Design / Fabrication Lab

open design lab
waag society

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Colophon
Text contributions by: Gary Rohrbacher, Matthijs Bouw, Pieter van Boheemen, DUS Architects, Anthony Rosengren, Laurie Skelton
Text editing: Ista Boszhard, Frank Kresin
Project management: Marc Boonstra

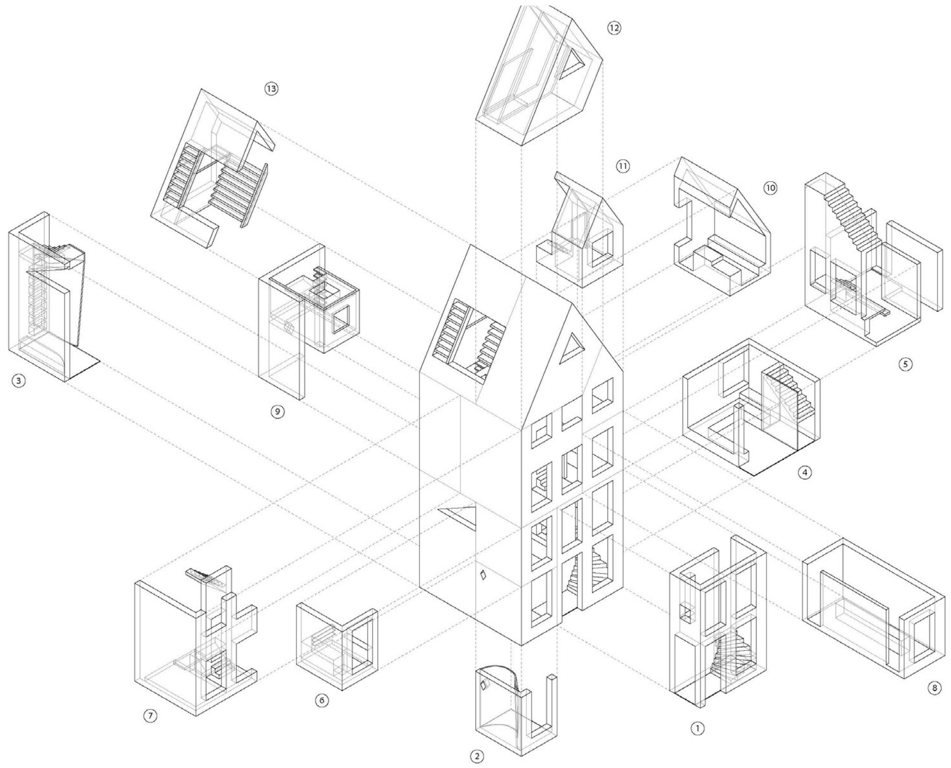
1. Introduction

Design/Fabrication Lab

Digital fabrication and open design promise to deliver radical changes to design professions. These methods have serious impact on producer-consumer and professional-amateur relationships; create opportunities for shared authorship and democratic economy; promise a shift from supply- to demand-focused processes; and enable global thinking followed by local actions. With the rapid rise of maker culture and maker spaces, many of these changes become visible in product design. In the fields of architecture, engineering, and construction (AEC), however, industries are adapting slowly.

Waag Society and its partners, One Architecture and Filson and Rohrbacher, hope to stimulate digital fabrication and expand it to include the AEC industry. The partners believe that the Netherlands—with its history in (collective) private commissioning, the challenge of retrofitting much of its building stock, complemented by a series of bottom-up designer led digital fabrication-initiatives and (last but not least) the housing crisis—makes for a fertile breeding ground.

It is, however, imperative that access to digital fabrication, business development, and entrepreneurial expertise is strengthened. Industry partners with these skills are based on the West Coast of the United States. With the goal of transatlantic fertilization in mind, Waag Society proposed a three-day event during which Dutch and US practitioners, companies, and institutes acted as a Living Lab to present projects. Participants debated their way forward, strengthened their network, and worked on the idea of a digital fabrication laboratory. A follow-up meeting was held in the Waag in Amsterdam. US and Dutch creative industry partners were invited to the Fablab to demonstrate, discuss, and continue the work that began in San Francisco. Results were shared with a broader audience during a public event held at the Waag, with knowledgeable speakers, and an enthusiastic audience. This booklet provides an overview of the Design/Fabrication (D/F) Lab project and explores the future of digital fabrication and architecture.



2. Project partners

waag society

Waag Society

Waag Society—Institute for Art, Science and Technology—is a pioneer in the field of digital media. Over the past 21 years, the foundation has developed into an institution of international stature, a platform for artistic research and experimentation, and has become both a catalyst for events and a breeding ground for cultural and social innovation. It explores emerging technologies, and gives art and culture a central role in the designing of new applications for advances in science and technology. The organisation's artistic research includes six labs operating around themes in which Waag Society's view is unique, and its approach has an international impact. The D/F Lab project is part of the Open Design Lab that focuses on digital fabrication and new crafts.
waag.org

one architecture

One Architecture

One Architecture is an award-winning firm that designs buildings, infrastructures, and urban environments. One Architecture also uses design to help cities, regions, and countries with their long term spatial and infrastructure planning. One Architecture has offices in Amsterdam and New York, and is interested in processes as much as in projects. Over the years, this interest has resulted in an open, collaborative, practice in which issues such as finance, organization, (digital-) technology, culture, and policy/politics form an active part of any work we do.
onearchitecture.nl

FILSON AND ROHRBACHER

Filson and Rohrbacher

Filson and Rohrbacher is an architecture, design, and research firm. We take our experience in building award winning architecture for institutional, cultural, and residential clients and bring it into a wide variety of spatial scenarios. Our firm pursues design in broad contexts by redefining how we practice, by finding affordances with digital tools and techniques, and by expanding design scope to consider the interrelated conditions that surround spatial concerns. By rethinking how we work as architects, we find that we have the capacity to create potent design that is capable of addressing significant challenges.
filson-rohrbacher.com

DUS Architects

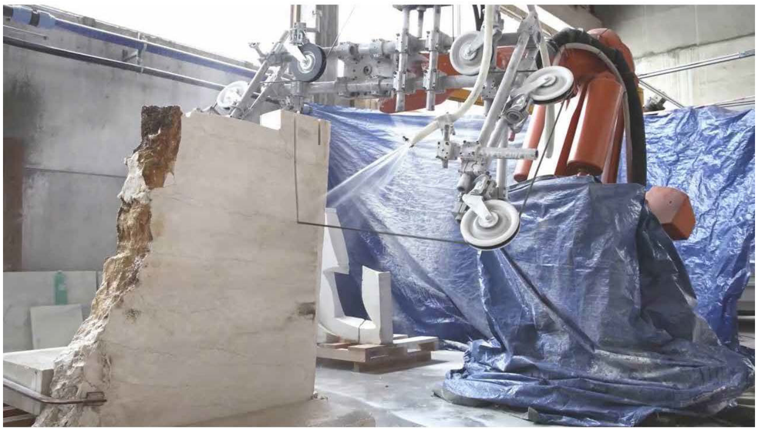
Based in Amsterdam, DUS Architects make public architecture – design that consciously influences everyday life. DUS designs things that make you feel at home in the world – from your favorite coffee mug to the neighborhood that you live in. To DUS, architecture is a craftsmanship, and all their work has a personal touch. As is shown by their most recent project, the 3D Print Canal House, where they are 3D printing an entire house as research into how new digital fabrication techniques can lead to affordable tailor-made architecture.
dusarchitects.com

Testa & Weiser

Testa & Weiser is a Los Angeles based architecture and design studio founded by partners Peter Testa and Devyn Weiser in 2002. The studio is known for conceptual and technical breakthroughs that integrate advanced material processes at all scales. From pioneering software applications to creating new composite building systems, Testa & Weiser is recognized as an international design leader redefining architecture.
testaweiser.com

Jelle Feringa

Jelle Feringa is an architect and expert in the field of architectural robotics. Jelle is co-founder and EZCT Architecture & Design Research. The work of the office is widely exhibited, exhibitions include the Mori Art Museum, Tokyo, Archilab, Orléans, Barbican Gallery, London Design Miami/Basel and is part of the permanent collection of the Centre Pompidou, Paris. Jelle is co-founder Odico formwork robotics, the first European factory, located in Denmark that specializes in robotics for construction, where he is chief technical officer. Since 2014, Odico has rolled out its fabrication technology and as such is in involved in the realization of some of Denmark's most exciting building projects. As an architect, Jelle is interested in moving from a demand driven towards a supply driven architectural practice. Jelle's recent publications include AD "Made by Robots" and Fabricate 2014.
odico.dk, ezct.net

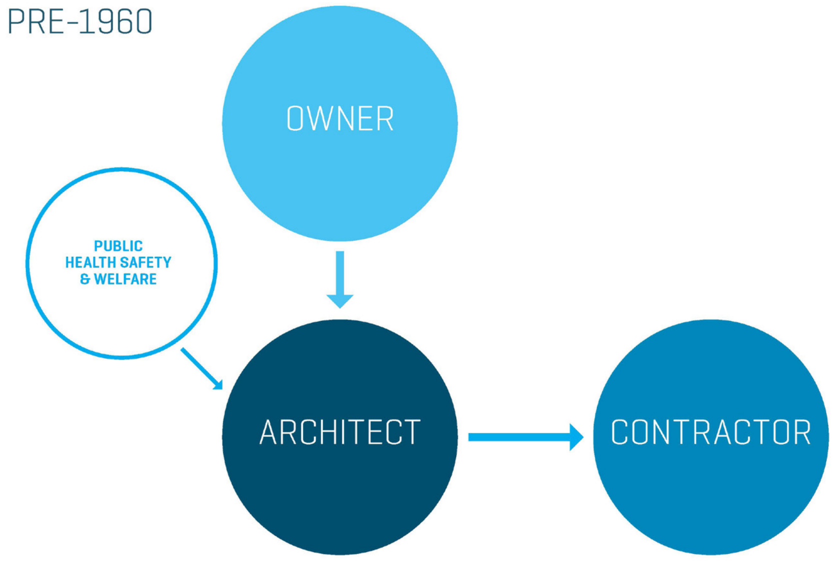


3. Context - Digital fabrication & the AEC industry

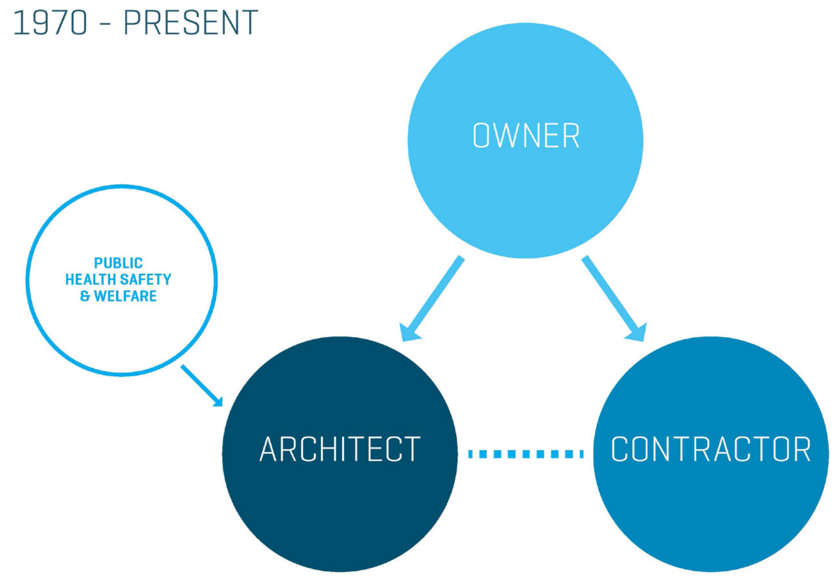
The AEC industry

Gary Rohrbacher – Filson and Rohrbacher

A brief recent history of the organization and evolvement of Architecture / Engineering / Construction.

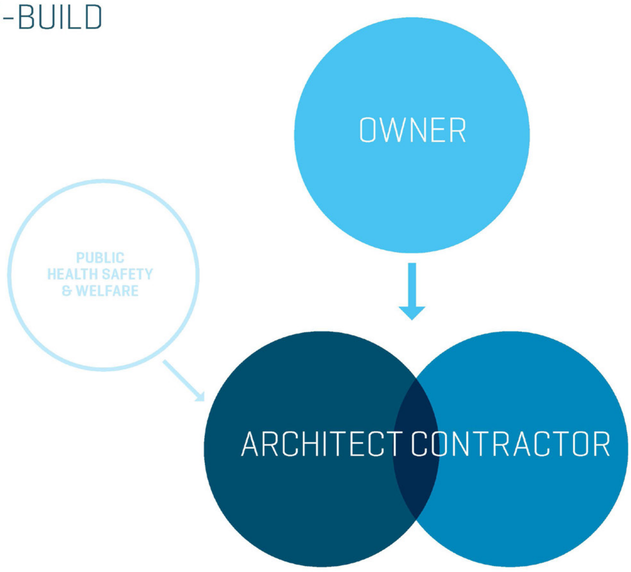


Prior to 1960, the organisation of AEC was organised to be both hierarchical and collaborative. As a profession, architecture has an obligation to work on behalf of the public good and (at a minimum) to care for health, safety, and welfare through their work. This is what establishes a profession.



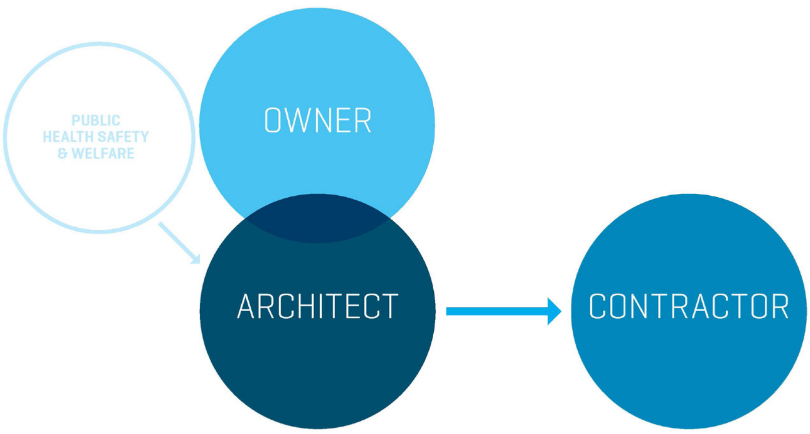
From 1970 to present, with the rise of litigation, the hierarchical relationship between the architect and the contractor has been eroded. The result is an increasingly adversarial relationship between the constituencies that need to rely upon one another to move an industry forward. This has since lead to the question: who is looking after the public good?

DESIGN-BUILD



Over the past few decades, in reaction to the increasingly outmoded conventions, some in AEC have been exploring new models of organization, relationships, and project delivery. Firstly, there is a model called "Design-Build," in which the architect acts as contractor, or the contractor has in-house design. Secondly, there is a model referred to as "self development," in which the architect self-finances a project and then sells or rents to the market.

SELF DEVELOPMENT MODEL



These new models are efforts to shore-up or reinvigorate a failing business model, but do not account for all the checks and balances of the original hierarchical and collaborative scheme. Possibly, they present a conflict of interest for the architect, whose charge is ultimately to protect public health, safety, and welfare. Yet, discouragingly, more and more buildings are being built without an architect involved—a figure that amounts to +90% of US construction. This begs the question: who is looking out for the public's best interest?

At the same time, client, architect, and construction entities have changed and are becoming increasingly more hybrid, differentiated, and complicated. This requires not only new workflows, but also the necessity for interoperability across diverse packages of software (from task to task and phase to phase). Clients are more often client groups (rather than single entities) that utilize new financing models and may be organized as joint ventures or public private partnerships. The role of the architect has been segmented into design architect, architect of record, and various other kinds of specialized consultants and collaborators. Construction itself has changed (usually fast-tracked), involving multiple sets of contractors and sometimes construction managers, sub-contractors, special fabrication, and others. This has manifold effects on the AEC as a whole—especially when we're not self-aware enough to acknowledge these changes, and still persist in the belief that we are operating under pre-1960's conditions.

This has resulted in a scenario in which, over the past 30 years, AEC costs are up while profits and quality are down. AEC productivity is lagging behind all other economic sectors by over 200%. While all other sectors have found productivity in digital technologies, AEC (13% of the global economy) still struggles.

We're citing three conditions for this. The first is that we have failed to re-organize into a networked, distributed model that might be more responsive to the sets of affiliations required to deliver architecture. The second is that, quite simply—AEC is hard. It takes a hundred people to make even the most modest building (including financing, client, architect, consultants, entitlements, public participation, code compliance, construction, post-occupancy, etc). There is a reason why architecture thinks of itself as the highest form of art: because the challenge of creating a building has never been insignificant. With increased pressures on the economy, the environment, and energy combined with the complications listed above, it has never been more difficult. The third is that Architecture, Engineering, and Construction have adopted digital technologies very slowly and unevenly. Perhaps one could excuse the fact that digital workflows have been slow to take shape because of the complications described above. When digital technologies have been adopted, it has primarily been on the design side rather than the delivery or construction side (where the broadest impact would be felt). And, when innovation in construction has occurred, it has been in the most exclusive of scenarios, as though we are relying on trickle-down tech-transfer in construction. Regardless, we see the massive lag in construction productivity as the effect of an ill-considered and outmoded workflow as well as frustrated interoperability.

An icon for everyone - the architect as a creator of scalable products

Matthijs Bouw

Until recently, De Kamermaker from DUS Architects could be found in Amsterdam-North along the road from the ferry to the district. In this small pavilion, the giant 3D printer worked to produce a canal house as a public project. Now, the printer has moved to the construction site. While DUS has been working for quite some time on the project (or actually, on the research), much still needs to be discovered. Innovation in architecture depends, as always, on technological development. Therefore, 3D printing, already a quite promising example in the medical field, is also an important new development in architecture. Sometimes, the technology can seem like a bit of a hype as successive claims of a new 3D printed buildings tumble over each other in architecture blogs.

This is not surprising. 3D printing speaks to a wide audience by bringing invention and production closer together. In the same way that one can produce fun flyers on an inkjet printer or self-designed jewelry on a 3D printer, everyone can now print his or her own building. 3D printing democratizes the primacy of the expert and is consistent with the general movement towards people becoming more able to co-create their own environment. Architects embrace 3D printing and other digital technologies with the same commitment to democratization (namely the construction chain). Citizens think, "Finally, I no longer need an architect," while the architect thinks, "Finally, I no longer need contractors or developers."

Intelligent Modeling

Digital technology has an impact on three aspects of building practice: on how teams work; on how architecture is simulated; and on the way in which these simulations are made physical through "direct prototyping" and production with computer-driven (CNC) tools.

Digital platforms that facilitate cooperation and manage workflows enable digital models and their associated data to become open to experts as well as interest groups and local citizens. Information can be unlocked in such a way that it offers the possibility of involving selective parties in the process at various levels. Through cooperation, mutual influencing, and dealing with large amounts of information, more resilient solutions become possible.

Building Information Modeling (BIM) is evolving into Building Intelligence Modeling, where, for example, energy and climate analysis data can be steered with parallel simulations of available manufacturing capacity towards an optimum. Through successive iterations, large amounts of data are introduced into the design step by step.

Effects on the design process

The development of digital platforms also has major effects on the development process. Municipalities can open development for citizens to encourage involvement. The structure of the real estate chain (often focused on the institutional lender, large bureaucracies, the landowner, and the major contractor) used to take place mostly top-down. Citizens were less involved in their own environment. Digital technology makes it now possible to better engage the public as a part of the team.

The direct link between 3D modeling, simulation software, and the new digital-driven devices (like 3D printers, CNC routers and robotics) radically changes the design process. Architects, engineers, and other potential users evaluate variations of proposals based on their own expertise, while at the same time benefitting from collaborative analysis and evaluation. This makes the design process more agile and effective than it has ever been in history. At the same time, it offers both the possibility of making physical prototypes and of unprecedented communication capabilities with stakeholders. Through prototyping, the risk during the actual construction is limited.

Sometimes, the interest in 3D printing distracts from the broader possibilities of digital technology, particularly regarding production. Here, the most promising digital fabrication technologies are actually CNC routers and robotics.

Jelle Feringa (from the Paris-based agency, EZCT Architecture & Design Research) is involved in many experiments with digital technology. He puts it this way: "There are additive and subtractive technologies. In additive technology, you use an expensive material put together, layer by layer, by a 3D printer into an almost baroque whole. In subtractive technology, you use the robot or computer-controlled cutting and drilling with a CNC-router on cheap material (like EPS or plywood), making complex compound shapes or molds. The molds can then be filled again with a low-priced material (such as concrete). Subtractive technology currently makes much more sense from the perspective of production technology: mass-production for what can be mass-produced, customization of what one wants to customize."

Feringa developed the technology of wire-cutting with the help of industrial robots. Odico Formwork Robotics—a Danish start-up based on Feringa's technology—produces EPS shapes using large, robust and relatively cheap industrial robots. The approach is compatible with existing technologies, and lends itself in particular to the production of intricately shaped concrete formworks.

In Odense, Odico uses robots on 25 meter-long tracks so that, in a single morning, one hundred cubic meters of formwork can be produced. Odico produces for a Danish prefab concrete industry (Hi-Con, Spaencom, Dalton) and for the clean tech industry (Siemens Wind Power).

Promise of mass-production
Mass customization and the ability to set up a new kind of company based on this is the background for A Mies for All. A Mies for All is a company committed to using digital technology to recreate the iconic houses of the Modern movement, such as the Farnsworth House by Mies van der Rohe, and make them available to many people (http://farnsworthhouse.org).

A Mies for All wants the houses of Mies van der Rohe, Le Corbusier, Neutra, Gropius, and Frank Lloyd Wright (to name a few) to be as easily accessible to the general public as a new version of the Barcelona Chair or Le Corbusier sofa. The company hopes to deliver on the unfulfilled promise that is the foundation of the modern architecture: the promise of mass production and maximum efficiency through the use of modern technology.

The original vision of standardization and democratization, to which modern architects adhered, seems to have disappeared in even the most iconic examples of their work (such as the Farnsworth House). Most are either unoccupied or function as museums. They have been given the final status of an ideal, an inaccessible dream that produces bad copies and that legitimizes endless quotations. Ultimately, this leads to the degradation of the original idea to a badly copied model.

Today, many wealthy people have a modernist house in the style of Le Corbusier, Neutra and Mies Van Der Rohe, designed by more or less well-known architects. One could, given the ease with which architects quote colleagues, say that the architecture is "open source" par excellence! The striking thing, however, is that they are built in a traditional way with old techniques and materials. Mass production and new technologies can be seen especially in construction for poor people, in which formal appearance is made subservient to the regularity of production, the availability of the material, or any other economic imperative to rationalize.

A Mies for All wants to perfect the modernist project of accessible, mass-produced, quality architecture. The company wants to provide the quality of a unique and authentic modernist design for the price of a standard building. Why would you want to live in a mimicked Mies van der Rohe or Frank Lloyd Wright when you can live in the original design of Mies or Wright?

Innovations
By applying contemporary digital processes to these houses, one sees a radicalization of the architect's vision. In 1964, Mies van der Rohe said, "I've tried to make an architecture that anybody can do."

A Mies for All uses digital technology in such a way that the traditional role of the architect becomes renewed in the areas of software, technology, manufacturing, and distribution.

Custom-made, parametric software makes it possible to optimize both energy and materials. The composition as well as the height and width ratio of a building can be adapted to both the situation and the location. The entire original design has been put in BIM, so that 2083 parts can be considered individually based on, for example, costs of production and transport, or their ecological footprint. It allows individuals to look for alternatives by part, or by location. "Apps" and an Internet forum involve people interested in the project to see what has changed, to see what can be improved, and to solicit contributions from other experts.

The Farnsworth House was originally built with an exceptionally high degree of workmanship in a very laborious manner. For instance, the steel parts with bolts and nuts were first attached to each other; then they were welded; and, finally, the bolts were buffed and sanded. Today, such elaborate production is unthinkable.

Because the goal of A Mies of All is to build a simpler Farnsworth, a production method has been developed for a CNC-controlled, wooden version of the House. With the help of the computer, the whole building is broken down into plywood patterns with a minimal number of different parts and the most efficient use of plates. The plate thickness is adaptable in the program, so it works both in the US and in Europe. After delivering the patterns to your local computer-controlled router, the construction package can be picked up after a short time. In this new version of Farnsworth, the energy efficiency in particular (both in terms of production and of its use) has been greatly improved compared to the original one.

Method of distribution
In addition to writing software and developing new (mass) production methods, a new domain exists in which the architect evolves from a designer of unique pieces to a creator of scalable products: the method of distribution.

Digital technology makes it possible for the production to take place as closely as possible to the site. As the 3D printer stands close to the construction site, the engineered files for the Farnsworth House for standard sheets can be sent to a local CNC router anywhere in the world. And, once manufactured, anyone (either alone, with a group of friends, or with the help of local labor) can put the pieces together.

Shipping data instead of construction means that questions about intellectual property, copyrights, and licensing arise. The rights to the Farnsworth House are quite limited and, therefore, used by A Mies for All. Apple has a patent on the Apple Store, where the design is merely described in text. Do we protect design or technology? How do we ensure that the wealth of open design, with a strong involvement of other experts and citizens, is not lost?

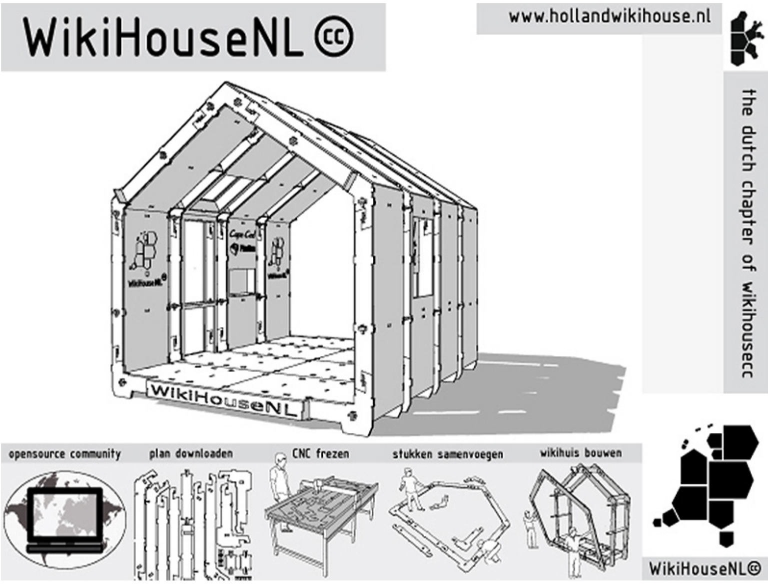
A Mies for All is a technology company founded by an artist (Pierre Bismuth), an architect in the Netherlands (One Architecture), an architect and furniture designer in the U.S. (Filson Rohrbacher/ AtFab), and a research institution (CAER). This combination may say as much as about the position of the architect as it does about the status of the building: from a model of the unique to a model in which they are part of the multiple, plural, and possibly made by digital technology.

Ecology of collaborating companies
Using existing designs, it is not necessary that the company designs itself. Liberated from the neurosis of design, A Mies for All can focus fully on the further development of the technology. The innovations in this field and the changing role of the architect are immediately noticeable. A Mies for All is also a polemical research project.

The partners in A Mies for All are part of a global ecology of frequently collaborating companies that explore how digital technology will change architecture. Each of the companies focuses on a specific product with which the puzzle of changing the building chain can be slowly resolved.

Facit Homes, for example, uses a computer to make fairly traditional, customized designs that are cut with a CNC router from a 3D model on the construction site and then immediately assembled on the spot.

Wiki House provides no design, but develops an open source product: a construction package that allows people to design, download, and then produce home themselves later. Wiki House has organized itself into a community wherein designers from around the world work together in groups engaged in software, hardware, and "general affairs" like process, contracts, and licensing.



The possibility of digital technologies offering new connections between designers, creators, and consumers is the reason that the people behind Wiki House have also established a distribution platform for digitally distributed furniture: Open Desk.cc. "Furniture offers the opportunity to practice on a small scale," say Filson Rohrbacher, who sell their product, AtFab, through the platform. AtFab has a furniture series available for purchase through the website that has been designed so that the pieces can be made to fit the needs of the user and the material used. The information generated by AtFab files can then be used for local production. The result is a family of unique pieces of furniture that can be found worldwide. An AtFab chair in Sao Paolo, for instance, will be made of a slightly different material and have slightly different dimensions from its relative in Jakarta. AtFab has also designed the interior of the Makerbot (a 3D printing company) headquarters.

So, where is this going? Slowly, different architects are expanding their research to larger scales, wider applications, and greater roles in the construction chain. Supported by a number of major American industrial partners, Filson-Rohrbacher will develop a physical space, a type of store, together with One Architecture. Here, the idea of a Fablab, a type of open workspace in which tools such as CNC-cutting banks and 3D printers are available for people to make things on their own, evolves to a larger scale: furniture, small buildings, a Farnsworth, and possibly even small real estate developments. Private fabrication can evolve into private development, in which the architect is sometimes a designer, sometimes a software-engineer, sometimes a creator, sometimes a facilitator, and often a partner.

Architecture in the open

Pieter van Boheemen

The tremendous increase in connectivity is the main driver behind many changes in society. In the field of design, for example, we are witnessing a transformation into a more open and digital design and fabrication process. During this process designers, users, and many secondary stakeholders (such as suppliers and manufacturers) have a direct influence on the process itself and are able to collaborate in an unprecedentedly open way.

In the past, such collaboration had to be coordinated by a central organization, such as the lead architect of a construction project. Under the influence of open standards and open design processes, this is no longer necessary. Therefore, we have seen a transgression from centralized models of production and design to more decentralized ways of working. From there, we can move towards a truly distributed design process. In a distributed network, all nodes are equal. Just like the cells in the human body, each node has the ability to sustain and thrive on it's own. However, the advantages of collaboration with peer nodes is much more beneficial and efficient. In software and design, this has become an established practice. Yet, only recently has digital fabrication brought this methodology to the field the manufacturing.

Furthermore, one of the characteristics of a truly open and distributed design process is that information flows freely between all nodes. Free, but not without restrictions. There are certain conditions that need to be met in order to become a node in the network. For example, the conditions that are stipulated in open design licenses, like the acknowledgement of each contributor and "viral clauses" that demand that derivative work are published under the same conditions. Even though these conditions seem fair and elegant, the effects are profound and need to explored in a pragmatic and iterative manner.

The road of transition from a closed process, based on proprietary knowledge and secrecy, towards the open design process is, in particular, not without obstacles. It requires new business models, collaboration incentives, and, above all, a new way of thinking. The possibilities, however, to transform the design field are endless and only starting to be explored.

Fablab Amsterdam with open design architecture project

3D Print Canal House: disrupting the building industry

DUS Architects

The building industry is one of the largest global industries. However, good quality housing is not available or accessible to many people. And, when it is available, it is often standardized and monotonous, based on mass produced elements from factories. The building sector is not a demand-driven market. It is also highly polluting, responsible for 40-50% of the global CO2 output, and consuming 40% of the materials entering the global economy. Factory production requires complex logistics from factory to building site as well as a stock of building materials. Standardization gives rise to high levels of waste, as the size available rarely corresponds with the size one actually needs. And, when everything is pre-made in factories and then transported to a building site, extra work must always be done on site, causing higher costs, more waste, and greater time loss.

DUS believes digitalization provides the solution to these problems. 3D printing allows for local production on site, requiring only the transport of raw material. Only the material that is needed is used (additive manufacturing). Digital design and fabrication allows you to easily customize designs to your own wishes. You can share files digitally and print them locally, democratizing production and bringing housing solutions to the masses. In other sectors, such as music (Spotify), transportation (Uber), and tourism (Air BnB), digitalization has had a very disruptive effect on the industry. A similar effect will occur in the building sector.

What if we can scale up the advantages of 3D printing for the building industry? DUS explores this idea with the 3D Print Canal House, a revolutionary project in which an international, cross-sectoral team of partners works together on 3D printing a full scale canal house in the heart of Amsterdam. The building site is designed as a growing expo and laboratory, and is open to the public. The feedback from audiences generates input for research and market explorations. In other words, it's a live user test. The research is structured into four, main R&DO's (Research & Doing): 1. global design customize tools, 2. XL 3D printer development, 3. bio material development, and 4. smart integrated building systems. From design to production, all parts of the building chain are developed simultaneously by DUS and various partners.

The aim is to develop the whole digital building chain, provide a cross-sectoral platform, and demonstrate the benefits and advantages of 3D printing in architecture. Unique design for the masses!

4. The project - an overview

Expert meeting in San Francisco

12-14 May 2015
Matthijs Bouw – One Architecture

A group of planners, architects, technologists, and public advocates—representatives of a nascent ecology of digital designers and fabricators from Amsterdam—gathered in San Francisco at Maker Media's Make Lab to discuss how their respective work and practices operate within the AEC Industry. All agreed that there is both an enormous obligation and a revolutionary opportunity for holistically re-thinking the industry; and that a Design/Fabrication Living Lab should be set up in Amsterdam to serve as an industry disruptor. The D/F Lab, as a space of collaborative and applied research, education, and production, would organize a wide range of stakeholders to change the making of buildings and cities.

The San Francisco event took place parallel to the MakerCon conference at the Palace of Fine Arts in San Francisco. Hosted by MAKE, the organizer of MakerCon, MakerFaire, and MAKE Magazine, D/F Lab was offered the Makerspace for the Lab. The Lab consisted of three elements:

1) a series of workshop sessions in which ideas and issues surrounding Digital Fabrication and a D/F Lab in Amsterdam,
2) a series of presentations by the participants and a general presentation to MakerCon
3) conversations with software companies (AutoDesk, Trimble – John Baucus, Shopbot – Ted Hall) and tours of digital fabrication facilities.

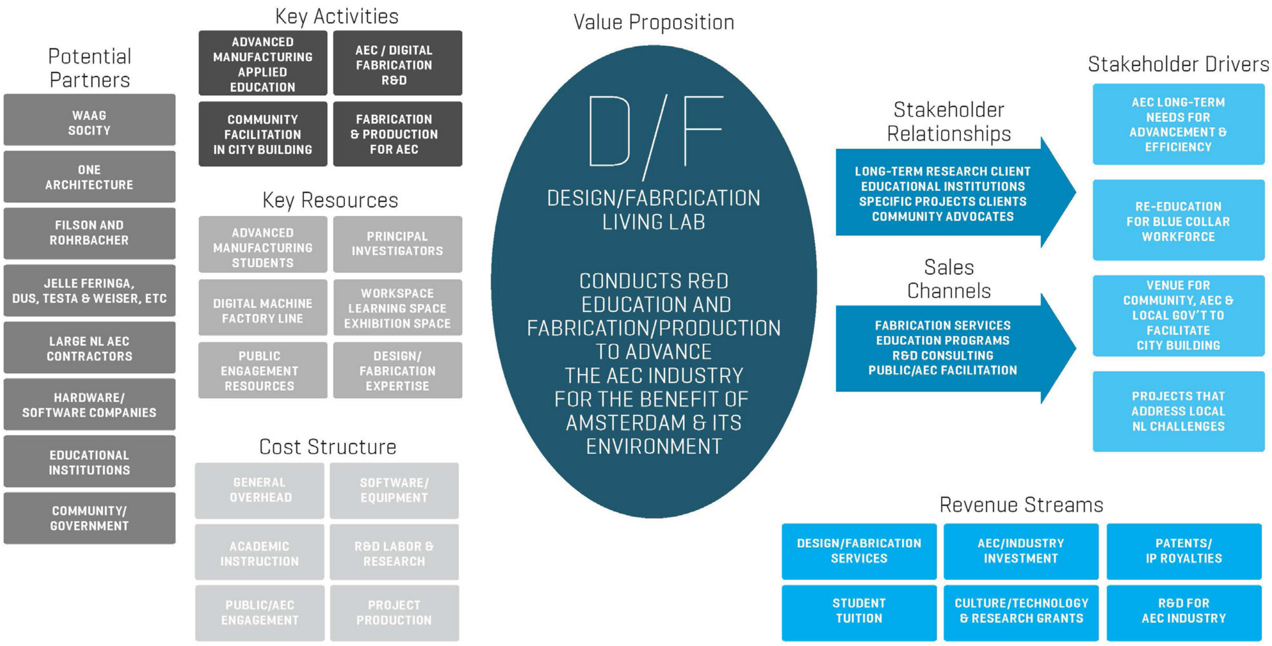
The event was set up so that three approaches to digital fabrication—3D printing (additive manufacturing), CNC milling (subtractive manufacturing), and robotics—were all represented. This allowed the conversation to focus on the broader issues related to the proposition of expanding the role of D/F in the AEC (architecture, engineering and construction) industry. One of the recurring themes was the changing role of the designer in the process: rather than leading a specific task within the development of the entire project, the designer in D/F should engage the entire workflow, using the software tools that allow her to do so.

The outcomes of the conversations can be summarized as follows:

1) Participants embraced the idea of a Living Lab for AEC in Amsterdam as a way to nurture the already nascent D/F ecology. The Living Lab, a loosely configured number of D/F in AEC programs and projects should facilitate knowledge exchange, help with funding, tell a bigger story, and connect practice with education and academia. The Living Lab should be an open and nurturing environment for makers and designers.
2) The Living Lab should be design-driven. Design has a great ability to integrate and to tell stories.
3) The Living Lab for D/F in AEC brings a number of values into its story:
    a. It aims to benefit the greater good
    b. It is opposed to undue proprietary
    c. It acknowledges the potential benefits of D/F for the efficient use of resources and the environment, and wants to drive those.
    d. It sees technology as a conduit to culture
    e. It has a focus on workflow
    f. It sees D/F as a way to rethink the role of labor with guilds and a democratic economy as models
    g. D/F Lab is committed to materializing ideas
    h. D/F Lab considers "making" as a cultural project, and sees parallels to the use of technology in architecture from a cultural perspective in such architects as Mies and Prouve
4) D/F Lab should have the following (organizational) components:
    a. A "democratic" voting structure
    b. A sharing platform (format for collection and distribution of projects)
        i. Material database
        ii. Techniques and processes
    c. IP
    d. Frequent progress and evaluation meetings on VC
    e. Distributed manufacturing
    f. Funding
5) As a next step, the following elements should be developed:
    a. a business plan for D/F Lab and subsets
    b. a strategy for cultivating new relations
    c. a strategy for leveraging current institutions, i.e. F&R, Kentucky, Penn
    d. a framework for IP development or funding (including legal support)
    e. a brand strategy to create a bankable entity

What we learned in San Francisco is that, more than anything else, workflow is the issue. Too many of us are consumers of software that, in the end, are exclusive, proprietary, or resistant to interoperability. Communications and information exchange is frustrated over the course of a project—and between and across collaborators and stakeholders—unless we can develop new accessible and open workflow for making cities.

Business Model



Expert meeting Amsterdam

27 October 2015

Anthony Rosengren – Waag Society

The expert meeting can be summarized in the following four / five topics that consist of a mix of ideas, wishes, and currently running projects.

Topic 1: Role of the Architect as an Advocate

The architecture profession has a clear social responsibility to apply its expertise to making a positive impact on the urban environment. However, it is becoming increasingly difficult for architects to have a real impact. This difficulty arises from adversarial relationships between the architect and the contractor, as well as the creation of models such as the self development model, which can compromise an architect's fidelity to the public. This can result in cities developing with little regard for creating public spaces that enhance quality of life.

The role of the architecture profession should encompass advocacy as a way to ensure positive design outcomes. Architects do not need to be limited to designers of form. They can also be considered as process designers and advocates for good design and good design principles. There is a significant contribution that architects can make through their involvement in other industries such as politics, law making, and business.

In a recent interview, Norman Foster, one of the most influential architects of our time, reflected on the impact that the profession has on our urban environment. He was quoted as saying "I have no power as an architect, none whatsoever." Rather, he believes that "Advocacy is the only power an architect ever has." This makes sense when you consider what an architect is trained to do: to understand the complex and varied dynamics of a site, to solve problems, and bring form to a solution. Currently, architects see their role as the designers in the design-build process.

If architects are to limit themselves to this role, they may only be increasing the friction between the stakeholders in the design build process. There is potential for architects to be a part of hybrid teams of engineers, programmers, scientists, and other professionals, unrestricted by traditional notions of design, but providing guidance to the design process.

By reconsidering the role of the architect in society, we open up the possibility for practitioners to apply their experience in a way that can have a greater impact on improving our quality of life.

Topic 2: The designer as the builder

The traditional structure of owner, architect, and contractor are no longer the simple entities they once were. For example, the architect is often split up into different consultancies, and the same applies to the contractor. The three groups are often adversarial and segmented; and relationships are often difficult to maintain, presenting significant challenges in communication, software, and workflow. Furthermore, the adoption of technology by the architect and contractor has occurred at varying rates, resulting in vast improvements in design software, while leaving the job site virtually untouched by developments in technology. As a result, the productivity of AEC has experienced significant lag when compared to the productivity improvements of other industries. One potential solution is to force a new organisation of the owner, architect, and contractor. If these three entities are able to be integrated with a common workflow, each process could inform the other, ensuring seamless adoption of technology and reducing friction between the architect and contractor.

DUS architects have begun to soften the boundaries between the designer and builder, by taking ownership of the production of the 3D Print Canal House. By prototyping the technology, DUS are able to approach the project in an iterative way and learn from experience. This creates an outcome in which technology is cohesively applied across the design and build processes. The approach heralds a move towards a new vernacular, where design and construction can easily reflect local context.

In this new organisation of AEC, the boundaries between the entities are blurred, breaking down the silos that currently make up the industry. A shared ownership of the tools and workflow would allow each entity to assist the other to ensure a common vision for the final built form.

Topic 3: Public engagement and open design

Throughout history, the automation of tasks traditionally performed by humans has transformed what were once considered as luxuries, into common comforts. And in many cases, technology and resources that were reserved for the privileged, have become ubiquitous. Examples have included Western medicine, motorised transport, electricity, and smartphones. Good design is a still considered a luxury, primarily because it is reliant on the skill of the designer, who must use his or her training in combination with vast amounts of time and energy to realise the final product.

Despite advances in technology, the process of delivering good design is still too inefficient for it to be made available to the majority. However, increasingly, many stakeholders in the AEC process are able to influence the design outcome, often resulting in a patchwork of unintended consequences. There is, therefore, an urgent necessity to manage the design and build process so that the various stakeholders are integrated in a way that achieves exceptional results. The primary stakeholder in our cities, the public, must be engaged in the workflow if quality of life is to be assured.

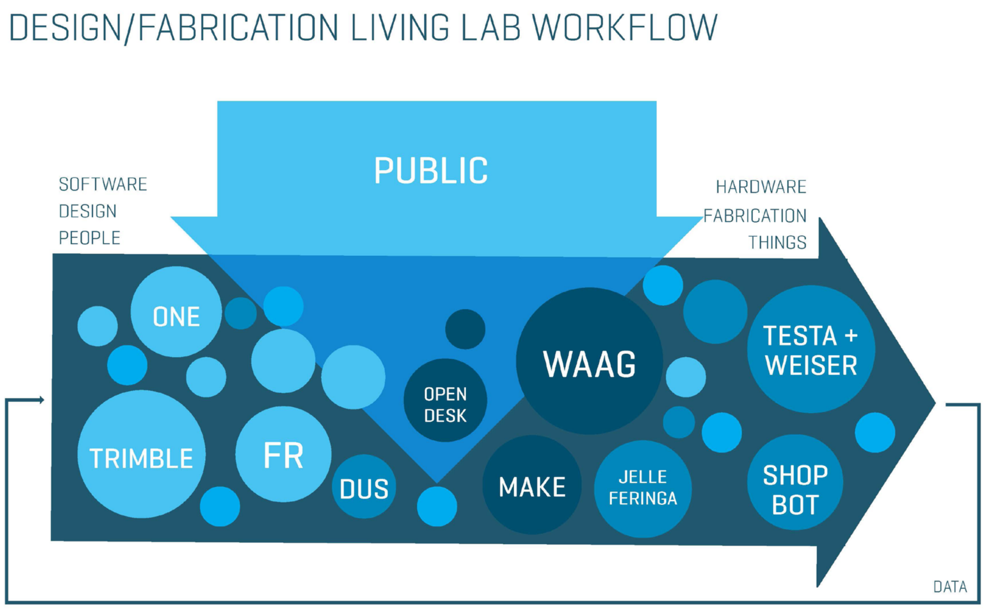
Public engagement could be achieved by providing greater democracy of design software, and reducing the distance between the design software and the prototype. Digital fabrication labs could have a role in this process, meaning that in the end, the public will have more agency, and stronger communities will develop. Architects can provide thought leadership to the process, but design control can be decentralised with the assistance of tools such as open data, new business models, and open software.

In other fields, such as healthcare, big data is being used to provide better outcomes to more people, while reducing the need for highly qualified professionals. It is essential that knowledge and data are shared in a way that can easily be used by others. For example, there is no reason why the findings of an academic paper cannot be disseminated to the community on multiple levels, from practitioners to schoolchildren. The image represents a potential model for how the public can be engaged in the process of combining digital fabrication with architecture through a shared research agenda.

Topic 4: Creating an Ecology of small projects and ideas

One way to advance the role of digital fabrication in architecture is to create a local ecology of designers, makers, advocates, and researchers focused around a series of small projects. Such projects already exist, and serve to create an awareness of what is possible with AEC. A stronger ecology may serve to galvanise the community into action. Two of these Amsterdam projects include the MX3D Bridge, which aims to use robotic arms to 3D print a bridge over a canal, and the DUS 3D Print Canal House, which uses 3D printing to explore design customisation and efficient on-site construction techniques. If the focus remains solely on design and analysis, the digital fabrication movement will not take off on a large scale. Iconic projects such as these can help to accelerate the movement.

While there are no groundbreaking business models around digital fabrication and architecture yet, small demonstration projects enable the movement to test ideas and create new business models through sharing the lessons learnt in the prototyping process. The projects do not have to be perfect, they just need to work on a basic level. An ecology around digital fabrication and architecture needs to focus on small steps, iterating in responses to unforeseen challenges and public response. Furthermore, if demonstration projects are to have the desired impact, they need to occupy spaces that are accessible to the public. One of the great aspects of the 3D Print Canal House is that, due to the projects audaciousness and its accessibility, it has become both a tourist attraction and a talking point among locals about what this might mean for AEC.

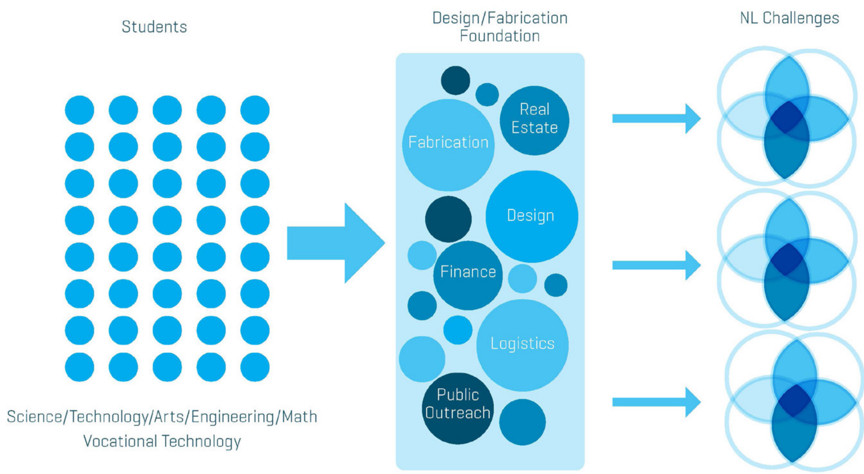


Another benefit of creating a local ecology of participants centered around small projects, is that each project serves to allay any fears that the public may have about implementing digital fabrication techniques on a larger scale. New construction methodologies typically take a long time to gain momentum, and the sooner this process starts, the sooner digital fabrication can be applied on a larger scale. Barriers to the implementation of these technologies include: safety standards, building regulations, and use of new materials. One of the most well known images of the MX3D Bridge is that of an employee bouncing on top of the prototype, proving its structural integrity. Images such as these take the concept from a fanciful dream to a construction technique that can be taken seriously.

Topic 5: Education & research

Gary Rohrbacher stresses that D/F Lab sees itself as a school and a research laboratory. In the same way that D/F seeks to reconsider AEC industrial organizations and relationships, it also seeks to interrogate old forms of design as well as technological, academic, and vocational modes of education. D/F Lab would, ideally, be comprised of agile squads of students from a broad diversity of backgrounds, ages, and interests—because it takes nearly every kind of thinking and intelligence known to conceive, make, and sustain our cities. These groups of students would have applied experience discovering new modes of inter- and trans-disciplinary collaboration—as they focus on any of a number of challenges facing our cities, environments, and economies (such as energy, climate, and more).

EDUCATION



Public event Amsterdam

27 October 2015

Laurie Skelton – Waag Society

In the Design/Fabrication Lab, an international collective of architects, industry, social design agencies, and governments work towards grappling with the dynamic nature of modern architecture. On October 27, 2015, Waag Society hosted an evening of D/F Lab presentations in the historic Theatrum Anatomicum. During this event, five architectural experts (Matthijs Bouw, Gary Rohrbacher, Anne Filson, Jelle Feringa, and Tosja Backer) and moderator Frank Kresin discussed their current work in the context of the changing architecture profession.

Matthijs Bouw works for both One Architecture and as a fellow for the University of Pennsylvania. From his time working in academia, he has noticed that students learn a lot of innovative, digital techniques, but do not work on innovative projects after graduation. He notes that recent architecture graduates are becoming detached from much of the production, and that the architect as we know it is becoming obsolete. In order to combat this, Bouw advocates for moving towards more local, user-centred, bottom-up methods. He also notes that cities based on local energies become more diverse, resilient, and sustainable.

The second speaker, Gary Rohrbacher (of Filson and Rohrbacher), discussed the history of architecture as a profession. Rohrbacher discussed the traditionally static and hierarchical relationships within the architectural world—and how that paradigm is changing. He notes that over the past fifty years, architects, contractors, and owners have become increasingly differentiated and segmented; and the relationships between these professions have become increasingly adversarial. There is also an uneven distribution of digital technologies within the discipline, which means that smaller companies are not always able to afford the same things that larger companies enjoy.

Anne Filson (also of Filson and Rohrbacher) then spoke about their company's project, A Mies for All, which aims to produce an affordable, wooden reproduction of Mies van der Rohe's classic Farnsworth House. Their modern version of the Farnsworth House consists of only 15,000 pieces (75 unique parts) that can be cut by anyone with access to a CNC router and standard lumber. These parts are also relatively intuitive to slot together, which means that the owner could (theoretically) build it themselves. Ideally, the house could be made using locally sourced material in a nearby maker space.

Jelle Feringa (Odico, EZCT) discussed ways to reverse the failure that architecture has experienced over the past 7 years (the population of architects has diminished by 60%). Feringa proposes new models in which the craft moves towards focusing on the intellectual activity of design. This way, architecture becomes less of a service and more of a product. Feringa, in particular, works primarily as a designer executing his designs using robotics. He believes that architecture is constrained by sentimentality and nostalgia, and that—while everything is possible in our age—nothing is happening. "Why go backwards when you can buy a bunch of robots and go forward?" he quipped.

The evening was rounded off by a presentation from Tosja Backer (of DUS Architects). Backer presented her company's exciting 3D printed canal house initiative, a project that aims to build a Dutch canal house from 3D printed materials. Backer noted that the building sector is broken. The system is large, generates a lot of waste, and many things intended to make the process easier do not work in practice. For instance, many pre-fabricated materials do not always fit together onsite. The ideal, then, would mean building everything onsite using technologies like 3D printing—a method that has many advantages. For example, 3D printing allows one to share files globally, which makes mass customisation much easier. And, because production is all local, the process will require less transport, no stock, and little waste material.

Over the course of the evening, the audience learned that the building processes that shape our cities and neighbourhoods are changing. They are becoming more open, involving a wider variety of people, and allowing for more creativity with access to new, digital tools. The speakers we heard from gave us tangible examples of what the future of architecture might look like.

5. Innovation in AEC

To briefly conclude: within the AEC industry, digital fabrication is researched in a number of important, yet relatively atomized initiatives, mostly using additive technology such as 3D printing. In order to make the next step in the AEC industry, creating an international community of practitioners around AEC Living Labs is essential. We kick started this living lab within the D/F Lab project. The complementary qualities of Dutch and US project partners and participants that took part in the expert meetings will form the basis for a lasting and collaborative exchange of know-how, experiences, and tools.

While the project started with the idea of setting up a physical digital fabrication living lab for the AEC in Amsterdam, the partners and participants came to the conclusion that it is more fruitful to continue strengthening and developing the network. From there, we can amplify and extend the many living labs that are already in place, although they are fragmented into small, isolated projects. By continuing to connect those fragments, we work towards a holistic approach of innovating the AEC industry.

The project partners and those participating in the expert meeting will take this next step, and explore together the potential of architecture and digital fabrication to change cities for the better. We want to thank all the participants and sponsors, and look forward to innovating within the AEC industry—benefitting the industry, architecture itself, and the cities we care for.

6. Impression D/F Lab in San Francisco

The MakerCon conference (12-14 May 2015), lunch near the Palace of Fine Arts and a group visit to Autodesk.