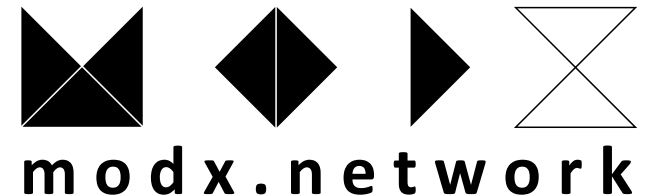


Offsite Construction in Wood: Reinventing the Role of the Design Professional

Presented by:

Ryan E. Smith, University of Arizona
Ivan Rupnik, Northeastern University
Tyler Schmetterer, MOD X



Disclaimer: This presentation was developed by a third party and is not funded by WoodWorks or the Softwood Lumber Board.

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.



Course Description

Prefabrication, modularization, offsite and industrialized construction are increasingly being used as strategies to address mounting supply chain challenges, labor shortages, and escalating costs. The market for factory-based construction continues to rise in the U.S., especially in multi-family housing, as developers seek alternatives to conventional delivery models. The approaches are also evolving. This type of construction changes the planning and procurement processes, and therefore the scope of various project team members. This webinar examines how the roles of architect and engineer are changing to meet the demand of offsite construction workflows.

Presented by architecture academics and consultants at MOD X, who are experts in offsite and modular wood construction, the session will begin with a discussion of market drivers and an overview of light-frame and mass timber modular systems. It will then shift to four personas or archetypes representing the roles architects and engineers are playing in this changing construction landscape. The personas will be illustrated with case studies of contemporary practicing design professionals in the U.S. who are leading the practice of offsite construction and leveraging its value in unique ways. Their stories characterize the offsite wood design sector and the role of design teams in the future of wood modular construction.

Learning Objectives

1. Assess the **drivers** for offsite and modular construction in the U.S. based on macro-economic context, labor shortages, and cost escalation.
2. Review current and emerging **offsite wood systems**, including light-frame and mass timber panelized and volumetric modular solutions.
3. Discuss the **changing role of the architect** in the offsite and modular construction supply chain, design for manufacture and assembly workflow, and business models (vertical and horizontal integration).
4. Share **four case studies** of specific architects in offsite and modular alternative practices as illustrative examples of the changing role of the architect.

MOD X

Leadership Team



Ryan E. Smith

Founding Partner, MOD X
Tucson, Arizona

Professor of Architecture
Director School Architecture
University of Arizona



Ivan Rupnik, PhD

Founding Partner, MOD X
Boston / Zagreb, HR

Associate Professor of
Architecture
Northeastern University
MARCH, PhD, Harvard
University

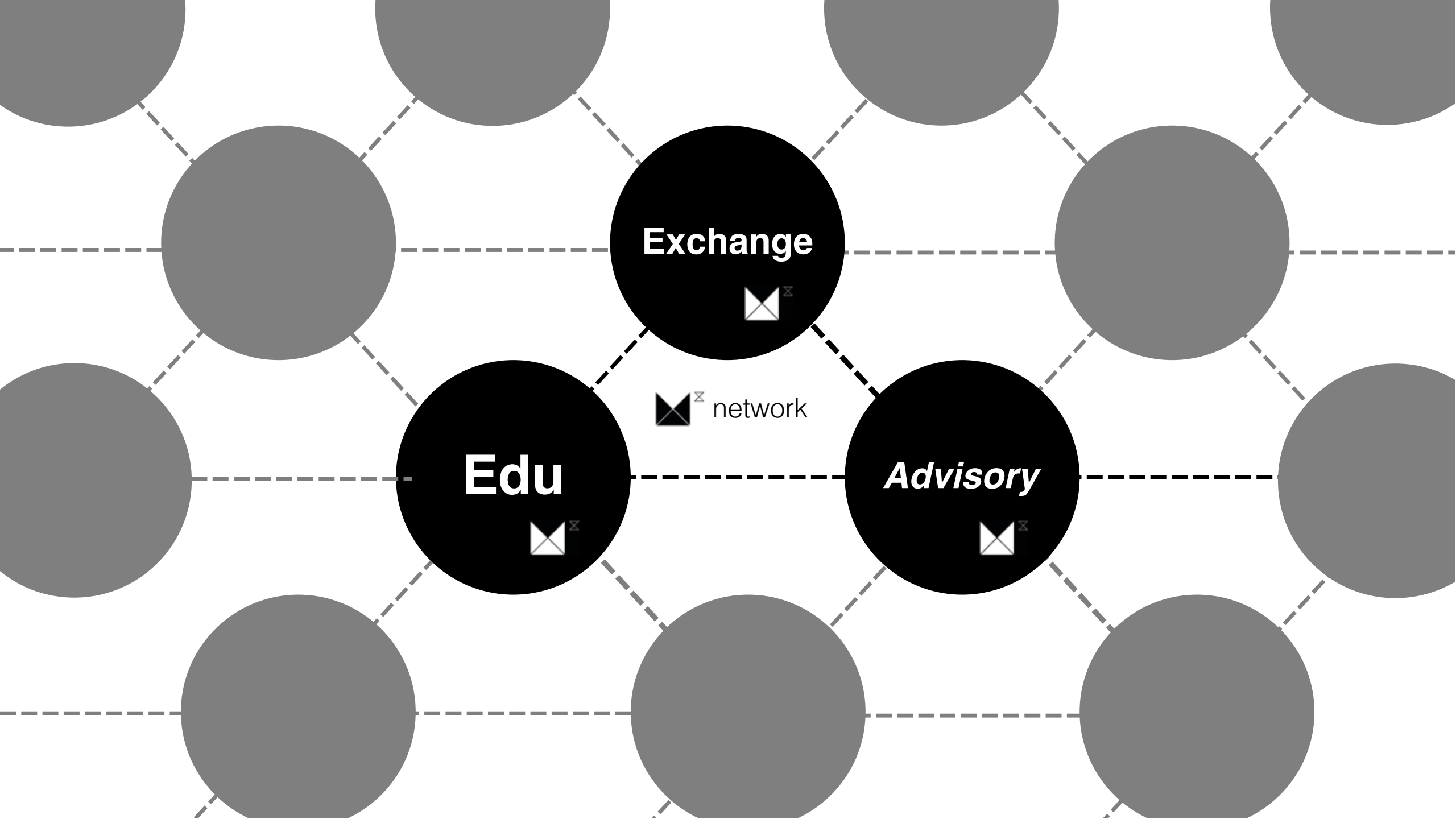


Tyler Schmetterer

Managing Partner, MOD X
NYC / Geneva

Founder | President & COO
New World Home

EthicalFin, MOWEA,
Passive House Advisory
Board Member



Exchange



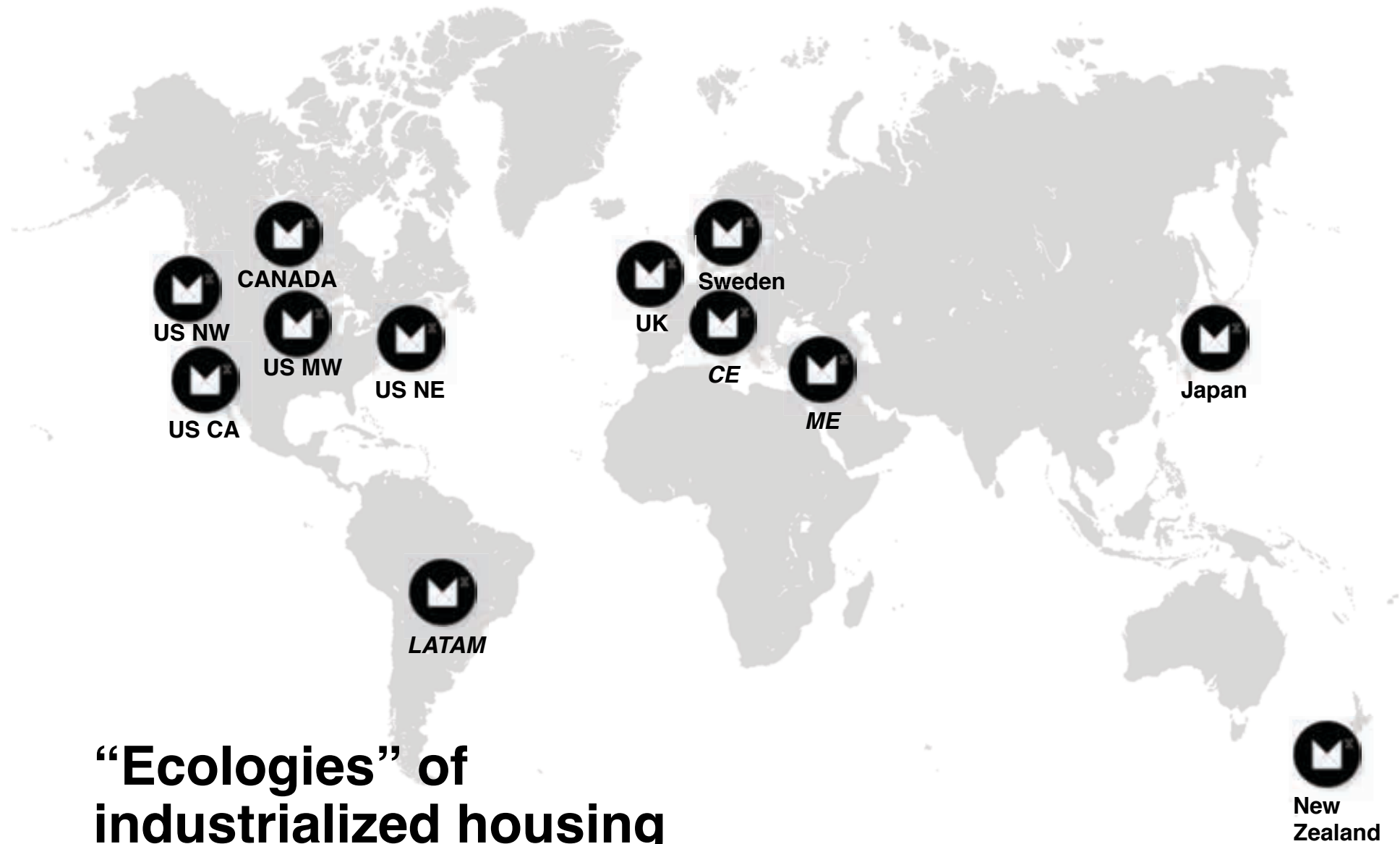
 network

Edu



Advisory





1. Drivers



\$1,000,000,000

Factory_OS

blueprint



PRESCIENT®

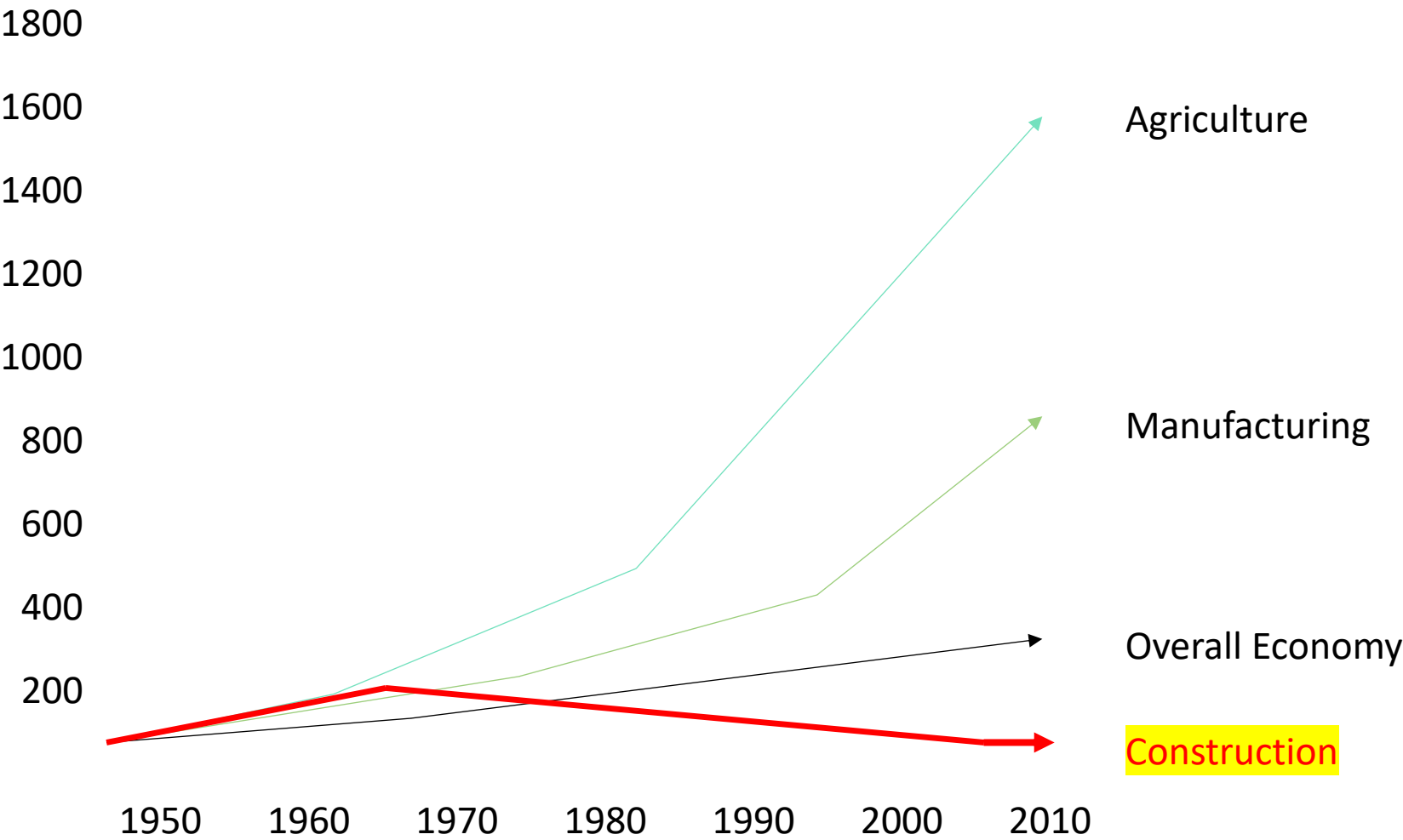


\$1,000,000

blokable

DE-INDUSTRIALIZATION OF CONSTRUCTION, USA

Gross value added per hour worked as measure of productivity (McKinsey, 2017)



FOR TECHNOLOGY TO DELIVER, THE CONTEXT NEEDS TO CHANGE

(McKinsey, 2017)

> 60%

Productivity boost
(onsite)

- Reshape regulation
- Rewire contracts
- Rethink design
- Improve procurement and supply chain
- Improve onsite execution
- Infuse technology and innovation
- Reskill workers

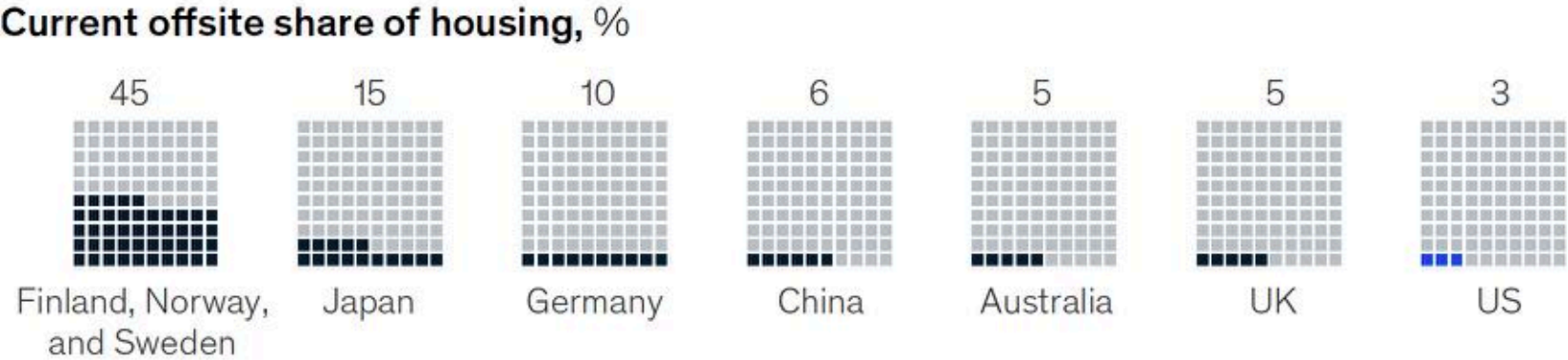
> 1000%

Productivity boost
(offsite – onsite)



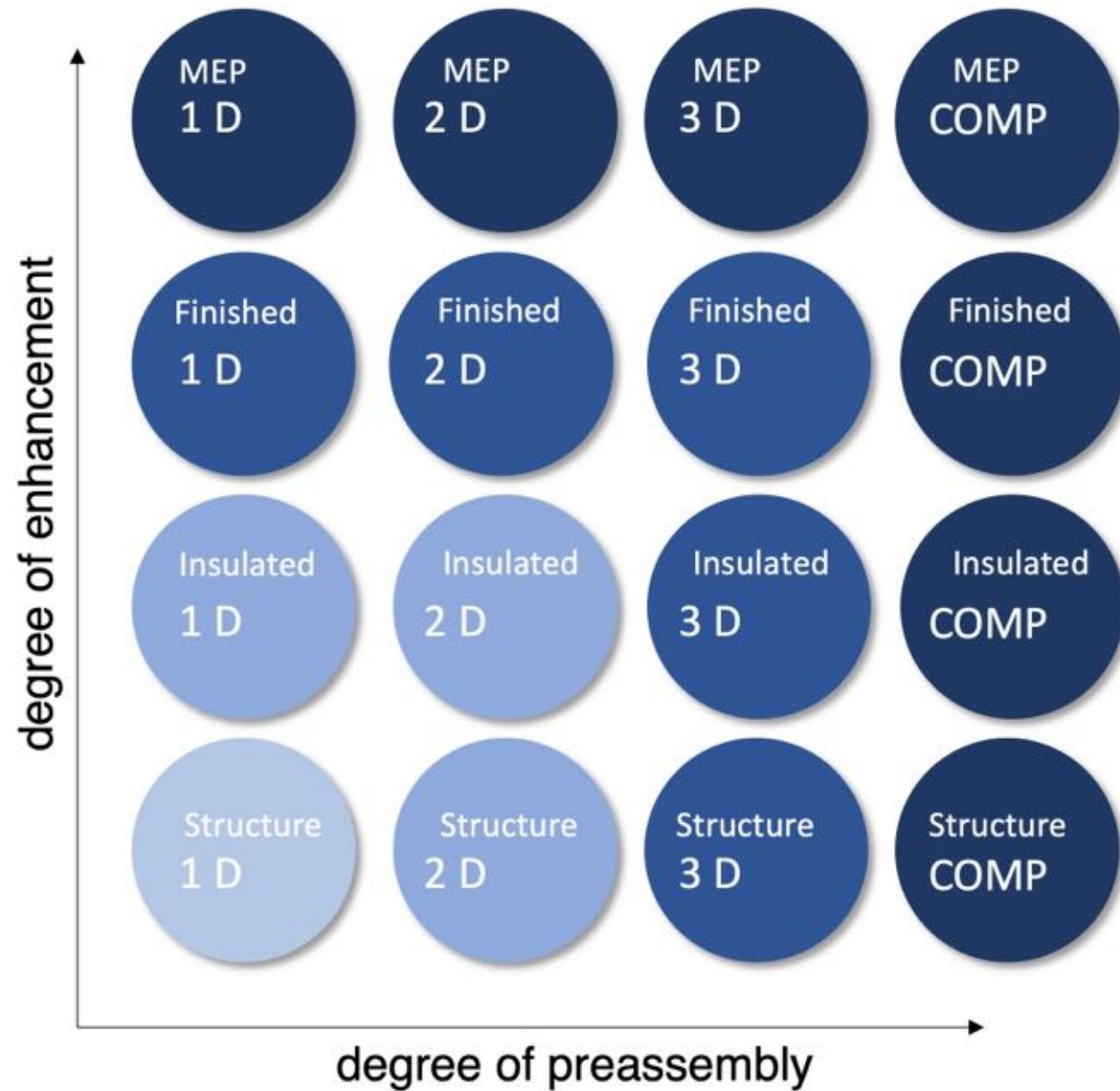
- Move to a manufacturing style production system

McKinsey Market Share?

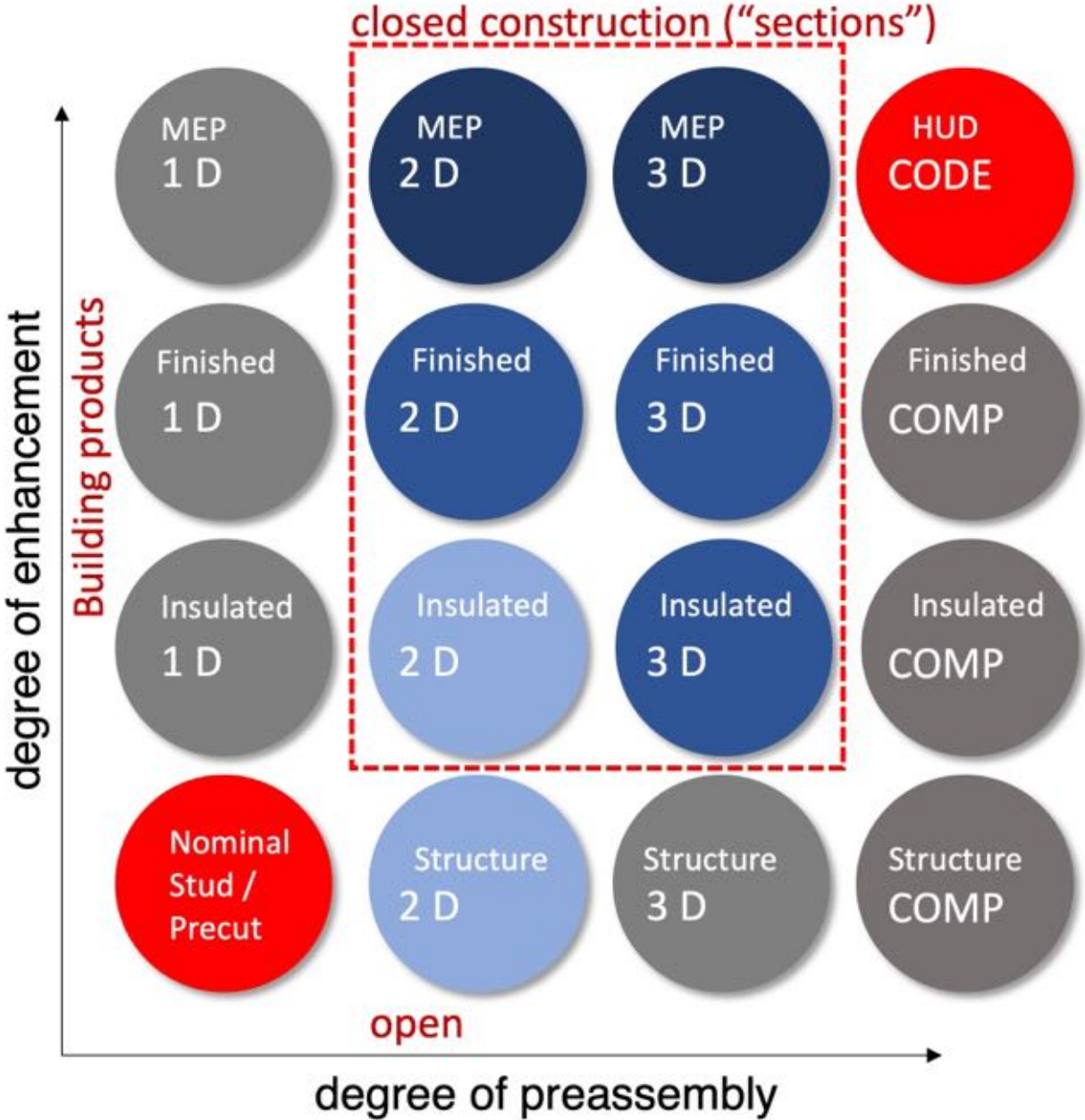


2. Offsite Wood Systems

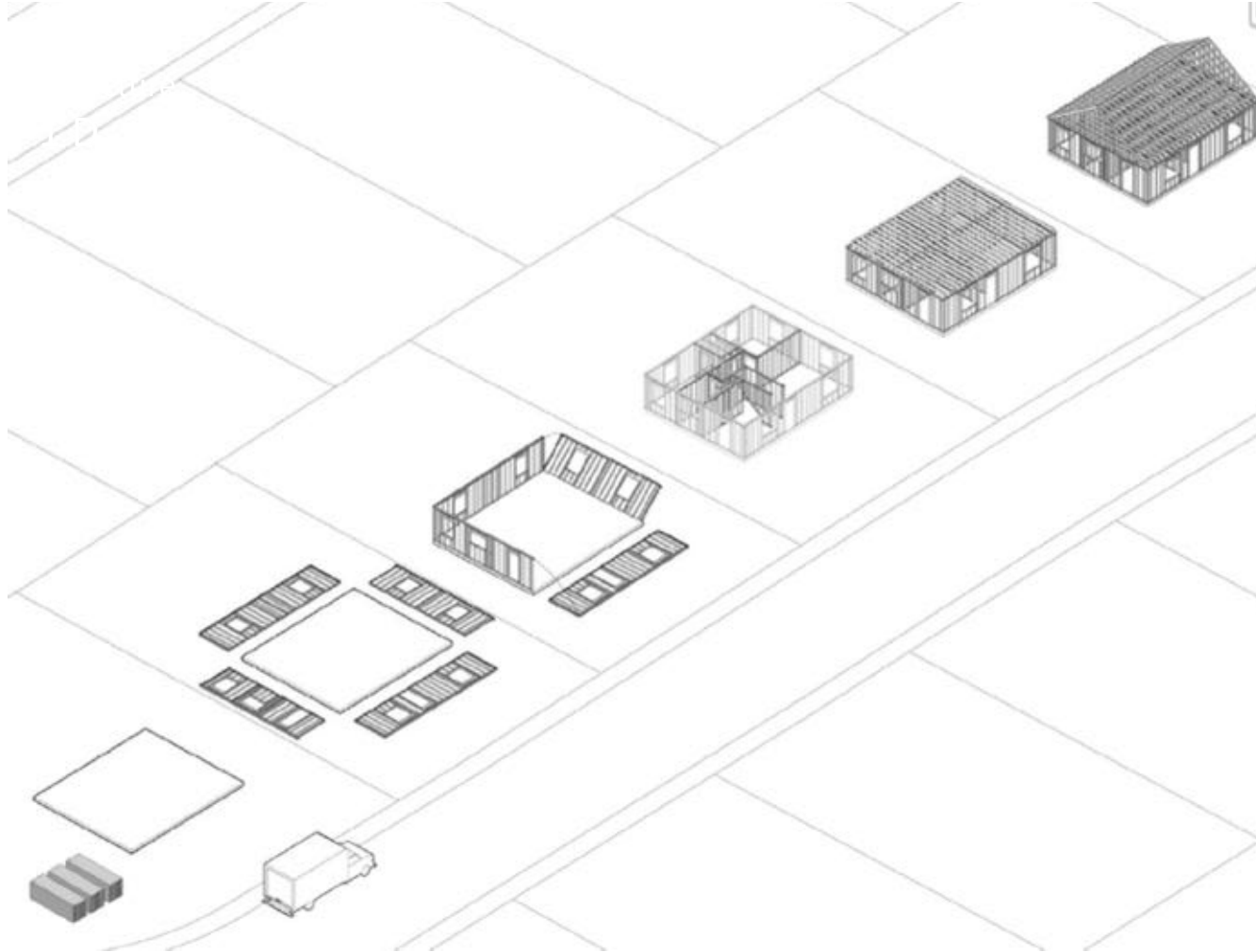
Categorizing Offsite Construction Systems



Categorizing Offsite Construction Systems

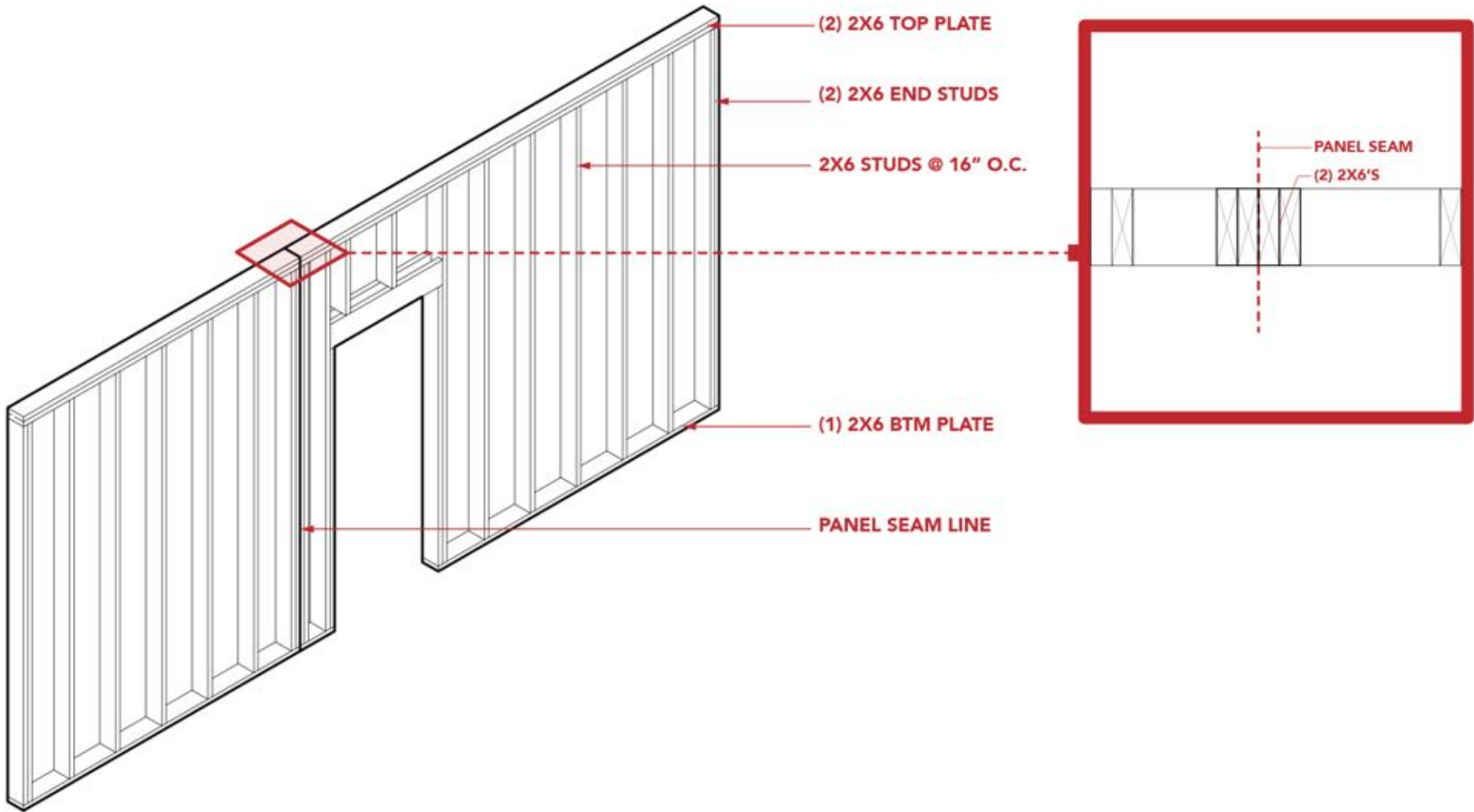


Industrialized stick built Construction

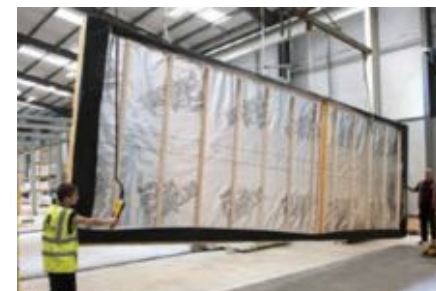


Source: Rupnik, "Home Delivery", 2011, Northeastern University.

Open Panel (Closed Panel) Construction



Source: Ryan E. Smith, Prefab

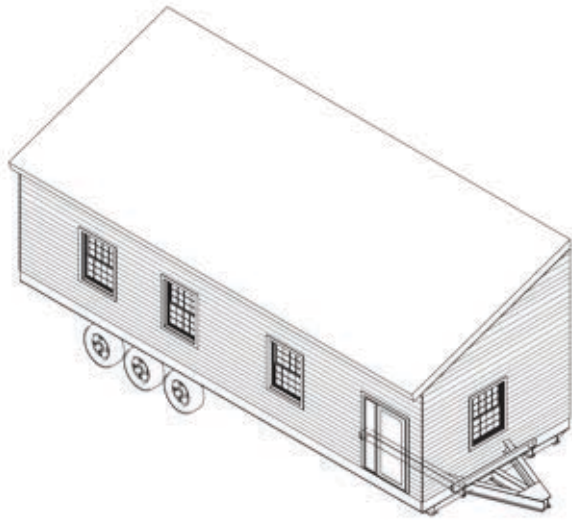


Credit: Campbell Construction Group, Glasgow, UK & COCIS Edinburgh Napier University

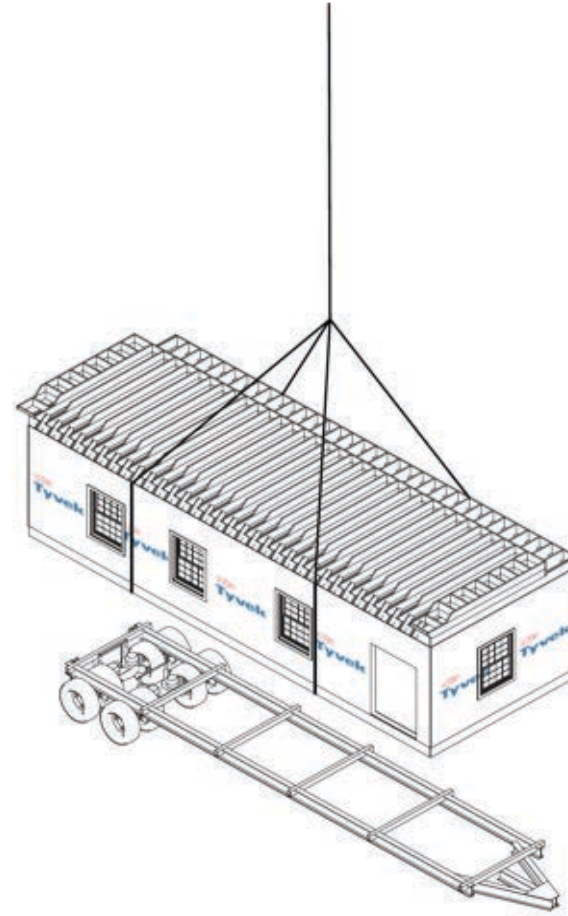
**Closed
Panel-based
Volumetric
Modular**



Manufactured / Modular

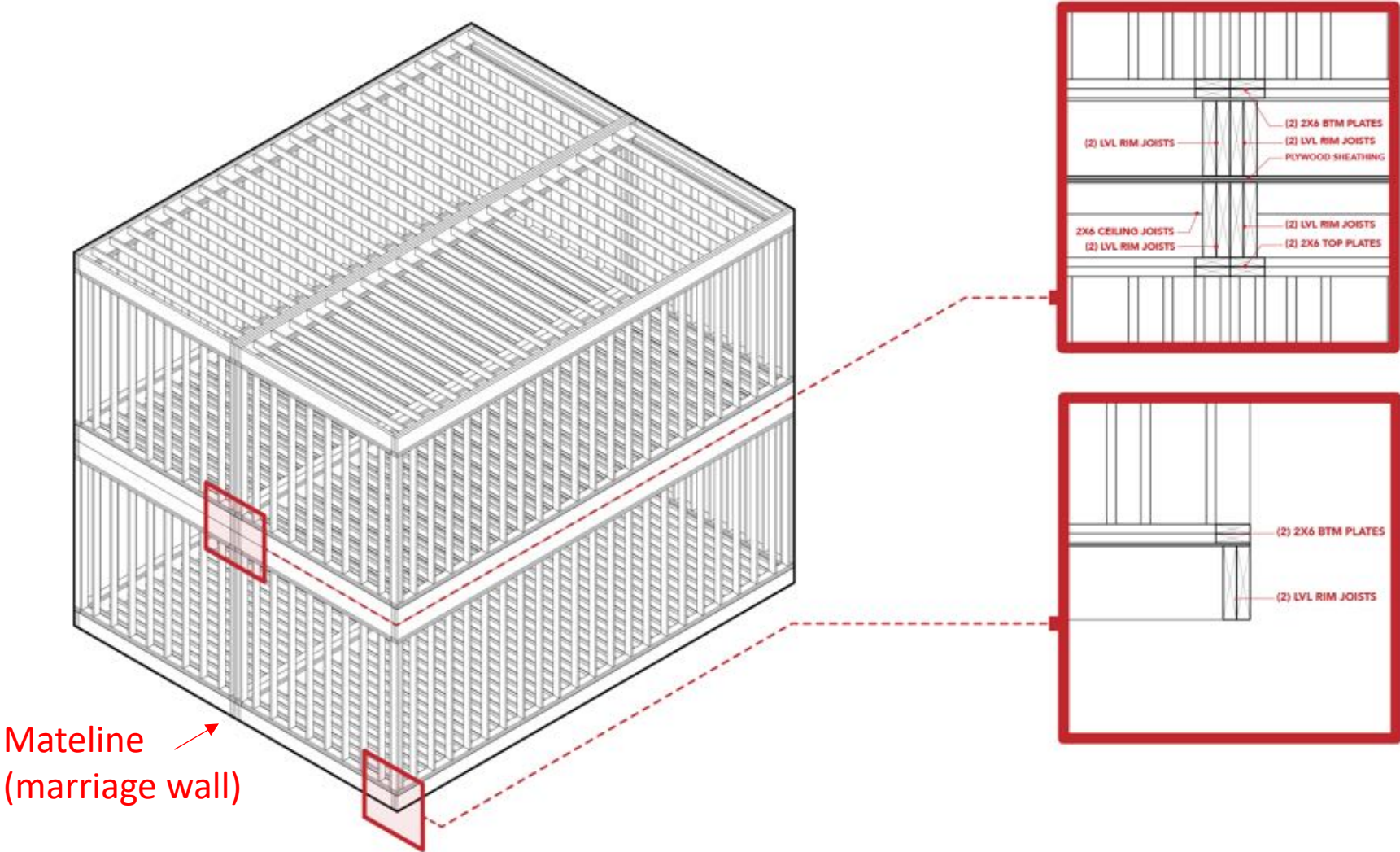


Regulated by HUD CODE
Nearly 100% factory completed
Platform frame (steel chassis)

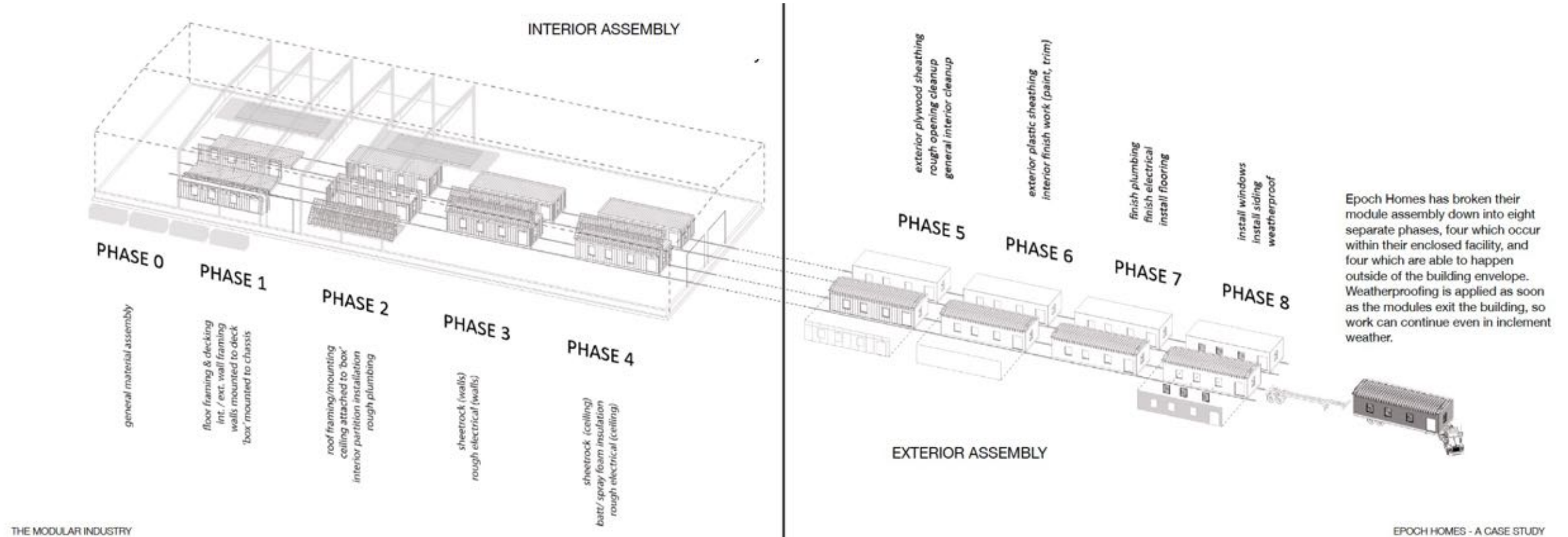


Regulated by IRC, IBC
50-80% factory completed
Platform frame (70%+ of manufacturers)

Volumetric Modular



Manufactured / (Volumetric) Modular



3. Role of Designer

> 60%

Productivity boost
(onsite)

- Reshape regulation
- Rewire contracts
- Rethink design
- Improve procurement and supply chain
- Improve onsite execution
- Infuse technology and innovation
- Reskill workers

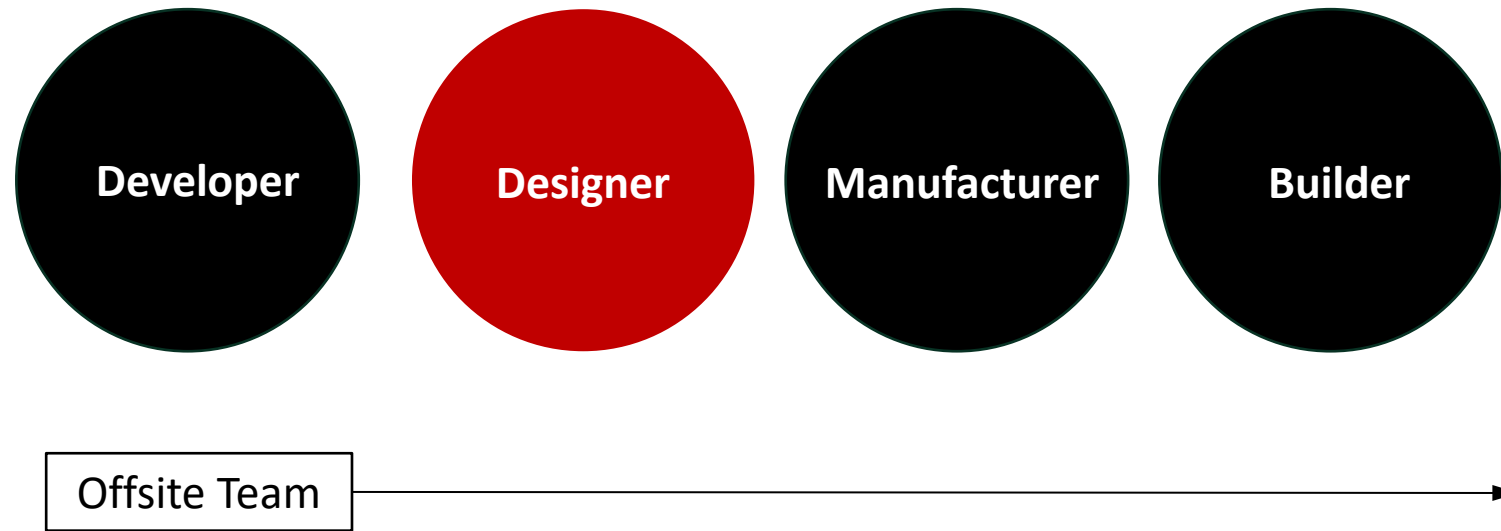
> 1000%

Productivity boost
(offsite – onsite)



- Move to a manufacturing style production system

TRADITIONAL: *Offsite Team* Approach



Project based design
Prototype Manufacturing - DfMA

To Rethink Design of Offsite

>

*Modularized
Product Platforms*

>

Digitalization
Industrialization
Circularity

Modularization is the activity of dividing a product or system into modules that are ... flexible (so as) to create different requested configurations, while reducing the number of unique building blocks (**module variants**).

> (by) re-using module variants across multiple configurations ... **economy of scale** is reached without standardizing the **product**.

Product platforms are a collection of modules ... that are common to several products. This commonality is developed intentionally to achieve desired effects in order to create value. (Source: Springer)

A product platform can be understood as a game with a finite but flexible set of playing pieces. (e.g., LEGO® or Dominoes)

*Product platforms are not products.
Modularization is not productization.*

Product platforms are not products or prototypes

Product platforms enable **economies of scale**

NOT because of standardization at the product level, **but** because of standardization at the **module level** to allow for more **variety** at the product level.

MODULARIZED PRODUCT PLATFORM

Smart Phone *Context / Site / Design*



Modularized Product



Manufacturing



Supply Chain



Variant



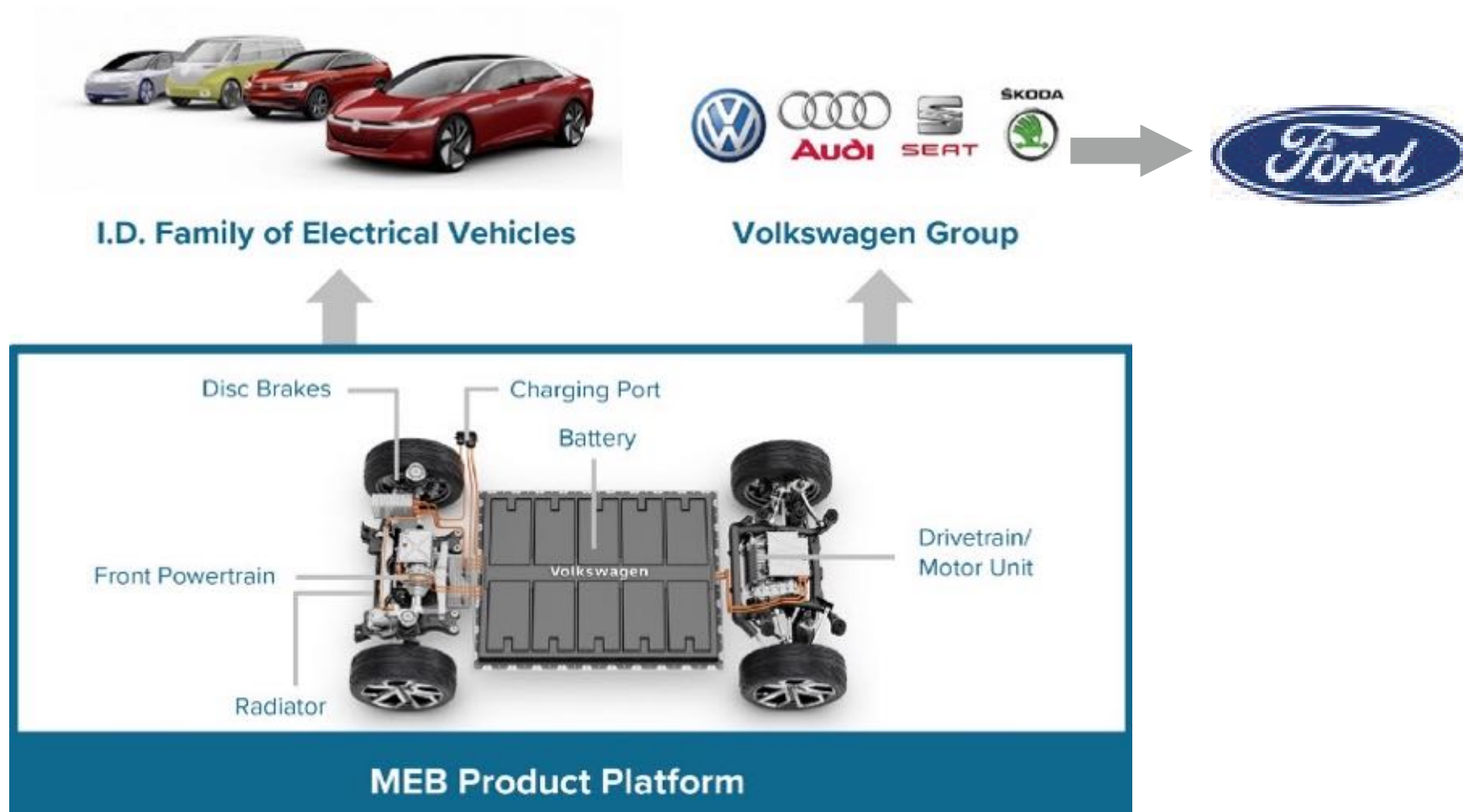
Sales



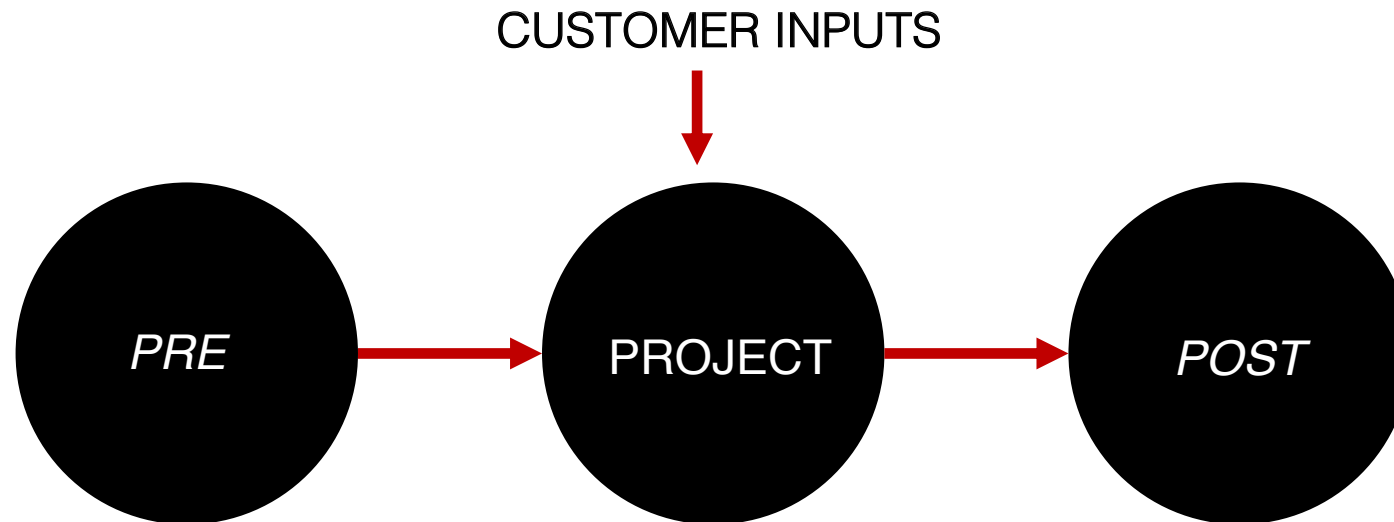
Continual Improvement

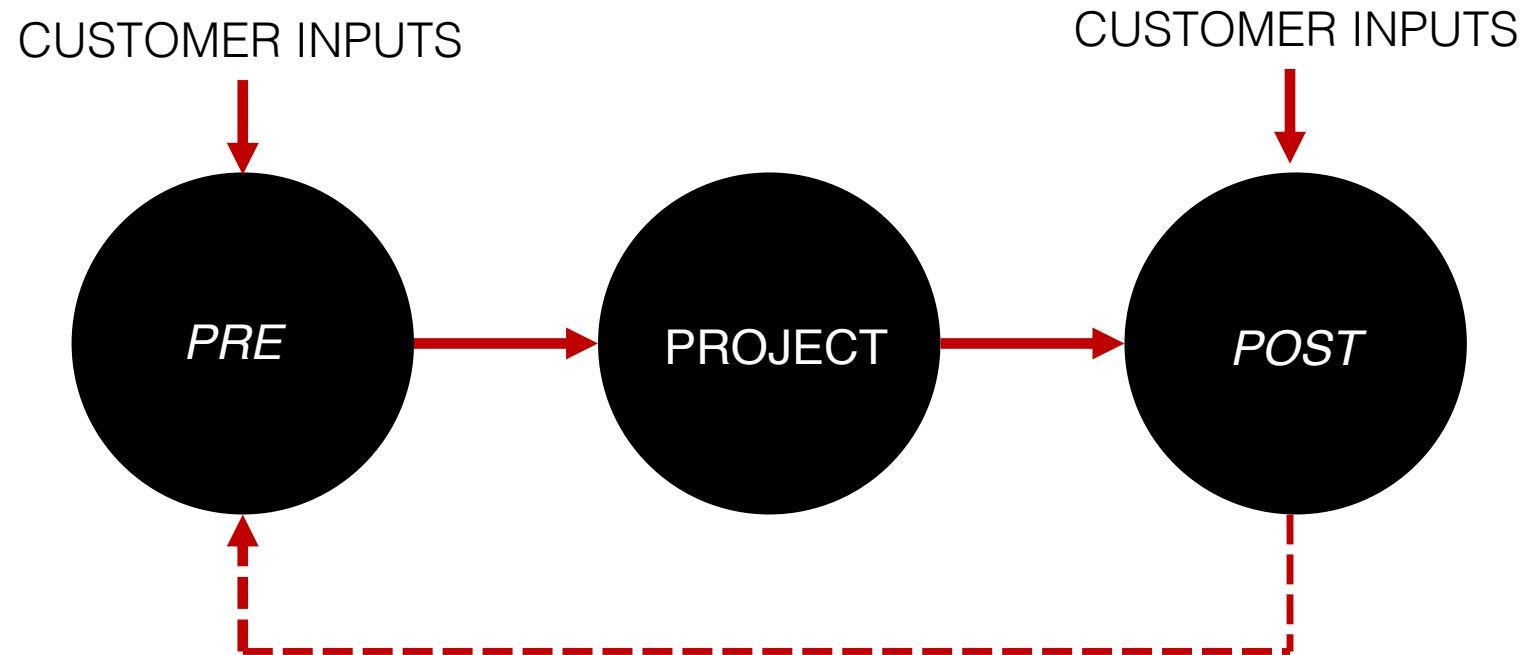
MODULARIZED PRODUCT PLATFORM

Automobile



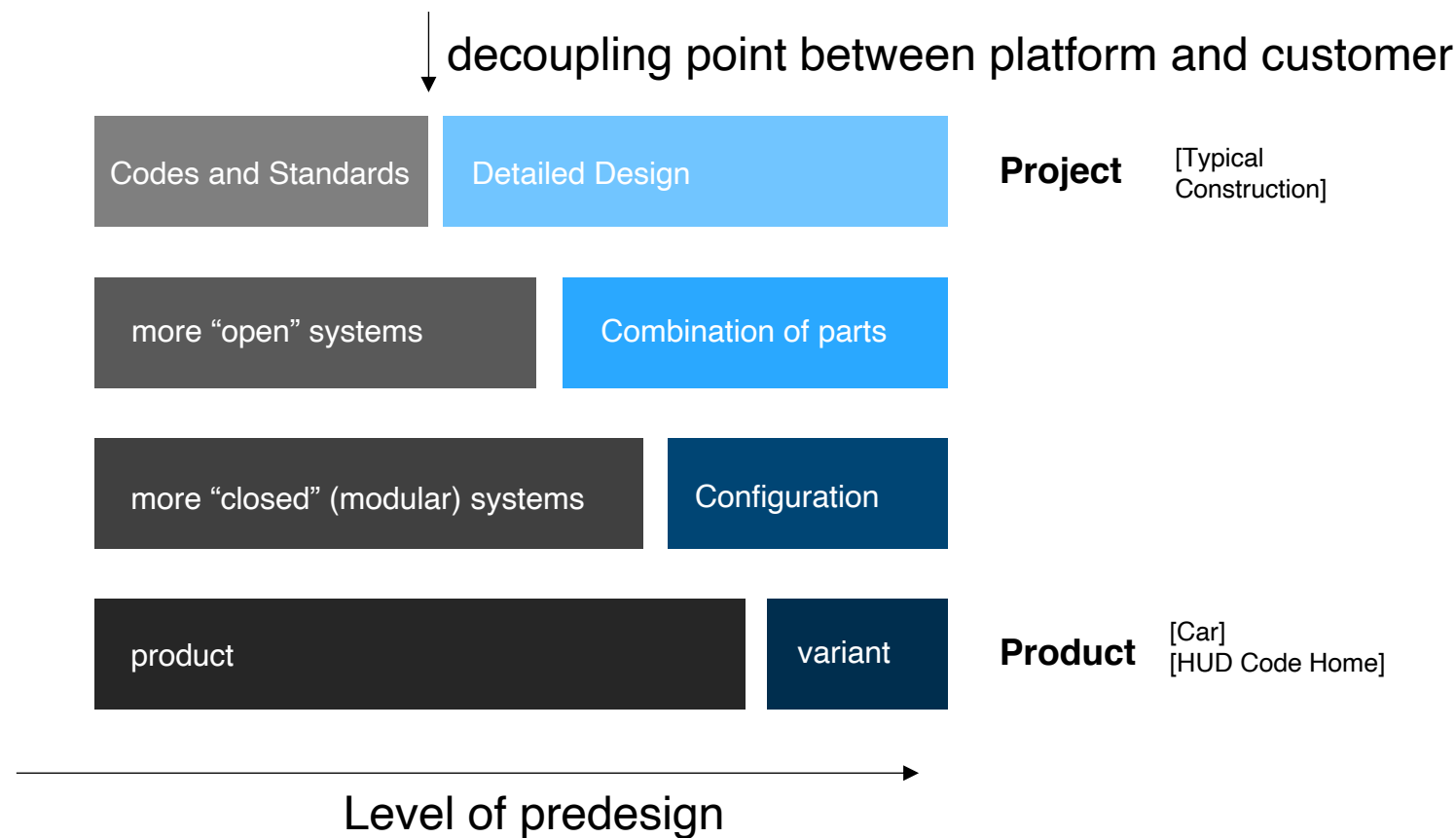
AEC Business Model – Project



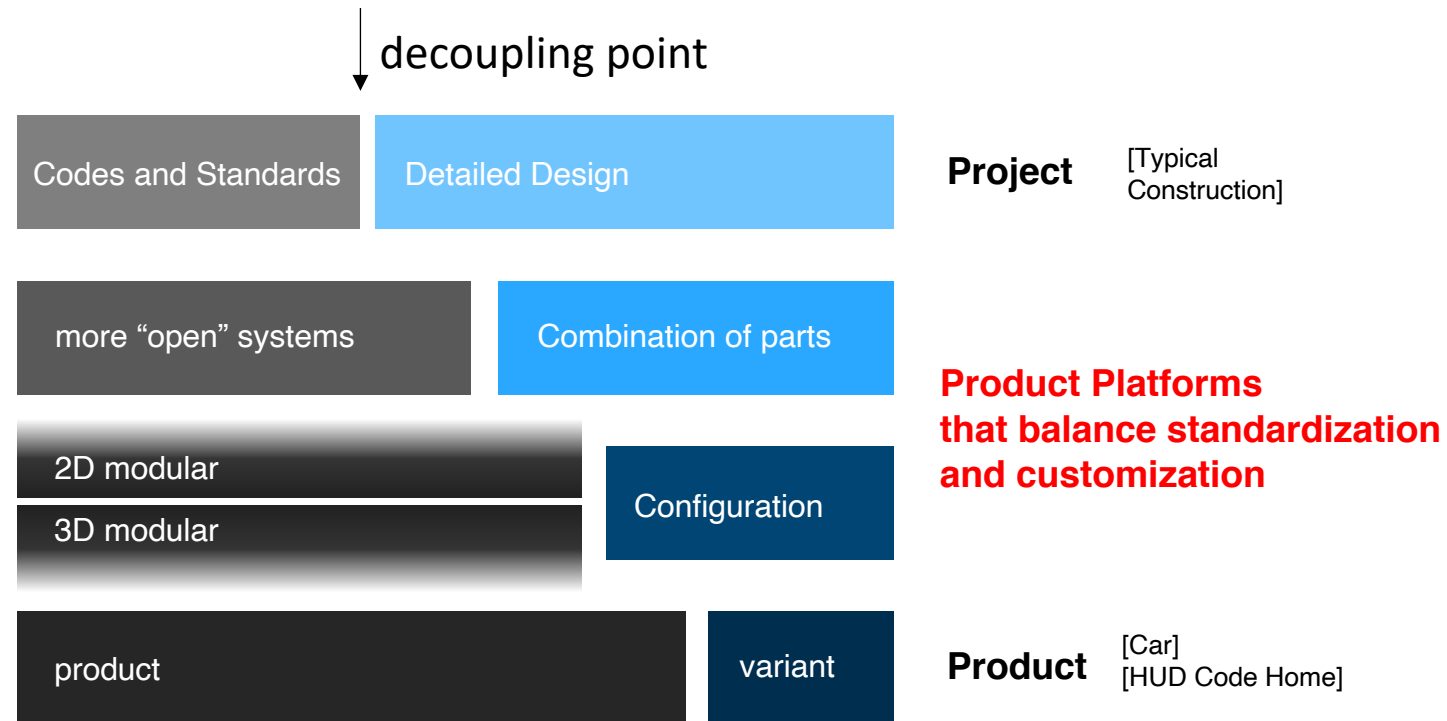


Not a prototype!

Offsite Construction from Project to Product

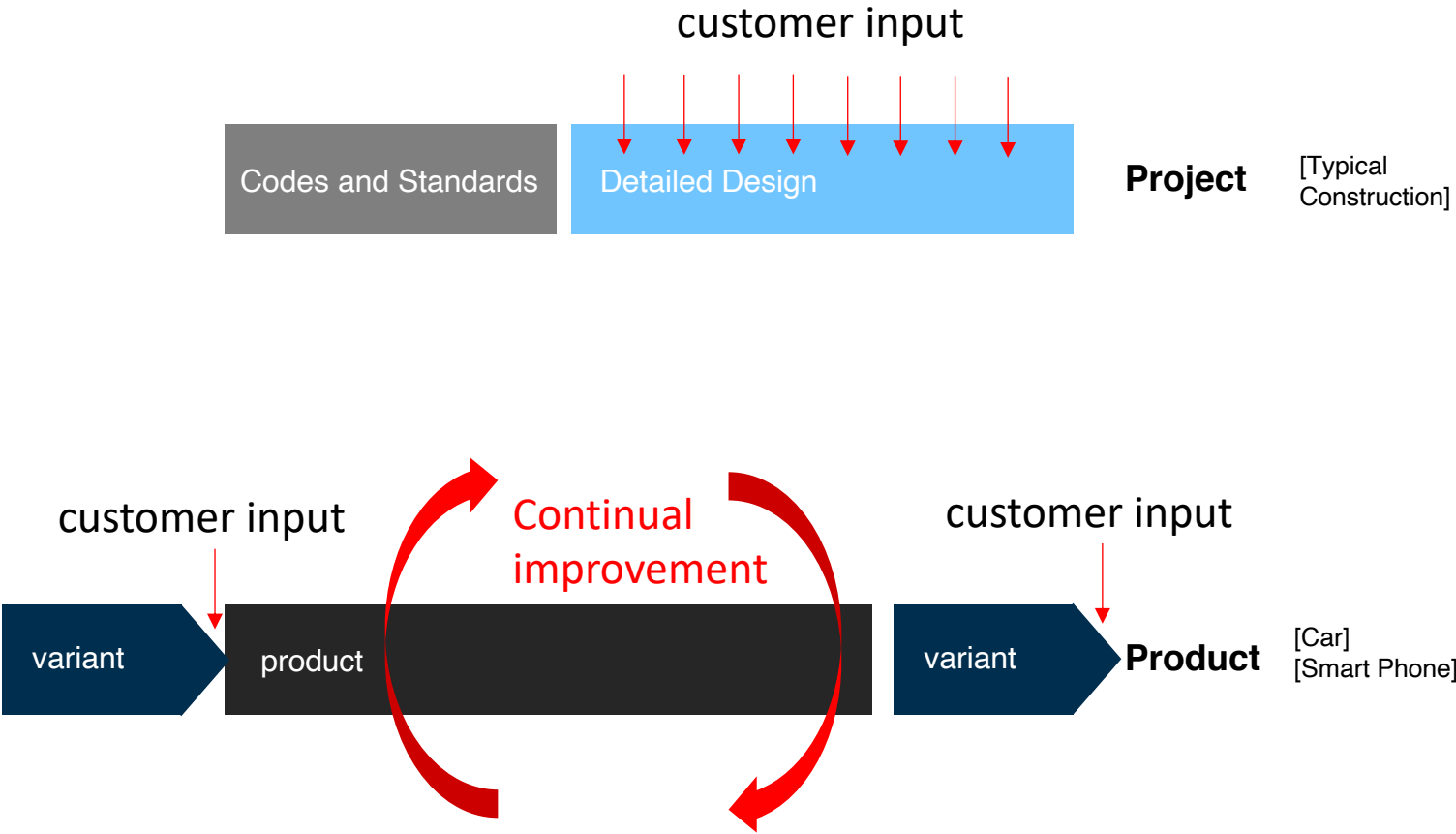


Product Platforms / Business Platforms



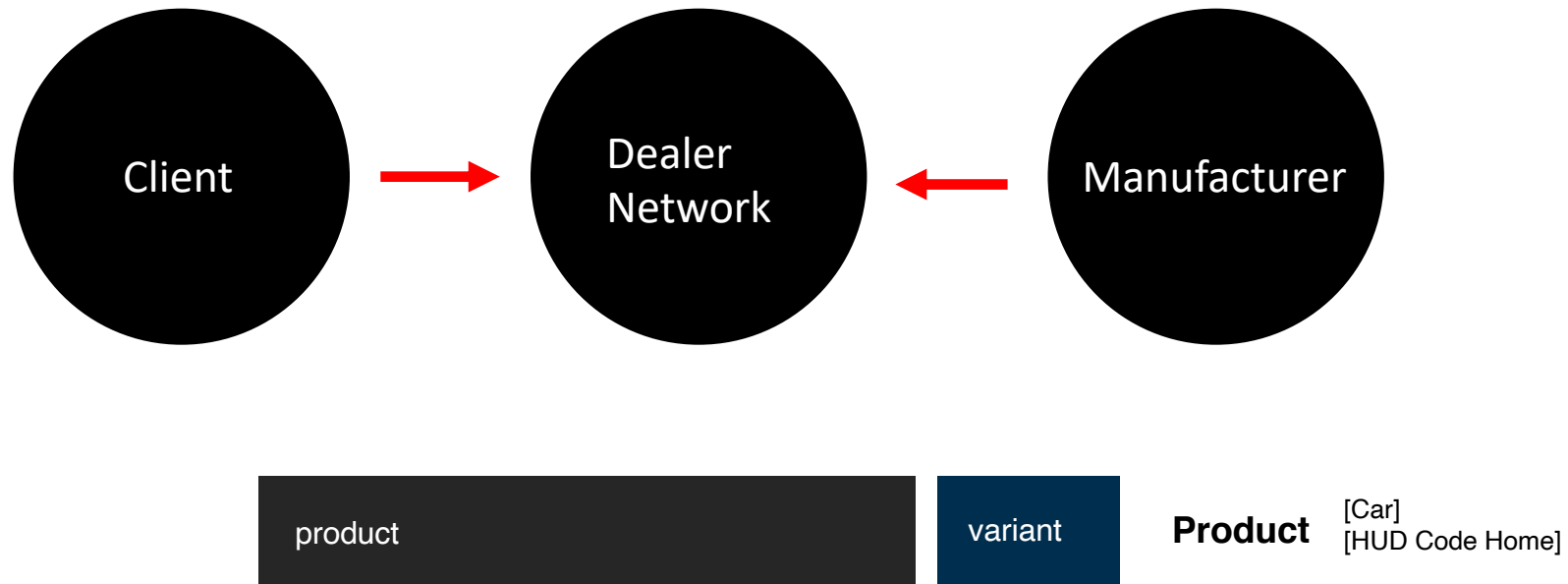
MODULARIZED PRODUCT PLATFORM

Continual Improvement



Established US Offsite Business Model

HUD CODE (Manufactured Home)



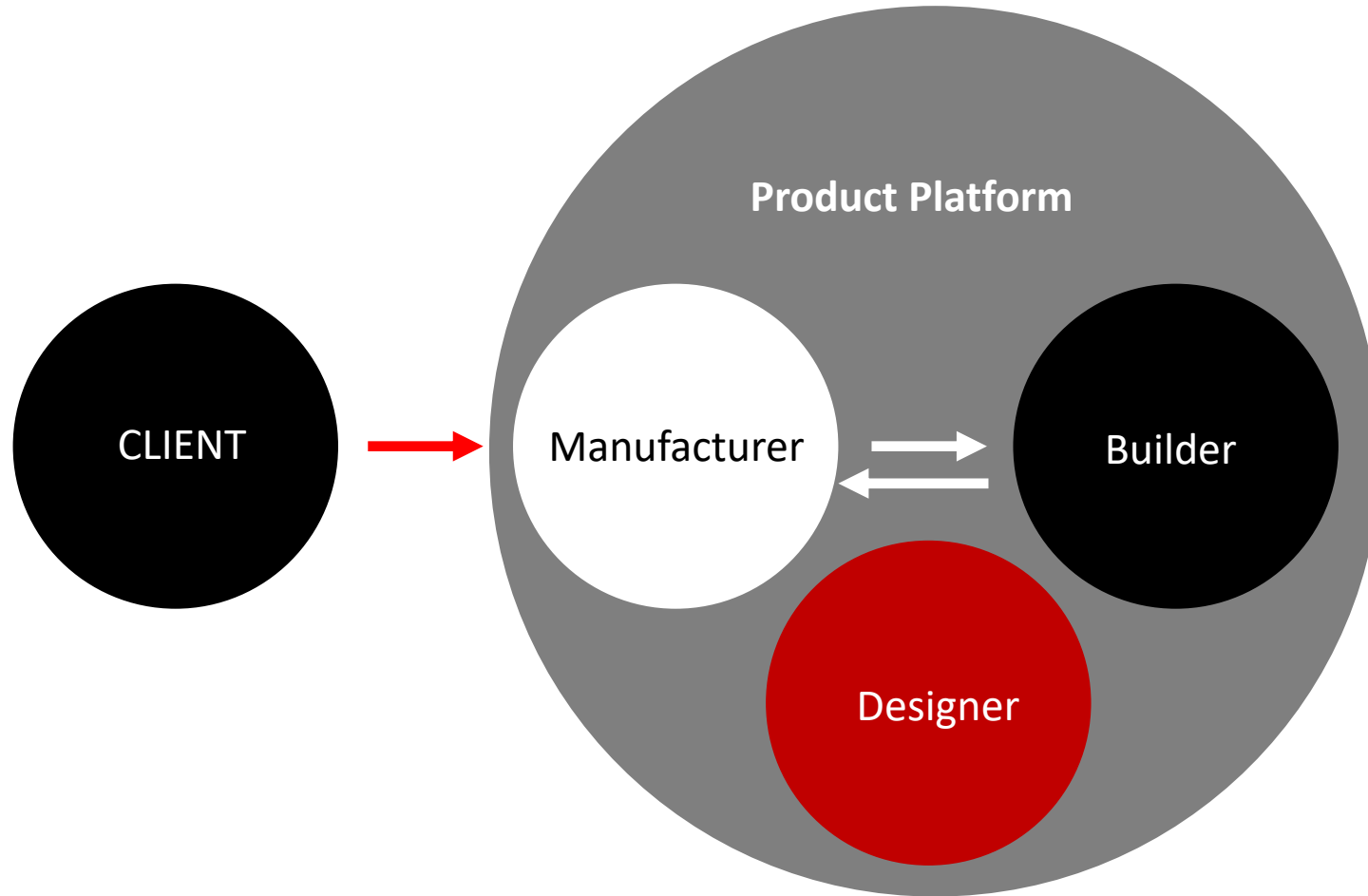
The core business model for volumetric modular comes from the manufactured housing industry as well >
“**productization without a modularized product platform**”

Product / Business Platform Examples



“model”

International Model: Product Platform



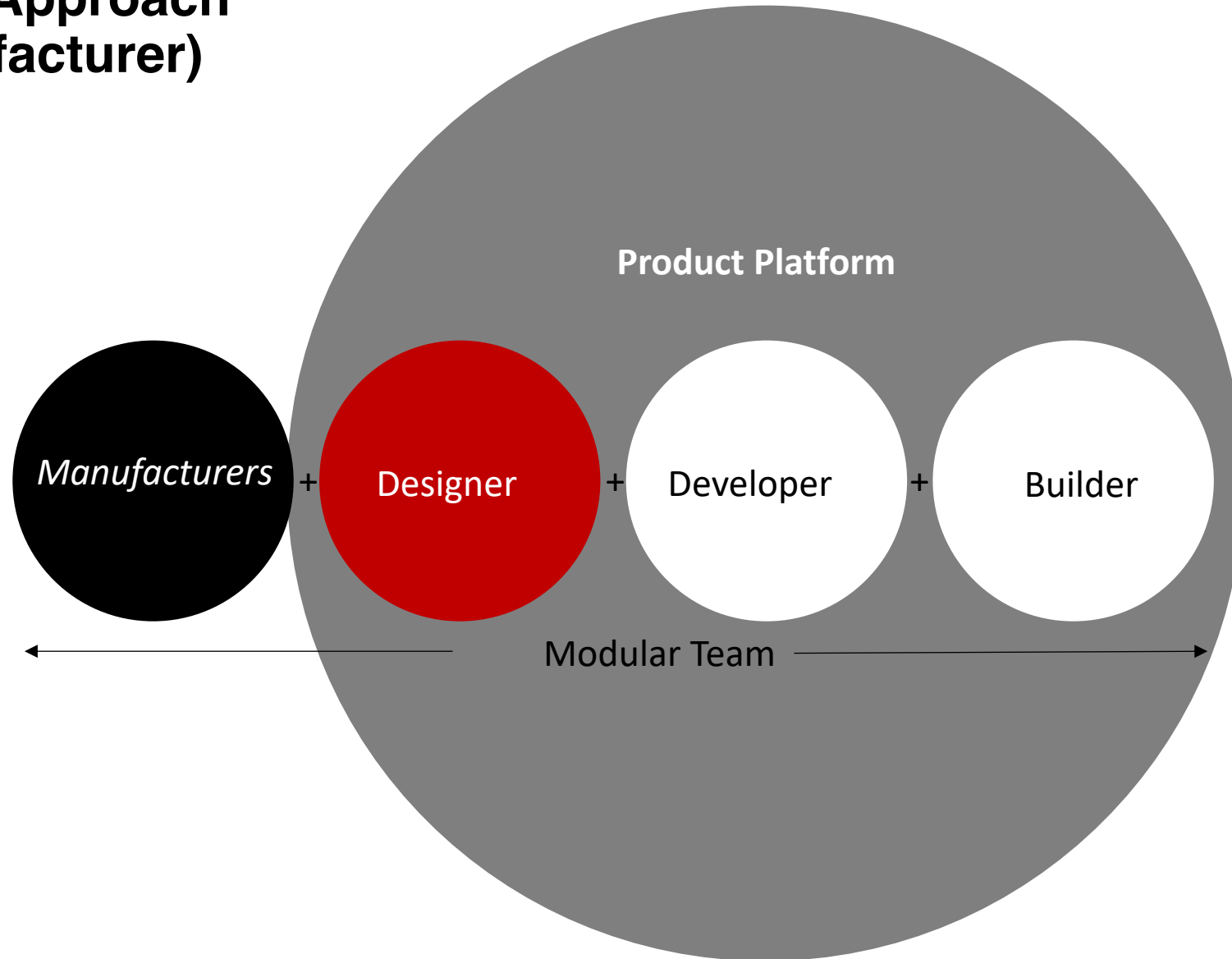
2D modular

3D modular

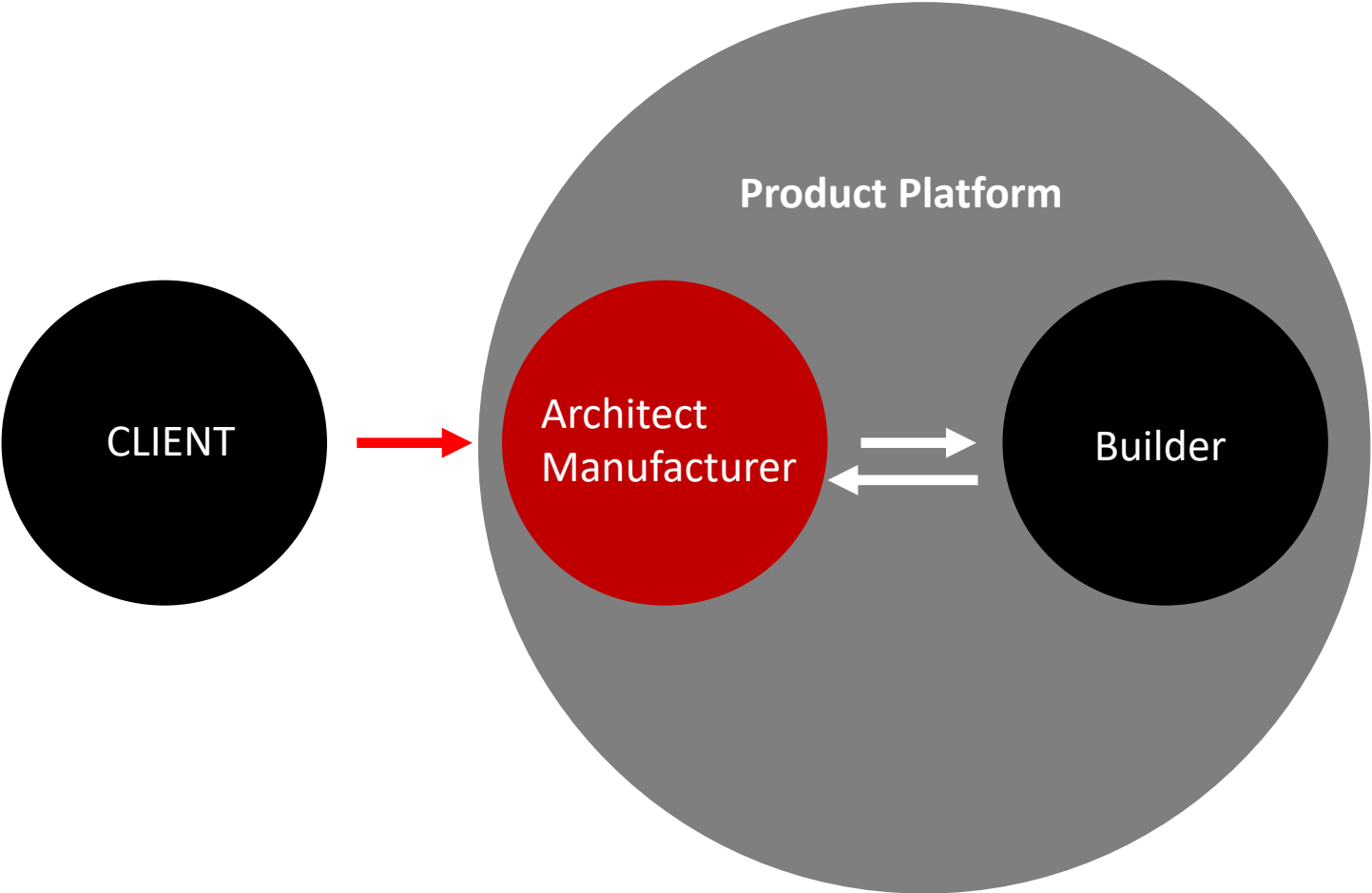
Configuration

Product Platform

Modular Team Approach **(variable manufacturer)**



MODULARIZED PRODUCT PLATFORM

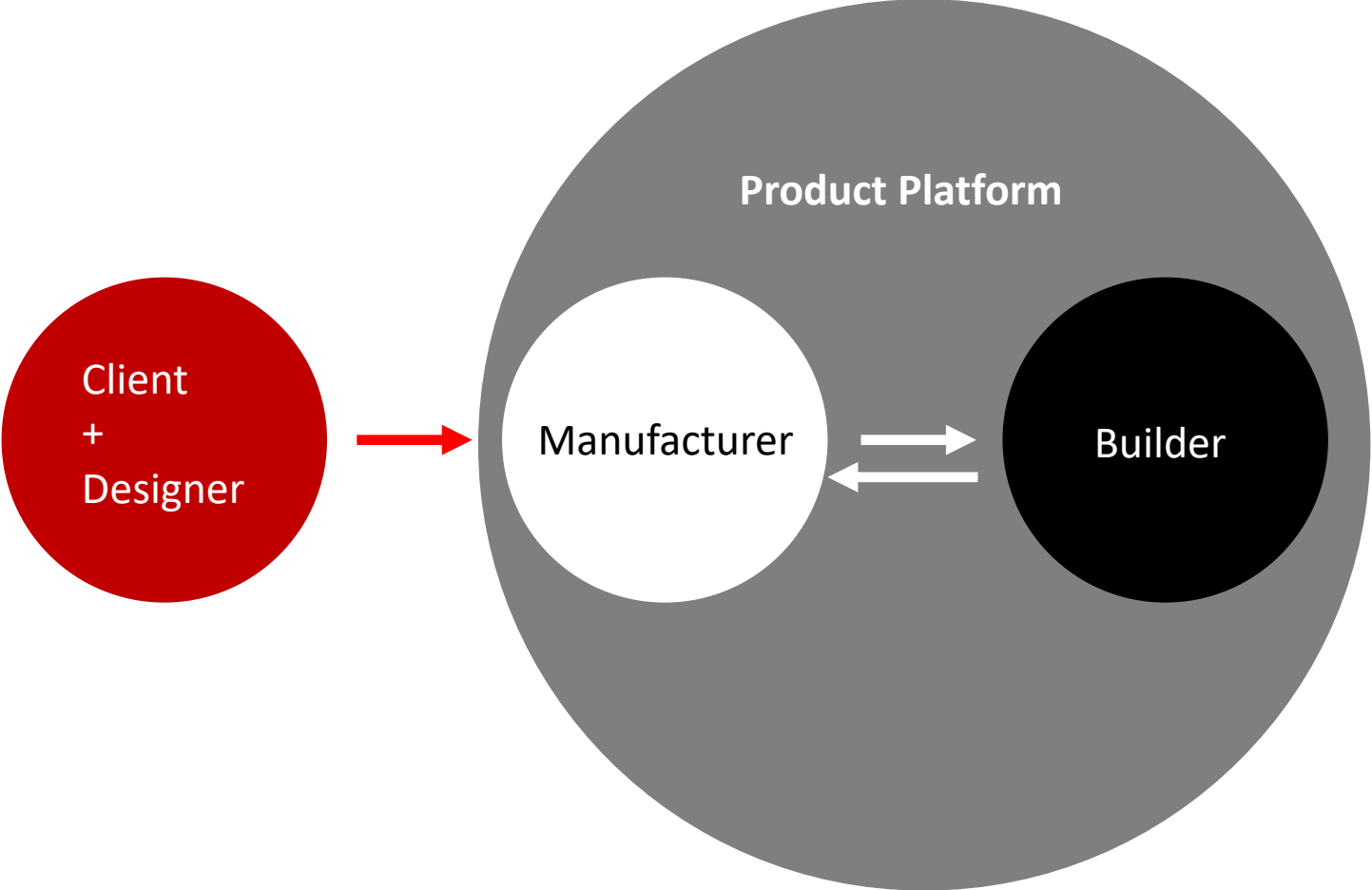


- 2D modular
- 3D modular

Configuration

Product Platform

Modular Business Model > *Product Platform*

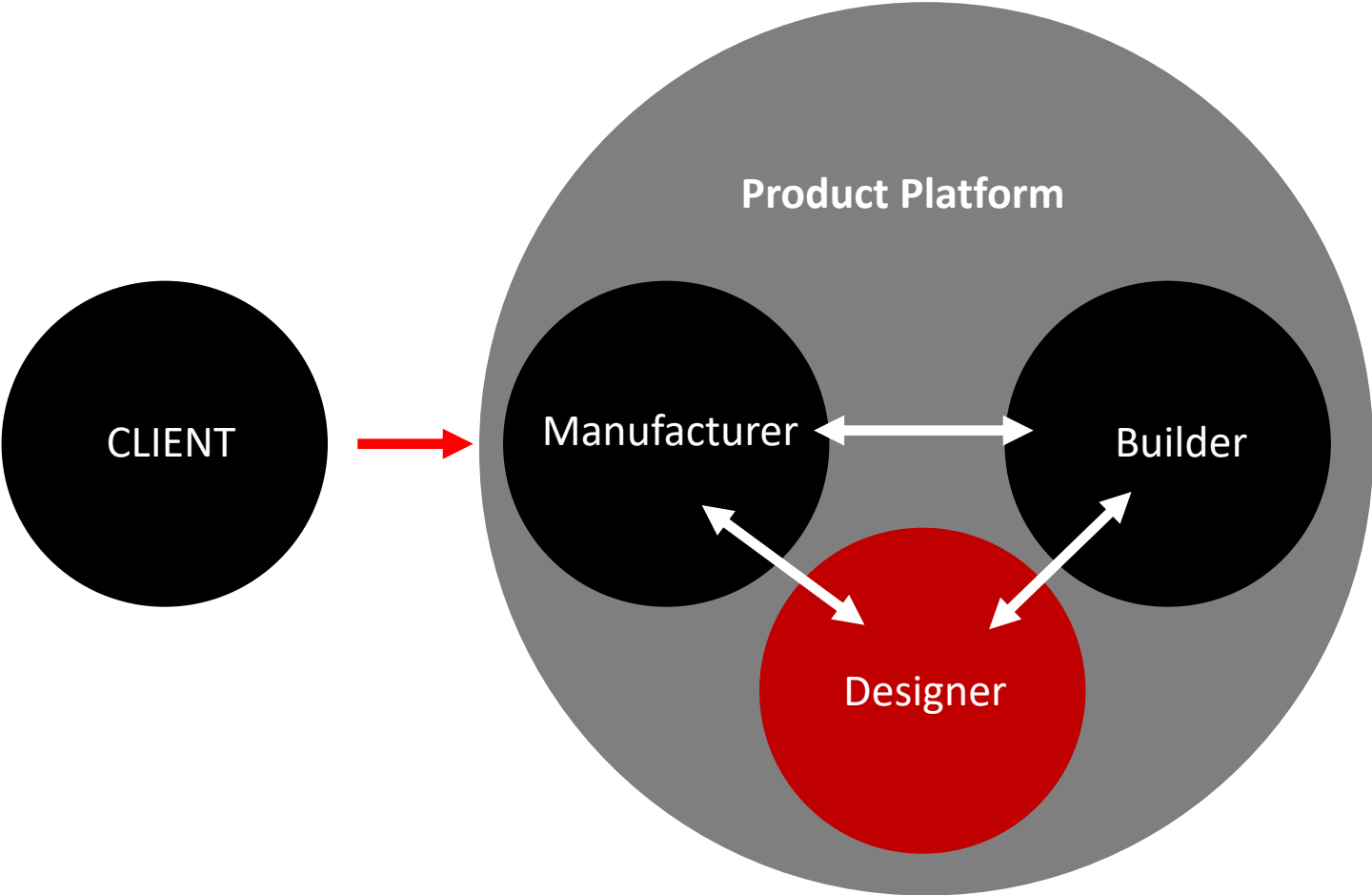


- 2D modular
- 3D modular

Configuration

Product Platform

MODULARIZED PRODUCT PLATFORM



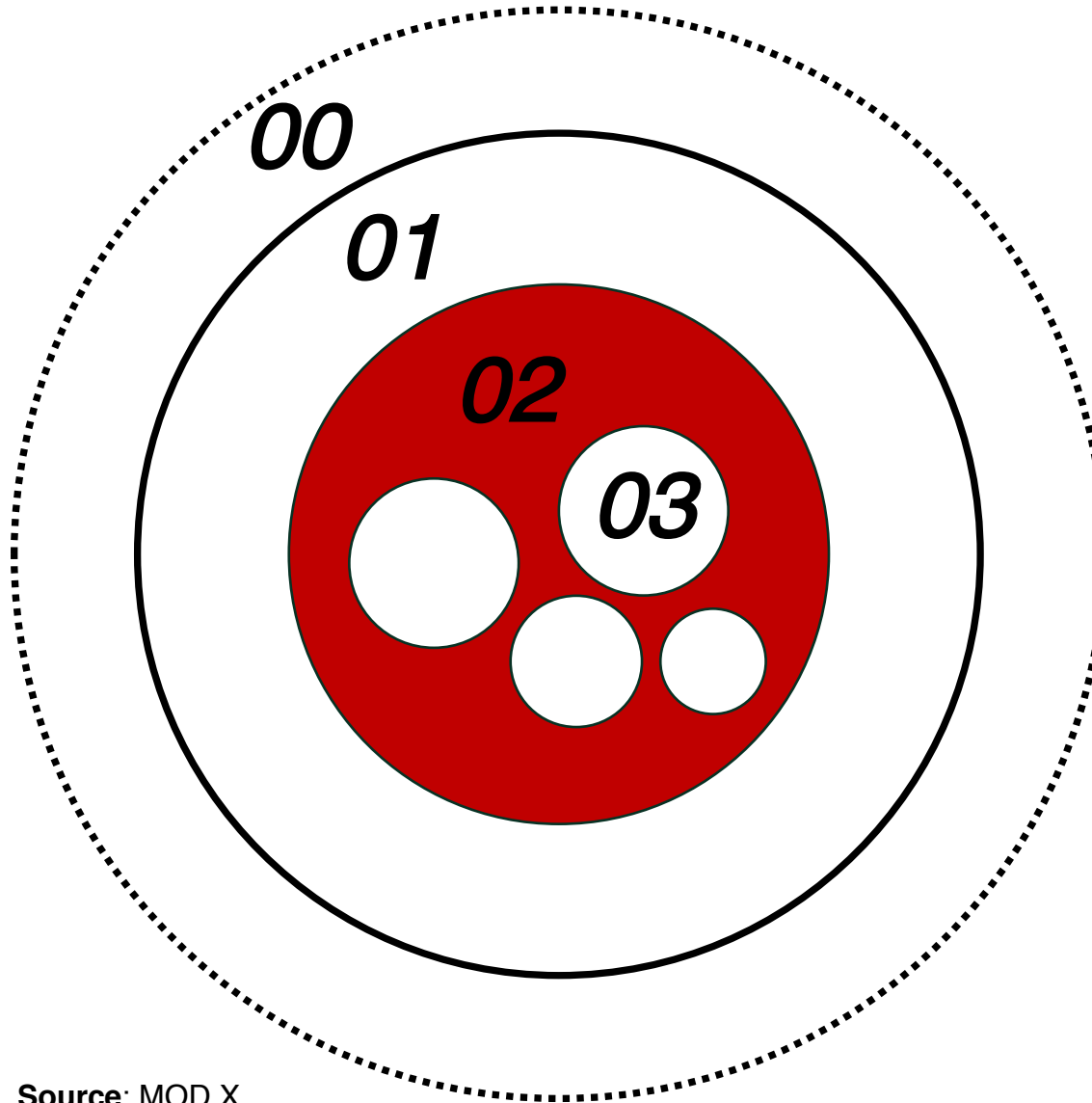
- 2D modular
- 3D modular

Configuration

Product Platform

Offsite in Context

Product Platforms - Between Business and Tech



Source: MOD X

00 - Context

- Market
- Material
- Labor
- Regulatory
- Culture

01 – Business Platform

- Value Creation
- Supply Chain
- Integration

02 - Product Platform

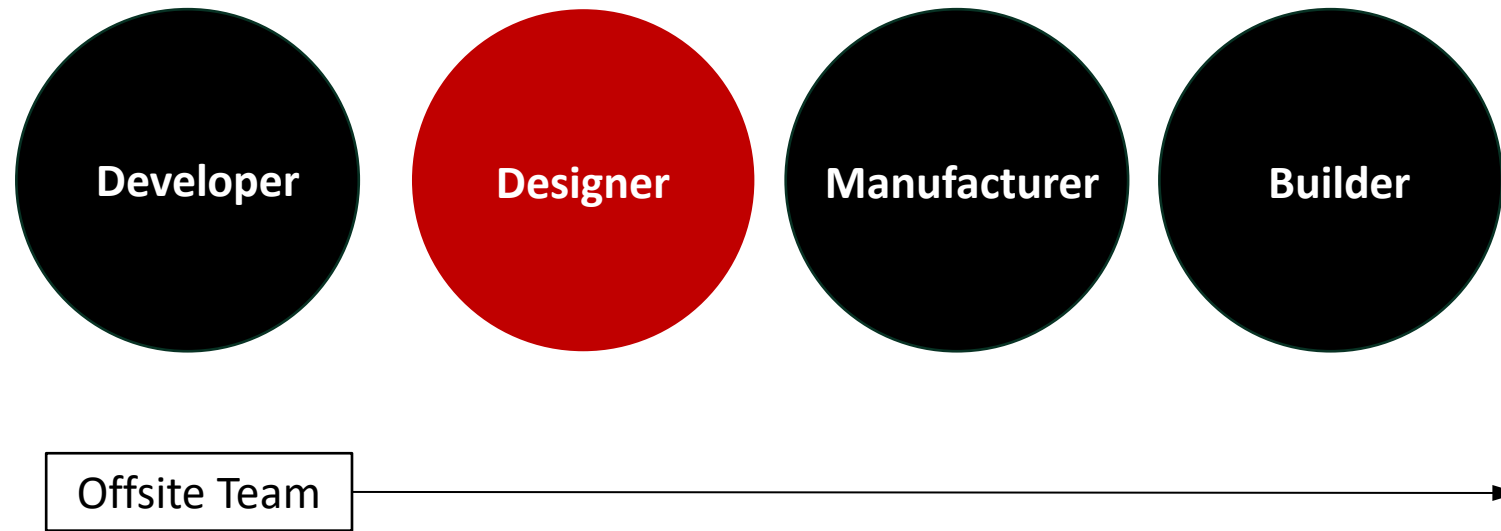
- Modularization
- Product Platforms
- Continual Improvement

03 – Technology

- Automation
- Digitalization

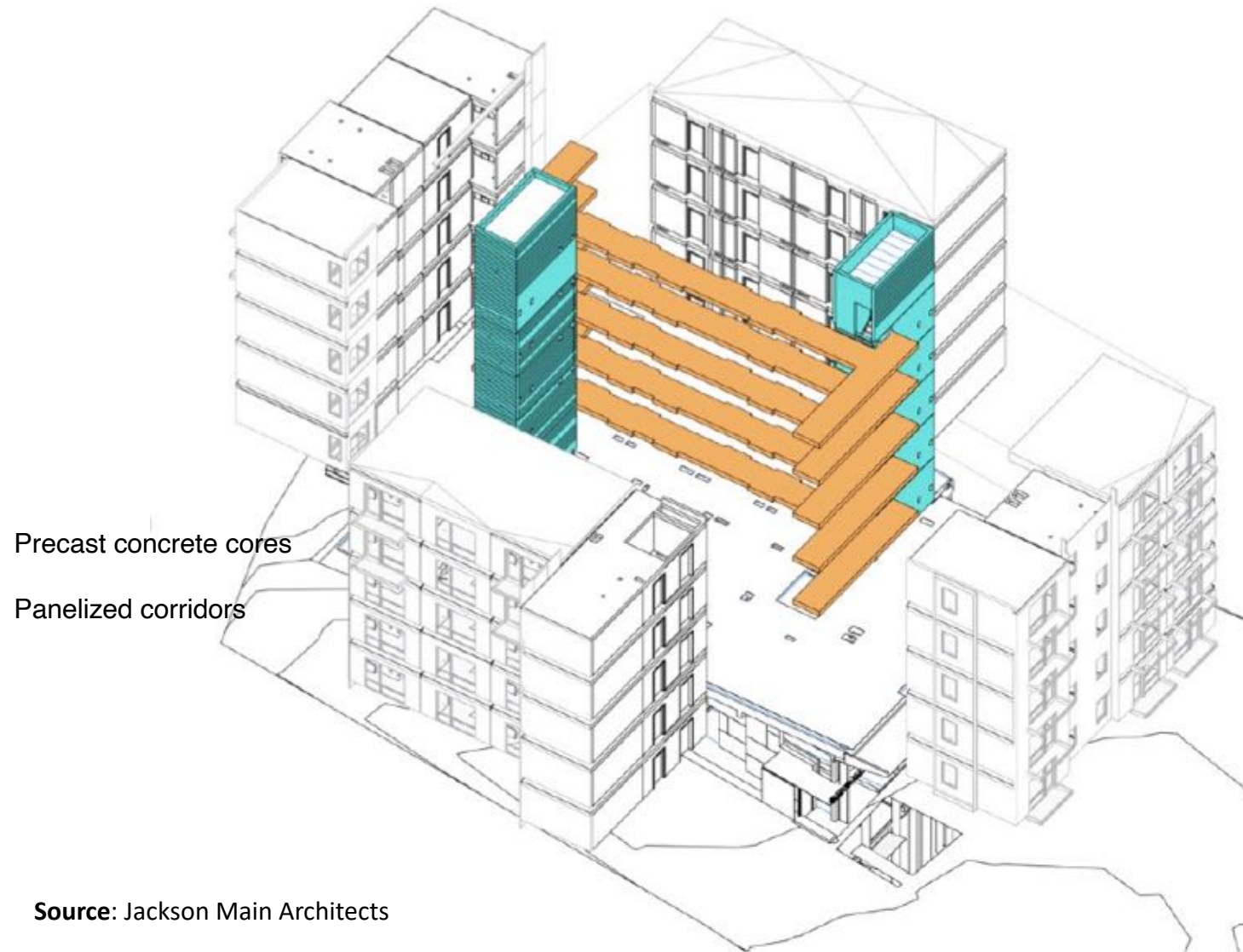
4. Case Studies

TRADITIONAL: *Offsite Team* Approach



Project based design
Prototype Manufacturing - DfMA

TRADITIONAL: *Offsite Team* Approach



TRADITIONAL: *Offsite Team* Approach



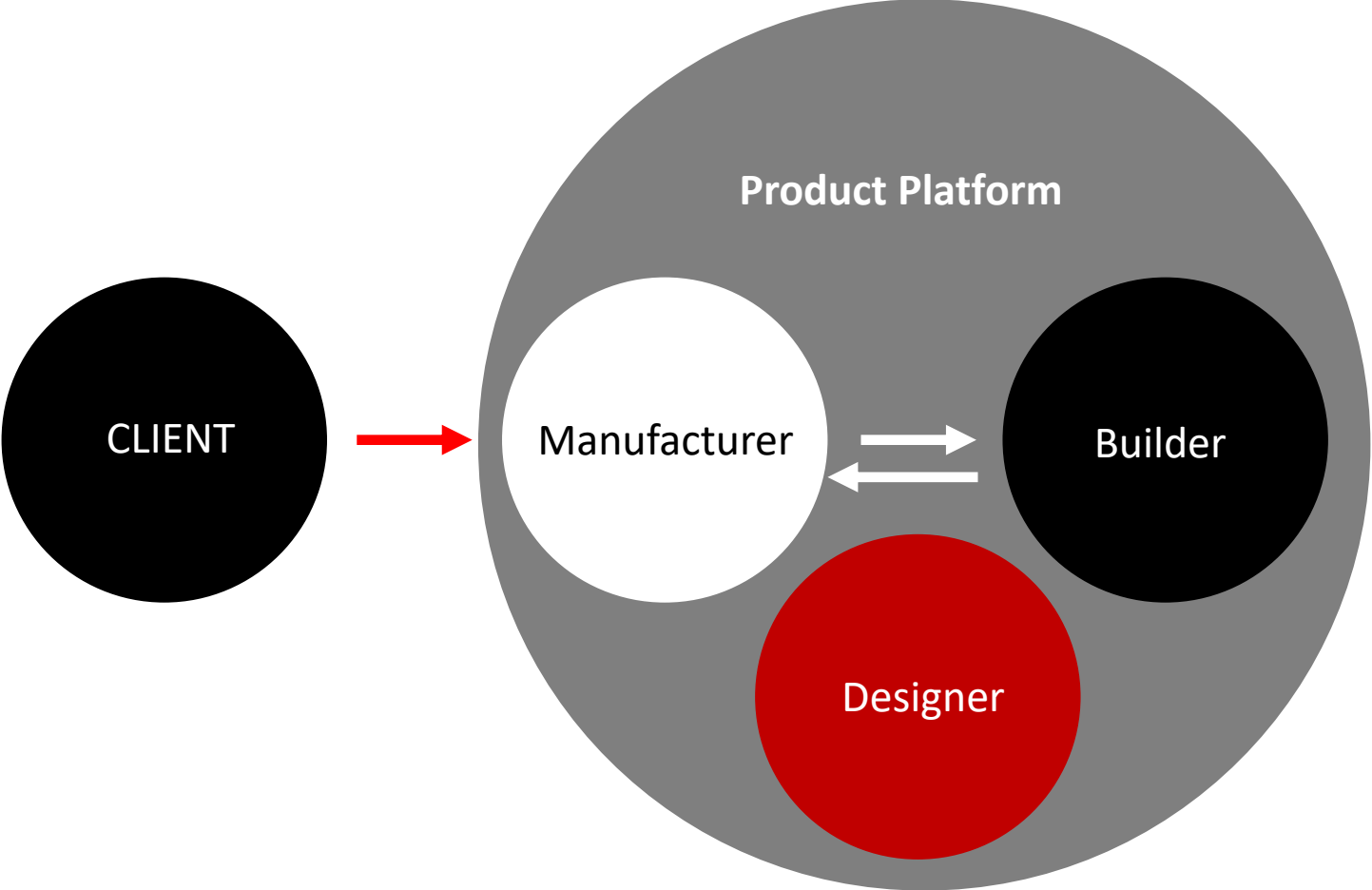
Preapproved modules
Preapproved connection details

Source: Jackson Main Architects

TRADITIONAL: *Offsite Team Approach*



MODULARIZED PRODUCT PLATFORM
Katerra



2D modular
3D modular

Configuration

Product Platform

MODULARIZED PRODUCT PLATFORM

Katerra Garden Apartments (USA)

K3 Example Unit

Katerra Optimized Units

Unit Planning Modules

Repeating parts reduce complex, manual field-work. Modules are planned to accommodate nation-wide accessibility standards.

Continuous Bearing Line: Fewer Jogs, Corners & Wall Panels

Longer, straighter walls simplify structure, prefabricated wall panel manufacturing, shipping and installation. Allows for fewer panels, fewer picks, fewer connections and more efficient shipping. Straight and continuous structural bearing lines simplify floor panels, wall panels and foundation bearing systems.

Bathroom Bath Kits

Pre-designed, pre-engineered to install in a day. Designed for optimal livability, efficiency and accessibility compliance. Repeatable bathroom layouts reduce the cost and time to develop a project. Parts within bath kits are configurable. Tubs and showers within the typical bath kit are configurable.

Load Center

Expedites installation by providing labor intensive electrical distribution in a pre-manufactured assembly.

Laundry/Utility Closet

Laundry/closet designs incorporate pre-engineered, panelized utility walls, optimized for space efficiency and installation.



Pocket Doors

Pocket doors ship inside wall panels. They save space by greatly reducing accessibility clearances.

K3 L Shaped Kitchen

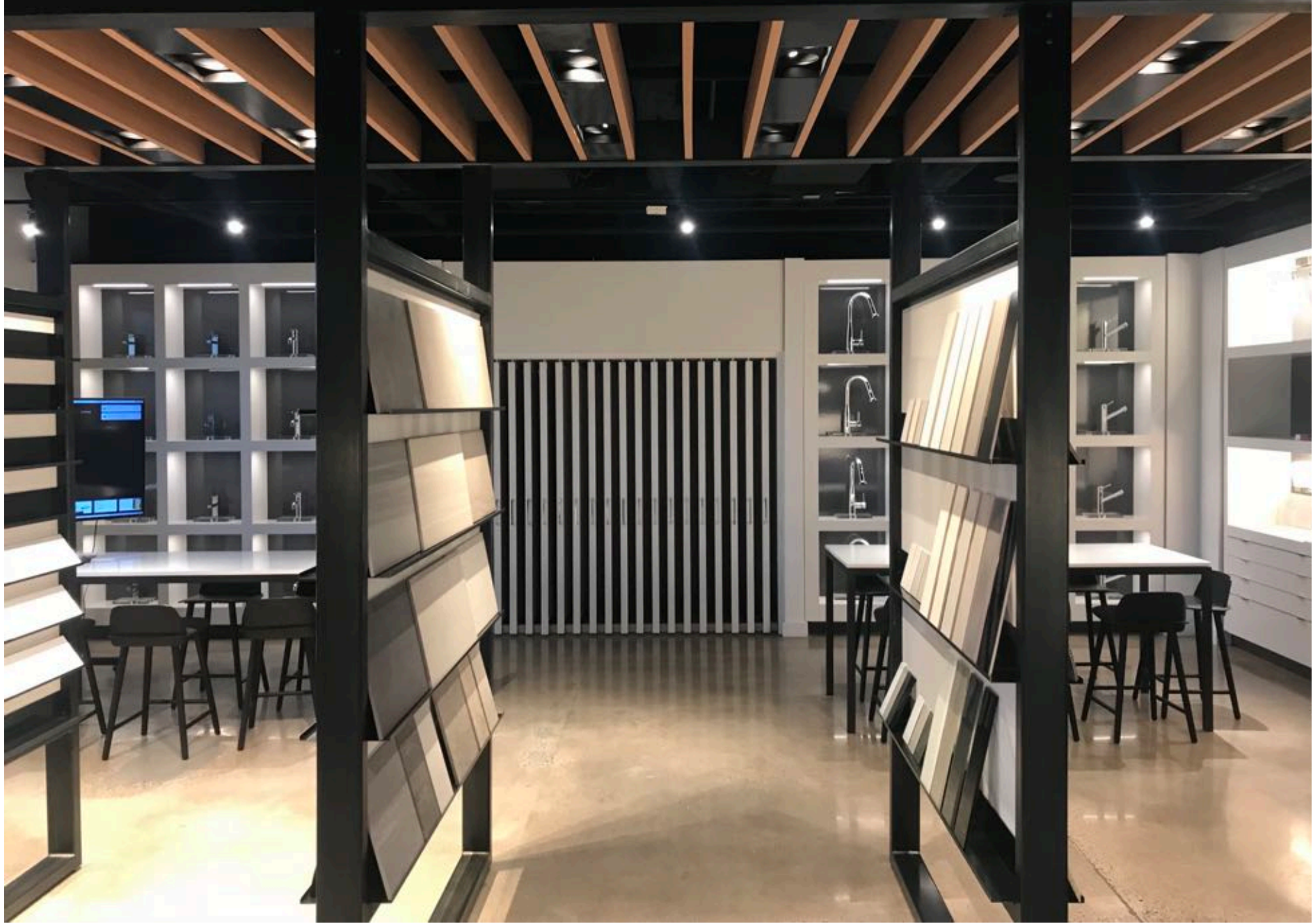
Katerra kitchens are pre-designed, pre-engineered and optimized for cost, manufacturing MEP simplification and accessibility. Furniture islands are available as an added amenity.

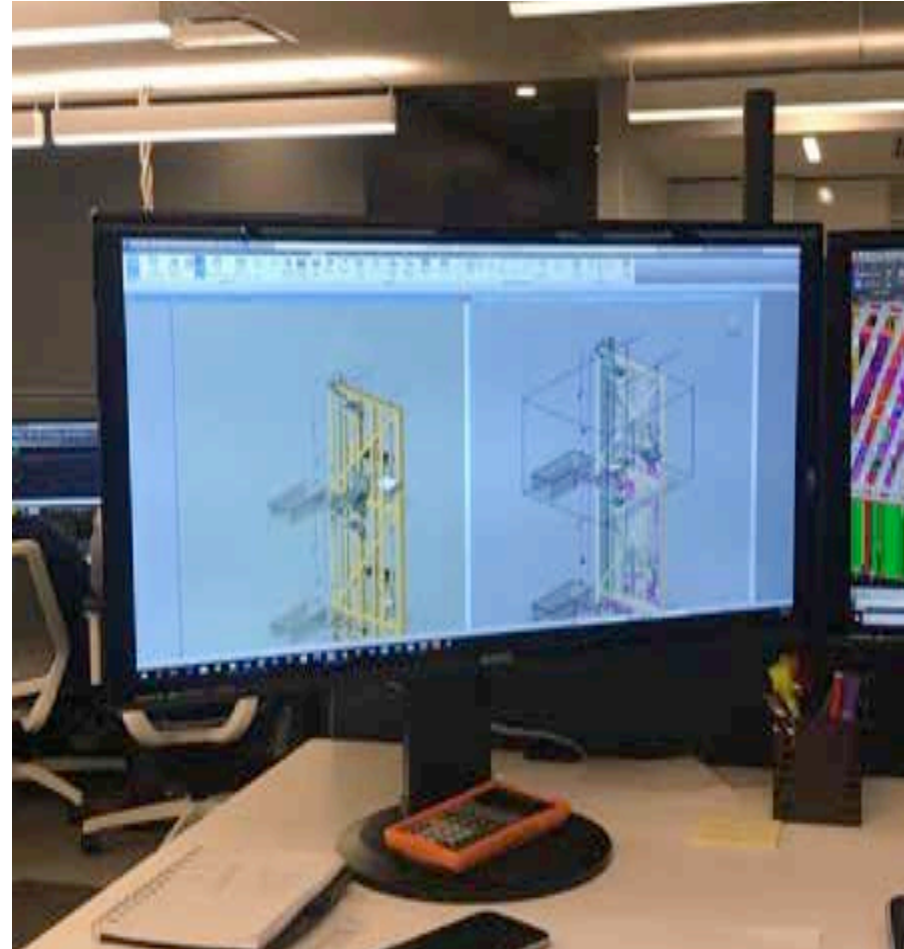
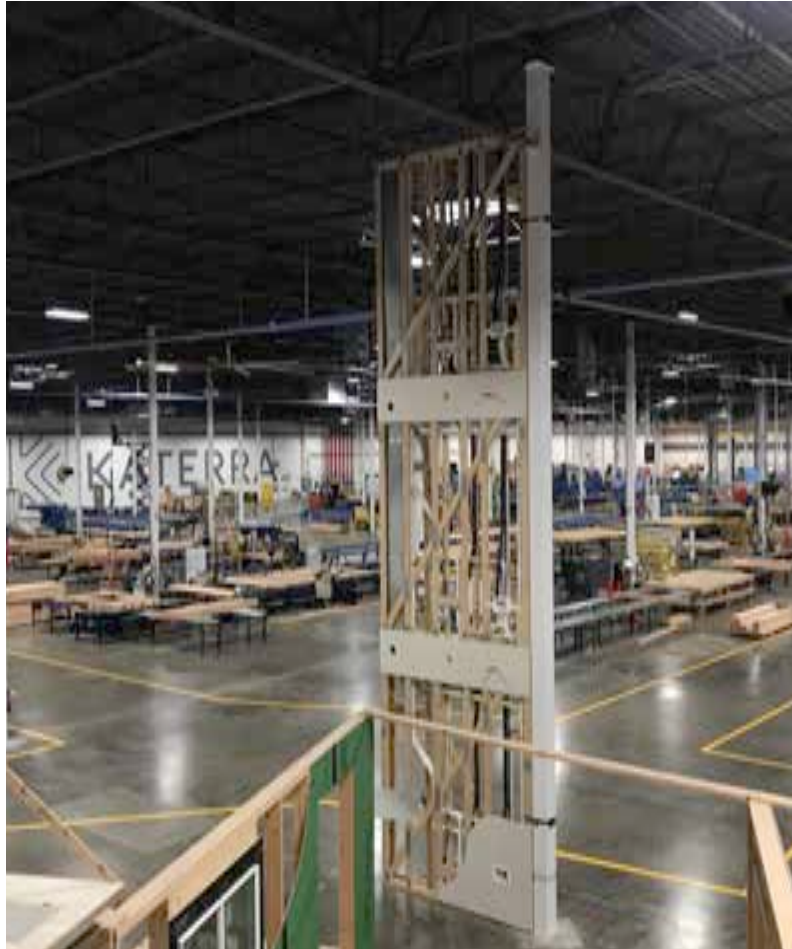
Kit Walls

Kitchen and bathroom assemblies incorporate furred-out utility walls, allowing for pre-assembly and optimization of MEP system engineering, installation and assembly.

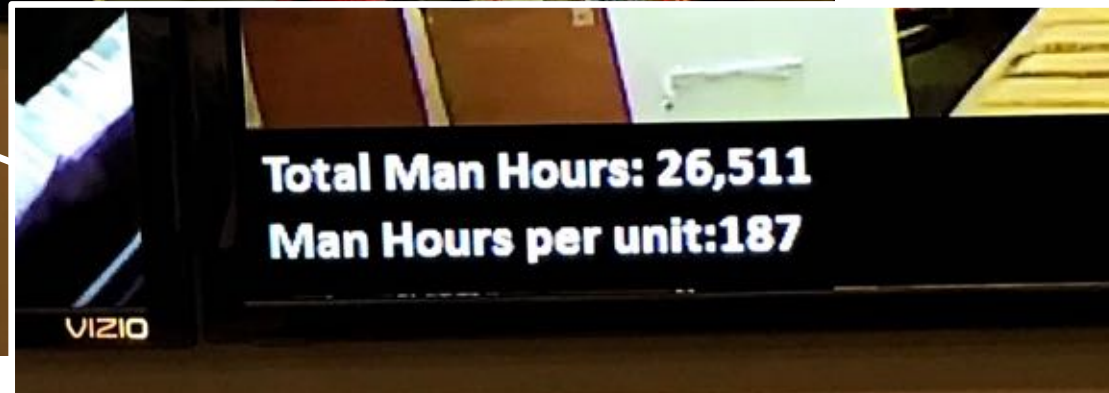
**MODULARIZED
PRODUCT
PLATFORM**

Katerra Garden
Apartments (USA)

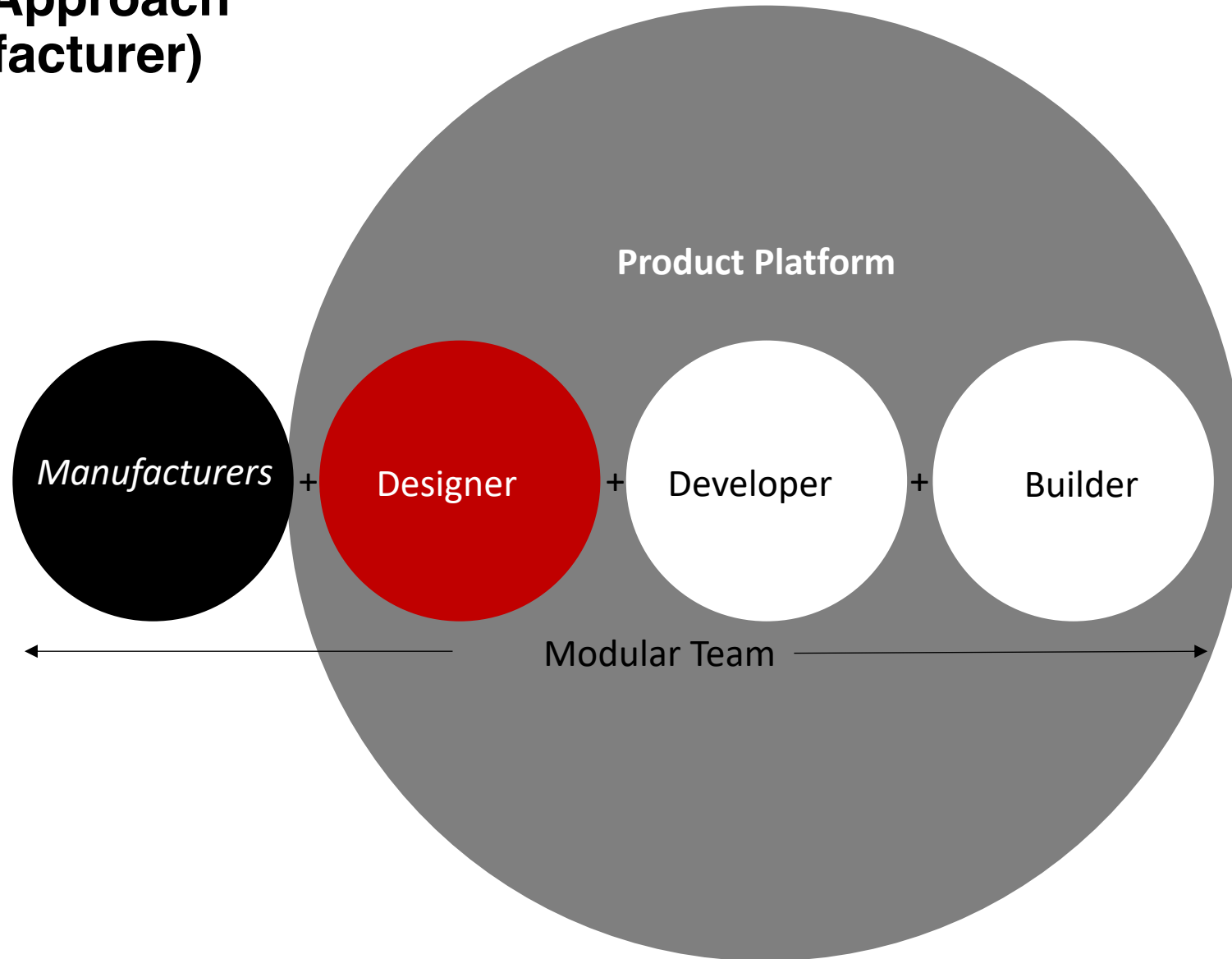








Modular Team Approach **(variable manufacturer)**



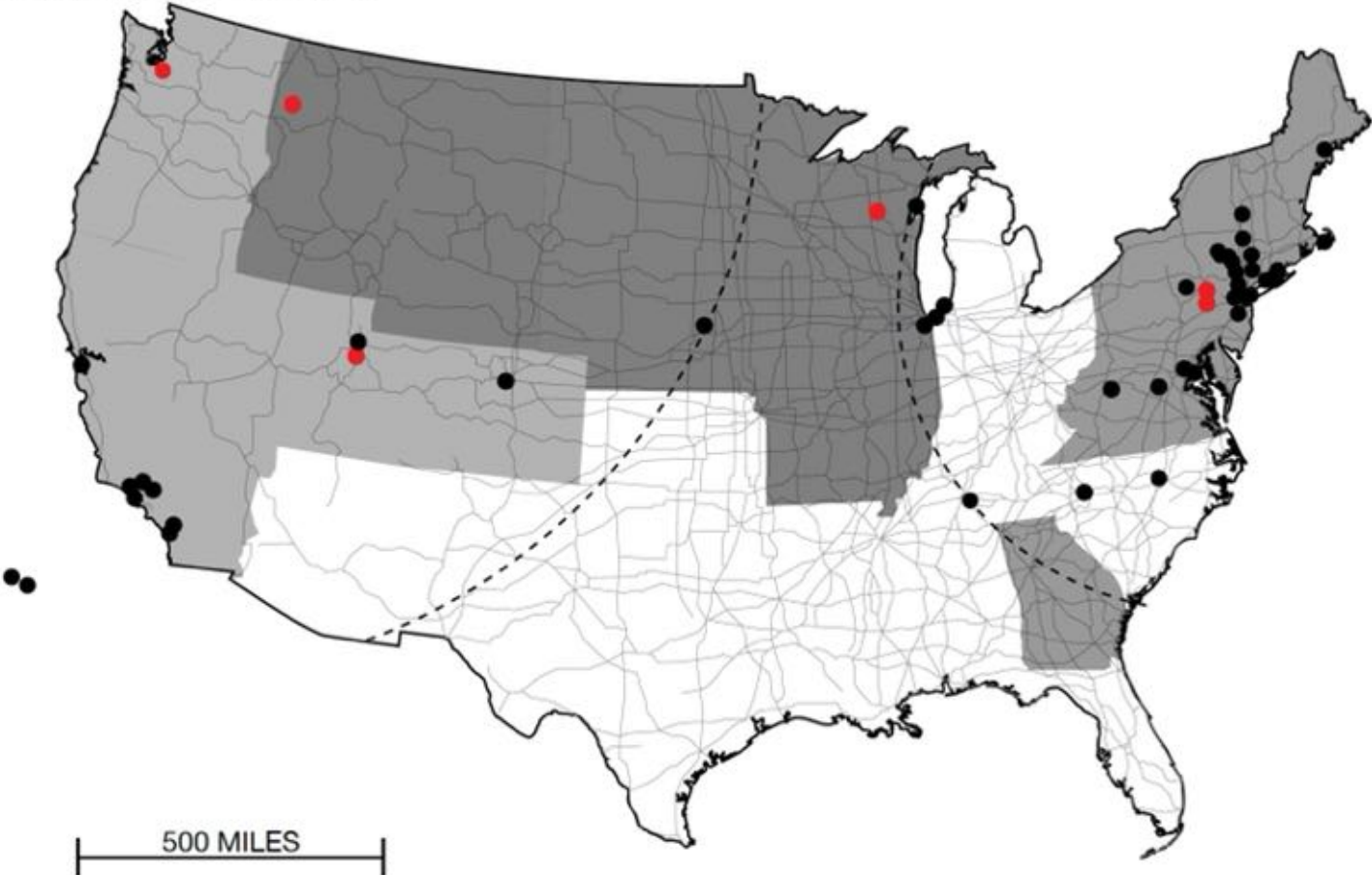
MODULARIZED PRODUCT PLATFORM

RES 4 Modern Modular (USA)



MODULARIZED PRODUCT PLATFORM

RES 4 Modern Modular (USA)



Since 2004, Resolution: 4 Architecture has refined the list of factories they prefer to work with, seeking factories that

build with the quality and expectations of their own design standards, shown here highlighted in red.

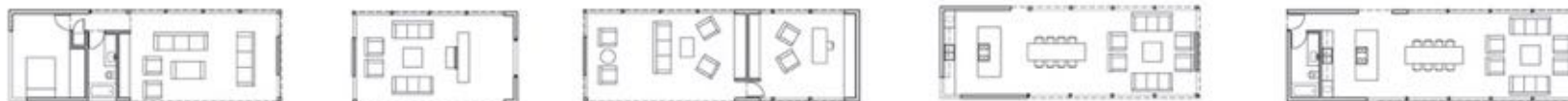
MODULARIZED PRODUCT PLATFORM

RES 4 Modern Modular (USA)

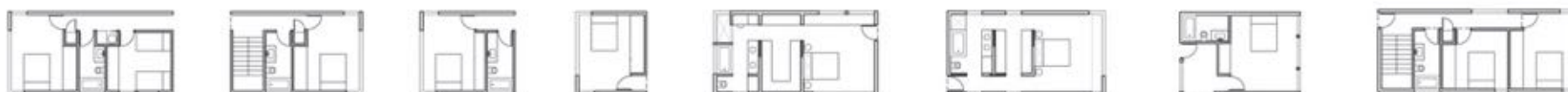
PHASE 1		PHASE 2		PHASE 3		PHASE 4	
Schematic Design	Design Development	Documentation	Bidding	Factory Production	Delivery	Set	Site Construction



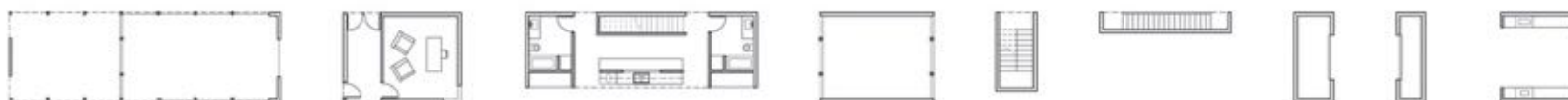
A local contractor is responsible for all the site work before and after the modules are set. So, RES4 requests and then analyzes contractor bids, to help the client select the right contractor for the job.



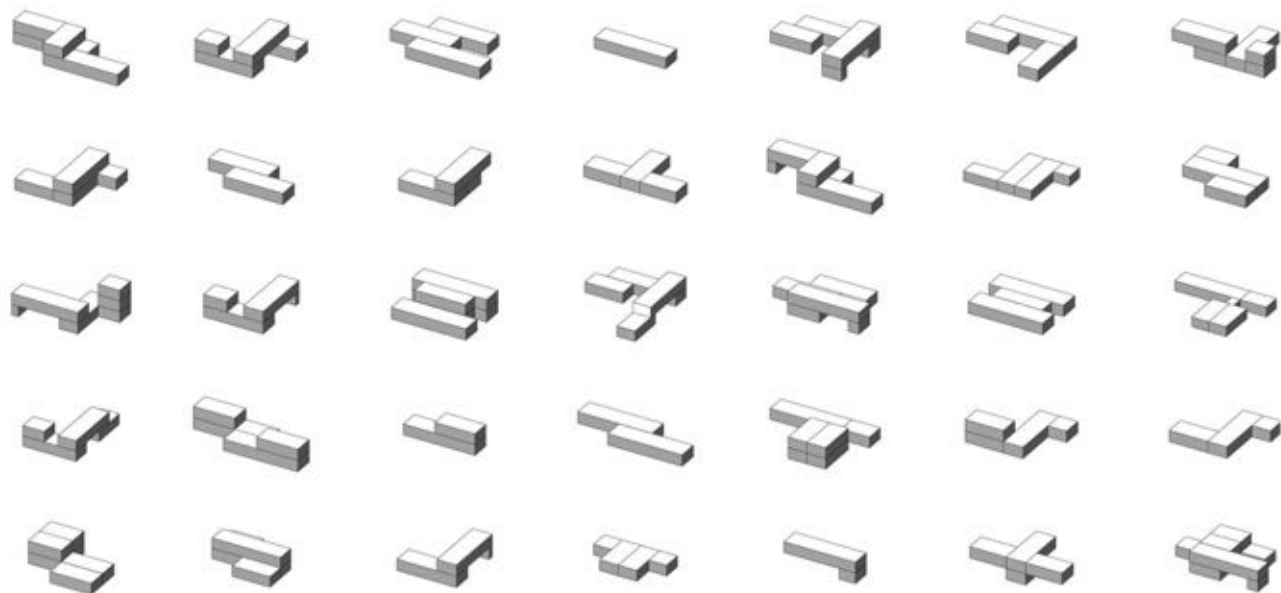
MODULES OF COMMUNIAL USE



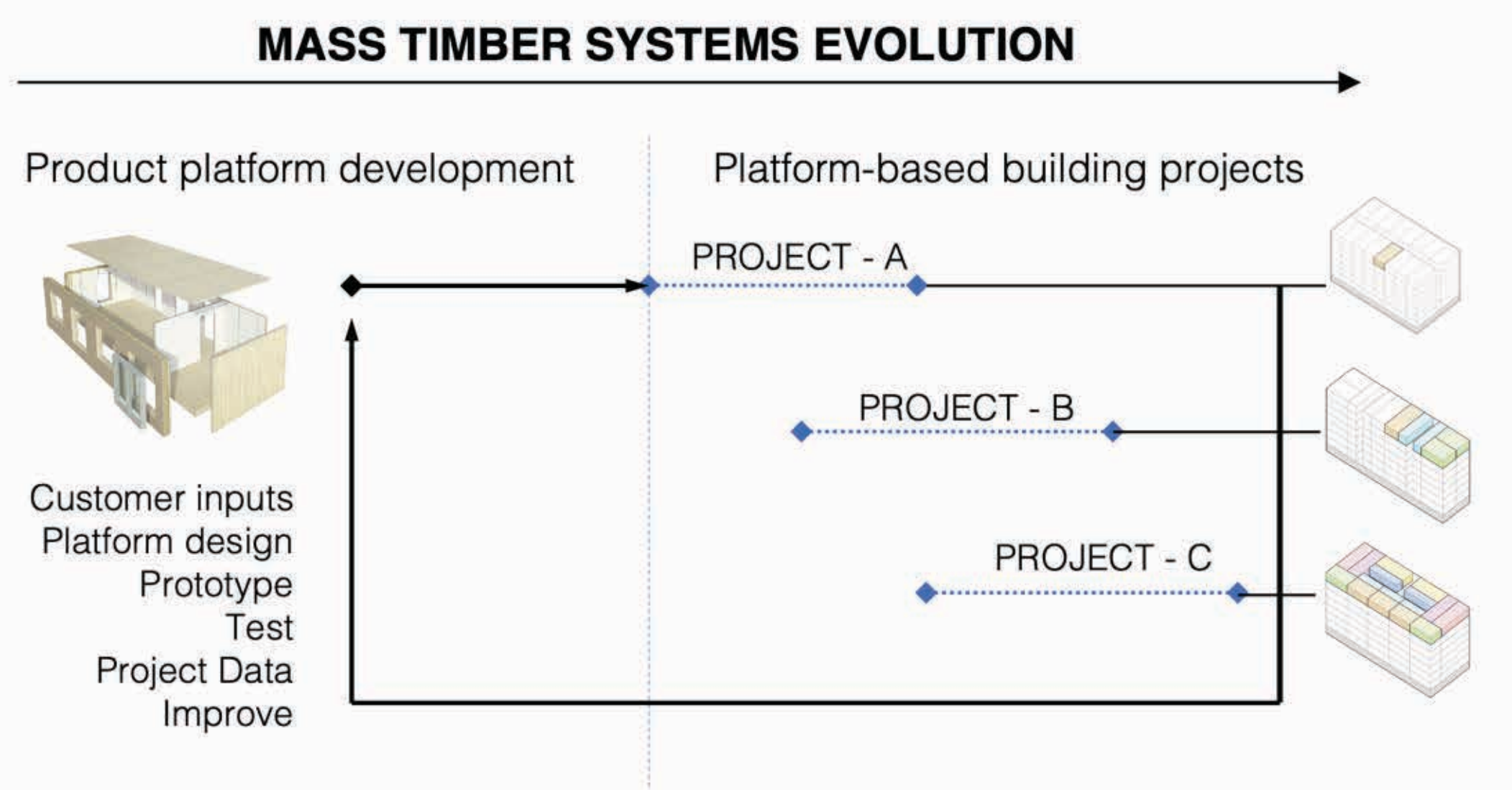
MODULES OF PRIVATE USE



ACCESSORY MODULES

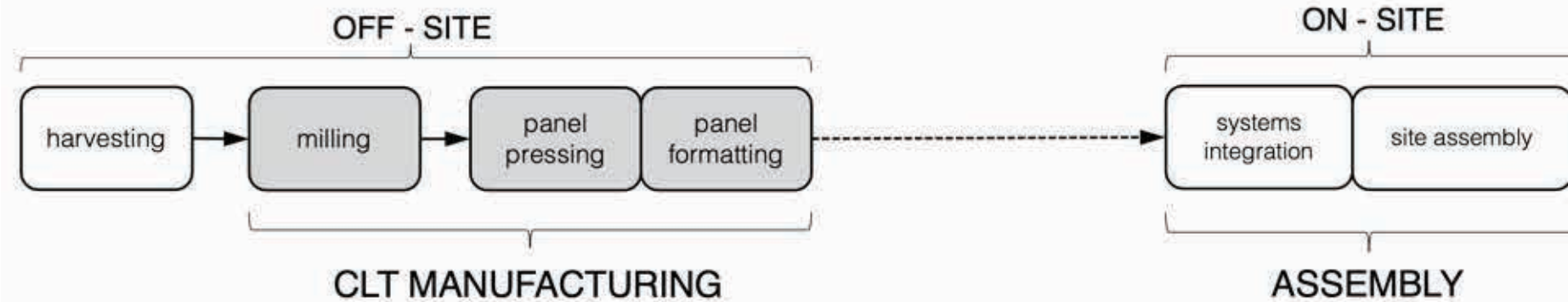


Mass Timber Product Platforms

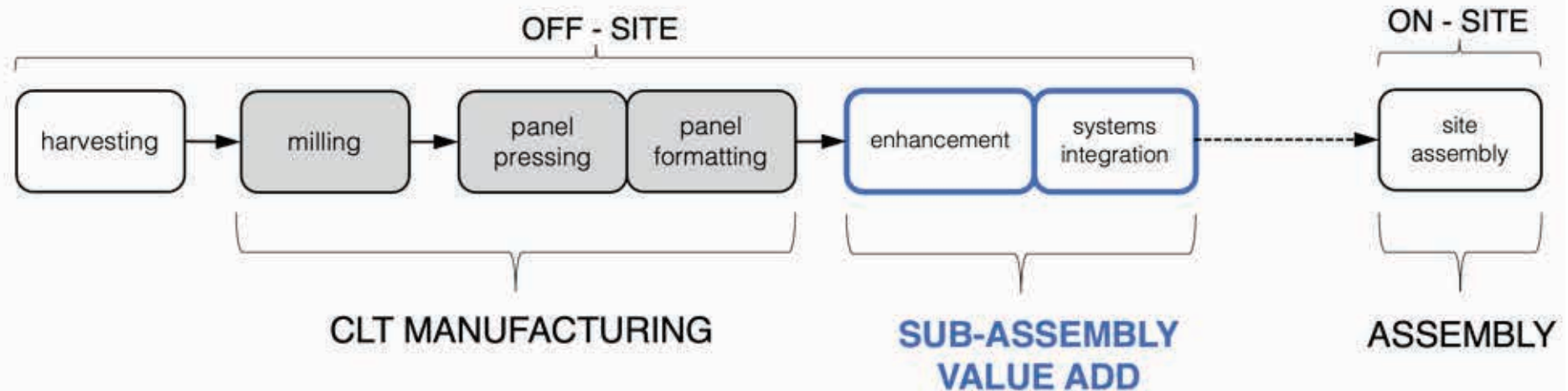


Mass Timber Product Platforms

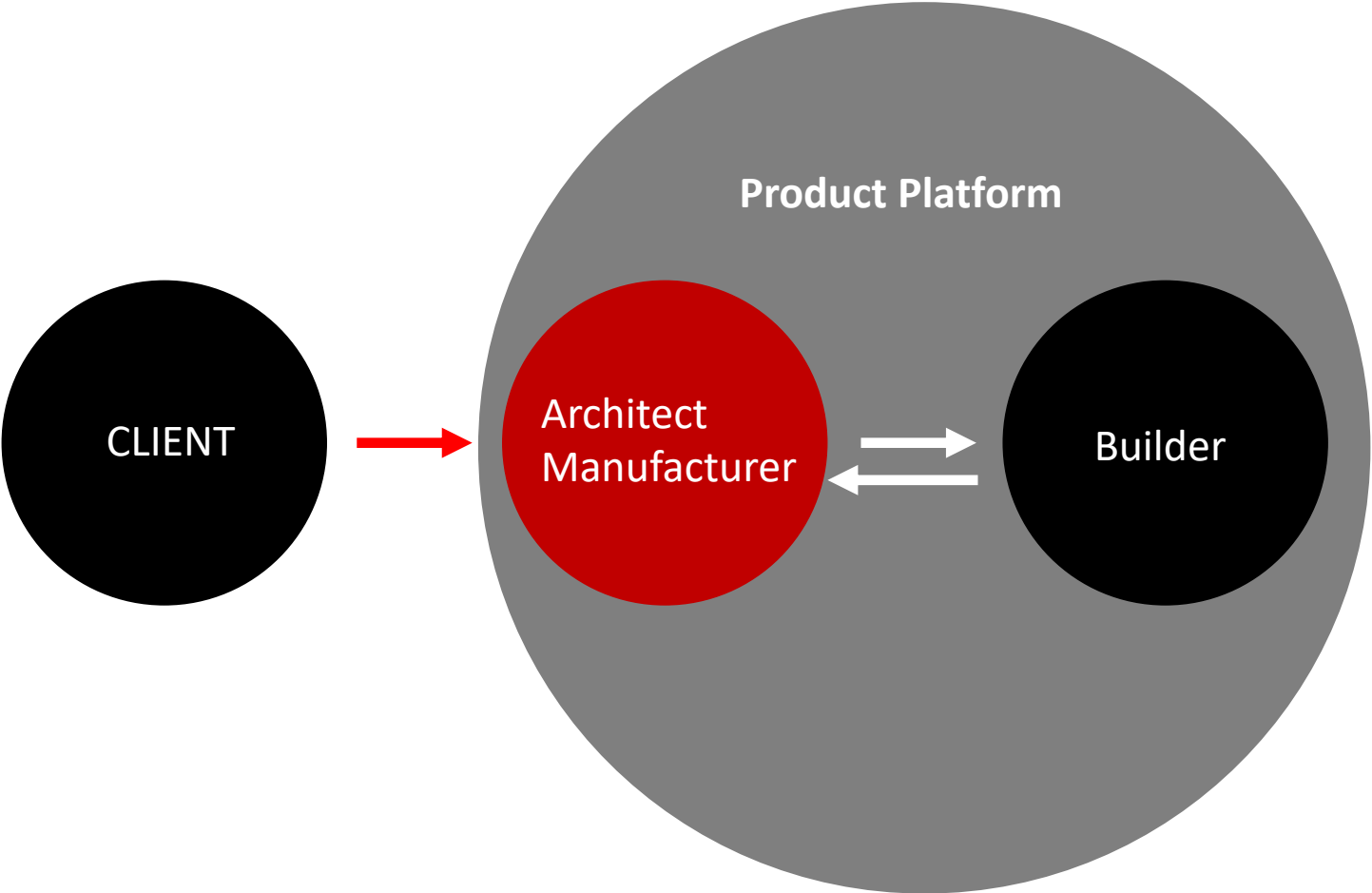
MASS TIMBER PRODUCTS



MASS TIMBER SYSTEMS



MODULARIZED PRODUCT PLATFORM
Connect Homes



2D modular
3D modular

Configuration

Product Platform

Connect Homes SF / ADU / Homeless Housing (US – CA)



Connect Homes Platform



Connect 1

460 SF TOTAL | 1 BEDROOM | 1 BATHROOM | 1 STORY



EXPLORE MODELS THAT
BEST FIT YOUR LIFESTYLE.

Square footage

of stories

of bedrooms

FILTER RESULTS

RESET



Connect 2

640 SF TOTAL | 1 BEDROOM | 1 BATHROOM | 1 STORY



EXPLORE MODELS THAT
BEST FIT YOUR LIFESTYLE.

Square footage

of stories

of bedrooms

FILTER RESULTS

RESET



Connect 4T

1280 SF TOTAL | 2 BEDROOMS | 2 BATHROOMS | 2 STORIES



EXPLORE MODELS THAT
BEST FIT YOUR LIFESTYLE.

Square footage

of stories

of bedrooms

FILTER RESULTS

RESET



Connect 10

3200 SF TOTAL | 4 BEDROOMS | 3 BATHROOMS | 2 STORIES



EXPLORE MODELS THAT
BEST FIT YOUR LIFESTYLE.

Square footage

of stories

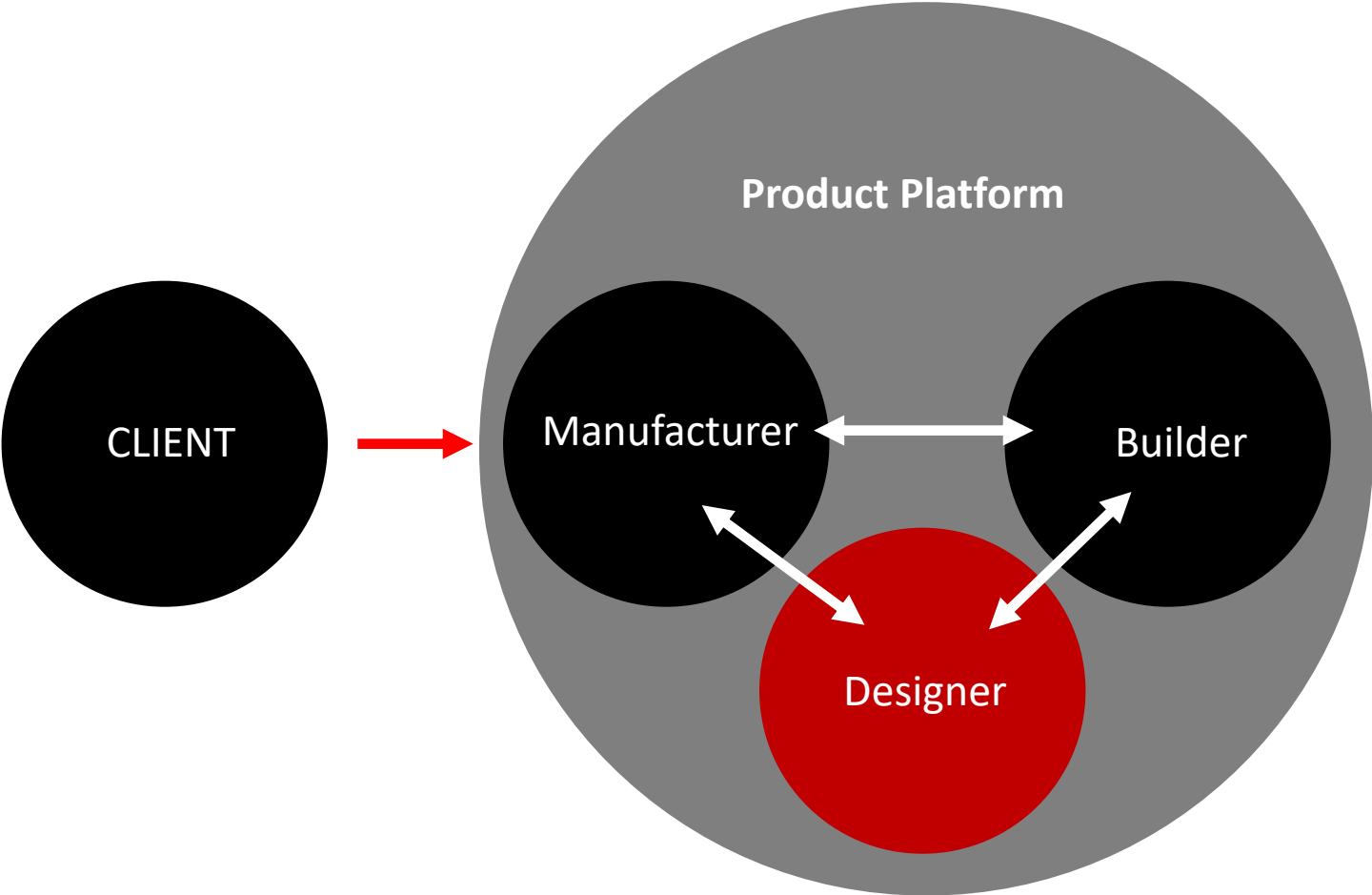
of bedrooms

FILTER RESULTS

RESET



MODULARIZED PRODUCT PLATFORM
Sekisui Chemical



2D modular
3D modular

Configuration

Product Platform

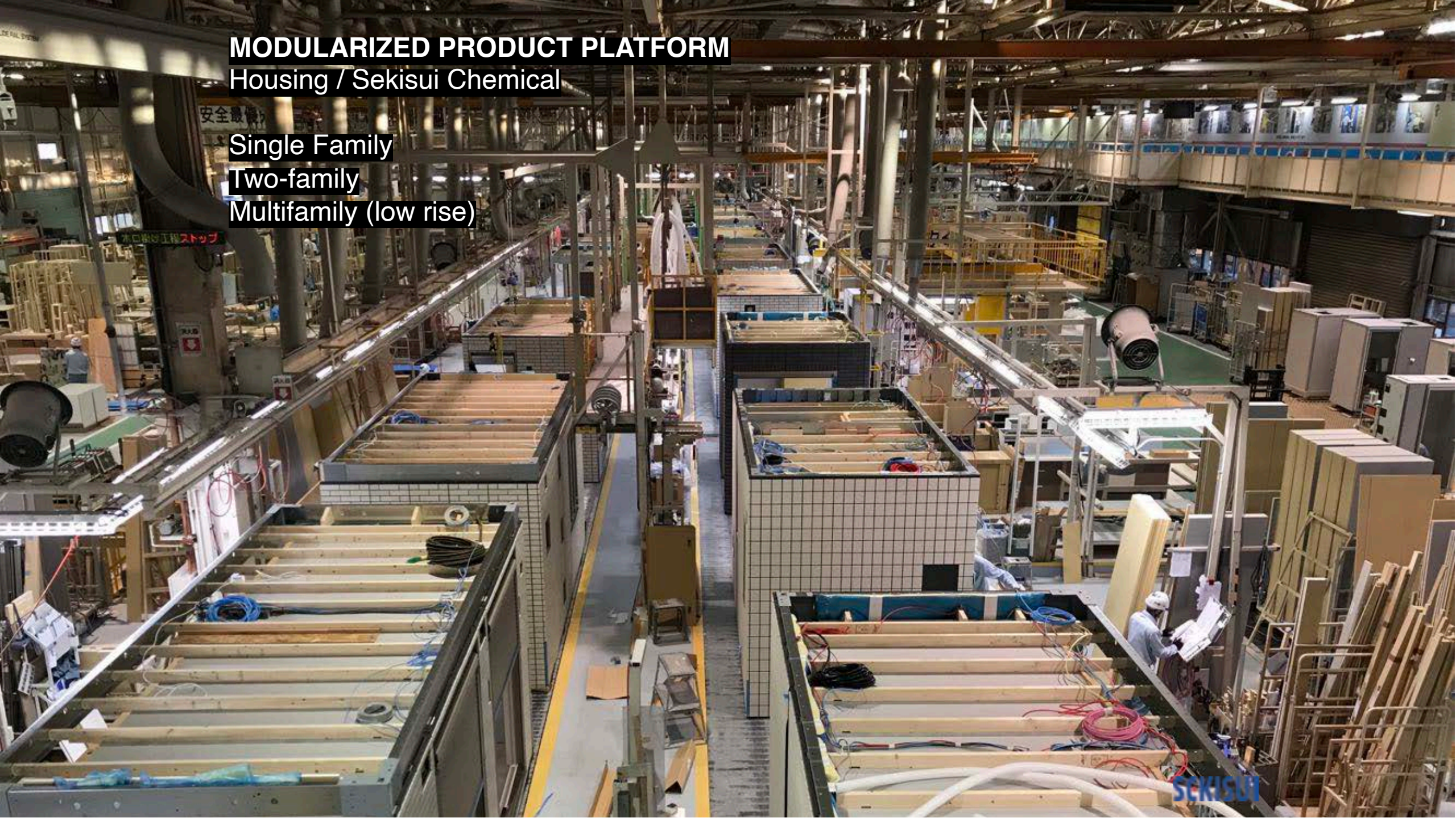
MODULARIZED PRODUCT PLATFORM

Housing / Sekisui Chemical

Single Family

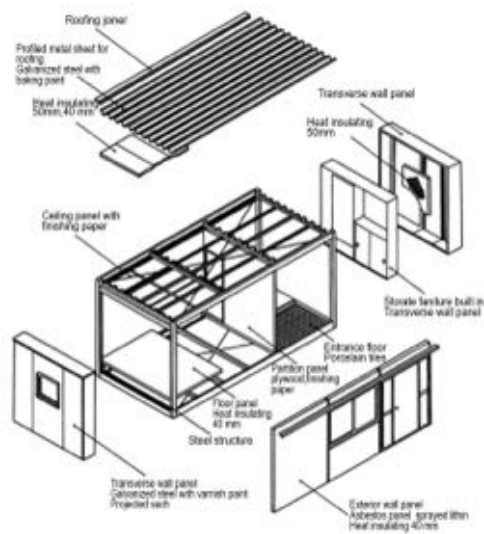
Two-family

Multifamily (low rise)



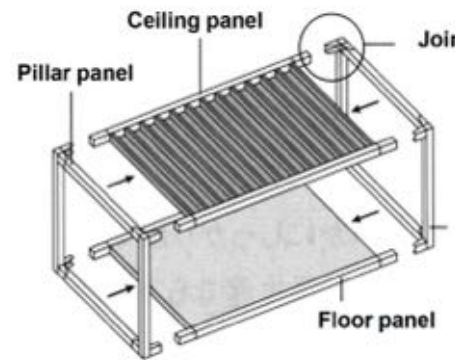
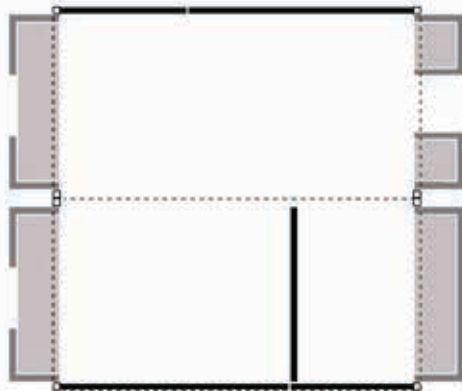
MODULARIZED PRODUCT PLATFORM

Housing / Sekisui Chemical > Evolution through Continual Improvement



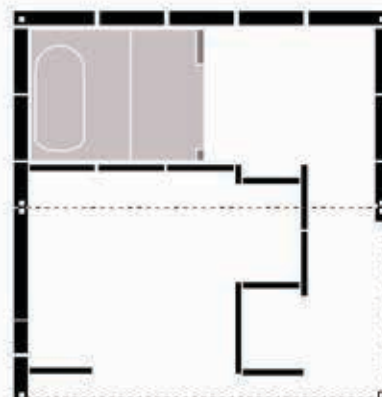
Katsuhiko Ohno
LGS Structural Chassis

1970



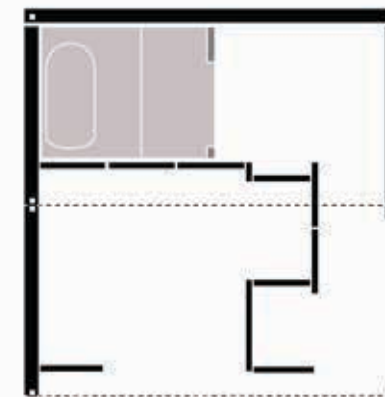
LGS Structural Chassis
LWF panels
Ceramic Cladding

1973 - Present



LWF / EW Structural Chassis
LWF panels
Stucco / Ceramic Cladding

1984 - Present



MODULARIZED PRODUCT PLATFORM

Housing / Sekisui Chemical > Lifestyle Brands



Singe Story House
Steel / Wood 1 Stories



Parfait
Steel 2 Stories



Parfait bj
Steel 2.5 Stories



Desio
Steel 3 Stories



Smart Power Station Urban
Steel 2 Stories



Domani
Steel 2.5 Stories



Life Planning Heim
Steel 3 Stories



Smart Power Station FR
Steel 2 Stories



Smart Power Station GR
Steel 2.5 Stories



Grand To You
Wood 2 Stories



V to Heim
Steel / Wood 2.5 Stories

MODULARIZED PRODUCT PLATFORM

Housing / Sekisui Chemical > Continual Improvement



MODULARIZED PRODUCT PLATFORM

Housing / Sekisui Chemical > Standard Sub-assemblies / Unique Layouts

90 pre-engineered chassis types
60K + Sub assembly components

“overhang” type
16’ long



9 lengths
6’, 8.5’, 12.5’, 16’, 18’
Most typical



2 widths
4’ + 8’

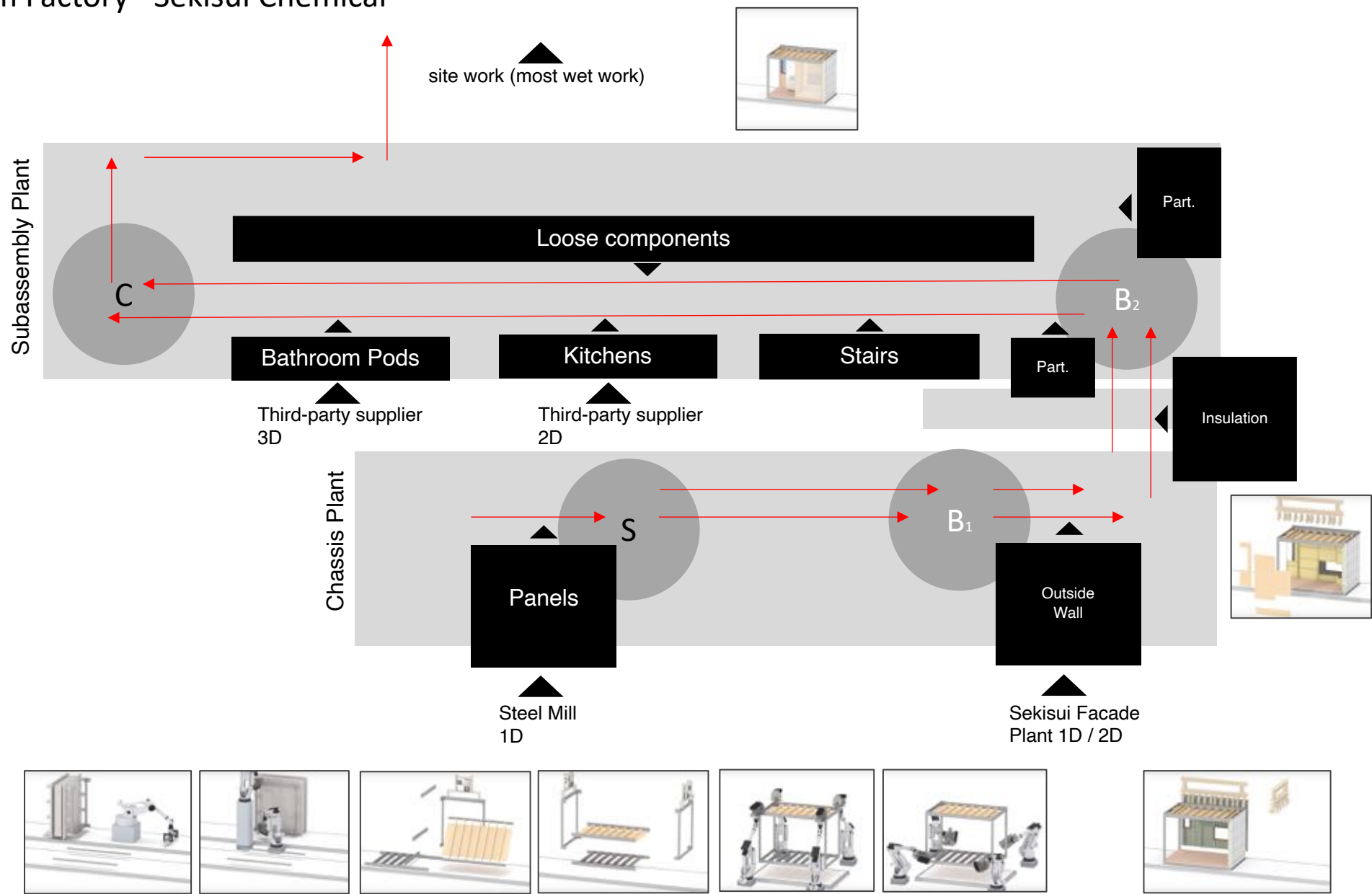


2 heights
8’ + 9’

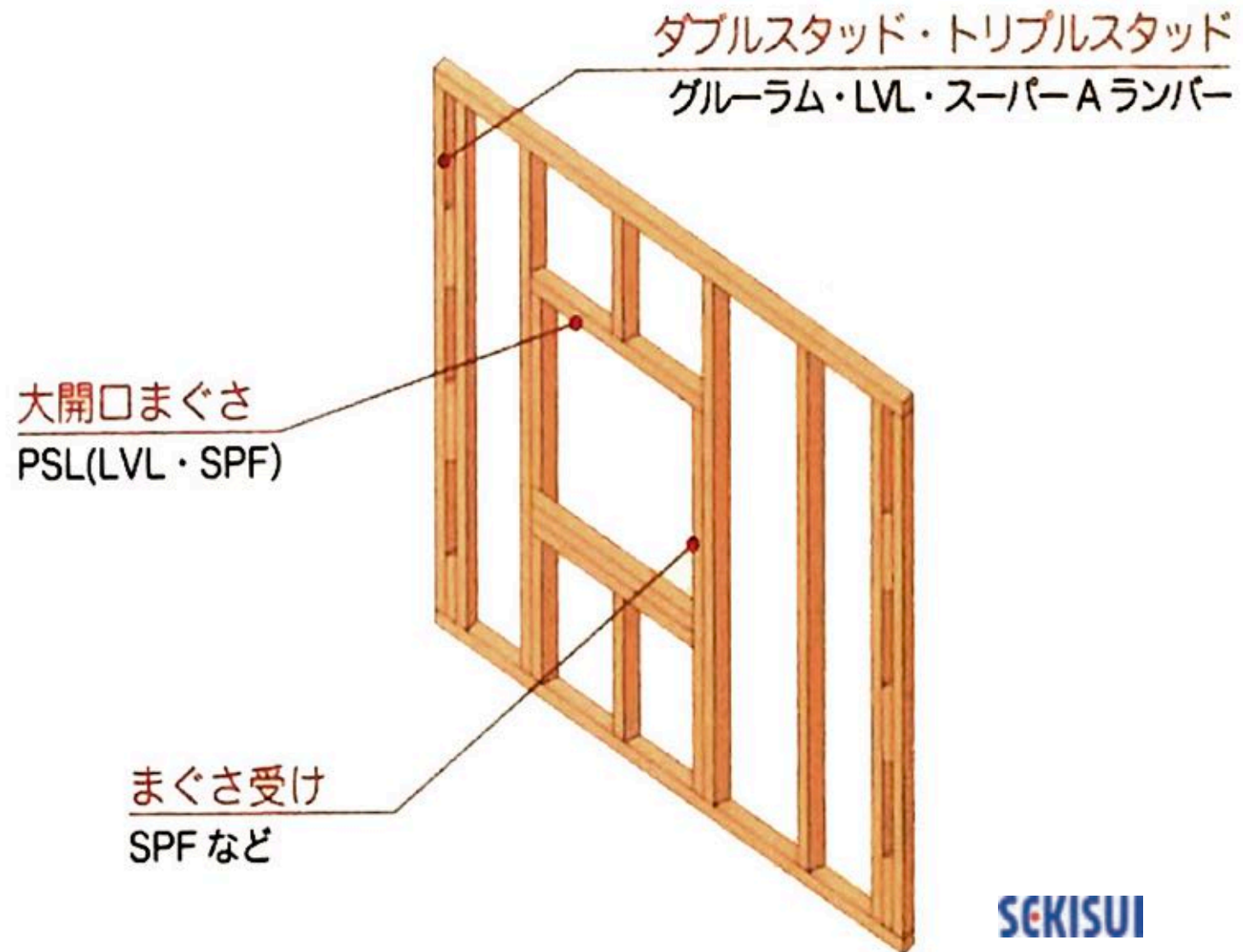


MODULARIZED PRODUCT PLATFORM

Tokyo Heim Factory– Sekisui Chemical



Product Platform / Modularization Sekisui Chemical



SEKISUI





Product Platform / Modularization Sekisui Chemical

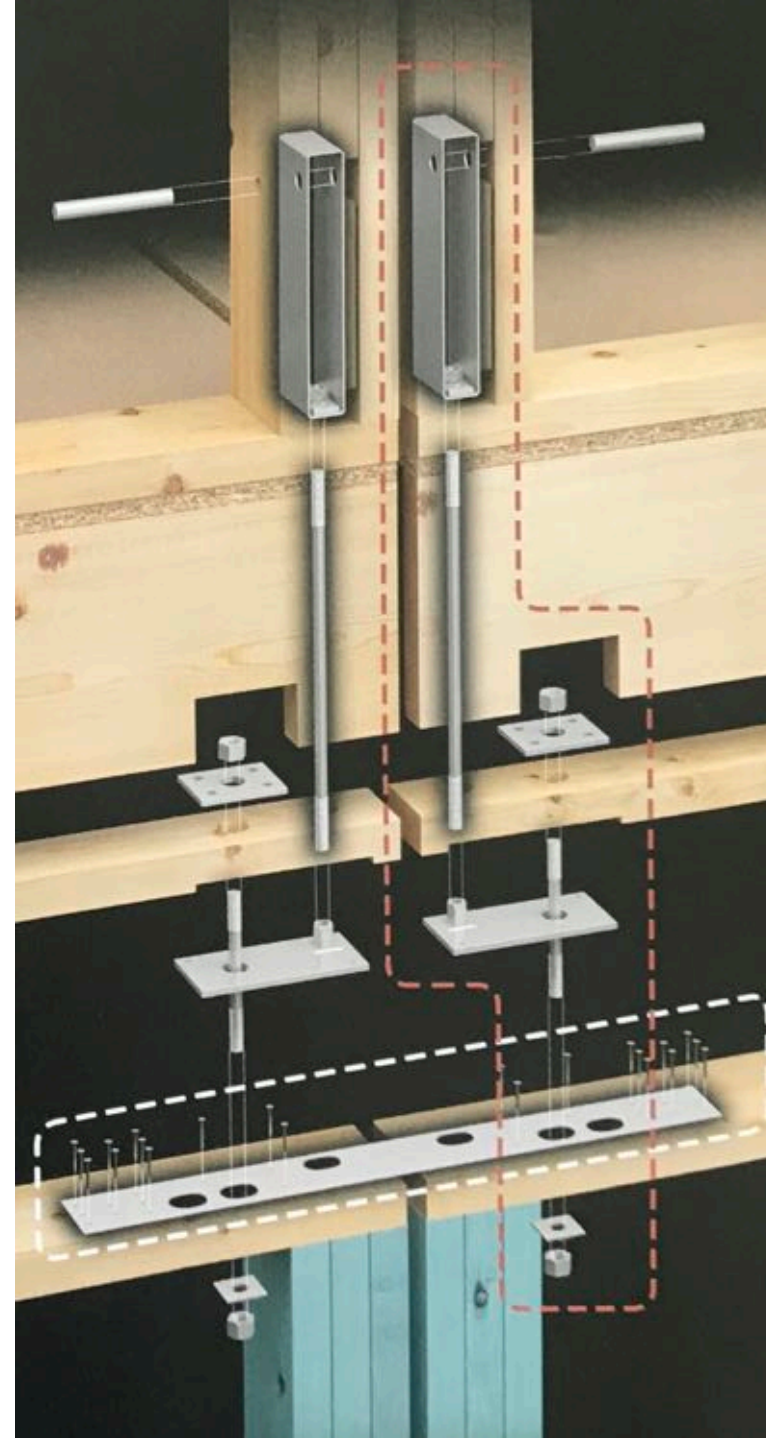
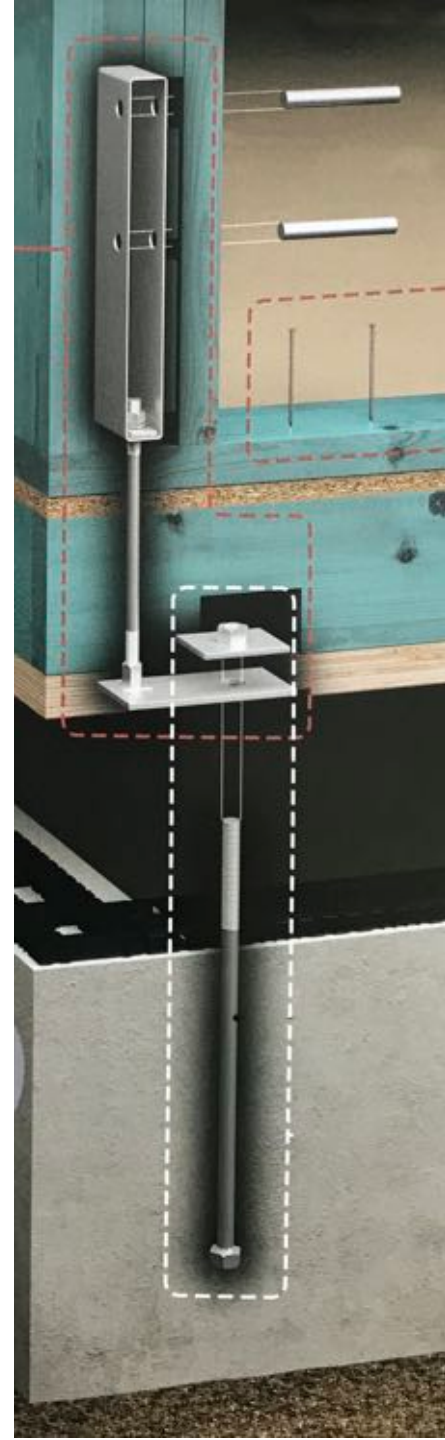
SEKISUI

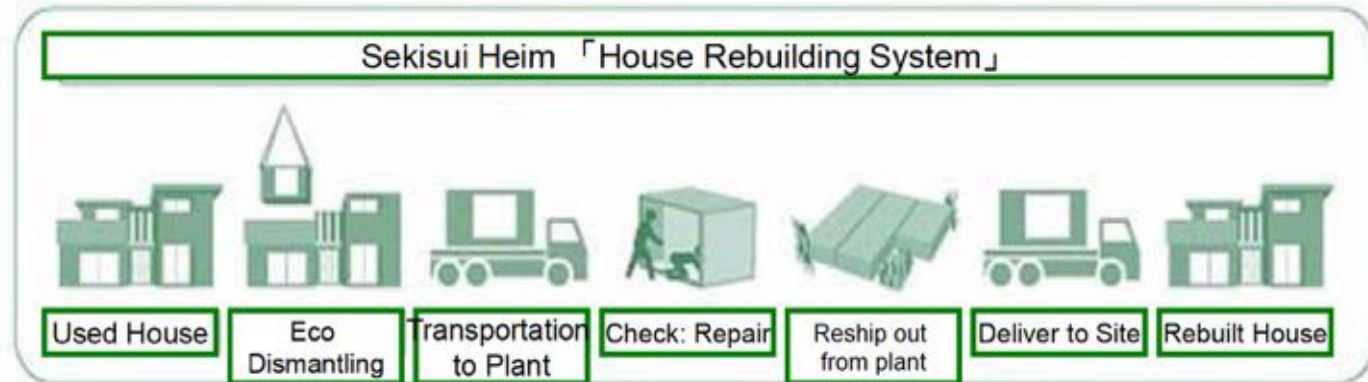


Product Platform / Modularization Sekisui Chemical



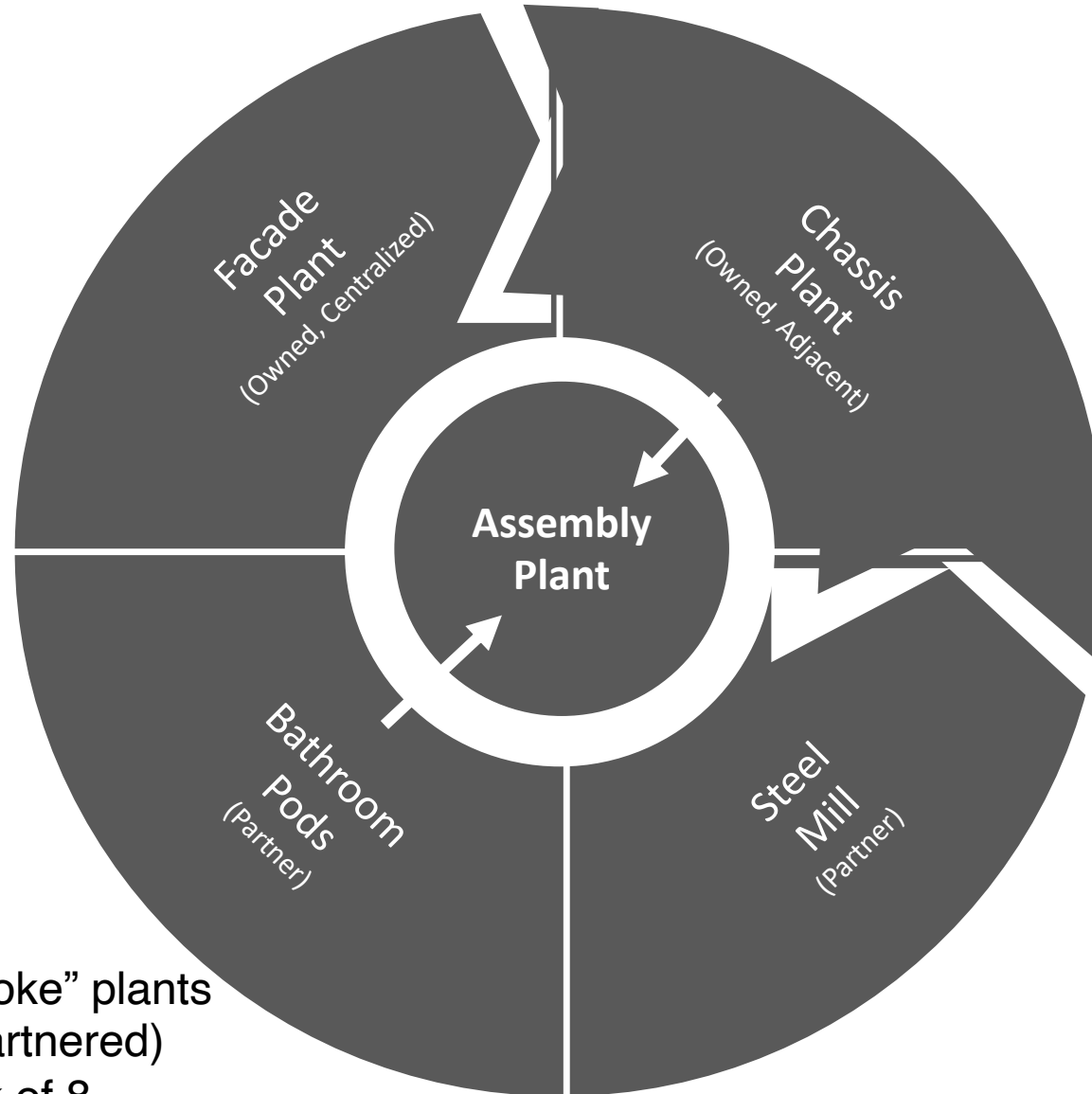
SEKISUI



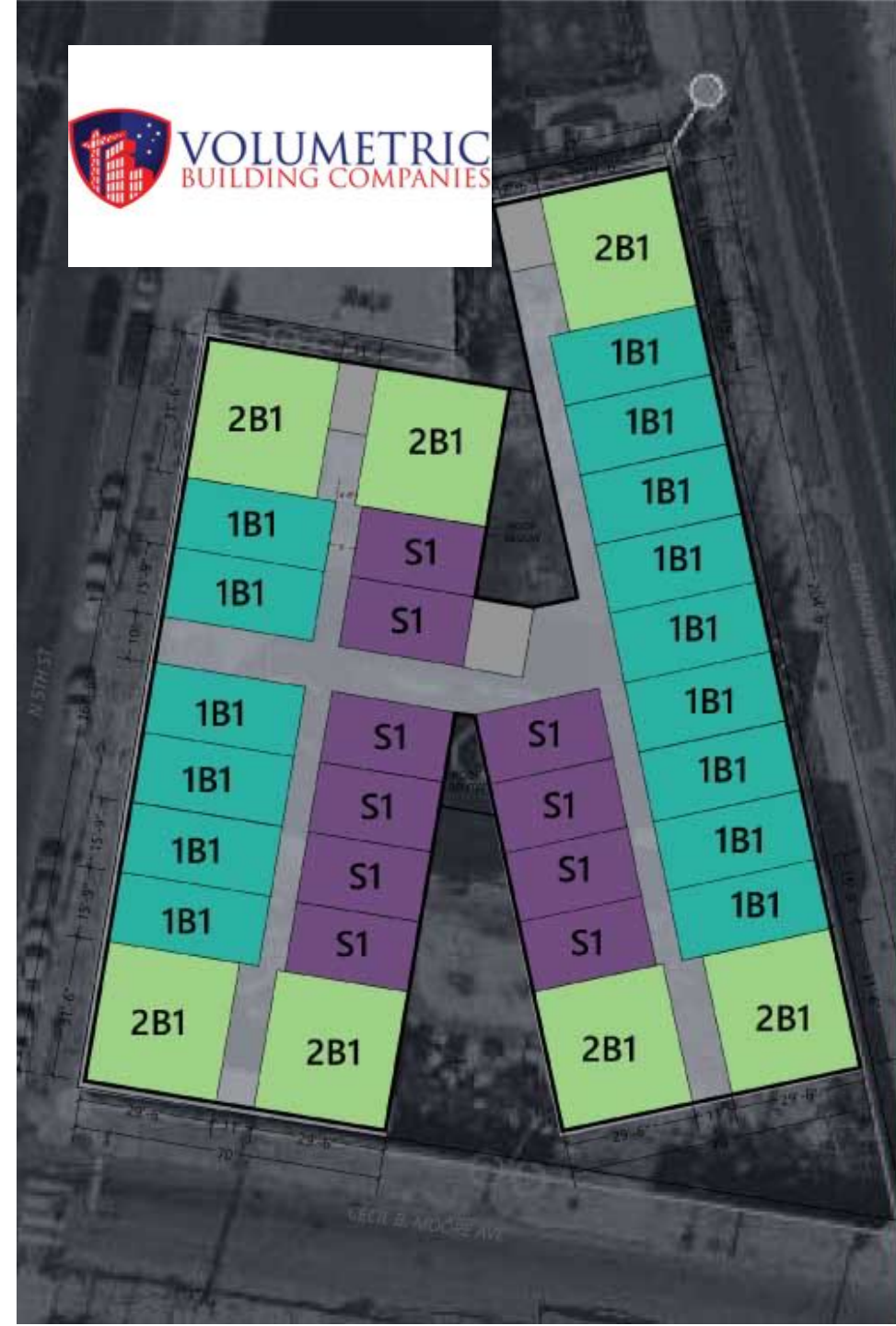


MODULARIZED PRODUCT PLATFORM

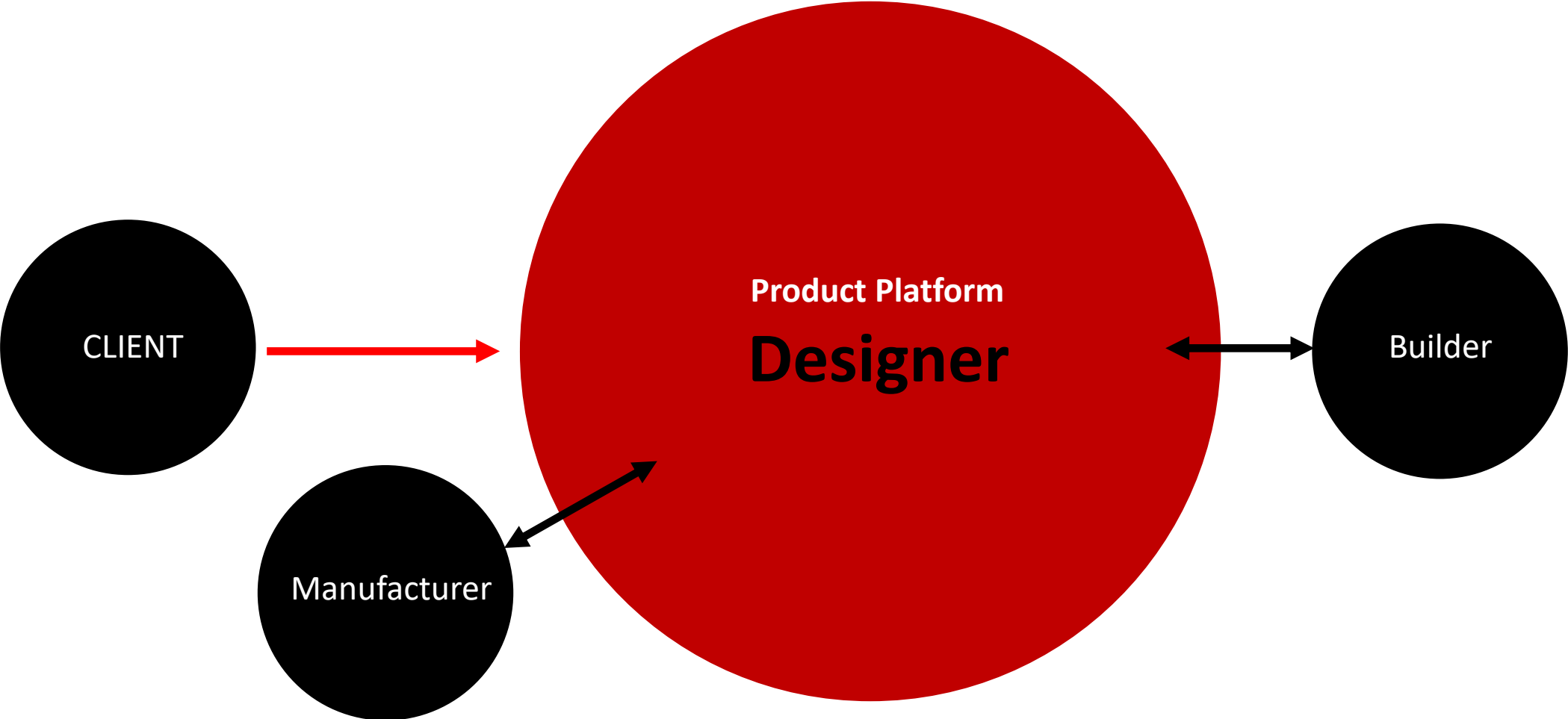
Katsuhiko Ohno – Sekisui Heim



Numerous “spoke” plants
(owned and partnered)
feed a network of 8
subassembly “hub” plant



MODULARIZED PRODUCT PLATFORM

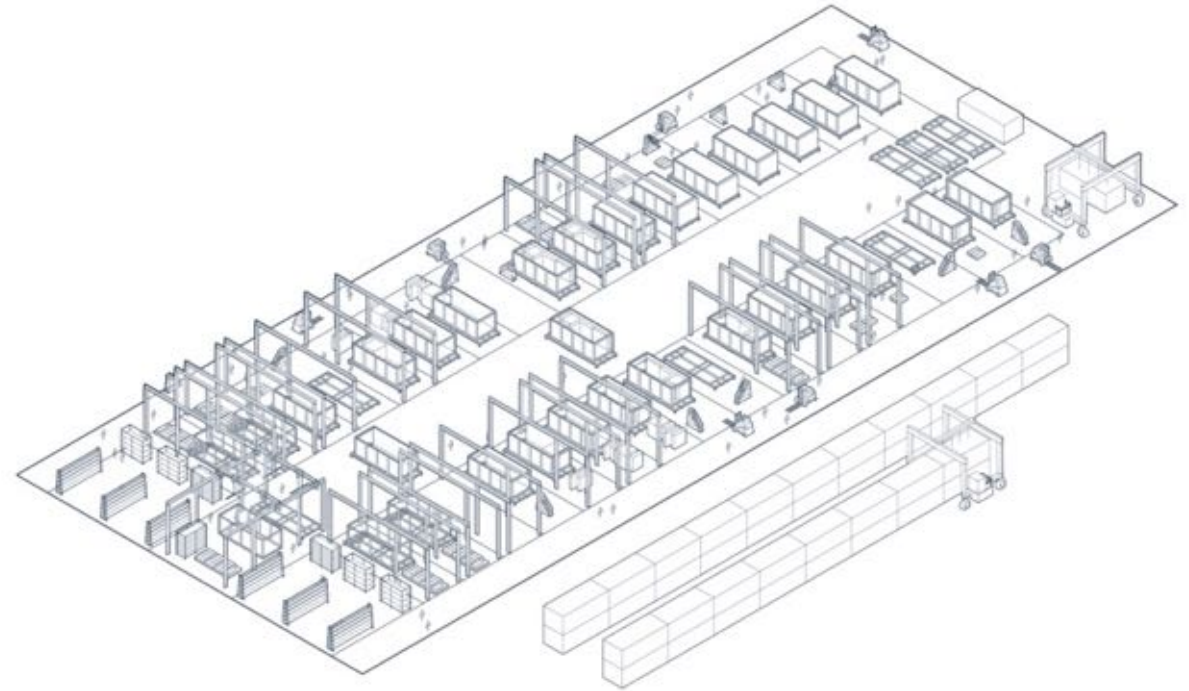


2D modular
3D modular

Configuration

Product Platform

ASSEMBLY OSM

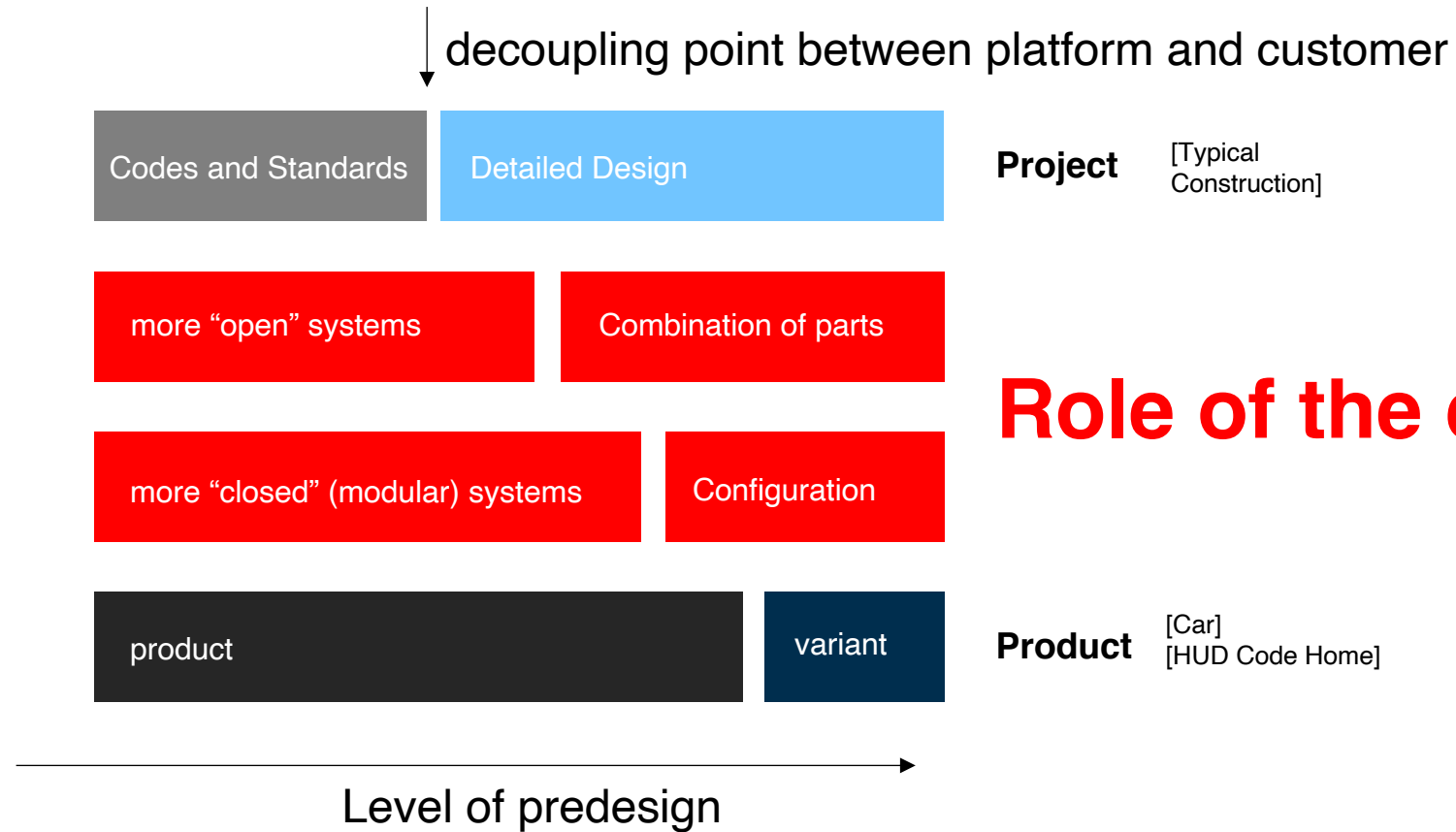


juno



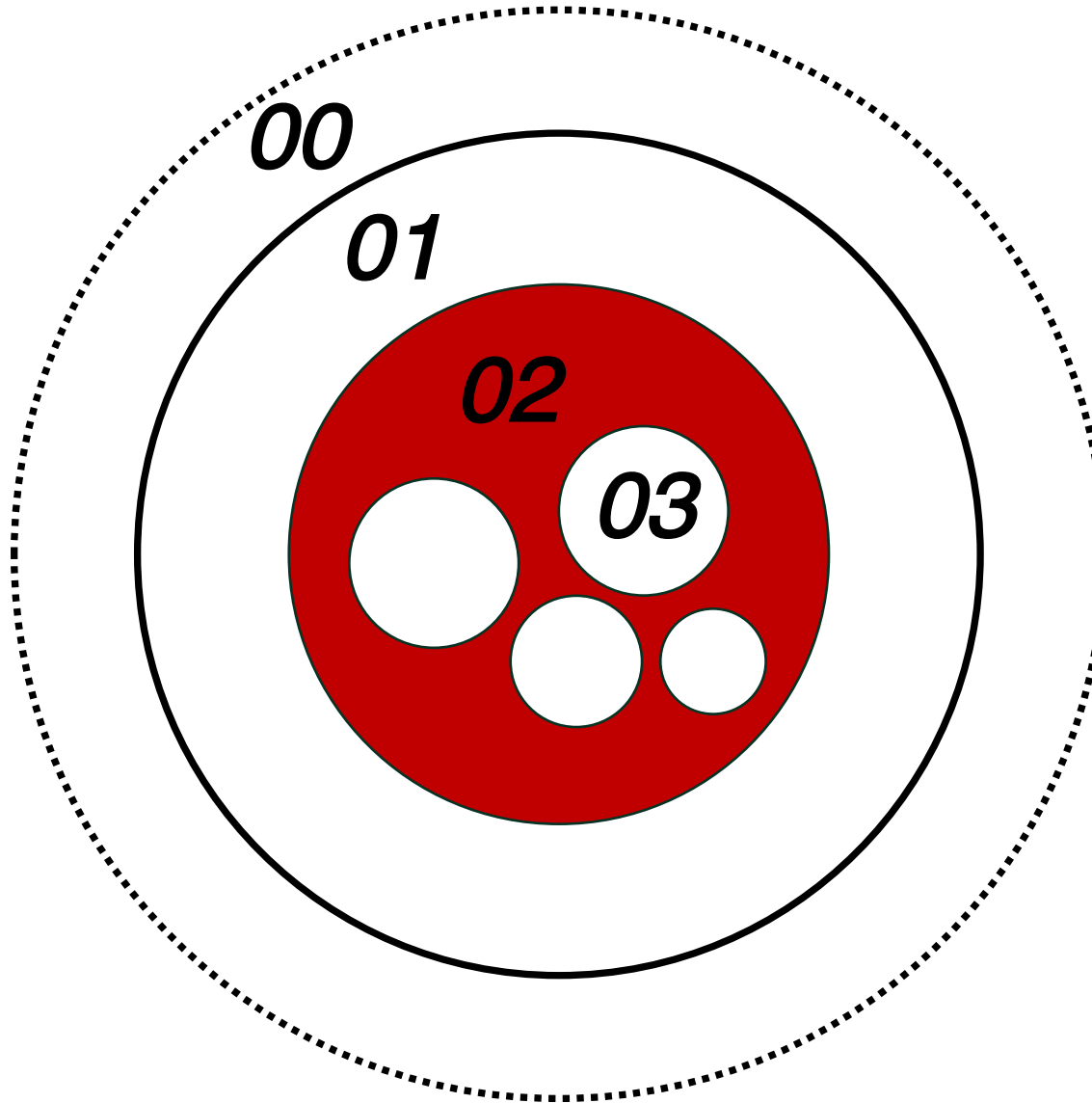
Conclusion

Modularized Product Platform



Role of the designer

Role of the designer



00 - Context

- Market
- Material
- Labor
- Regulatory
- Culture

01 – Business Platform

- Value Creation
- Supply Chain
- Integration

02 - Product Platform

- Subassemblies
- Manufacturing Logic
- Standards/variants
 - Project

03 – Technology

- Automation
- Digitalization

➤ QUESTIONS?

This concludes The American
Institute of Architects Continuing
Education Systems Course

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