# Technology Driven Disruption and the Building Industries – Future Trends

Dennis Shelden PhD AIA
Director, CASE

# DENNIS SHELDEN AIA PHD

## Academic

**MIT**

- BS Architectural Design ‘88
- MS Civil & Environmental Eng.
- PhD in Design Computation

Assoc. Professor of Practice 2005–2015

UCLA, SCIARC, UCB,…

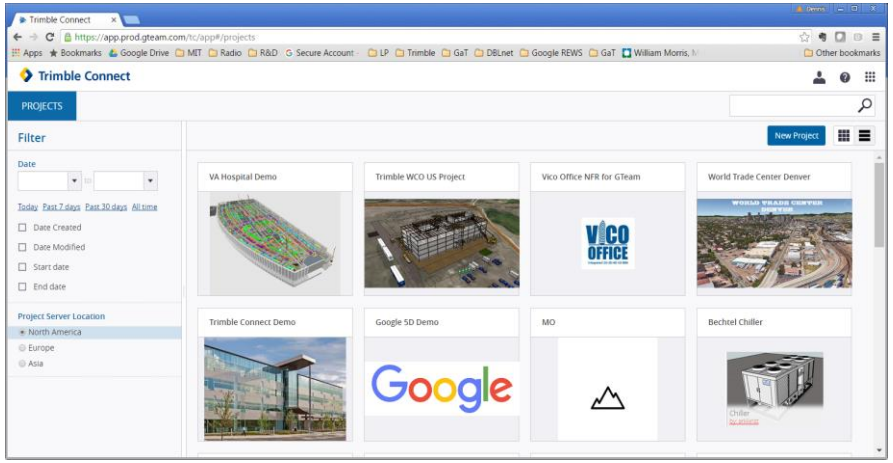
**Georgia Tech**

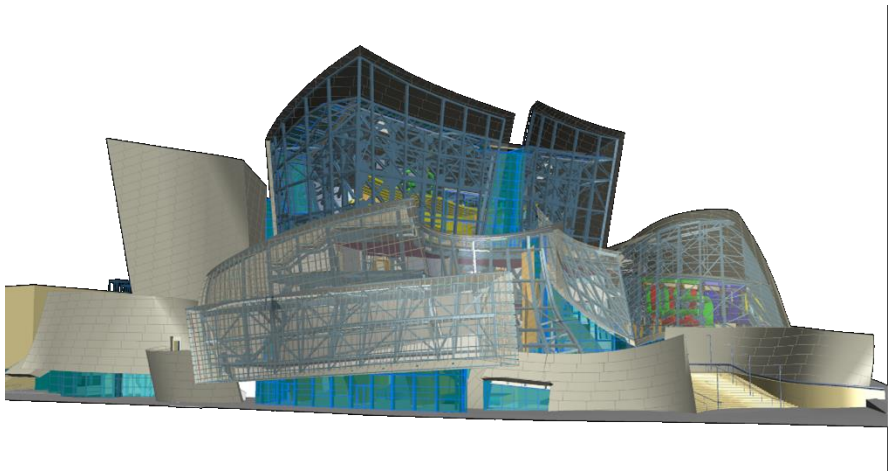
Director, Digital Building Lab Apr. 2016

## Professional

Technology Director for Frank Gehry, 1997

CTO Gehry Technologies 2002-2014



# THE BUILDING INDUSTRY PAST

**LARGE**

**$ 200T assets**

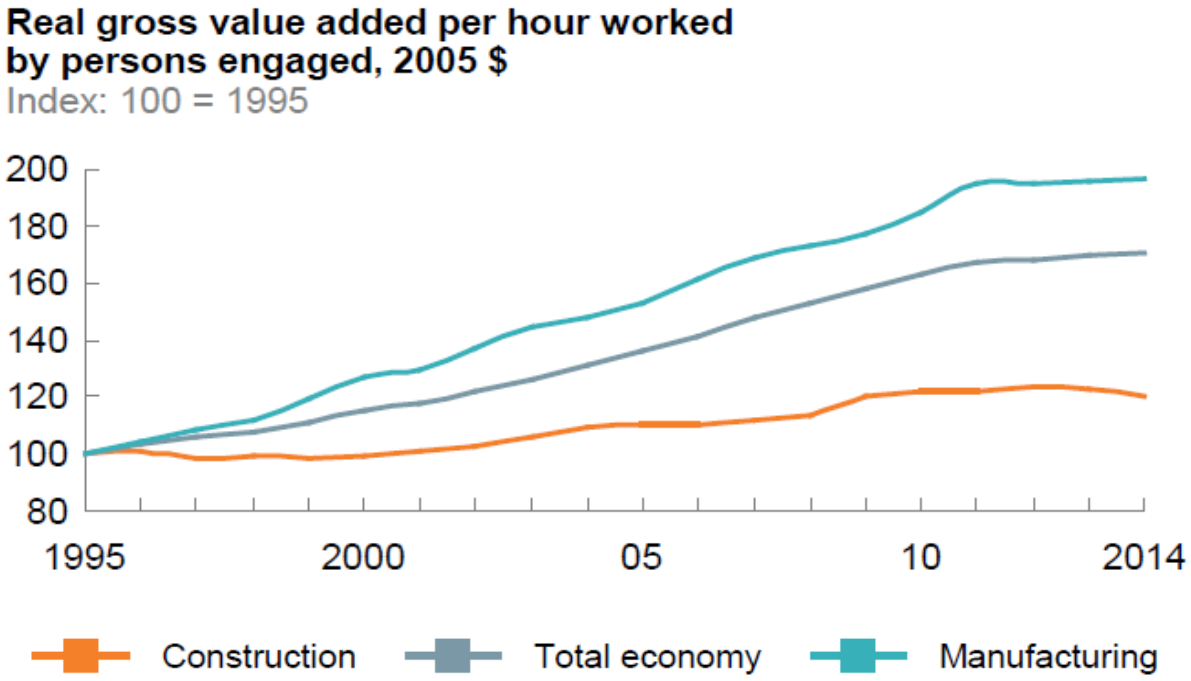
**$ 10T global expenditure**

**FRAGMENTED**

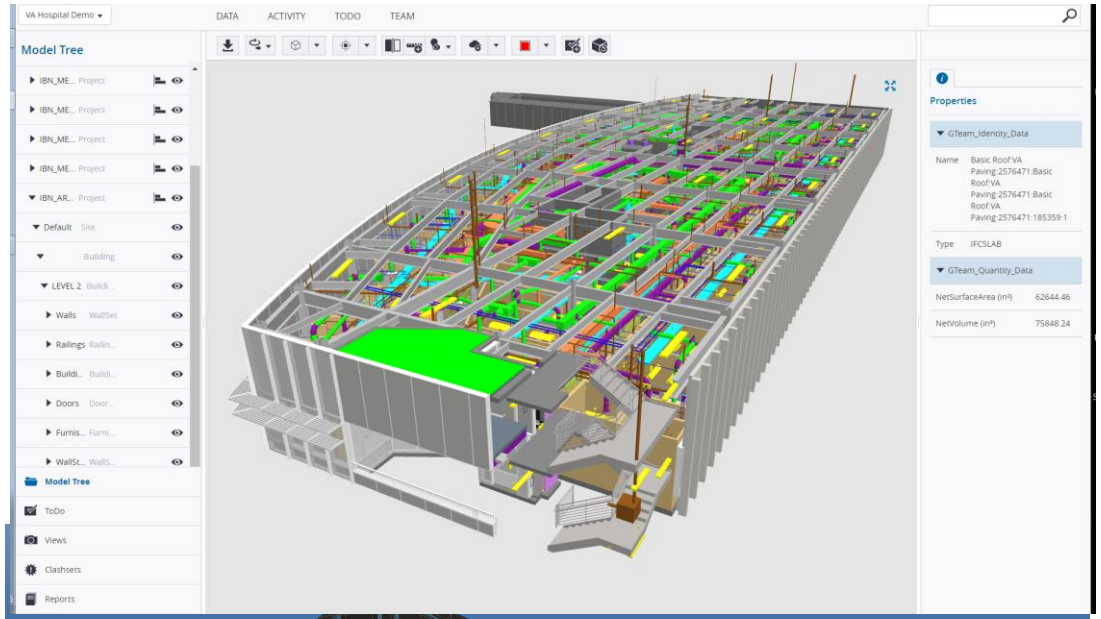
**LOW MARGIN & PRODUCTIVITY**

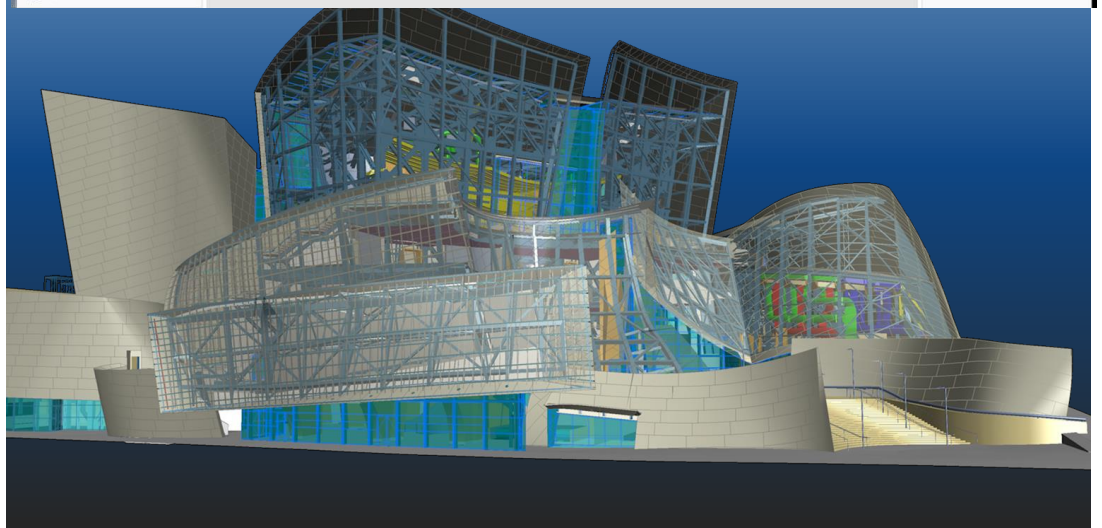
**REGIONAL**

**SLOW TO EVOLVE**



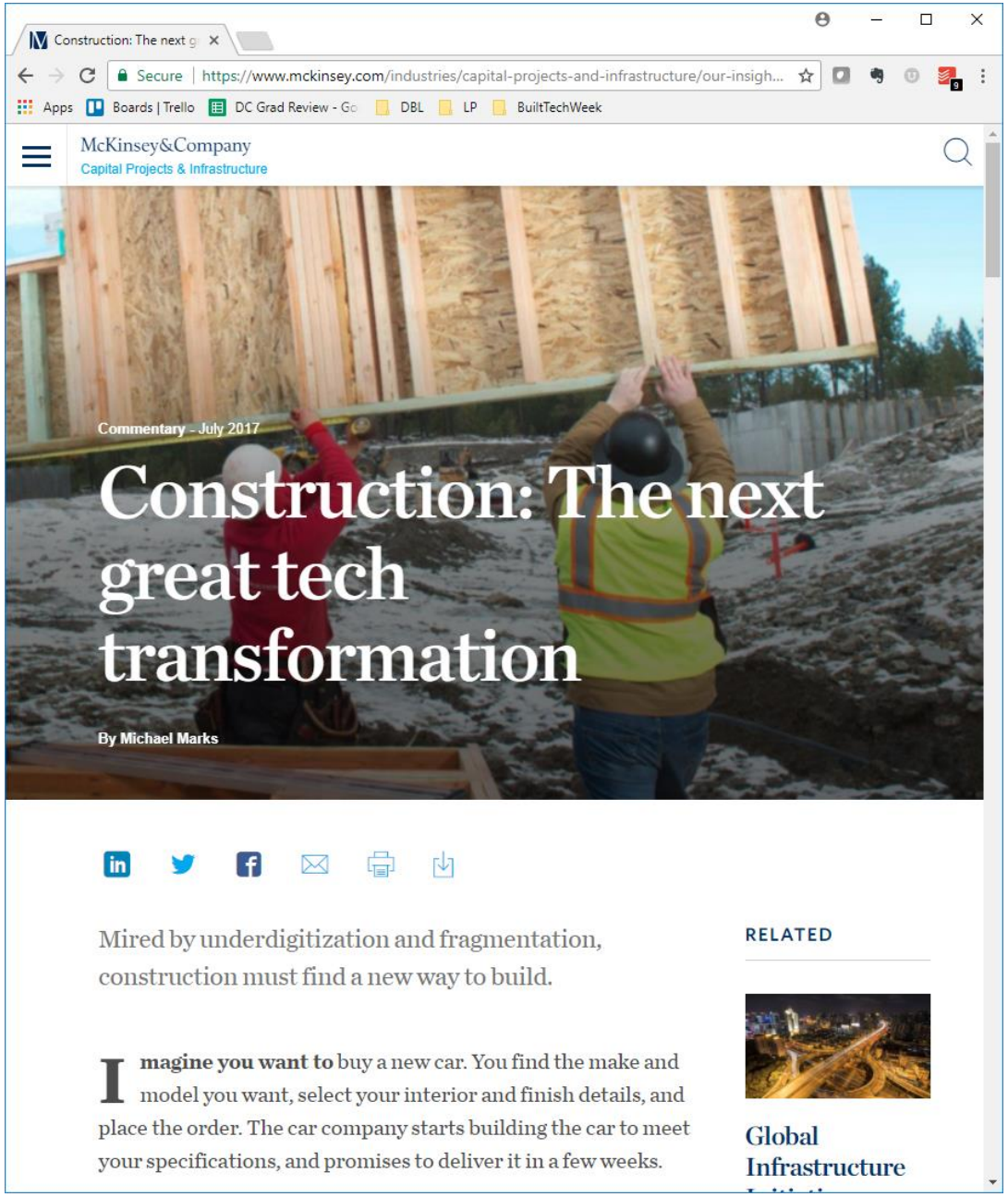
# BUILDING INDUSTRY & TECH UNTIL NOW



*BIM / VDC'S impact has been incremental or niche*

*Advances have been for professionals, Created push but not pull*




# NEXT GENERATION WILL PROFOUNDLY IMPACT:

## ECONOMICS OF DELIVERY MODELS

## RELATIONSHIP TO CAPITAL

## RELATIONSHIP BETWEEN PROFESSIONALS, CONSUMERS AND THE ENVIRONMENT

# WHY NOW?

## MOORE'S LAW

## PENT UP DEMAND & OPPORTUNITY

## EXPANDING SUPPLY

## IOT & UBIQUITOUS COMPUTING

# NEW INTEGRATORS

# “HARD PROBLEMS”

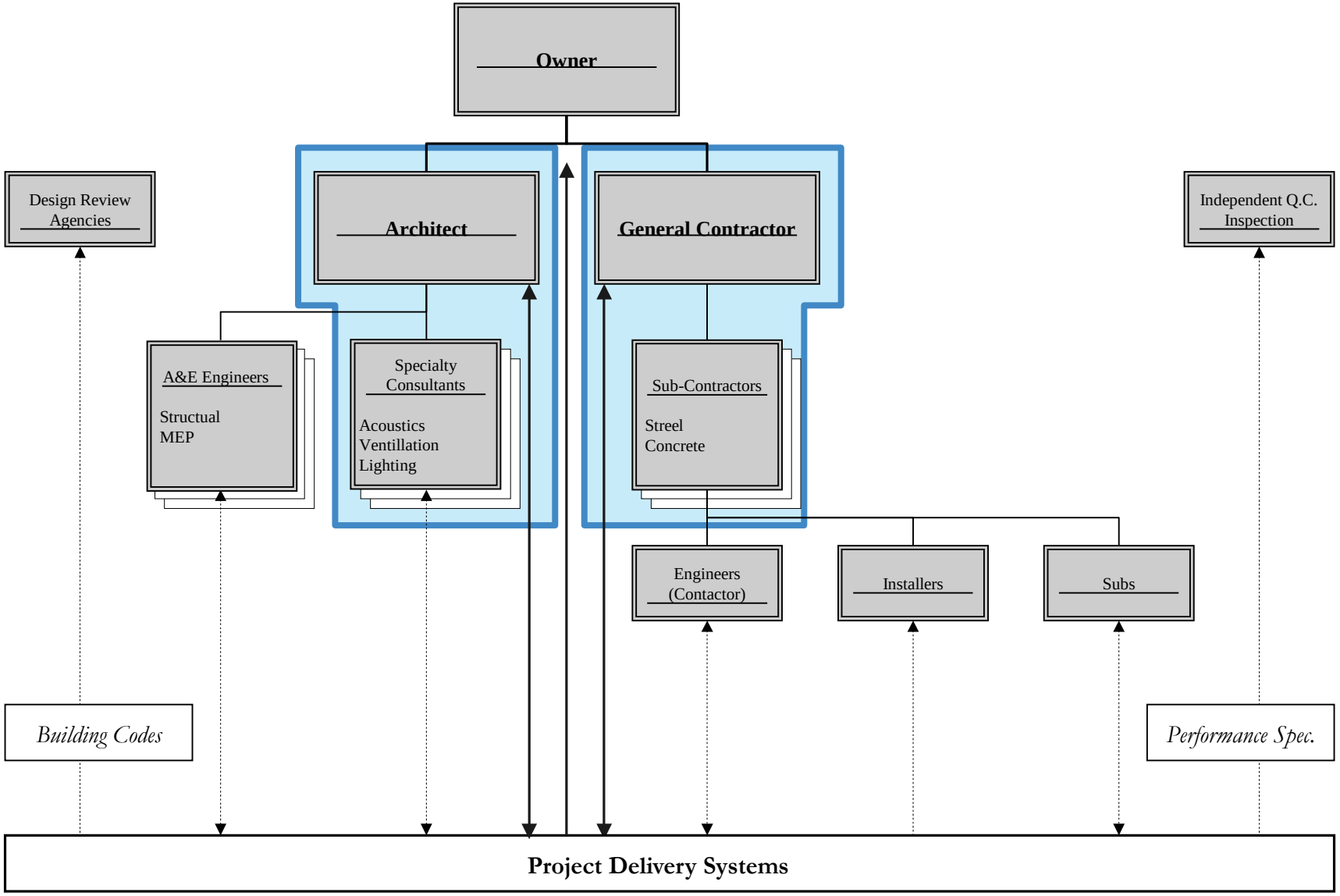
DealBook / Business & Policy

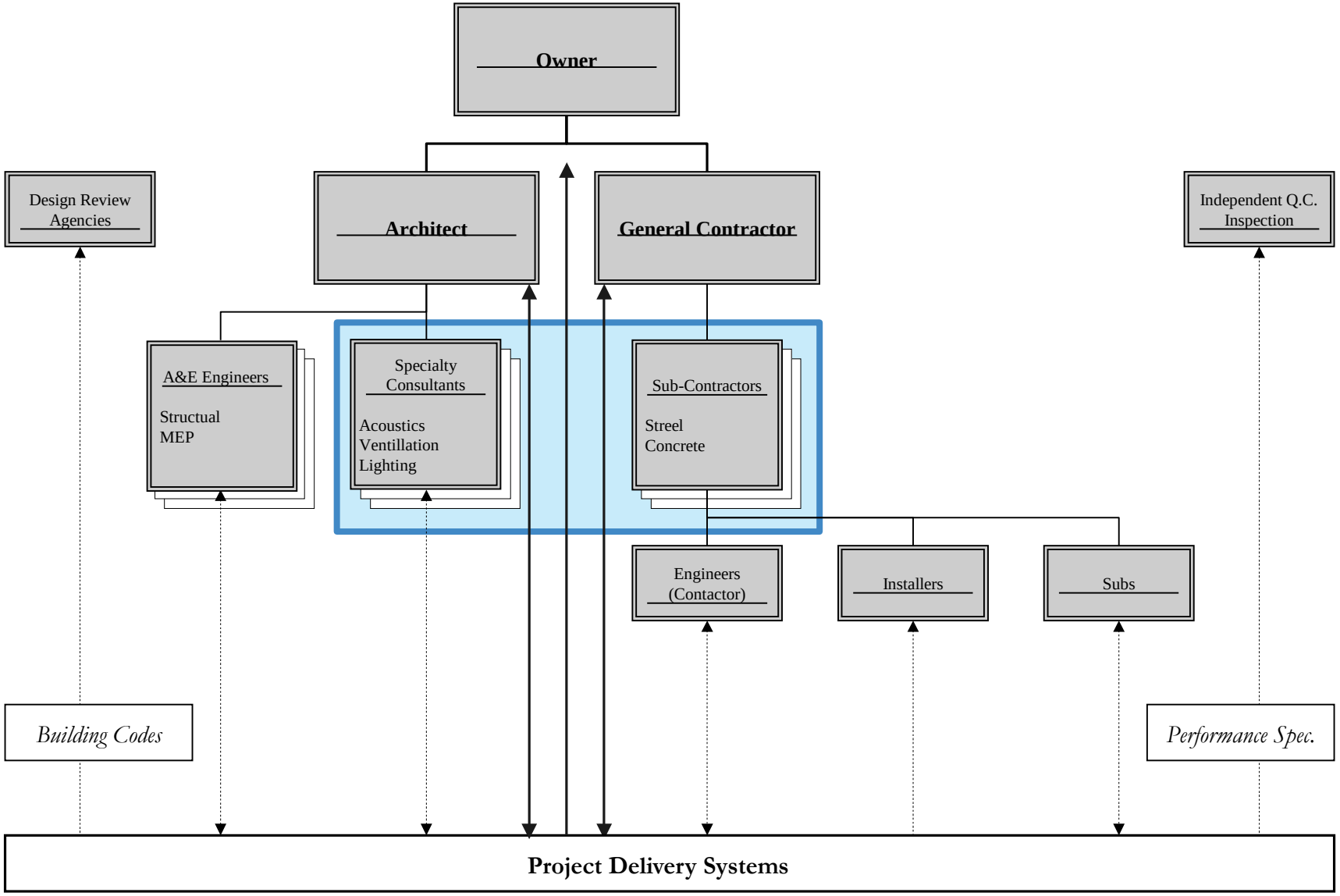
## *Katerra, a Construction Start-Up, Raises $865 Million*

Masayoshi Son of SoftBank. Katerra raised $865 million in a new round of financing led by SoftBank's Vision Fund, the nearly $100 billion investment vehicle that has shaken up the world of venture capital. Kazuhiro Nogi/Agence France-Presse — Getty Images

# Tech disruption - characteristics

- **Take on fragmented industries** by **integrating a number of traditionally distinct capacities** in a supply chain into a single enterprise and business model, often streamlining the internally integrated process, **“reducing friction”** across these steps, and monetizing multiple distinct offerings into a single service.
- Use technology – specifically **data driven technology** – as a way of streamlining cross process operations, **supporting capacity to scale non-linearly** (reducing the marginal costs of each additional customer or engagement).
- They capture data that is normalized by large scale repetition of process, and can use this data to pinpoint and **test variations in process and product to continuously improve**.
- Their integrated supply chains **connect to the customer** and end users, and they are able to use data both about and for their customers to **maintain continuous long term relationships**.
- They frequently operate as **hybrid product – services** companies: traditional one-of purchases are delivered though ongoing procurement and services.
- Many have **capital driven scaling** as business driver, with scaling prioritized over short term profitability. The scaling of these business models is quite different from the aggregative “roll-up” models prevalent in some sectors of the building industry.


Owner
Design Review Agencies
Architect
General Contractor
Independent Q.C. Inspection
A&E Engineers
Structual
MEP
Specialty Consultants
Acoustics
Ventillation
Lighting
Sub-Contractors
Streel
Concrete
Engineers (Contactor)
Installers
Subs
Building Codes
Performance Spec.
Project Delivery Systems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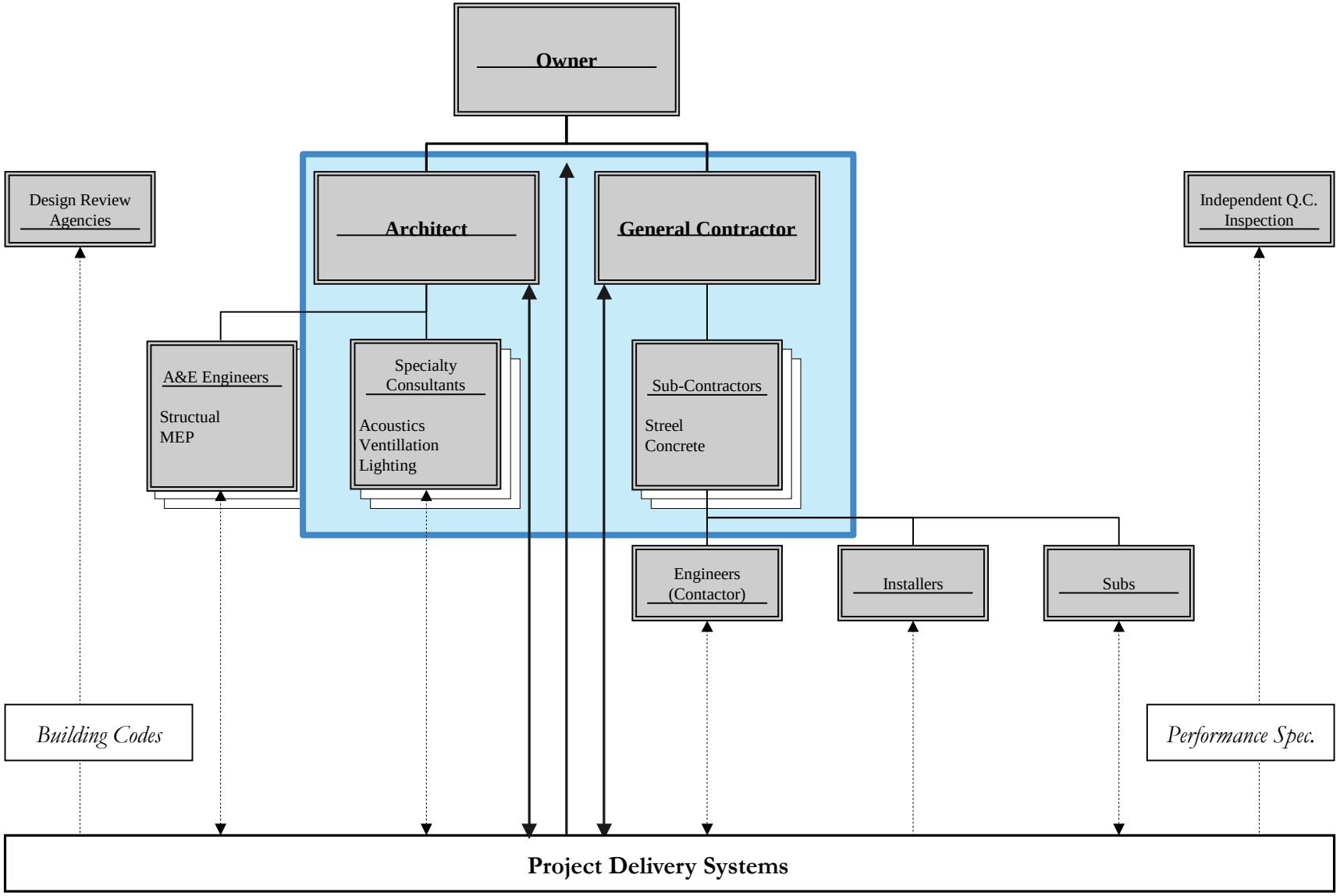
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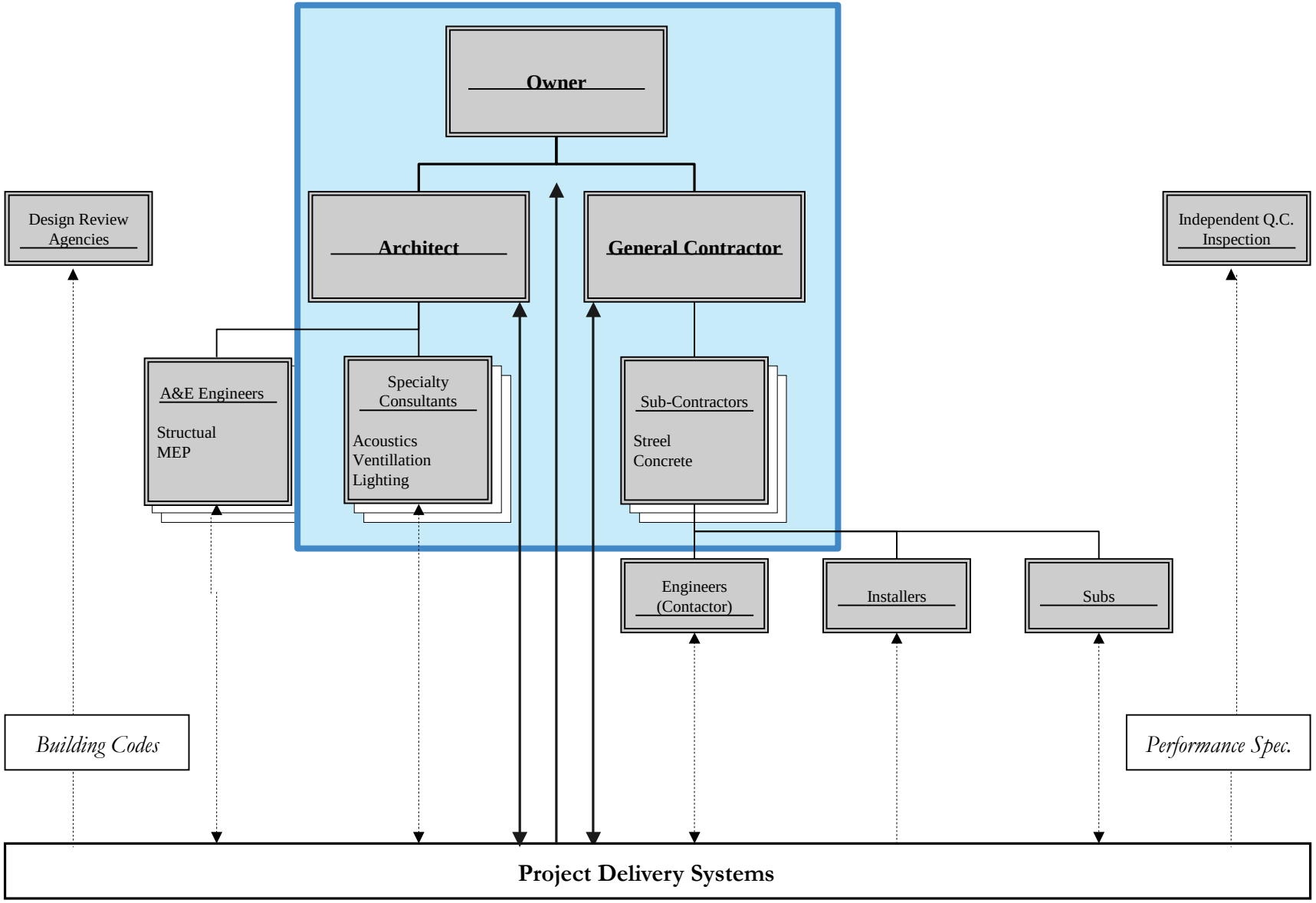
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Lighting
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Streel
Concrete
Engineers (Contactor)
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Subs
Building Codes
Performance Spec.
Project Delivery Systems

# STARTUPS

OxBlue™ segur rescour Virgent Realty GROUNDFLOOR TOMMYRUN POINTIVO CONSTRUCTWARE

# APPS

# INCUBATORS

TTWiiN

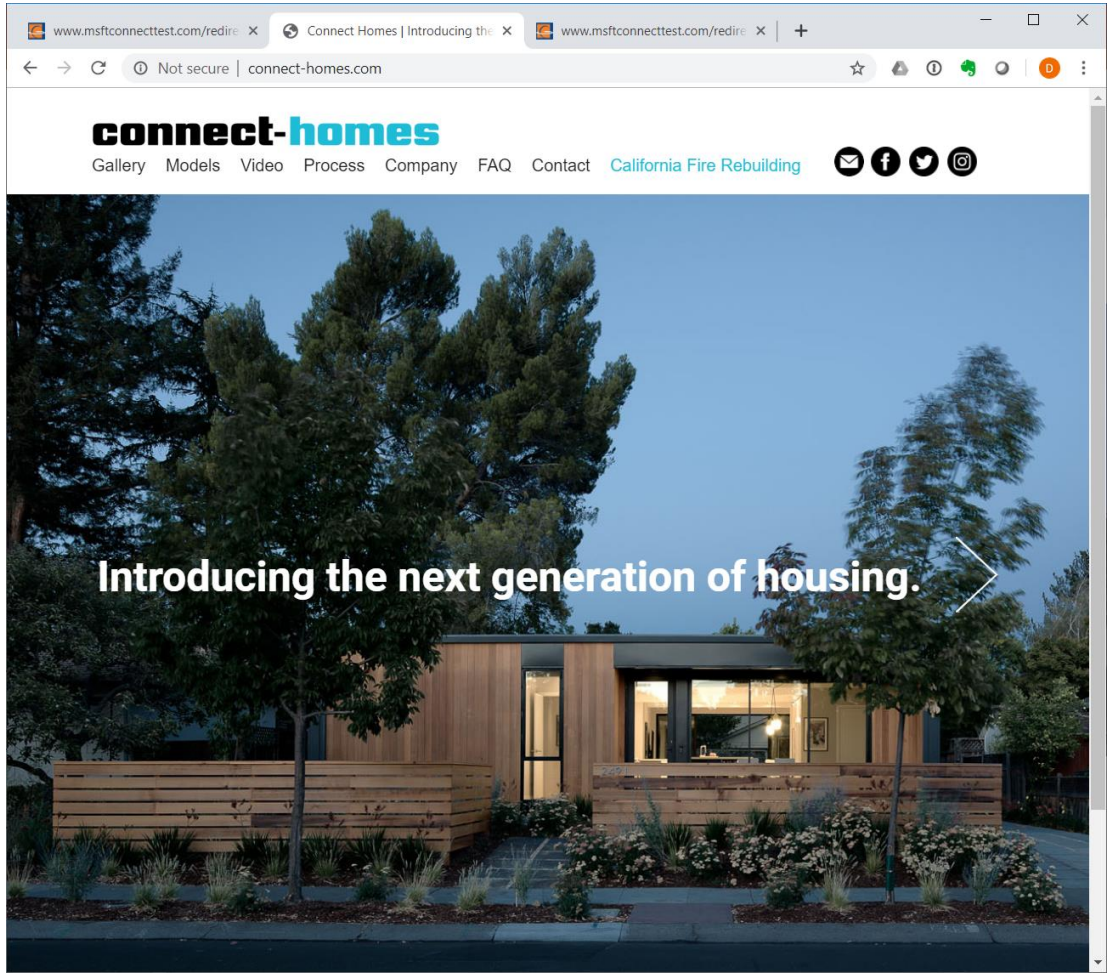
PUMPKIN Mounts

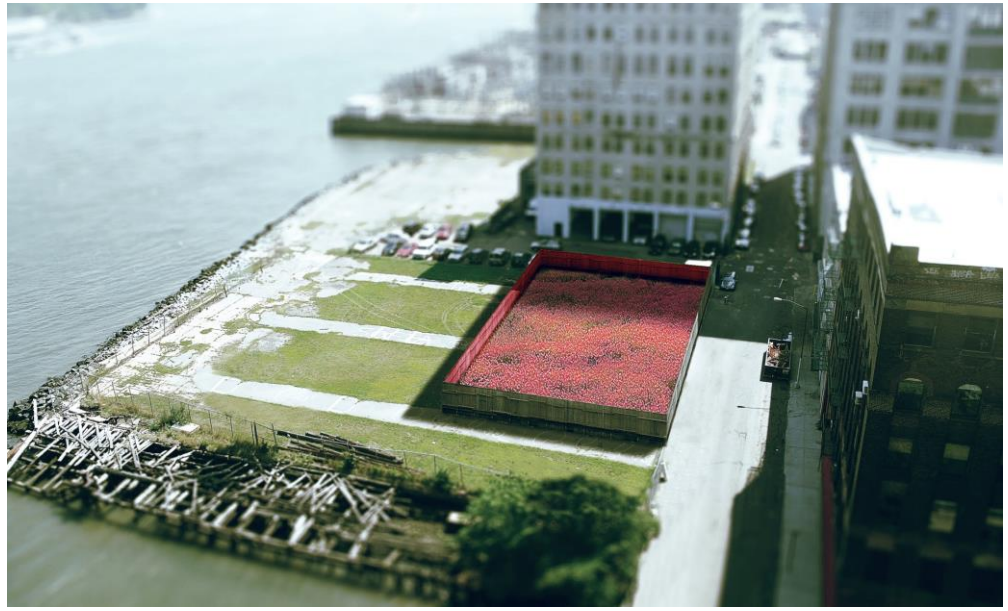
HUMMINGBIRD kinetics

VistaMat Suite

KONSTRU

PZFLEX


www.msftconnecttest.com/redire
Connect Homes | Introducing the
www.msftconnecttest.com/redire
Not secure | connect-homes.com
connect-homes
Gallery Models Video Process Company FAQ Contact California Fire Rebuilding
Introducing the next generation of housing.



# Alloy

**CHANGE ORDER**
*AIA Document G701*

**PROJECT**
Dumbo Townhouses
55 Pearl Street
Brooklyn, NY 11201

**PROJECT NUMBER:** 1202
**CHANGE ORDER #:** 4
**DATE:** March 4, 2014

**OWNER**
55 Pearl Street LLC
c/o Alloy Development Holdings
20 Jay Street, Ste. 1003
Brooklyn, NY 11201

**THE CONTRACT IS CHANGED AS FOLLOWS:**

*As per the attached Euro Iron invoice #I140225271 dated 2/25/14, RSA CSKs #10R4, #11R5, #12R2, #13R, the approved record set of structural steel shop drawings dated 2/12/14 and correspondence from RSA between 2/21 - 2/25:*

| | |
|---|---|
| Fabrication and installation of additional (6) HSS 5x3x3/8" columns and (5) W12x19 beams at Grid 'A', and (4) MC12x35 channels at Penthouse Terrace framing at North skylights | $ 12,800.00 |
| Fabrication and installation of (24) web stiffeners at Mezzanine perimeter W21x93 and W14x43 beams at Ductal bearing plate locations | $ 1,500.00 |
| Additional detailing due to said revisions | $ 2,500.00 |
| Subtotal: | $ 16,800.00 |
| Overhead and Fee (0%): | $ - |
| Subtotal: | $ 16,800.00 |
| Insurance (0%) | $ - |
| **TOTAL CHANGE ORDER** | **$ 16,800.00** |

| | |
|---|---|
| The original Contract Sum was | $ 5,901,682.12 |
| The net change by previously authorized Change Orders | $ 21,204.00 |
| The Contract Sum prior to this Change Order was | $ 5,922,886.12 |
| The Contract Sum will be increased by this Change Order in the amount of | $ 16,800.00 |
| The new Contract Sum including this Change Order will be | $ 5,939,686.12 |
| The Contract Time will be increased by | 0 days |
| The date of Substantial Completion as of the date of this Change Order therefore is | 3/30/2015 |

**NOT VALID UNTIL SIGNED BY THE ARCHITECT, CONSTRUCTION MANAGER AND OWNER.**

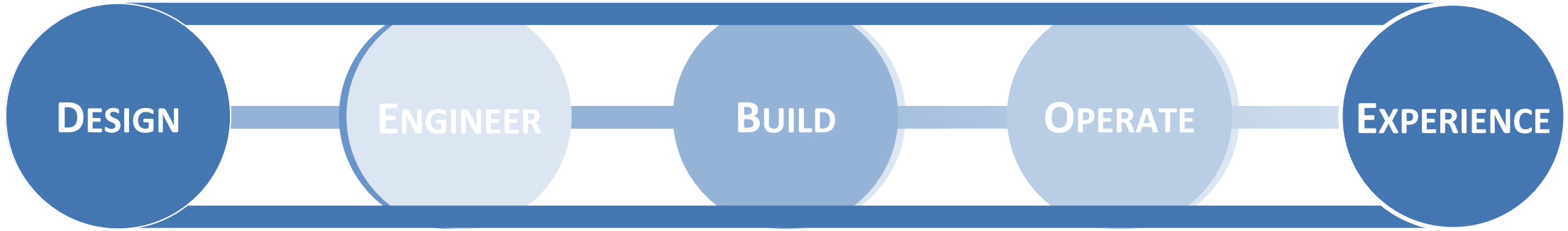
| | | |
|---|---|---|
| AC 55 Pearl Street LLC | 55 Pearl Street LLC | Alloy Design LLP |
| **CONSTRUCTION MANAGER** (*Firm name*) | **OWNER** | **ARCHITECT** (*Firm name*) |
| 20 Jay Street, Ste 1003, Brooklyn 11201 | 20 Jay Street, Ste 1003, Brooklyn 11201 | 20 Jay Street, Ste 1003, Brooklyn 11201 |
| **ADDRESS** | **ADDRESS** | **ADDRESS** |
| **BY** (*Signature*) | **BY** (*Signature*) | **BY** (*Signature*) |
| Jared Della Valle | Jared Della Valle | Jared Della Valle |
| (*Typed Name*) | (*Typed Name*) | (*Typed Name*) |
| 3.12.14 | 3.12.14 | 3.12.14 |
| **DATE** | **DATE** | **DATE** |

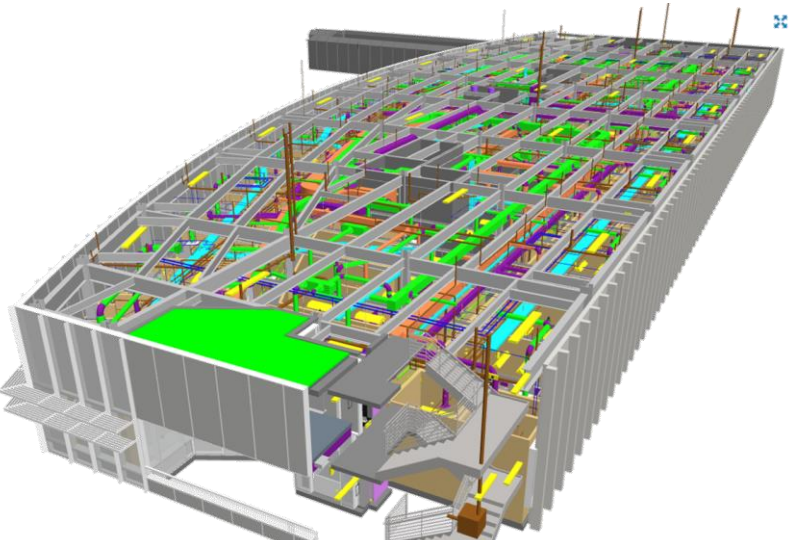
# DIGITAL TWIN

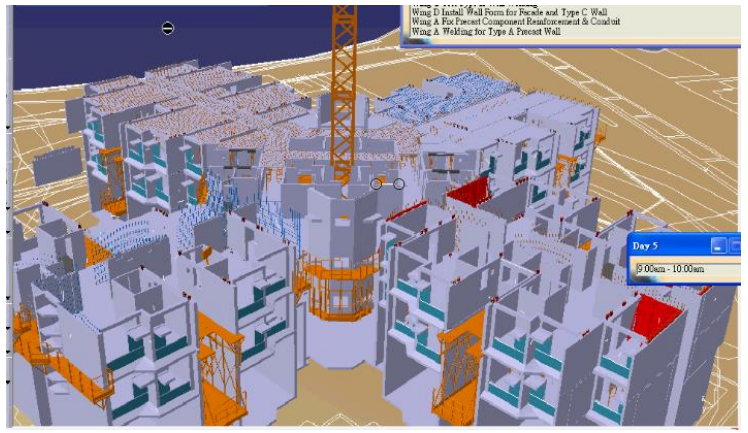
SENSORS

CONTROLS

# CYBER-PHYSICAL WORLD VIEW





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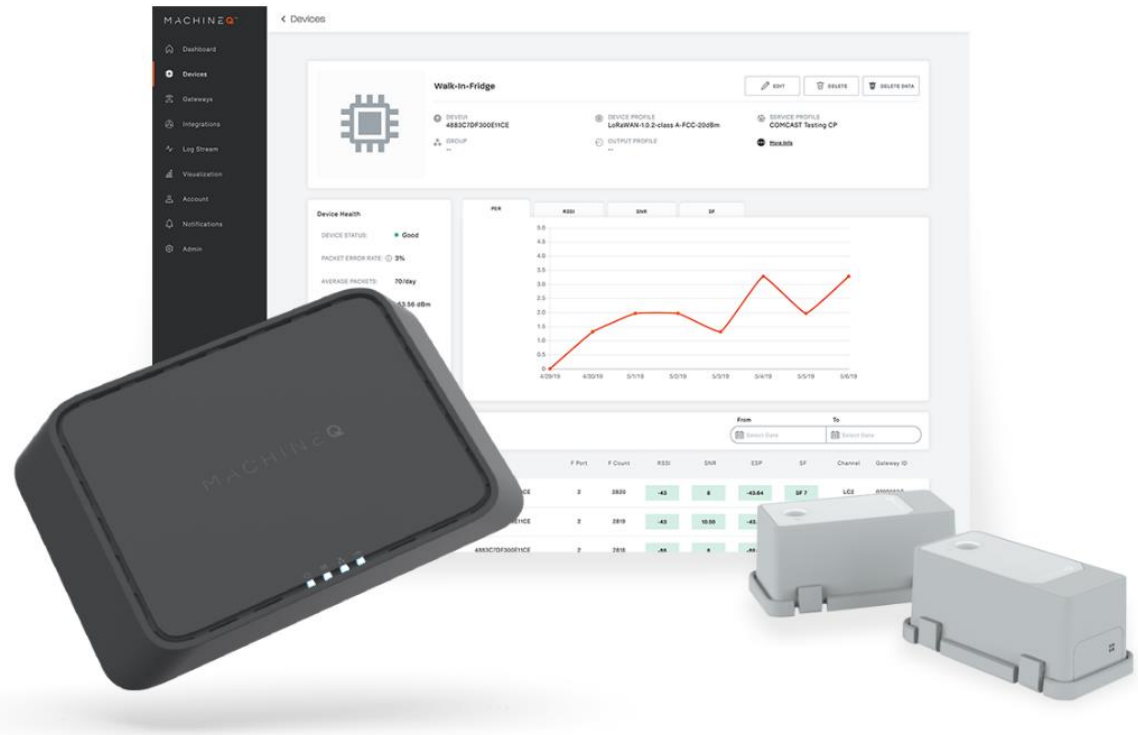
platforms including Microsoft Azure, Amazon AWS, and Oracle Cloud.

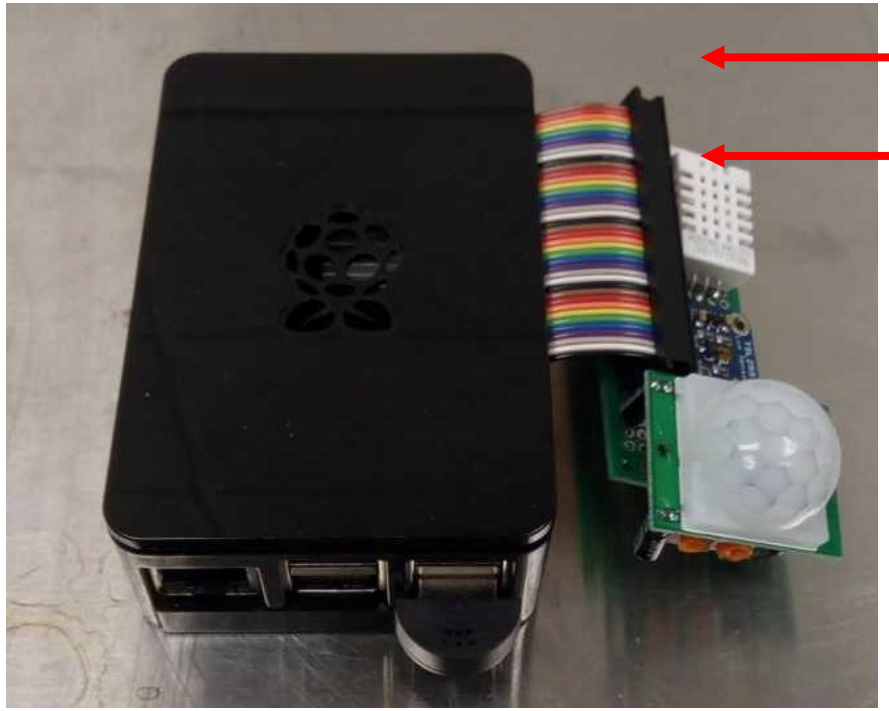
platforms to deliver tailored, industry-specific solutions.

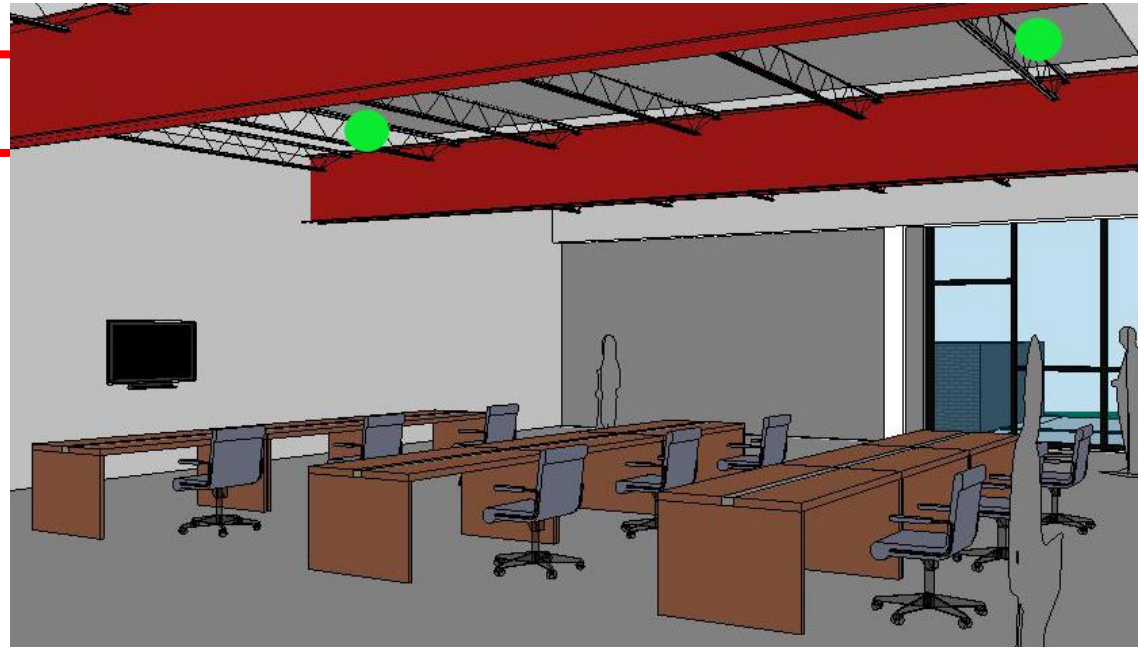
including support for inventory and asset management.

and customize alerts, allowing you to launch pilots and scale with minimum time to market.



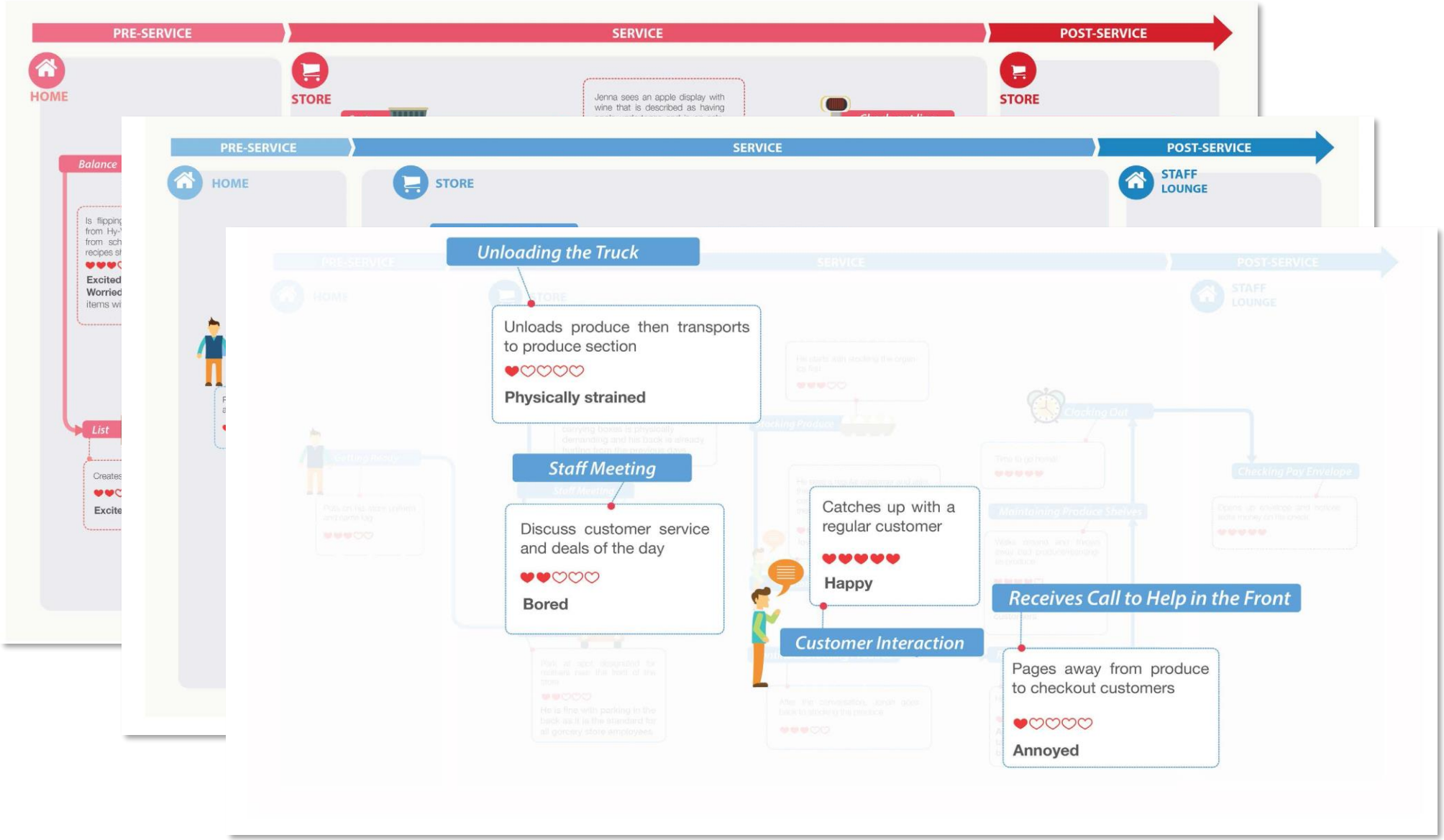

VIEW PRODUCTS



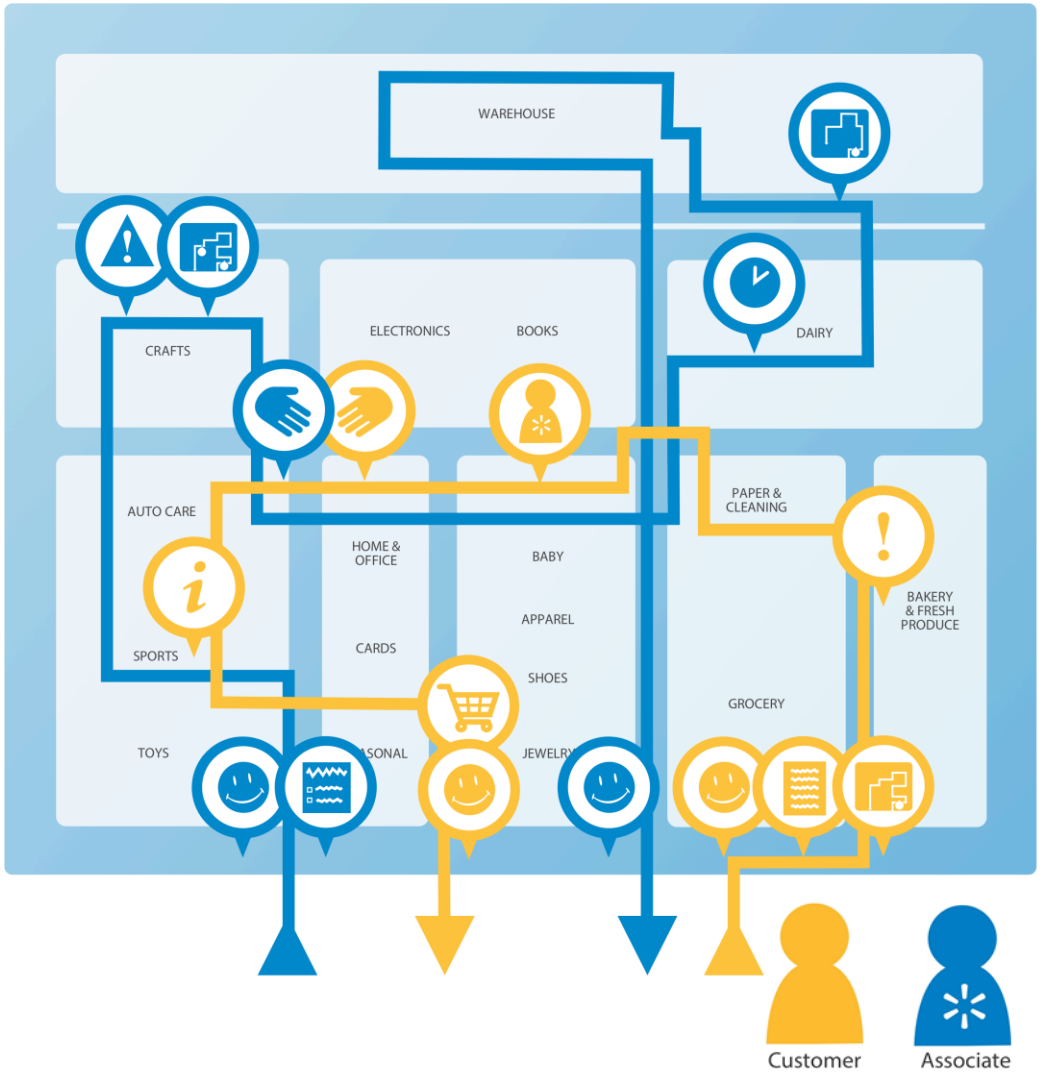


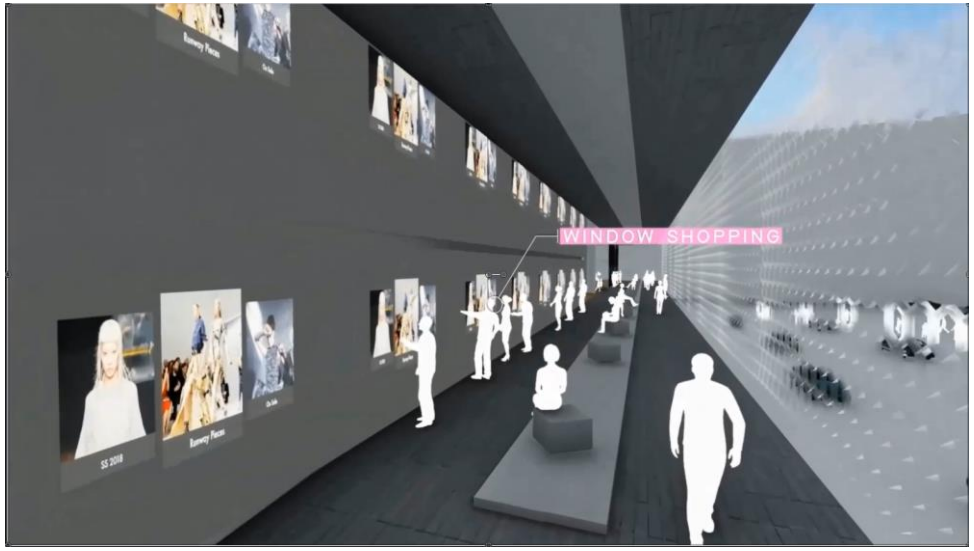
*Yong Cho, Nazanin Tabatabaei*

# EXPERIENCE / SERVICE DESIGN



# Retail design studio





# THE DISRUPTORS

Guest-edited by
DENNIS SHELDEN

## TECHNOLOGY-DRIVEN ARCHITECT-ENTREPRENEURS

02:2020
THE DISRUPTORS: TECHNOLOGY-DRIVEN ARCHITECT-ENTREPRENEURS
WILEY
02 | Vol 90 | 2020

**New Scope**
Similarly, technology companies are places where architects can learn the value of innovation to entrepreneurs as advisory board members. Serving on such boards of software companies like Caustic Graphics, MatterMachine and Gehry Technologies was an education in building a technical services and digital tool company, financing, shareholder agreements and acquisition negotiations.

Greg Lynn FORM's role at Curbside, a company positioned at the intersection of digital and physical shopping, was not project based, but instead that of design advisor for all physical structures including its deployable pick-up pods, Palo Alto office headquarters, and all other elements of the physical brand. Compensation was a combination of time and expenses with equity ownership. This investment in the success, cost and performance of the design and construction process meant that innovation and entrepreneurship were linked. Even after the recent acquisition of the Curbside by Rakuten, the mutual investment in design innovation and business relationships persists.

As co-founder and CEO of consumer robotics company Piaggio Fast Forward, the need to build processes and a business strategy around innovative plans is acutely apparent, encompassing market creation, supply chain, logistics, distribution, manufacturing, assembly, customer care and product development. The company is majority owned by Piaggio Group, the largest two-wheeled vehicle manufacturer in Europe, and maker of the Vespa among other lightweight vehicles. Piaggio Fast Forward was founded in 2015 with Jeffrey Schnapp and Michele and Roberto Colasimino, two recent architecture school graduates from MIT and Harvard, two graduates from the Rhode Island School of Design, a University of California, Los Angeles (UCLA) business school graduate, and a junior faculty member from Harvard. The first task was to define a large problem different from other mobility and robotics start-ups; a question that connects with the lifestyle legacy of the Vespa scooters, Moto Guzzi and Aprilia motorcycles that Piaggio designs, builds and sells. The robotics company is defined by 'Autonomy for Humans', involving machines that understand potsstrinism. More and more machines are beginning to move autonomously in the presence of people, however the problem of human-machine interaction on sidewalks is more complex than how self-driving cars move on roadways. Where perhaps engineers can solve the challenges of autonomous cars sharing roads with human drivers, a more architectural and urban insight is required to design intelligent machines that move with people on sidewalks and in and out of buildings. The company needed to innovate new products with wheels that use following to move without being driven, and these are being rapidly commercialised for entrepreneurial consumer markets.

Greg Lynn FORM,
Curbside Pick-Up Pod,
2017.

The pods is intended, identifiable landmark for drivers, cyclists and pedestrians as they approach to pick up their parcels. Bottom: when in a high-powered illuminated beacon for tracking customer location. The lower part provides divide for the employees access to parcel storage. The entire structure is built from lightweight composites so that it can be mass produced. Non: see set of pods; its light weight mould it can be built with relatively large parts, reducing the assembly time and easing logistics so that it can be deployed as fast as a delivery van can. Curbside retail locations.

Architects' vision and perspicacity means they are poised to become innovators. Yet they are trained to believe their work is finished with the creation of an original idea, meaning they lack entrepreneurship

**Innovator or Entrepreneur?**
Experience in understanding the distinct domains of entrepreneurship and innovation is important. Architects' vision and perspicacity means they are poised to become innovators. Yet they are trained to believe their work is finished with the creation of an original idea, meaning they lack entrepreneurship. The work of an entrepreneur is not to be original or innovative. Even though entrepreneurs may look and sound like innovators and creatives, they rarely are. They are execution specialists who take on risk and responsibility in building companies in exchange for reward. More like developers than architects, they feed on innovation, but do not often create it. However, there are ways that architects can become more entrepreneurial: first, by automating parts of the existing scope of architectural services and replacing the expensive labour associated with the profession with machines that they design, engineer and own; and second, by getting out of the business of handing over plans to others for execution, and instead taking on the risk and possible reward of building and developing in addition to designing. ⊿

Piaggio Fast Forward,
gita robot,
2109

A hands-free carrier designed, engineered and manufactured at consumer robotics company Piaggio Fast Forward, co-founded by Greg Lynn. This is the first lightweight mobility robot designed for the consumer market to follow people on errands and neighbourhood trips to help reduce car usage, ride sharing and courier rental. Gives a option of milk, a carpooled, several school books or two bags of groceries with no difference between a walking and driving trip. By using machine vision and path-planning technology to autonomously follow / accept commands from its owner, it frees up its occupants of the cognitive load of navigating so they can be more present with their children, friends and colleagues. Gita has the same payload capacity as a typical bicycle basket and can travel at speeds of up to 22 kilometres per hour (13.5 miles per hour), which is the maximum speed limit for bicycles in many US cities and towns.

Ian Volz Stills John Wiley & Sons Ltd
Images pp 126–28 © Greg Lynn FORM; p 127 © Piaggio Fast Forward

currently a great deal of discussion about mobility as well – for instance using more electric bikes and reducing the number of cars. But there is also a great deal of research and experimentation taking place in the Netherlands with respect to densification, and how to establish new neighbourhoods that can incorporate emerging technologies to sustain growing populations.

A good example of this is the Brainport Smart District (2018), a project in Helmond, near Eindhoven, where a large number of big technology companies are located. UNStudio has designed the urban vision for this new neighbourhood, while UNSense plays a key role in the planned use of technology. The district will support a combination of living and working. Ninety per cent of services will be circular, including 100 per cent energy neutrality and self-supporting water systems. Food production aims to create new forms of community building. People will be able to enjoy shared gardens, where they can produce food for themselves and the community, should they wish. Forty per cent of the required food can be produced in the district, and 80 per cent within a radius of 100 kilometres (62 miles).

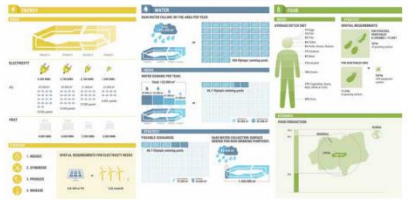
Underlying the project will be a data platform, which will make it possible to monitor the performance of the different building systems for all of the 1,500 houses. The data platform is set up as a separate company in order to be able to involve other small investors.

UNSense is starting with an experiment involving 100 houses. The project is intended to research and develop new models in which inhabitants of the district as a whole can benefit directly from data. UNSense wants to investigate what happens when data is used for the benefit of the community. For instance, residents in the neighbourhood could organise themselves in order to exert more influence on, for example, how mobility and energy are organised. However the residents remain the owners of their own data at all times. They decide whether or not they want to take part in an experiment. To guarantee this, a trusted body is currently being formulated that can provide a guarantee for experiments, so that residents can see whether they meet requirements on privacy, property, security and ethical considerations.

UNStudio and UNSense,
Brainport Smart District,
Helmond, The Netherlands,
2018–

KLM Catering to new local and international users. Brainport Smart District seeks early adopters of new ways of living and working.

Below: Circular services strategies for electricity, water and food. This is what 1,500 houses will be able to generate at most in the form of services.



### Developing New Technologies on the Product Scale

In addition to urban projects, UNStudio and UNSense are involved in the research and development of new architectural products, one of which is a new photovoltaic (PV) module which can be used as cladding for the building envelope. High-rise buildings do not have enough roof surface to accommodate the amount of solar panels that would be needed to make the buildings net zero, and whilst building-integrated photovoltaics (BIPV) have made steps in the right direction, they do not offer a complete design solution for architects. This is why UNStudio's Knowledge team originally worked on the research, design and development of a new technology for aesthetic solar-panel cladding modules for full facade integration. This research and development was carried out as part of a European research project and in collaboration with the Construct PV consortium. The product is called Solar Visuals and is now approved and can be implemented. However, as it needs to go to market in innovative ways, UNSense joined forces with the printing company TS Visuals and 'ECN part of TNO' (the Energy Research Centre within The Netherlands Organisation for applied scientific research). Currently companies are being selected to partner with and to invest in this product, including large glass companies, while the modules undergo further development.

Another product that UNSense is developing is RESET (2017), which was first prototyped by UNStudio and SCAPE at the Salone del Mobile in Milan. There, RESET was organised as a series of pods that featured scientifically proven stress-reduction methods in a playful and interactive way. It was designed to empower people to deal with stress more effectively. Everything visitors did in the pods was measured by sensors. These sensors traced the visitor's response to the stress-reduction experiences and provided real-time 'factual' feedback. UNSense is now talking to travel tech companies, investigating possibilities to install similar RESET pods in high-stress spaces, such as airports or work settings.

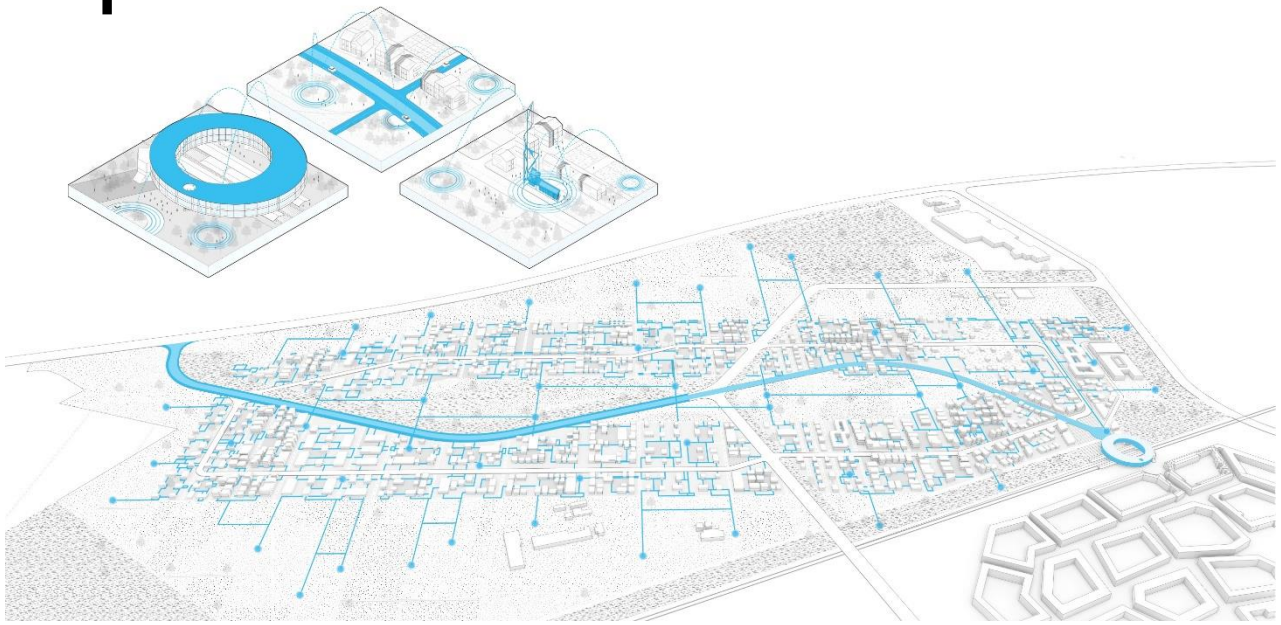
UNStudio and UNSense,
Solar Visuals printed solar panels,
Amsterdam, The Netherlands,
2108

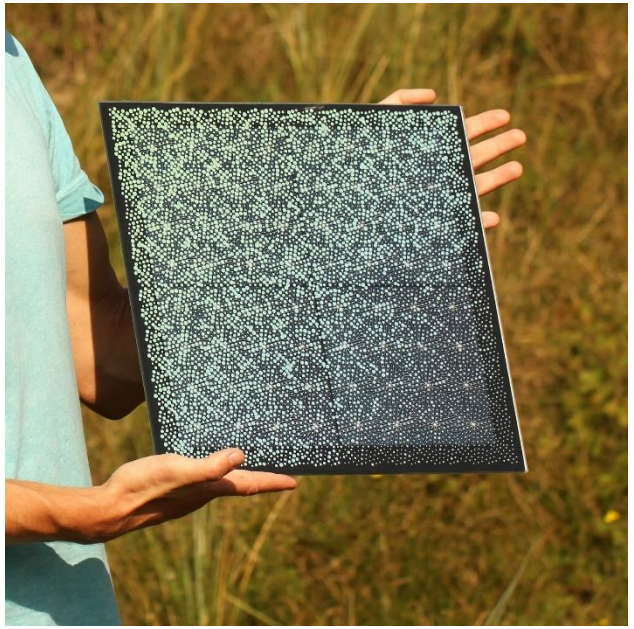
Solar Visuals, founded by UNSense and partners ECN part of TNO and printing specialist TS Visuals, is a start-up company that is now manufacturing cladding panels that can be integrated in facades of buildings.

UNStudio and SCAPE,
Prototype RESET stress-reduction pods,
Salone del Mobile,
Milan, Italy,
2017

RESET is a technology product – a sensoric space designed to help users cope with their stress levels through biofeedback, which is currently being further developed by UNSense.

# Spinoff Incubators: UNStudio / UNSense





*The architect needs to be a cultural entrepreneur: interested in business, but also with a genuine fascination for culture.*

*Technology is increasing – not decreasing – the demand for the social aspects of architecture & design.*

# Design – Build Integrators: Front

*Front ultimately [pulled] out of the contracting business and instead leveraged all of the knowledge that had been acquired – in logistics, scheduling, costs, procurement, means and methods, and detailed systems design, analysis, automation and quality control – emerging as an augmented and comprehensive building envelope design, engineering and consulting practice.*

*Front's evolution as a firm and the skill set gained through this evolution are what enable it to now take on [humanitarian] projects. As a global consulting practice, this capacity starts with a holistic understanding of the kinds of problems of envelopes, identification of needs, the ability to build relationships and to create the circumstances under which one can actually act, and ultimately to carry a project to realization.*

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MAY 8-11, 2020
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