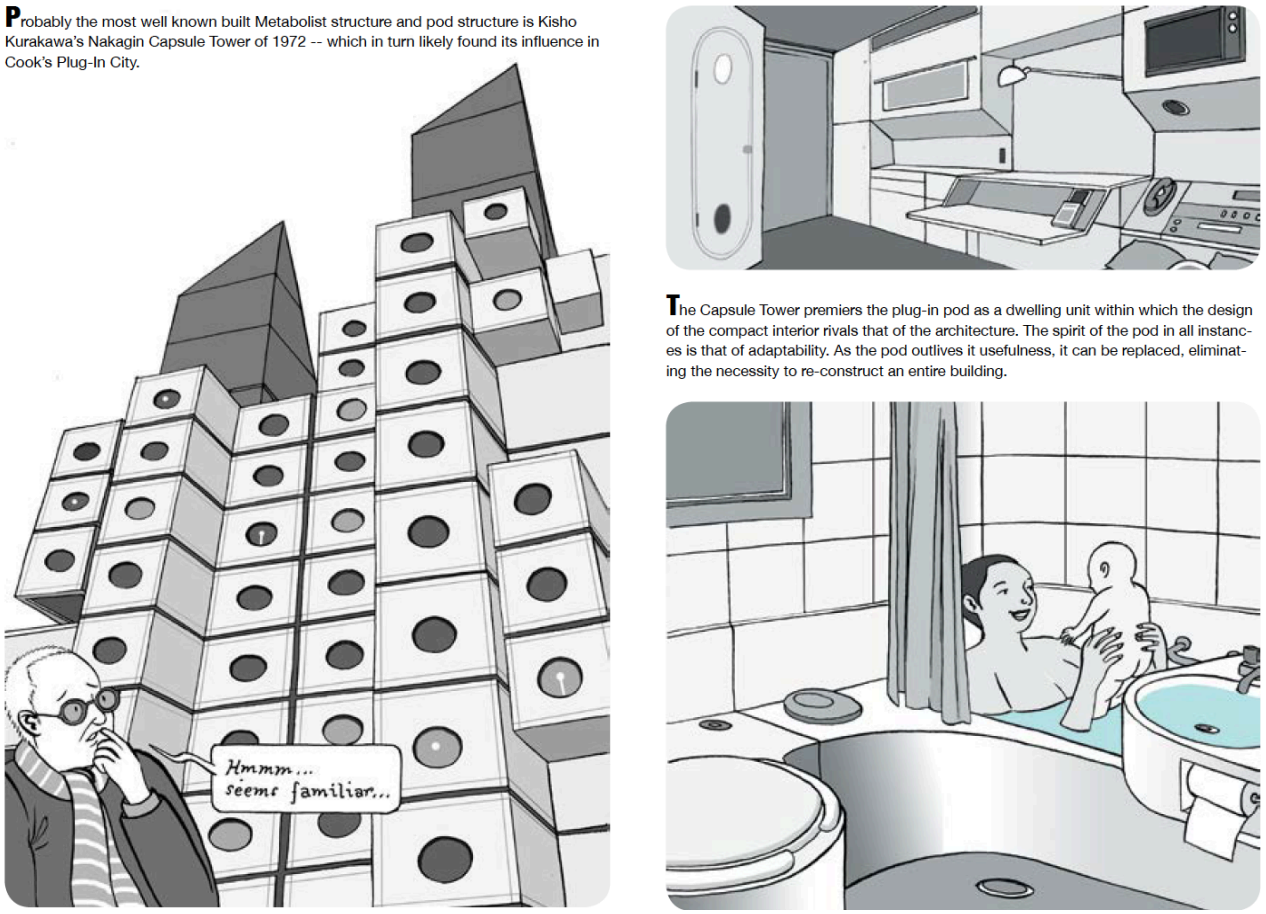


Figure 19: Illustration Spread Spread for The Prefab Bathroom: An Architectural History | Illustration: Bishakh Som | 2014 | the illustration demonstrates the international prevalence of pod and plug-in construction on both interior and exterior with views of the Nakagin Capsule Tower, Kisho Kurokawa | 1970

In contemporary architecture, firms like Kieran Timberlake advocate for off-site fabrication, emphasising the production of assemblies rather than individual parts. They draw parallels with the automobile industry's modular production methods, aiming for mass customisation and integrated component assemblies. In the book, I foreground recent innovations in prefabricated bathrooms, such as greywater sustainability systems and designs like the Cirrus MVR and the Flo bathroom. These designs incorporate regenerative design practices and ergonomic considerations for water conservation and user comfort. It discusses the Bathroom of the Future 2025 project by Pratt Institute faculty, which integrates prefabrication and regenerative design techniques like phytoremediation and biomimicry. The project emphasises atmosphere and ritual experience while addressing water conservation challenges (see Figure 20).

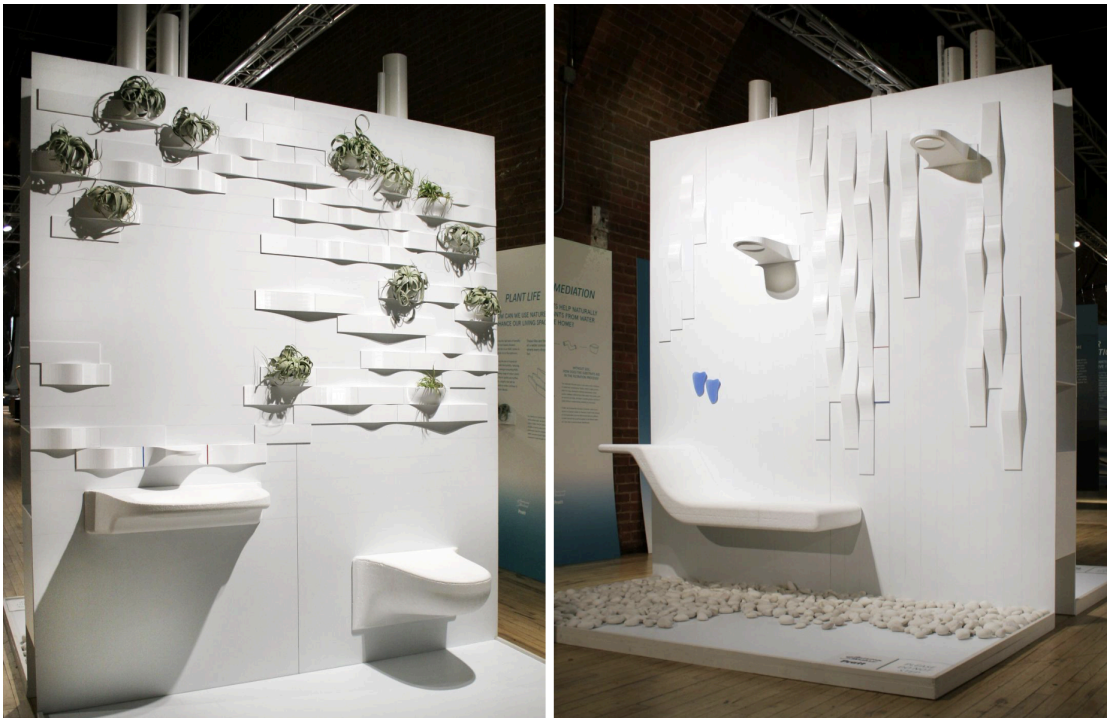


Figure 20: Bathroom of the Future 2025 | Courtesy Constantin Boym, Jess Smith, Will Stafford, and Alex Thompson from Pratt Institute's Design Clinic research accelerator | 2019

The bathroom is a room that must fulfill its function as a sanitary space parallel to the equally important purpose of relaxation that the bathroom of Western culture serves. Historically, the bathroom has undergone relatively few ergonomic or spatial changes. However, I argue that the prefabricated bathroom is a pivotal typology in revolutionising construction techniques and promoting regenerative design in the built environment. It underscores the importance of continued innovation in prefab construction to address contemporary challenges.[2]

[2] The use of mass-manufactured prefabricated elements/products (slip-cast clay WC's, sinks etc) is understood and embraced in bathrooms.

08: Commentary

08.I Context

My research, most notably “The Prefab Bathroom”, “Inside the Prefab House”, and “The Prefabricated Interior” (Schneiderman, 2014; Schneiderman, 2018; Schneiderman, 2025), reveals that the investigation into modern prefabrication has enjoyed much attention in the architectural community for over a century (Fuller and Marks, 1960; Herbert, 1984; Fetters, 2002; Kieran Timberlake, 2004;).Still, the literature documenting the significance of interior design and interior elements on prefabricated technology contains a notable gap. There has been virtually no pointed discussion on the influence and importance of prefabrication within the interior environment other than my own scholarship; as I make evident in “The Prefabricated Interior” (Schneiderman, 2025), the most critical references are discussions of kitchens (Beecher and Beecher Stowe, 1869, Beecher, 2001; Beecher 2008).

Innovations in the prefabricated interior have ranged from individual elements to complete assemblages.[3] As introduced in my first book, “Inside Prefab: The Readymade Interior” (Schneiderman, 2012), and further developed in my chapter “Inside the Prefab House” (Schneiderman, 2018) and “The Prefabricated Interior” (Schneiderman, 2025), my publications demonstrate that constructs of the prefabricated interior have defined space, either as complete prefabricated assemblages or through the repetition and fabrication of the module, essentially becoming place-makers within the built environment. I assert that elements of the interior effectively become place-makers when they are positioned or assembled in such a manner to organise an undefined area into a cohesive, defined, and programmed space. I argue that explorations of prefabricated interior elements have informed investigations and inventions in prefabrication, clearly evidenced in “The Prefab Bathroom” (Schneiderman, 2014), on greater scales within the built environment. The techniques and applications of prefabrication of the interior have been evident for thousands of years, and prefabrication in the built environment owes much of its advancement to concepts investigated in relation to interior elements and components.

[3] Elements refers to screens and modules, assemblages refers to units.

My scholarship evidences that articulating the prefabricated interior has been critical in developing modern prefabrication techniques and in the assemblage of interior three-dimensional space. The consideration and implementation of the prefabricated interior requires systems thinking. Systems thinking in interior design refers to an approach that considers interiors, buildings, and built environments as complex systems composed of interconnected and interdependent parts. Instead of viewing built environments solely as individual structures or elements, I introduce the notion that systems thinking emphasises understanding the relationships between various elements within the built environment in “The Prefabricated Interior” (Schneiderman, 2025). The appreciable benefits inherent in interior prefabrication foster regenerative design and include limiting material use and waste, end product adaptability, and extended life – multiple volumes of my published research demonstrate that the impact of such elements and strategies could influence the environment locally and globally (Schneiderman 2012; Schneiderman 2016; Schneiderman, 2018; Schneiderman, 2023).

08.II Objectives

Explore the role of prefabricated interiors in fostering emotional attachment within built environments, examining how design elements and customisation options can evoke belonging and personalisation for occupants, extending their useful life.

Examine prefabricated interiors as a typology of systems thinking, evaluating their ability to integrate various components, adapt to changing needs, and optimise performance through a holistic approach to design, construction, and operation.

Investigate the regenerative design implications of prefabricated interiors as a design strategy, analysing their potential for extended longevity, resource efficiency, and labour efficiency compared to traditional construction methods.

Assess the flexibility and adaptability of prefabricated interiors for transformation and relocation, investigating their capacity to accommodate evolving spatial requirements, facilitate modular expansion or contraction, and support the regenerative design practice of reuse.

Investigate the potential for user input and participation in designing and implementing prefabricated interiors, exploring methods for incorporating feedback, co-creation processes, and collaborative decision-making to enhance user satisfaction, functionality, and overall performance.

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08.III Theoretical Framework: 'Interior Systems Theoretical Framework' for Prefabricated Interiors

Upon contemplation of my scholarship, praxis, and teaching, I conceived the interior systems theoretical framework simultaneously for this commentary and was also able to incorporate it into my publication "The Prefabricated Interior" (2025). Although I have only recently established this theoretical framework, the introspection necessary for writing this commentary revealed that it has been a fundamental element of my work since the inception of my practice.

The interior systems theoretical framework represents a systems approach to interior design and construction, offering efficiency, flexibility, sustainability, and the potential for emotional connection. Drawing from Bertalanffy's General System Theory, Norbert Wiener's Cybernetics, Don Norman's Emotional Design Theory, and Yi-Fu Tuan's theory of Topophilia, this framework aims to provide insights into the design and experience of prefabricated interior systems.

The primary theory that establishes the technical aspects of my interior systems theoretical framework is General System Theory (GST). GST is a conceptual framework proposed by biologist Ludwig von Bertalanffy in the mid-20th century. It provides a holistic approach to understanding complex systems across various disciplines, emphasising principles such as interconnectedness, emergence, hierarchy, feedback, equifinality, and purposefulness (Von Bertalanffy, 1968).

Prefabricated interiors consist of interconnected elements such as modular components, building materials, and environmental factors. The arrangement and integration of these components affect the overall functionality and aesthetics of the interior space. Prefabricated interiors exhibit emergent properties that arise from the interactions between modular components and their assembly within the space. Prefabricated interiors often have hierarchical structures, with modular components forming subsystems that contribute to the overall spatial organisation, as evidenced in George Nelson's Storage Wall and

Charles and Ray Eames' ESUs. This hierarchical arrangement allows for flexibility in design and customisation while maintaining coherence and integrity in the interior space. Feedback loops within prefabricated interiors can influence user experience and environmental performance. For example, user feedback on the usability and comfort of modular furniture may inform future design iterations, leading to improvements in the overall interior system. Equifinality is achieved as prefabricated interiors offer multiple pathways for achieving desired outcomes regarding functionality, aesthetics, and sustainability. Different combinations of modular components, materials, and design strategies can lead to similar interior configurations, allowing for adaptability and innovation in design. Purposefulness is a critical aspect of prefabricated interiors as they are often designed with specific goals, such as optimizing space utilization, minimizing construction waste, or enhancing user comfort. Design decisions informed by GST principles aim to align these goals with the overall system behaviour and performance.

By applying concepts from GST to the design and implementation of prefabricated interiors, designers can create spaces that are functional, resilient, adaptable, and responsive to user needs and environmental contexts.

Cybernetics is an interdisciplinary field that studies systems, control processes, and communication *in* living organisms and machines. It explores how biological, mechanical, or social systems regulate themselves, interact with their environment, and achieve goals through feedback mechanisms. Cybernetics offers valuable insights and methodologies for designing intelligent, adaptive, and user-centric prefabricated interior systems. By applying cybernetic principles, designers can create interior environments that are responsive, efficient, and conducive to occupant well-being (Wiener, 1948).

Cybernetic principles inform the design and operation of prefabricated interior systems by focusing on feedback loops, control mechanisms, and adaptive behaviours. Feedback mechanisms enable prefabricated interiors to respond dynamically to user needs, environmental conditions, and changing contexts. Designing prefabricated interior systems

with cybernetic features enhances efficiency, comfort, and user satisfaction through intelligent control and the ability to customise them.

Don Norman's Emotional Design Theory is the primary theory that informs the psychological aspect of my interior systems theoretical framework. Emotional Design Theory emphasises the profound impact of emotion on user experience and engagement with products and environments. When applied within the context of sustainability and user participation in the design of modular component interiors or parametrically driven prefabricated interiors, it can significantly enhance user connection and increase the product's longevity (Norman, 2005).

Users participating in the design process of modular component interiors or parametrically driven prefabricated interiors can contribute to creating environments that align with their aesthetic preferences and personal tastes. Allowing users to express themselves through design choices makes the resulting interiors more likely to evoke positive emotional responses. When users have a hand in designing the interiors, they are more likely to engage with and appreciate the various aspects of the space, leading to increased attachment and a sense of ownership as evidenced in the work of Nervous System and Rael San Fratello. User participation in the design process allows individuals to tailor the interior space to reflect their unique identity, lifestyle, and needs. This customisation fosters a sense of ownership and belonging, encouraging users to maintain and care for the interior environment, prolonging its lifespan. The emotional connection formed through user participation in the design process translates into increased attachment to the modular component interiors or parametrically derived prefabricated interiors. Users are more likely to value and preserve environments they have contributed to creating, leading to greater longevity and a reduced likelihood of prematurely disposing or replacing the product.

Incorporating Don Norman's Emotional Design Theory into the design process of modular component interiors or parametrically driven prefabricated interiors enhances user connection and increases product lifespan, which fosters a sense of responsibility toward sustainability and supports a circular economy. This is exemplified effectively in my design

for the Ricco Maresca Gallery, where the gallerists have relocated twice since the gallery's Chelsea completion, necessitating the reconstruction of their slotted steel furniture and storage to suit the spatial requirements of the new venues. By empowering users to participate in the design process, designers can create interior environments that meet functional needs and resonate emotionally with users, leading to more regenerative design-based consumption behaviours.

Topophilia

Topophilia, or the love of place, describes people's emotional connection with their environments (Tuan, 1974). Prefabricated interior systems can foster Topophilia by fostering transportable place where screen, modular, or even unit-based environments can be transposed from one architectured site to another; home is re-established, transforming space to place. Creating prefabricated interiors that evoke a sense of place enhances user attachment, identity, and sense of belonging. The outcome is establishing place that can be relocated between spaces, making place relocatable and not tied to one specific location.

Theoretical Framework Reflection

My interior systems theoretical framework provides a comprehensive framework for understanding and designing prefabricated interior environments. By integrating principles from General System Theory, Cybernetics, Emotional Design Theory, and the concept of Topophilia, I have developed a theoretical framework that offers insights into optimising the performance, user experience, and emotional resonance of prefabricated interiors.

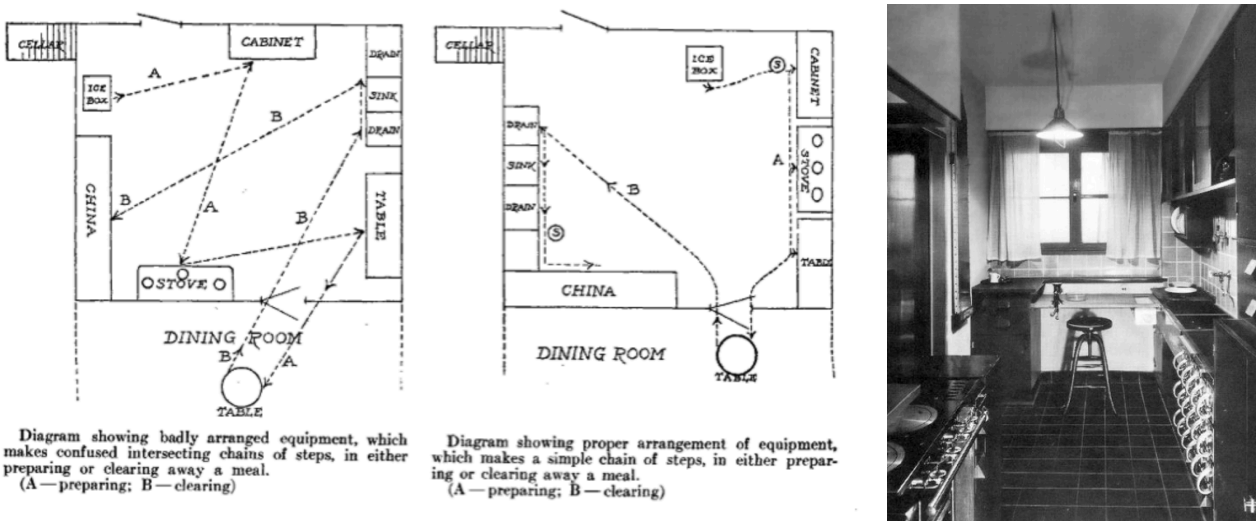
08.IV Review of Literature

After reviewing the existing literature for the subject area, I discovered that the investigation into modern prefabrication has enjoyed much attention in the architecture community for over a century. Still, the literature documenting the significance of prefabricated interior design and interior elements contains a notable gap. There has yet to be a discussion on the influence and importance of prefabrication within the interior environment outside my own scholarship. The commentary analysis is based on a review of the literature. In the publications, I investigate scholarly discourse in architecture, interior design, and technology. The sources incorporate both primary and secondary texts.

Interior prefabrication shapes environments in ways that respond to functional needs through systems logic and engage users emotionally. This literature review delves into the historical roots of interior prefabrication. It explores its contemporary applications in creating environments that extend the life of the interiors by utilising systems thinking to support user involvement, which can manifest in emotional attachment, which extends the life of the environments.

The exploration of prefabricated interiors finds its roots in historical discussions around domestic management and household organisation. Catherine Beecher and Harriet Beecher Stowe's work in "The American Woman's Home" (1869/1975) provides insights into early discussions on efficient kitchen design, which laid the groundwork for prefabricated interior concepts. The Sink and Cooking Form they introduced foreshadowed mid-twentieth-century packaged kitchens, integrating mechanical cores for water heating and ventilation systems as noted by Dorothy Hayden in “The Grand Domestic Revolution: A History of Feminist Design for American Homes, Neighborhoods and Cities” (1981). While these discussions focus primarily on functionality and organisation within domestic spaces, they set the stage for later developments in prefabricated interiors and prefabricated kitchens in particular, with primary examples including the works of Christine Fredrick and Margarete Schütte-Lihotzky.

Frederick's seminal volume “Household Engineering: Scientific Management in the Home” on household engineering emphasises scientific management principles to optimise domestic tasks (1919). While she lays the groundwork for efficient home management, Susan Henderson's examination of Schütte-Lihotzky Frankfurt Kitchen in the chapter “A Revolution in the Woman’s Sphere: Grete Lihotzky and the Frankfurt Kitchen” demonstrates how prefabricated components can enhance functionality and ergonomics (see Figures 21 and 22). Frederick's focus on efficiency complements Henderson's emphasis on user-centric design, making the potential of prefabricated interiors to balance practicality with user satisfaction evident.



Figures 21 and 22: Christine Fredricks Kitchen Diagrams | 1919 | Schütte-Lihotzky’s Frankfurt Kitchen | 1926

Mary Anne Beecher's analysis of manufactured kitchen cabinets in “Promoting the ‘Unit Idea’: Manufactured Kitchen Cabinets (1900–1950)” (2001) and her subsequent article “Packaged Kitchens: Understanding Prefabricated Manufactured Units as Mid-Century Interiors” (2008) offer a deeper understanding of how prefabricated elements became integral to interior design.

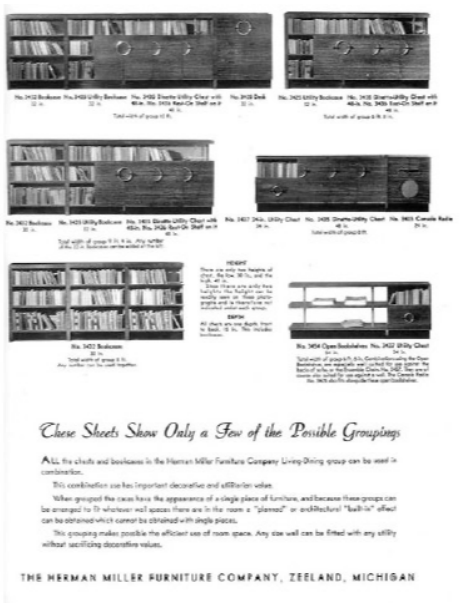
Beecher's examination of the Unit Idea underscores the significance of modularity and versatility in prefabricated kitchen designs, which align with office design, evidencing their ability to meet consumer desires for usefulness and adaptability. Stanley Abercrombie's examination of office furniture design in "Office Supplies" (2000) parallels the prefabricated

interiors discussed in Mary Anne Beecher's works. While Abercrombie focuses on the workplace environment, his exploration of flexibility, collaboration, and employee well-being resonates with the principles underlying prefabricated interiors. Furthermore, in her article “Le Corbusier: Furniture and the Interior” (2000), Charlotte Benton underscores the importance of standardised modular components, aligning with prefabricated elements' functional integration within interior spaces. She notes that Le Corbusier's approach to furniture design as placemaking echoes the aim of prefabricated interiors to create emotionally resonant environments that cater to users' needs and preferences.

Ettore Sottsass Jr.'s (1972) conceptual vision presented in "To Nanda, who Explained Everything to Me," Toshihiko Suzuki's (2008) discussion on architectural furniture design in "Design of Architectural Furniture", and Phyllis Ross's (2004) analysis of Gilbert Rohde's contributions to Herman Miller in "Merchandising the Modern" all delve into the integration of modular units, adaptable systems, and the blurring of traditional boundaries within domestic spaces, albeit from different angles and historical contexts. As conveyed through Ambasz's compilation, Sottsass's visionary narrative presents a conceptual framework of movable modular units resembling shell-like closets on wheels. These units, adaptable to various functions, including kitchen, seating, and storage, challenge conventional spatial distinctions within the home. Sottsass envisions a liberated domestic space where hierarchical boundaries dissolve, fostering fluid and dynamic arrangements. In contrast, Suzuki's discussion of Kenchikukagu, unit-based furniture/rooms, bridges architecture, and furniture design by offering cabinet-like elements—Mobile Kitchen, Foldaway Guestroom, and Foldaway Office—integrated into a cohesive interior environment. Suzuki underscores the transportability and adaptability of Kenchikukagu, which facilitates the segmentation and definition of space within existing interiors, emphasising interchangeability and versatility. Ross's examination of Gilbert Rohde's work at Herman Miller sheds light on modularity within furniture design, emphasising standardised components and modular systems.

According to Ross, Rohde's approach prioritised flexibility and adaptability, enabling easy customisation and reconfiguration of furniture layouts to suit evolving needs and

preferences. Ross underscores how modular furniture empowered users to actively shape their living spaces, fostering a sense of ownership and personalisation. Joseph Pine's concept of mass customisation, as addressed in *Mass Customization: The New Frontier in Business Competition (1993),* aligns with Ross's exploration of modularity in furniture design, emphasising the role of user involvement in creating personalised environments. Pine discusses the benefits of tailored solutions to individual needs, while Ross highlights how modular systems enable users to customise their living spaces. Ross's examination of Gilbert Rohde's furniture designs (see Figures 23 and 24), emphasising flexibility and adaptability, parallels Simon Sadler's analysis of Archigram's plug-in architecture in his book “Archigram: Architecture without Architecture”, which prioritises user participation in shaping the built environment (2005). Both sources highlight the potential of modular systems to facilitate user involvement and emotional attachment. While Ross focuses on furniture design, in “Archigram Architecture Without Architects”, Simon Sadler expands the discussion to include larger-scale architectural concepts, demonstrating how prefabricated environments can adapt to changing user needs and preferences.



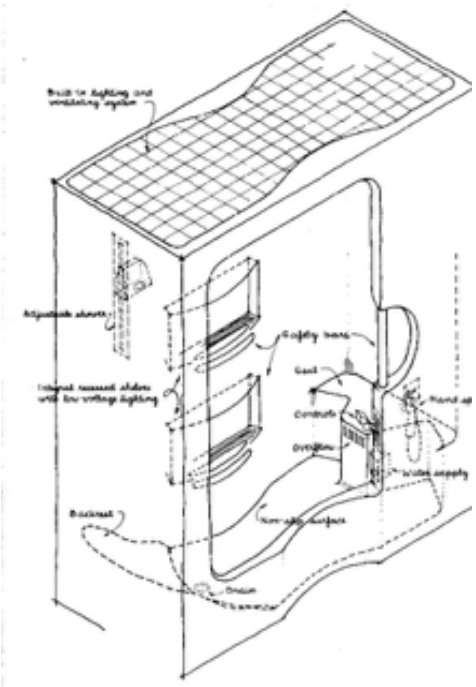
Figures 23 and 24: Gilbert Rohde Modular Case Goods | Modular Upholstered Seating | 1934

Integrating prefabricated elements into design goes beyond functional considerations to evoke emotional responses from users. When describing Archigram's visionary projects,

Peter Cook's book “Archigram” emphasises the importance of responsive architecture and user engagement, envisioning dynamic environments that adapt to users' evolving needs and preferences (1999). This user-centric approach aligns with contemporary design practices prioritising emotional attachment and user involvement in the design process. Similarly, in his book “The Prefabricated Home”, Colin Davies challenges traditional notions of authorship and individuality in prefabricated housing (2005), advocating for a balanced approach that combines standardised models with customisable options to address diverse user needs. This approach reflects a shift towards user-centric design, where customisation is pivotal in creating emotionally resonant environments. Emotional design focuses on creating products or environments that elicit positive emotions from users. In his volume, "Emotional Design: Why We Love (or Hate) Everyday Things", Donald Norman argues that emotional design enhances user satisfaction, leading to increased usability and attachment (2004). By incorporating principles of emotional design, prefabricated interior evidence systems can be tailored to evoke specific emotional responses, such as comfort, tranquillity, or inspiration.

Alden Hatch’s “Buckminster Fuller: At Home in the Universe” (1974) and Thomas T. Fetters “The Lustron Home: The History of a Postwar Prefabricated Housing Experiment” (2002) shed light on the practical applications of prefabrication in architecture and housing that also address interior elements. Fuller's Dymaxion bathroom exemplifies the efficiency and innovation inherent in prefabricated design. At the same time, Lustron homes demonstrate the mass production of prefabricated housing units that include but do not exemplify integrated interior components. In contrast, Alexander Kira's volume “The Bathroom: Criteria for Design” underscores the importance of prefabrication for ensuring quality control to effect the optimal functionality of his researched ergonomic design (1966). What separates Kira’s investigation from those of his peers is not only his rigorous study of anthropometry (the study of the human body and its measurements) but his research is also distinctive because of his design tenet that the design of the bathroom must provide for the ritual aspect of bathing. His prefabricated proposal, the Experimental Relaxing/Washing Facility, includes design solutions for the incorporation of both the cleansing and relaxing functions he considers critical (see Figures 25 and 26). While the

authors address the benefits of prefabrication, Kieran and Timberlake in “Refabricating Architecture: How Manufacturing Methodologies Are Poised to Transform Building Construction” (2004), and Fetters focus on broader architectural processes, while Kira's study delves specifically into the practical applications of prefabrication of bathrooms to ensure optimal ergonomic conditions.



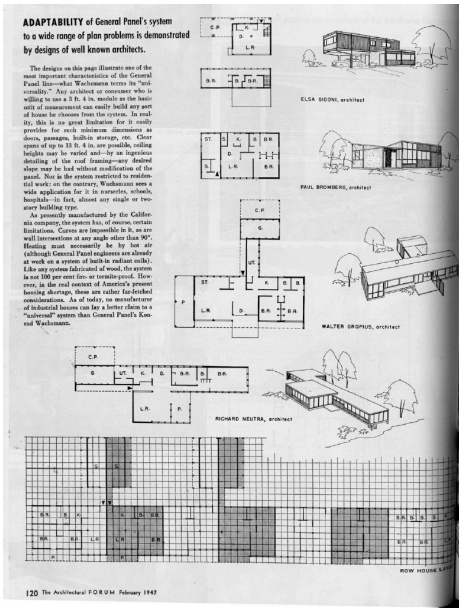
Figures 25 and 26: Alexander Kira’s anthropometric studies and illustration for his prefabricated bathroom design The Experimental relaxing/washing facility | 1966

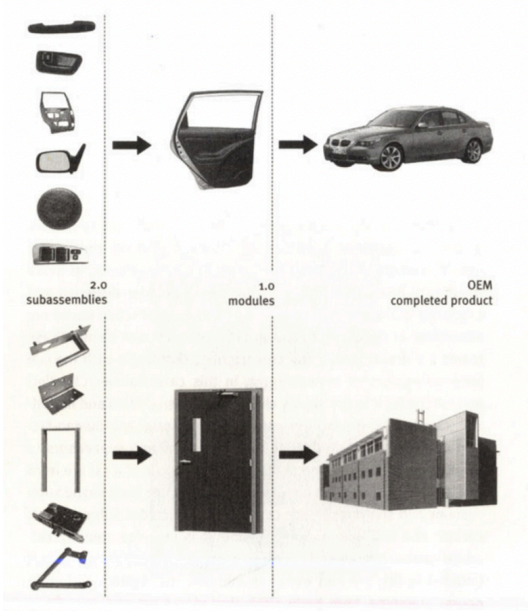
Knerr's volume “Suburban Steel: The Magnificent Failure of the Lustron Corporation, 1945–1951” describes the integration of prefabricated interior components, detailing how they functioned as programmed space and established a material continuity from interior to exterior (2004). Despite challenges in mass production, the Lustron House informs the evolution of prefabricated interiors, demonstrating their significance in architectural history. While the volumes recognise elements of the prefabricated interior, they do not articulate a greater significance of the prefabricated interior as a whole.

Emphasis on Holistic Design in R. Buckminster: Fuller and Robert Marks. “The Dymaxion World of Buckminster Fuller” offers a unique perspective on prefabrication, emphasising holistic design principles such as efficiency, sustainability, and holistic thinking (1973).

While not directly addressing interior prefabrication, Fuller's work underscores the importance of integrated design methodologies in architectural practice. The principles outlined by McDonough and Braungart in "Cradle to Cradle: Remaking the Way We Make Things" are foundational in the discourse surrounding regenerative design and interior prefabrication (2002). They challenge the prevailing cradle-to-grave manufacturing model, advocating for a paradigm shift towards continuous recycling and reuse of products, aligning with the ethos of sustainability and resource efficiency.

Gilbert Herbert's “The Dream of the Factory-made House: Walter Gropius and Konrad Wachsmann” analyses Gropius and Wachsmann's prefabricated housing experiments and provides historical context for developing prefabrication techniques (1984). Meanwhile, Alicia Imperiale's paper “An American Wartime Dream: “The Packaged House System” of Konrad Wachsmann and Walter Gropius” explores the Packaged House in terms of systems thinking and underscores the role of prefabrication in addressing societal needs while considering user customisation through a systems approach (2012). While Herbert's work highlights technical and cultural dimensions, Imperiale's approach aligns with General Systems Theory, emphasising holistic design approaches. Together, these perspectives describe the evolution of prefabrication toward a more integrated and user-centered model. Imperiale's examination of the Packaged House System reveals a collaborative approach to prefabrication, aligning with General Systems Theory (see Figure 27). Kieran and Timberlake, in “Refabricating Architecture: How Manufacturing Methodologies Are Poised to Transform Building Construction”, advocate for a transformation of architectural construction processes, emphasising off-site fabrication and dynamic design approaches (2004). The authors underscore the importance of embracing technological advancements and collaborative methodologies in creating prefabricated structures prioritising efficiency, user participation, and connectedness (see Figure 28).





Figures 27 and 28: The Packaged House | 1942 | KieranTimberlake Assembly Diagram | 2003

In “Designing Consumer-Product Attachment,” Schifferstein et al. focus on understanding consumer emotions and behaviours to inform product design decisions (2004). They delve into the psychological aspects of consumer-product attachment, proposing design strategies to strengthen emotional connections. Their research focuses on understanding consumer behaviours and emotions to inform product design decisions, aiming to enhance product attachment through tailored design approaches. In the article “Manufacturing the Bespoke: Making and Prototyping in Architecture”, Bob Sheil explores the application of bespoke manufacturing in architecture, highlighting the potential for personalised, unique creations (2012). He discusses how bespoke manufacturing techniques can be applied to architecture, emphasising the intersection of traditional craftsmanship with modern manufacturing methods to create customised, emotionally resonant architectural designs. In their article “Hybrid Reassemblage: An Exploration of Craft, Digital Fabrication and Artifact Uniqueness”, Amit Zoran and Leach Buechley investigate the fusion of craft and digital fabrication, emphasising the importance of embracing uniqueness to create emotionally resonant artefacts (2013). Prefabricated interiors support the practice of whole-life design. According to Mausbach and Safa (2021) in their research “Ecofitting – whole-life design upgrading cars to zero emissions at the Royal College of Art”, whole-life design advocates and fosters the practice of reusing, recycling, and enhancing products in

terms of usability, technology, and aesthetics to alter consumption behaviours and advance the principles of a circular economy. Integrating these perspectives underscores the significance of personalised, emotionally resonant design in fostering strong attachments between consumers and products, as evidenced in Topophilia and Emotional Design Theory.

Yi-Fu Tuan's volume “Topophilia: A Study of Environmental Perception, Attitudes, and Values” (1974) and Don Norman's formulation of Emotional Design Theory elucidate the profound influence of human emotions and perceptions on spatial experiences. Tuan's concept of topophilia underscores the emotional attachments and cultural associations individuals form with their environments. In contrast, Norman's Emotional Design can be understood to extend the life of products that users have an emotional attachment to. By juxtaposing Tuan's emphasis on place attachment with Norman's focus on user-centric design, one can interpolate the significance of creating prefabricated interiors that foster a sense of place identity as they can be transported from space to space and that the act of this transportability of place reflects emotional attachment which can be realised with prefabricated interiors. This ability to transport and customise place is supported by systems thinking in the design of prefabricated interiors.

Norbert Wiener's exploration of Cybernetics in “Cybernetics: Or Control and Communication in the Animal and the Machine”(1947) and Ludwig von Bertalanffy's articulation of General System Theory in “General System Theory: Foundations” (1968) offer distinct yet complementary perspectives on understanding complex systems. Wiener's focus on feedback mechanisms and self-regulation resonates with prefabricated interiors' dynamic nature, wherein responsive design elements can adapt to user needs and environmental conditions in real-time. Conversely, von Bertalanffy's emphasis on holistic system analysis underscores the interconnectedness of spatial components within prefabricated environments, advocating for an integrative approach that considers the interdependencies between system elements. By juxtaposing Wiener's cybernetic principles with von Bertalanffy's systemic framework, designers can develop

comprehensive strategies for optimising the functionality and adaptability of prefabricated interiors.

Literature Review Reflection

The review of literature constructs the topic of ‘The Prefabricated Interior.’ It establishes the basis for my interior systems theoretical framework with historical and theoretical sources that combine psychological insights, manufacturing techniques, and design principles. Through analysis, this history and theory can be established by sourcing elements from the literature. However, sources do not acknowledge the overarching topic of the prefabricated interior, which is critical in the built environment. Designers can create environments that engage users through systems capabilities, meet functional needs, and evoke meaningful emotional connections with users that extend their useful lives.

08.V Prefabricated Interior Milieu

What is Prefabrication: A Very Brief Contextualization

The word prefabrication, when used to describe a building typology, was not coined until the 1930s[4] when the business of making building components that could be assembled on a remote site developed into a substantial industry. Prefabrication or off-site fabrication refers to parts of the building, interior or exterior, with either fully or partially fabricated end results assembled in a place other than the building site (typically a controlled factory environment). Ideally, assemblies are fabricated simultaneously (reducing total construction time and costs and creating a more precisely constructed end product) in various locations and fully assembled into the whole at the building site (Kieran and Timberlake, 2004). In my scholarship, I argue that prefabrication or building off-site in a controlled environment supports regenerative design by limiting waste in materials and inefficiencies in labour – while fabricating elements with the benefits of modularity or transportability allows for installation adaptability, increasing the useful life of all the elements. I introduce the benefits of off-site fabrication for interiors in “The Prefab Bathroom”, “Inside the Prefab House”, and “The Prefabricated Interior”, notably these fabrications are more robust than their architectural counterparts as they often have the added capability to be reconfigurable, interchangeable, or transportable (Schneiderman, 2014; Schneiderman, 2018; Schneiderman, 2025).

Foundation

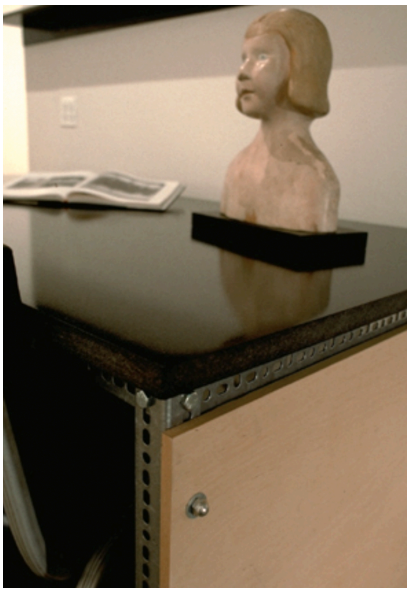
My research on the prefabricated interior began in practice. In 1997, I founded my design practice, deSc: architecture, design, research, focused on sustainability and fabrication techniques aligned with mass production. My projects employed prefabricated and mass-produced products to facilitate construction methods aligned with regenerative design, including slotted steel, plumbing pipe and fittings, steel framing systems dimensions, ready-made steel building kits, and shipping containers. A notable instance of this amalgamation is the integration of slotted steel within various architectural

[4] According to Merriam Webster Dictionary the first use of the word prefabricate was in 1932, the coining of the word is not attributed.

components, including desks, partition systems, and art display/storage solutions (see Figures 29 and 30). The innate structural durability and simplicity of fabrication and re-fabrication associated with slotted steel render it a favourable material for fabricating workstations, adaptable spatial partitions, and efficiently organised art and other storage elements. Furthermore, I utilised plumbing pipes unconventionally as door handles, towel bars, and structural supports in furniture designs. Additionally, the formulation of a systems approach to interior window installations, aligned and grouped within the standardised 16-inch-on-centre framing, served to optimise construction processes and enhance overall efficiency. In my professional work, I also created cut diagrams to ensure that the design accounted for construction materials efficiently, resulting in minimal waste.

In an unbuilt project, I worked with Butler Manufacturing[5] to develop a residential prefabricated steel building design. This endeavour is intended to maximise efficiency by integrating multiple prefabrication techniques. I specified a shipping container within the interior to delineate the interior spaces for the kitchen and bathroom. This approach sought to leverage shipping containers' inherent modularity and portability to expedite construction timelines and enhance the project's overall sustainability. While the project remained unrealised, the exploration was critical in the development of scholarship and teaching of the prefabricated interior.

[5] Established in 1901 in Kansas City, Missouri, Butler Manufacturing™ pioneered the global metal building industry. Originating with the production of factory-made stock water tanks, the company expanded to produce grain bins before evolving into a manufacturer of pre-engineered buildings.In 1942, the Army Signal Corps tasked R. Buckminster Fuller with swiftly developing 200 units. Manufactured by the Butler Manufacturing company, these units were deployed worldwide before the US entered World War II. Each unit carried a price tag of $1,250 at that time. However, due to wartime steel shortages, subsequent production was halted. https://www.nytimes.com/2014/01/02/garden/war-shelters-short-lived-yet-living-on.html




Figures 29 and 30: Ricco Maresca Gallery Desik and Reception | I designed the Ricco Maresca Gallery with the intention of applying regenerative design principles, incorporating systems thinking and regenerative materials. The use of slotted steel angles allowed for the reconfiguration of furniture and art storage in response to the gallery's evolving needs. Since the initial design, the gallery has relocated twice, and the gallerists have successfully adapted the furniture and storage systems to fit the new spaces | 1997

In 2007, I began a tenure track position in interior design at Arizona State University with the expectation of transitioning the tenets of my practice into scholarship. As a designer who, at every possible juncture, replaced words with visual language, this feat seemed impossible. However, in my first teaching semester, I found a natural transition from visual to text-based research. As a new and unfamiliar resident in Phoenix, AZ, I did not have readily available local building knowledge or building plans for developing an interior design studio assignment. Instead, I created my studio project assignment using the familiar prefabricated steel building components. I developed a relationship with Butler Manufacturing; they provided drawings for a building of my specifications to utilise as my studio site (see Figure 31). The students were assigned to research prefabricated interiors as part of the project. The resulting research was limited to office partitions.

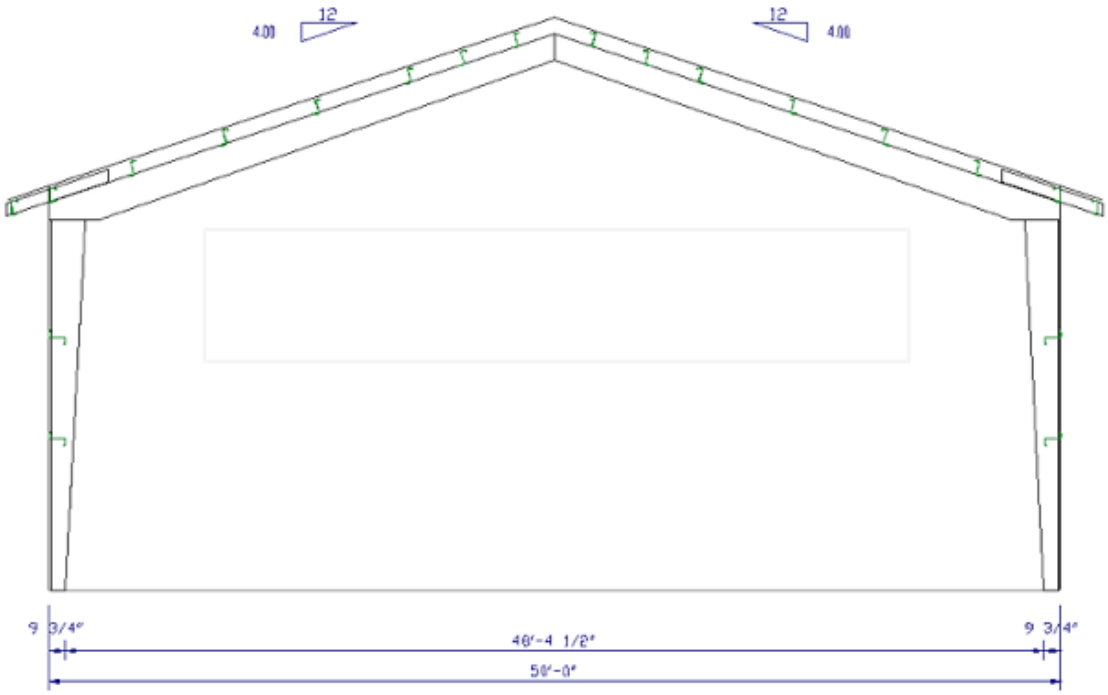


Figure 31: Section through Butler Building Site | When I initiated the Sustainable Envelope Studio, I contacted Butler Manufacturing and requested building drawings tailored to my specifications for the studio. In response, Butler Manufacturing not only provided the drawings but also visited the studio to present their manufacturing processes to the students. Additionally, they organised a series of field visits to Butler Buildings in the area, offering students practical insight into their design and construction methods | 2007

Also critical to instigating this area of scholarship was my visit to the Home Delivery exhibition at the Museum of Modern Art (MoMA) in New York City in 2008, as it provided critical insights into the field of prefabricated interiors. One pivotal aspect of the exhibition was the inclusion of an inhabitable scale fragment of the Lustron House within the museum's interior (see Figures 32 and 33). The Lustron House, known for its prefabricated construction using enamelled steel panels, exemplified the efficiency and mass-production techniques in mid-20th-century prefab housing. The prefabricated furniture elements integrated into the Lustron House demonstrated the criticality of prefabricated interior elements. Another noteworthy exhibition aspect was the Cellophane House, designed by KieranTimberlake and constructed at full scale in a parking lot near the museum.[6] Collaborating with a bathroom manufacturer to construct the Cellophane House

[6] The Bosch Rexroth structural aluminum frame system in Cellophane House was originally designed for interior use to support production lines and was adapted for this multi-storey building fabrication.

underscored the importance of prefabricated bathroom modules in interior design. Prefab bathroom manufacturers were chosen for their expertise in precision manufacturing and installation processes, highlighting the significance of bathrooms as key elements in prefabricated interiors. Though the exhibition included various examples of prefabricated interiors, the concept of prefabricated interiors was explicitly defined or described as a distinct field of inquiry within the context of the exhibition. It then became apparent that there was a gap in the interior design body of scholarship; the topic of prefabricated interiors did not exist, so my research began.

Figures 32 and 33: Lustron House Installation at MoMA | Exterior View | Interior View of Vanity | 2008

What is Prefabricated Interior Design

Interior Prefabrication refers to interiors fabricated off-site that become place-making within an architectured or non-architectured site. Prefabricated interiors, unlike prefabricated architecture, can promote emotional attachment as they are typically customizable, transformable, and transportable, making place relocatable. The conception of these elements has often informed construction on the greater scale of architecture. There has been a long tradition involving the creation of prefabricated interior components, including decorative elements, staircases, and mantles. Even gypsum board, introduced in the early-twentieth-century Sears Kit Homes,[7] is an example of an interior component fabricated off-site and brought to the interior ready to install (Stevenson and Jandl, 1986).

[7] Sears kit homes were prefabricated houses sold through mail-order catalogs by the Sears, Roebuck and Co. company in the United States between 1908 and 1940. These kit homes offered an affordable and convenient housing option for Americans, during the early 20th century.

More importantly, though, in “Inside Prefab: The Ready-Made Interior” (Schneiderman, 2012), “The Prefab Bathroom” (Schneiderman, 2014), and “The Prefabricated Interior” (Schneiderman, 2025), I establish that prefabricated interior constructs have defined interior space and have informed the language of prefabricated architecture. The Prefabricated Interior can be understood as typologies and territories.

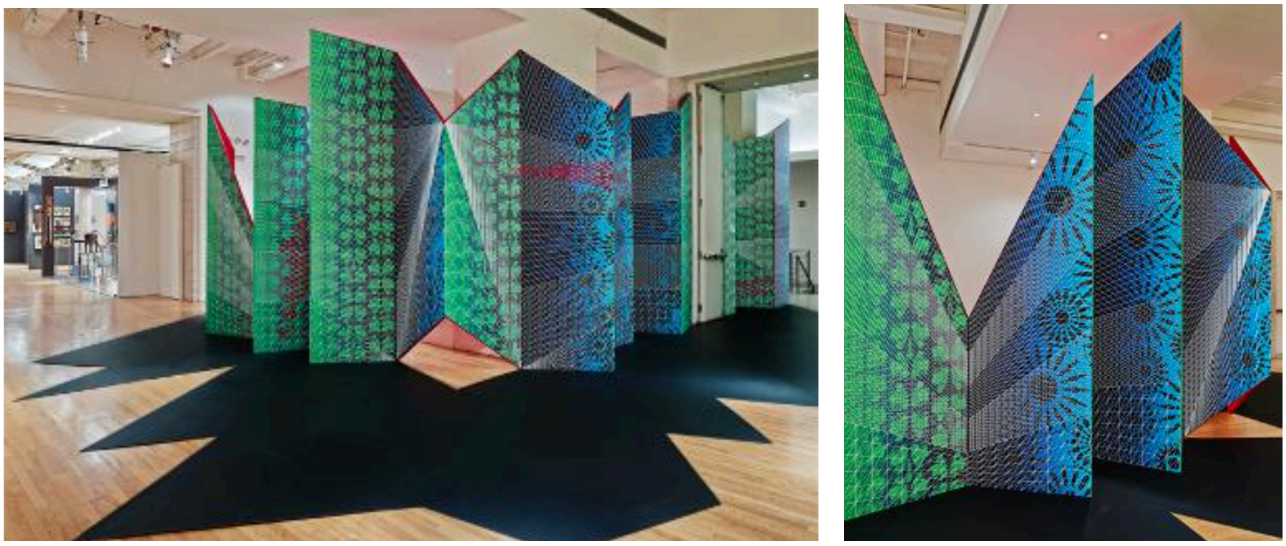
Typologies: The Screen, the Module, the Unit

My published research, including “Inside Prefab: the Ready-Made Interior” (Schneiderman, 2012), “Inside the Prefab House” (Schneiderman, 2018), and “The Prefabricated Interior” (Schneiderman, 2025), establishes terminology and criteria for understanding the prefabricated interior environment. I have developed the nomenclature of typologies and territories in order to analyse the prefabricated interior. The typologies of the screen, the module, and the unit are the basis for the prefabricated interior environment.[8] A screen is a planar element that divides space into a relatively fixed or readily movable object and is the first prefabricated architectonic element.

Screen-based prefabrication is well evidenced in Zigzag (2013), a temporary installation collaboratively designed by Igor Siddiqui from ISSSStudio and my practice deSc, for the MetroShow Art Fair in New York City aims to fuse graphic representation with the tangible experience of spatial design (see Figures 34 and 35). The installation features a prefabricated continuous 100-foot screen with a zigzagging form in both plan and elevation, crafting a spatial sequence that guides movement and selectively reveals or conceals specific viewpoints. Two distinct patterns coexist on the surface, one

[8] The typologies of the screen, module and unit are implemented in the design studio work developed my by students. The typologies have also been referenced in multiple dissertations and theses outside of my institution including - Influence de la phase d’usage dans les enjeux de la rénovation de bâtiments résidentiels écologiques : vers une approche diachronique par Mario Patenaude Faculté de l’aménagement Thèse présentée à la Faculté des études supérieures en vue de l’obtention du grade de Philosophiæ Doctor (Ph.D.) en aménagement; Application of industrial production methodologies in the development of stationary furniture for the building industry. The case of the company CASAIS - EC. Cláudia de Lima Brito Dissertation for Master’s Degree in Product and Industrial Design; Adaptable Prefabricated Interiors in Urban Dwellings, Yiyi Zhou Post-Professional Master of Architecture: Urban Design and Housing McGill University, Peter Guo-hua Fu School of Architecture.

emphasising repetition and the other algorithmically generated using Grasshopper for non-repeating motifs.



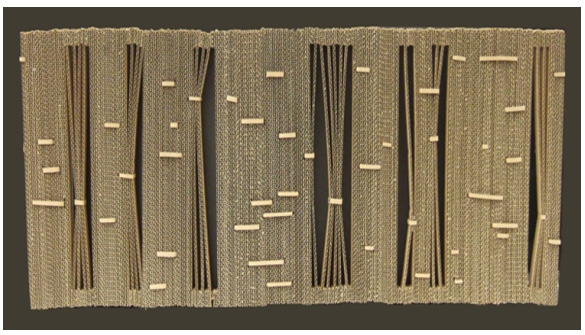
Figures 34 and 35: Zigzag | Deborah Schneiderman | Igor Siddiqui | 2013 | Photographs: Frank Oudeman | The Zigzag project exemplifies the typology of off-site fabrication. This project was designed by my studio in Brooklyn, New York, in collaboration with ISSSStudio in Austin, Texas. The panels were fabricated in Chicago and subsequently installed in New York City | 2013

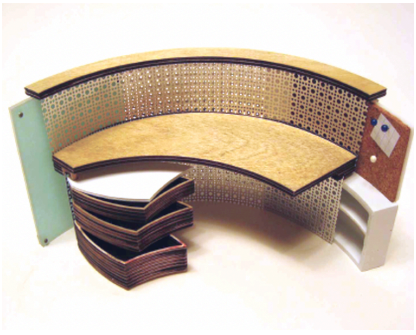
Modular construction, or module, is a standardised component of a system. The module, on its own, typically does not accomplish its intended function. However, in repetition, the module can function as a creator of defined spatial environments. In "Ornamental Futures" (Schneiderman, 2019a), I present computationally generated, digitally produced modular mouldings that can be transported between different interior spaces.

In my definition, unit construction describes a singular unit element designed as an all-inclusive whole (the discussion of the unit can be complex, as it can also be understood to represent the module as a building block). This commentary refers to the unit only as an all-inclusive element and is well evidenced with Joe Colombo’s Total Furnishing Unit (Schneiderman, 2018; Schneiderman, 2025).

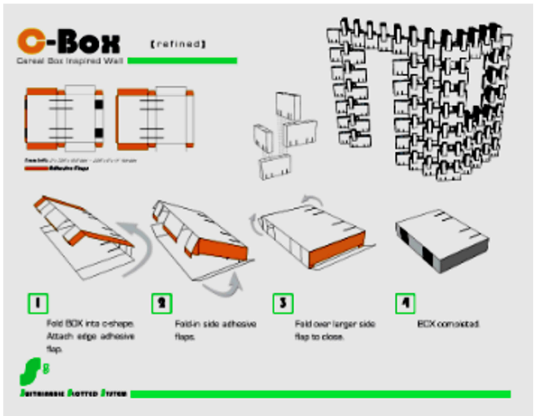
The typologies of interior design are not only referenced in my scholarship but continue to be critical drivers for my student work (see Figures 36-41). Students have integrated these

typologies into their studio proposals and implemented and tested them with the fabrication and installation of full-scale inhabitation for eighteen projects since 2010 (see Figures 42-60).





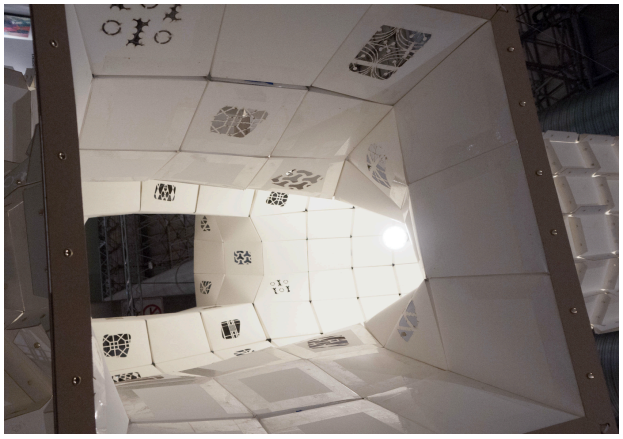
Figures 36, 37, and 38: Arizona State University Student Work | Group Projects | Screen | Module | Unit | The screen, the modular wall, and the desk unit were developed as part of the Sustainable Envelope Studio. The screen and modular wall originated from charrette projects undertaken at the beginning of the semester, both of which were fabricated at full scale. The screen was designed as a desk partition intended to modulate privacy and publicity. The modular wall was conceived as a modifiable partition system, capable of being constructed using upcycled or waste materials. The desk is a unit-based system encompassing all necessary aspects of office work. Through strategies of rotation and telescoping, the unit can expand and contract as needed | 2009

Figures 39, 40, and 41: C-Box | Arizona State University Student Work | Group Project |The modular wall system was designed as a charrette project undertaken at the beginning of the semester in the Sustainable Envelope Studio. This system was conceived as a reconfigurable solution, capable of being constructed using upcycled or waste materials. In 2010, the full-scale prototype was installed in the Arizona State University Design School lobby for an entire year. To make the system accessible to a wider audience, the students developed a website providing instructions on how to build the system | 2009

Figures 42, 43, 44, 45, and 46: Pratt Institute Student Work |Group Project | Full-scale fabrication of CloudSpace installed at the Sculptural Objects and Fine Art (SOFA) fair in Chicago, IL | The installation employed regenerative design principles, utilising discarded plotter tubes for the fabrication of the seating elements. The seating landscape was conceived as a modular system, allowing segments to be separated and stacked for efficient shipping. This system was complemented by inflated trash bags to form a canopy, creating a large-scale beacon that could be readily reduced when deflated. Fabricated at Pratt in Brooklyn, NY, the installation was transported to Chicago, Illinois, on a single pallet| 2013

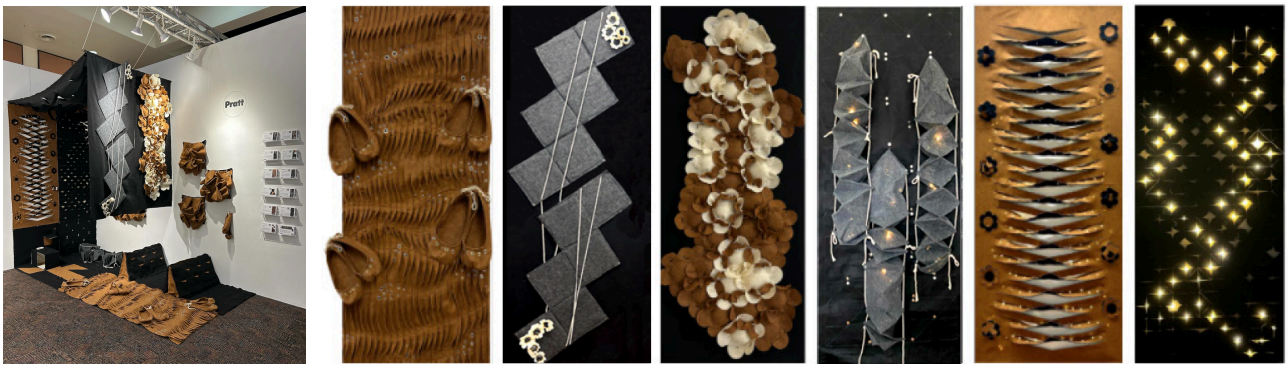
Figures 47, 48, 49, and 50: Pratt Institute Student Work | Group Project | Full-scale fabrication of Call + Response installed at the Sculptural Objects and Fine Art (SOFA) fair in Chicago, IL | The project was designed and fabricated by my students in Brooklyn NY and installed at the SOFA Art Fair in Chicago Il and was transported on one shipping palette. The laser-etched cards represent the Pratt students' call to the visitors, and the blank cards act as the response. The carpeting is etched with a series of questions for visitors to answer on the blank cards; those cards can then be exchanged for a laser-etched card (an object of art and design that the visitor can keep). In this exchange, the canopy evolves from a space generated by pattern to one formed by colour. The project implements regenerative design through the upcycling of felt cast-offs for the seating and flooring and the use of recycled paper for the fabrication of the laser-etched and blank cards| 2014



Figures 51, 52, 53, and 54:. Pratt Institute Student Work | Group Project | Full-scale fabrication of Paper + Air design installed at the Sculptural Objects and Fine Art (SOFA) fair in Chicago, IL | The Pratt student and faculty team is motivated by an ability to make large structures transportable. For this installation, my students designed and fabricated an environment from two primary materials: paper, made spatial through parametric design and folding, and air as an inflatable structure. The use of paper is binary; it represents the future by implementing a computer-aided process that creates infinite permutations of form and nods to the past with the human intervention of folding and assembly. The remote-controlled inflatable structures transform from a formless pile to something recognisable and architectonic and back again. The project was fabricated in Brooklyn and transported in 10 suitcases to Chicago for installation | 2015

Figures 55 and 56: Pratt Institute Student Work | Group Project | full-scale fabrication HarborWaves storage system at Harbor Middle School | HarborWaves, designed for and installed at Harbor Middle School, is a slotted wall system that mimics the nature of the waves. Its form creates necessary dynamic storage, seating, and work surfaces. The project is designed to flat pack and was CNC fabricated. The project was made possible with funding from the Taconic Fellowship Pratt Center| 2023

Figures 57 and 58: Pratt Institute Student Work | Group Project | full-scale fabrication WRKBench system at Harbor Middle School | The WRKbench system designed and installed by my students in spring 2024 provides primary fixed and secondary rotating work surfaces, storage for tools, pegboard with relocatable shelves, modular tool belts, seating with storage, and places for displaying student-created projects. WRKbench is designed to flat pack and was CNC fabricated. The project was made possible with funding from the Taconic Fellowship Pratt Center | 2024



Figures 59 and 60: Pratt Institute Student Work | Group Project | full-scale fabrication FeltRoom system at Intersect Palm Springs, CA | Students in my Prefabricated Interior Options Lab, taught at Pratt Institute, individually and collectively designed and fabricated a set of 30” x 72” interactive panels that come together to form a prefabricated transportable inhabitable environment. The panels function individually, but the sum is greater than the parts. The panels are fabricated from a base material of recycled PET felt and embrace design, making, and human participation. The project was exhibited at the Intersect Palm Springs Art Fair | 2024

Territories of the Prefabricated Interior

While typologies encompass construction methods, I delineate and define territories within prefabricated interiors encompassing inhabitable spaces in multiple publications (Schneiderman 2014; Schneiderman 2018; Schneiderman 2025). In this usage, territory refers to the defined spaces within a built environment, including programmatic inhabitable spaces, that serve specific functions or activities. These territories are delineated by physical boundaries, perceptual cues, and functional considerations, contributing to the organisation and usability of the interior space. Here, territories describe critical interior locations. I define the prefabricated interior in eight primary territories: soft structures (in the built environment or on the body), furniture, the bathroom, the kitchen, the workspace, hierarchically significant interiors of prefabricated houses, mobile interiors, and the digital realm. (Schneiderman, 2014; Schneiderman, 2016; Schneiderman, 2018; Schneiderman, 2019a; Schneiderman, 2019b; Schneiderman, 2025).

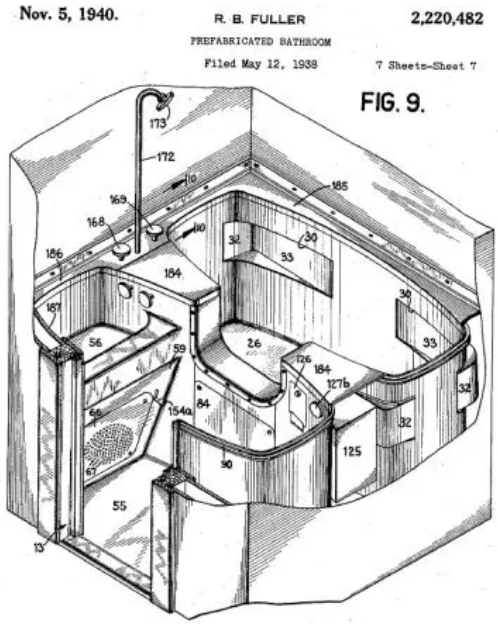
I first introduced the criticality of prefabricated textile Interiors in “Productive Drapery” (Schneiderman, 2019b) and then further developed the territory in “The Prefabricated Interior” (Schneiderman, 2025). The history of prefabricated soft or textile inhabitations is

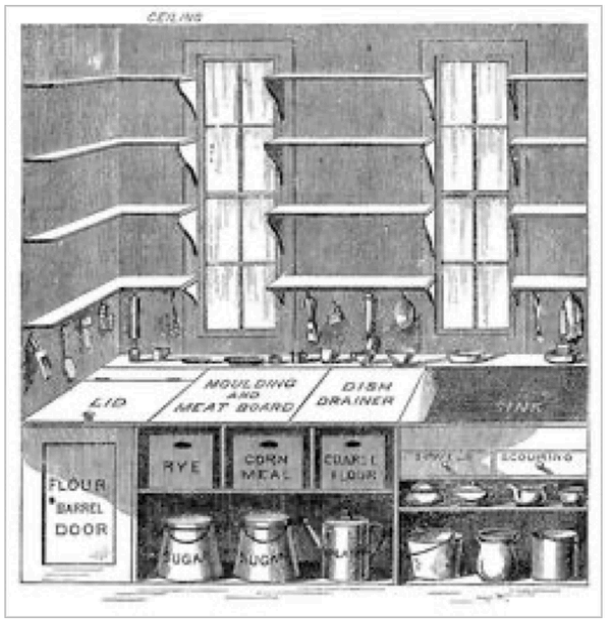
closely linked to the evolution of prefabrication methods, textile technology, and the desire for flexible, portable living spaces. Through my instruction and coursework, my students have had the opportunity to design, install, and test prefabricated textile interiors.

The advent and purpose of prefab furniture, which can be unit, modular, or screen-based, is not only interconnected with the greater concepts of prefabrication in the built environment, but it is also inherently interconnected with and profoundly influenced by the development of the Modern House (Schneiderman, 2025). The bathroom became the ideal prototype and testing site for prefabrication and regenerative design technologies. In my book, "The Prefab Bathroom", I introduced the historical context of architects experimenting with prefabrication concepts within bathroom designs (Schneiderman, 2014). Many significant designers and architects took on the logistical and aesthetic challenges of designing a functional and inviting bathroom (see Figure 61); as such, the design history is addressed more broadly than the prefabricated bathroom alone. Explorations into the kitchen's efficiency may be found as early as the 1860s in Catherine Beecher and Harriet Beecher Stowe's book “The American Woman’s Home” (1869). The Sink and Cooking Form was not itself prefabricated (see Figure 62). Still, I assert that it inspired the prefab kitchens that followed in my articles “The Prefabricated Kitchen: Substance and Surface” and “The Prefabricated Interior” (Schneiderman, 2010; Schneiderman, 2025). Workspace prefabrication, specifically the cubicle, is often the only readily recognised region of the prefabricated interior. My publications, “Inside Prefab: The Ready-Made Interior” and “The Prefabricated Interior,” evidence that the prefabrication of workspaces far predates the screen-based cubicle (Schneiderman, 2012; Schneiderman, 2025). While the earliest assemblage of the prefabricated workspace is the unit-based cabinet office secretary, examples of modular workspaces are also prevalent.

My research has also focused on hierarchically significant interiors of prefabricated houses. In “Inside the Prefab House”, I establish that prefabricated house interiors can challenge the hierarchy of architecture, interiors, and furniture (Schneiderman, 2018). Transportation vehicles, like architecture, are designed with a housing that is intended to be long-term and an interior that can be readily retrofitted as technology and user needs evolve. My book

“The Prefabricated Interior” establishes the potential for interior design as an industrial product in the discussion of interiors en route (Schneiderman, 2025). This design for re-use or even re-purpose, coupled with the necessity for mass production, places these vehicles as prime locations for mass-produced prefabricated interiors. My publications demonstrate that until recently, the prefabricated interior has been customisable to support function, interior architectural fit, and individual taste only to a limited degree. The current and evolving generation of digitally induced industrially produced products can at once be one-of-a-kind, aligned with preference and taste, fabricated to fit the architectonic of the interior precisely, and can even be made-to-measure for a specific body of the inhabitant (Schneiderman 2019a; Schneiderman 2025).





Figures 61 and 62: Dymaxion Bathroom | 1936 | Sink and Cooking Form | 1869

Regenerative Design, Circular Economy, and the Prefabricated Interior

In my research, I assert that an overarching result of using prefabricated elements is particularly relevant in today’s receptive attitude toward sustainability, regenerative design, and achieving a circular economy. The exploration of sustainability is in flux. The nomenclature has evolved over time, as has the inclusiveness of each meaning. The term sustainable development is credited to the World Commission on Environmental

Development (WCED) from its 1987 report entitled “Our Common Future”. Green design remained the popular term for architecture and design until the new millennium. This document is commonly termed the Brundtland report in honour of the committee chairperson. “Of significance is the concept that sustainable development is not a permanent state but a process of change in which the exploitation of resources, the direction of investments, the orientation of technological investments, and institutional change are made consistent with future as well as present needs” (Winchip, 2011). Sustainable design must promote human well-being through all processes of production (Papanek, 1984). To achieve a contemporary sustainable development status, the design project must go beyond environmental health and a human connection with nature to consider the ecology and the environment, economy, employment, equity, and equality. Arguably, the prefabricated interior is better delineated as an aspect of regenerative design.

Regenerative design is a concept defined and developed by various individuals and organisations over time. One prominent figure in this field is John Tillman Lyle, an architect, planner, and educator. In his book "Regenerative Design for Sustainable Development" (1994), Lyle explored the idea of designing systems that sustain themselves and contribute to the regeneration of natural and social environments. Material efficiency is a component of regenerative design and a critical aspect of a broader approach. Regenerative design aims to create systems that actively contribute to the restoration, renewal, and enhancement of ecological and social well-being.

The concept of the circular economy originated from the notion of replacing energy with human labour; a principle initially articulated in a report to the European Commission authored by Walter R. Stahel and Geneviève Reday-Mulvey during their tenure at the Battelle Research Centre in Geneva, Switzerland, in the early 1970s. They observed that refurbishing buildings required fewer resources than constructing new ones. This principle extends beyond architecture and applies universally to various forms of capital, including mobile phones, agricultural land, and cultural heritage (Stahel, 2016). The circular economy represents a paradigm in which materials are perpetually cycled through various processes, thereby negating the concept of waste and fostering the regeneration of natural

systems. Within this framework, products and materials are continuously maintained, reused, refurbished, remanufactured, recycled, or composted, addressing critical global issues such as climate change, biodiversity loss, waste accumulation, and pollution.

Interior prefabrication is a regenerative design process that facilitates the achievement of a circular economy. The prefabrication of elements in a controlled environment limits waste in materials and inefficiencies in labour – while fabricating elements with the benefits of modularity or transportability allows for flexibility, increasing the useful life of all the elements. In my scholarship, I argue that the possibility that prefabricated interior elements can be more adaptable to individual tastes (along with fit and function) and even create memory and emotional attachment because of the user involvement in their creation could lead to products aligned with regenerative design principles. If the user is more connected to the product and it has a better fit and function, it is less subject to disposability resulting in a reduction in consumption and hence waste. As conveyed in my publications, an additional regenerative design outcome for digital fabrication is the ability to fabricate global designs locally. Digitally fabricating interior elements with locally sourced material aligns with regenerative design principles in its production, materiality, and ability to connect to local culture (Schneiderman, 2016; Schneiderman, 2025).

The fusion of systems thinking and emotional design theory within my interior systems theoretical framework aligns effectively with regenerative design and circular economy principles, emphasising efficient material usage and prolonged functionality (Schneiderman, 2025). While regenerative design and the circular economy are evidenced in all of my publications, they are most expansively aligned with several. "The Prefab Bathroom" (Schneiderman, 2014) focuses on regenerative design aspects, particularly highlighting greywater systems integration. In "Productive Drapery" (Schneiderman, 2019b), modular curtain designs made from recycled materials aim to curtail energy consumption. Additionally, "Ornamental Futures" (Schneiderman, 2019a) introduces a novel approach to regenerative design and the circular economy with modular mouldings 3D printed from recycled paper. These publications specifically address projects integrating material reuse

and environmentally efficient design principles, such as greywater systems and passive design strategies.

Milieu Reflection

When aligning regenerative design and the concept of the circular economy with my interior systems theoretical framework and the prefabricated interior, it is evident that building off-site has demonstrated reduced material waste and labour costs, as evidenced in my Embedded Portrait mouldings, HANNAH's Ashen House, and the work of FACIT Homes. HANNAH integrates advanced high-precision 3D scanning and robotic-based fabrication technologies to repurpose Emerald Ash Borer-infested "waste wood" into a readily accessible, cost-effective, and regenerative building material. Employing a digitally-driven approach, these technologies are central to creating the architectural prototype, Ashen House, in Ithaca, NY, 2019. Facit Homes utilises site-adjacent facilities housed in shipping containers to fabricate off of the construction site, utilising digital fabrication methods across multiple projects. The fabrication of modular or transportable elements allows for adaptability and reuse, increasing the life of all the components while making place transportable. My project Ricco Maresca Gallery, in New York City, employs a slotted steel system as a design strategy that facilitates adaptation and relocation to extend the useful life of designed elements. Further, the user's ability to co-design the final arrangement (through assembling modular components) or attune the aesthetic and proportion (through parametric manipulation) creates an emotional attachment that reduces the risk of disposability.

09: Conclusion

My scholarship within and beyond this commentary has founded and defined the prefabricated interior topic and established the interior systems theoretical framework. This commentary has delineated the distinct methodological approaches I employ within this submission's six scholarly publications. Through the lens of my interior systems theoretical framework, which integrates systems thinking with emotional design, it is evident that prefabricated interiors foster user attachment and promote regenerative design, and have significantly advanced the evolution of prefabrication across the built environment.

I am the first scholar to discuss prefabricated interiors as an interior design practice, theoretical approach, and pedagogical subject. As such, I have received global recognition as an authority on the subject. The body of scholarship presented in my submitted publications and this commentary marks a significant milestone in understanding and appreciating prefabricated interiors within the architecture and design discourses. Through a rigorous exploration spanning over two decades, my research has made evident the profound impact of prefabricated interiors on the evolution of construction technologies and design methodologies in the built environment.

The innovative methodology employed throughout my scholarship, particularly in classifying the typologies and territories of prefabricated interiors, has provided a comprehensive framework for understanding this overlooked aspect of design. By evidencing the symbiotic relationship between interior design elements and prefabricated technologies, my research has underscored the integral role of interiors in shaping the spatial experiences and functionality of built environments. The technological advancements made in designing and manufacturing prefabricated interiors serve as a testing ground for developing larger-scale prefabricated buildings and systems.

Central to this body of work is my recognition of prefabricated interiors as an agent of regenerative design and sustainability that support a circular economy. Through a fusion of systems thinking and emotional design theory, resulting in my interior systems theoretical

framework, I argue that prefabricated interiors have emerged as catalysts for efficient material usage, adaptable functionality, and enhanced user experiences, achieved through customisation, which prolong their useful life and potentially decrease consumption. This perspective aligns with contemporary regenerative design goals and offers a pathway toward creating more resilient and adaptable built environments.

Moreover, my research has defined the historical evolution and contemporary relevance of prefabricated interiors, filling a notable gap in the existing architectural and interior design literature. It is evident that the prefabrication of interiors is applicable across multiple typologies and territories. Additionally, it allows for customisation, enabling a better fit with the architecture for a diverse range of users, considering factors such as health, age, neurodivergence, and size.

I am currently developing the realm of the wearable prefabricated interior (see Figure 63). The convergence of fashion and architecture in interior design unveils a realm where space becomes temporal, seasonal, and deeply personal, distinct from the enduring forms of traditional architecture. Unlike fixed exteriors, interiors are customisable, akin to tailoring, forming a ‘second skin.’ This intimate relationship with materials prompts inquiry into wearable interiors, where textiles transcend their typical purpose to shape inhabitable garments. This concept diverges from wearable architecture by prioritising functional spatial solutions over aesthetic mimicry, thereby reshaping human-environment interaction. Rooted in Gottfried Semper's insights on the textile origins of architecture and historical precedents like wearable shelters, modern interpretations explore garments that transform into portable spaces, responding to crises or enhancing urban mobility. From Hussein Chalayan's transformative collections to educational innovations, contemporary designs demonstrate the evolving fusion of fashion, functionality, and interior design in wearable interiors (see figure 63). Further research will explore a paradigm shift in spatial design, illustrating its potential to redefine human experience and architectural discourse.

I intend to develop my research within the digital realm further to include artificial intelligence (AI). AI can be implemented within the designer's control to support coding

user-friendly parametric platforms. AI can make parametric platform development more user-friendly for designers, enabling them to establish workable frameworks in their design languages and parameters within which users could customise prefabricated interiors.

I wrote the volume "The Prefabricated Interior" alongside this commentary, and the theoretical framework I developed here has been essential. It allowed me to incorporate a theoretical stance into the new volume, making the research more substantial and clearly interconnected across typologies and territories. Looking ahead, the insights gleaned from this scholarship are poised to expand my interior systems theoretical framework into an Interior Systems Theory, which I intend to pursue through a dedicated theoretical volume. Interior Systems Theory could inform future design practices and pedagogies, both prefabricated and site-built, paving the way for more sustainable, adaptable, and user-centric built environments.

My scholarship is at the forefront of interior prefabrication and interior systems thinking and has been widely cited in scholarly publications. The influence of this scholarship extends beyond scholarly publications and citations, impacting the academic environment in the classrooms where I have mentored over one thousand students. It also reaches the broader academic community through the more than 35 universities worldwide, where I have been invited to lecture on the topic. The students utilise the design approaches, methodologies, and theoretical framework presented in my publications, taught in my classrooms, and shared during my lectures to further their design practices.

Figure 63: Wearable Changing room for a COVID dining environment time-shared with a vintage clothing store developed for the Prefabricated Interior: Interior/Exterior Studio at Pratt Institute by | Claudia Oertli | MFA Interior Design Candidate | The wearable, designed and fabricated for my Prefabricated Interior Studio, transforms from a garment into a changing room. It was proposed for a COVID dining environment that temporarily shares space with a vintage clothing store | 2021

10: Figure Credits

Figure 1: Embedded Portrait | Deborah Schneiderman | 2016

Figure 2: Kruikantoor Mobile Office | Tim Vinke | 2010

Figure 3: Wearable apparatus to make the experience of riding on a train in coach more comfortable developed for the Prefabricated Interior: Mobile Interior Studio at Pratt Institute | Yuxi Wang | 2022 | MFA Interior Design Candidate | Deborah Schneiderman's collection of archived student work

Figure 4: Embedded Portrait | Deborah Schneiderman | 2016

Figure 5: Productive Draping | Retractable Curtaining and Snap Switch Curtaining | Deborah Schneiderman | 2018

Figure 6: Composite House | SU11 Architects | 2003

Figure 7: Composite House | SU11 Architects | 2003

Figure 8: Lustron House Advertisement | Life Magazine, October 11, | 1948

Figure 9: Lustron House Parts | Getty Images | 1949

Figure 10: Total furnishing Unit | Joe Colombo | 1971

Figure 11: Total furnishing Unit | Joe Colombo | 1971

Figure 12: Furniture House | Construction view | Shigeru Ban | 1995

Figure 13: Furniture House | Axonometric | Shigeru Ban | 1995

Figure 14: Furniture House | Interior View | Shigeru Ban |1995

Figure 15. ESUs | Charles and Ray Eames | Herman Miller | 1950

Figure 16: Sawdust Screen | Rael San Fratello | 2014

Figure 17: Saltygoo | Rael San Fratello | 2013

Figure 18: Cell Cycle Parametric Sofware Generator | Nervous System | 2009

Figure 19: Illustration Spread Spread for The Prefab Bathroom: An Architectural History | Illustration: Bishakh Som | 2014 | the illustration demonstrates the international prevalence of pod and plug-in construction on both interior and exterior with views of the Nakagin Capsule Tower, Kisho Kurokawa | 1970

Figure 20: Bathroom of the Future 2025 | Courtesy Constantin Boym, Jess Smith, Will Stafford, and Alex Thompson from Pratt Institute's Design Clinic research accelerator | 2019

Figure 21: Christine Fredricks Kitchen Diagrams | In "The New Housekeeping: Efficiency Studies in Home Management," Garden City, New York: Doubleday Page and Company | 1919

Figure 22: Margarete Schütte-Lihotzky's Frankfurt Kitchen | Institut für Stadtgeschichte, Frankfurt am Main | 1926

Figure 23: Gilbert Rohde Modular Cass Goods | Herman Miller | 1934

Figure 24: Modular Upholstered Seating | Herman Miller |1934

Figure 25: Alexander Kira's anthrometric studies for his prefabricated bathroom design the Experimental relaxing/washing facility | Scanned from Alexander Kira's "The Bathroom: Criteria for Design" | 1966

Figure 26: Kira's anthropometric illustration for his prefabricated bathroom design, the Experimental relaxing/washing facility | Scanned from Alexander Kira's "The Bathroom: Criteria for Design" | 1966

Figure 27: The Packaged House | 1942 | In The Architectural FORUM, February 1947

Figure 28: KieranTimberlake Assembly Diagram | In Stephen Kieran and James Timberlakes's Timberlake's "Refabricating Architecture: How Manufacturing Methodologies Are Poised to Transform Building Construction." New York and London: McGraw-Hill | 2004

Figure 29: Ricco Maresca Gallery Desk | Design: Deborah Schneiderman | Photo: Scott Lizama | 1997

Figure 30: Ricco Maresca Reception | Design: Deborah Schneiderman | Photo: Scott Lizama | 1997

Figure 31: Section through Butler Building Site | Courtesy Butler Manufacturing | 2007

Figure 32: Lustron House Installation at MoMA | Exterior View | MoMA | 2008

Figure 33: Lustron House Installation at MoMA | Interior View of Vanity | MoMA | 2008

Figure 34: Zigzag | Deborah Schneiderman | Igor Siddiqui | Photographs © Frank Oudeman | 2013

Figure 35: Zigzag | Deborah Schneiderman | Igor Siddiqui | Photographs © Frank Oudeman | 2013

Figure 36: Screen | Arizona State University Student Work | Deborah Schneiderman's collection of archived student work | 2009

Figure 37: Module | Arizona State University Student Work | Deborah Schneiderman's collection of archived student work | 2009

Figure 38: Unit | Arizona State University Student Work | Deborah Schneiderman's collection of archived student work | 2009

Figure 39: C-box | Arizona State University Student Work | Detail | Deborah Schneiderman's collection of archived student work | 2009

Figure 40: C-box | Arizona State University Student Work | Website | Deborah Schneiderman's collection of archived student work | 2009

Figure 41: C-box | Arizona State University Student Work | Installation View | Deborah Schneiderman's collection of archived student work | 2009

Figure 42: CloudSpace installed at the Sculptural Objects and Fine Art (SOFA) fair, Chicago, IL | Pratt Institute Student Work | Installation view | Deborah Schneiderman's collection of archived student work | 2013

Figure 43: CloudSpace installed at the Sculptural Objects and Fine Art (SOFA) fair in Chicago, IL | Pratt Institute Student Work | Canopy Detail | Deborah Schneiderman's collection of archived student work | 2013

Figure 44: CloudSpace installed at the Sculptural Objects and Fine Art (SOFA) fair in Chicago, IL | Pratt Institute Student Work | Seating Detail | Deborah Schneiderman's collection of archived student work | 2013

Figure 45: CloudSpace installed at the Sculptural Objects and Fine Art (SOFA) fair in Chicago, IL | Pratt Institute Student Work | Seating Detail | Deborah Schneiderman's collection of archived student work | 2013

Figure 46: CloudSpace installed at the Sculptural Objects and Fine Art (SOFA) fair in Chicago, IL | Pratt Institute Student Work | Seating Detail | Deborah Schneiderman's collection of archived student work | 2013

Figure 47: Call + Response | installed at the Sculptural Objects and Fine Art (SOFA) fair in Chicago, IL | Pratt Institute Student Work | Installation View | Deborah Schneiderman's collection of archived student work | 2014

Figure 48: Call + Response | installed at the Sculptural Objects and Fine Art (SOFA) fair in Chicago, IL | Pratt Institute Student Work | Installation View | Deborah Schneiderman's collection of archived student work | 2014

Figure 49: Call + Response | installed at the Sculptural Objects and Fine Art (SOFA) fair in Chicago, IL | Pratt Institute Student Work | Installation View | Deborah Schneiderman's collection of archived student work | 2014

Figure 50: Call + Response | installed at the Sculptural Objects and Fine Art (SOFA) fair in Chicago, IL | Pratt Institute Student Work | Installation View | Deborah Schneiderman's collection of archived student work | 2014

Figure 51: Paper + Air | installed at the Sculptural Objects and Fine Art (SOFA) fair in Chicago, IL | Pratt Institute Student Work | Deflated Installation View | Deborah Schneiderman's collection of archived student work | 2015

Figure 52: Paper + Air | installed at the Sculptural Objects and Fine Art (SOFA) fair in Chicago, IL | Pratt Institute Student Work | Inflated Installation View | Deborah Schneiderman's collection of archived student work | 2015

Figure 53: Paper + Air | installed at the Sculptural Objects and Fine Art (SOFA) fair in Chicago, IL | Pratt Institute Student Work | Inflated Installation View | Deborah Schneiderman's collection of archived student work | 2015

Figure 54: Paper + Air | installed at the Sculptural Objects and Fine Art (SOFA) fair in Chicago, IL | Pratt Institute Student Work | Inflated Installation View | Deborah Schneiderman's collection of archived student work | 2015

Figure 55: HarborWaves Full-Scale Fabrication at Harbor Middle School | Pratt Institute Student Work | Installation View | Deborah Schneiderman's collection of archived student work | 2023

Figure 56: HarborWaves Full-Scale Fabrication at Harbor Middle School | Pratt Institute Student Work | Detail View | Deborah Schneiderman's collection of archived student work | 2023

Figure 57: WRKbenchs Full-Scale Fabrication at Harbor Middle School | Pratt Institute Student Work | Installation View | Deborah Schneiderman's collection of archived student work | 2023

Figure 58: WRKbenchs Full-Scale Fabrication at Harbor Middle School | Pratt Institute Student Work | Occupied View | Deborah Schneiderman's collection of archived student work | 2024

Figure 59: FeltRoom Full Scale Installation at Intersect Palm Springs art Fair | Pratt Institute Student Work | full-scale fabrication FeltRoom system at Intersect Palm Springs,

CA, 2024 | Installation View | Deborah Schneiderman's collection of archived student work | 2024

Figure 60: FeltRoom Full Scale Installation at Intersect Palm Springs art Fair, 2024 | Pratt Institute Student Work | full-scale fabrication FeltRoom system at Intersect Palm Springs, CA | Individual Panels | Deborah Schneiderman's collection of archived student work | 2024

Figure 61: Dymaxion Bathroom | Patent Drawing | Public Domain | 1936

Figure 62: Sink and Cooking Form | Harriet Beech Stowe Center [sent for previous publication] | Public Domain | 1869

Figure 63: Wearable Changing room for a COVID dining environment time-shared with a vintage clothing store developed for the Prefabricated Interior: Interior/Exterior Studio at Pratt Institute | Claudia Oertli | MFA Interior Design Candidate | Deborah Schneiderman's collection of archived student work | 2021

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