TR500009

New workflows in the transportation design process: a new way to design

Juan Antonio Islas Muñoz
Université de Montréal

Learning Objectives

- Discover opportunities for VR workflows in the creative design process
- Discover the value of working in VR in high fidelity with physical mockups in low fidelity
- Learn about envisioning a layout with VR applications for creative design spaces
- Discover the different types of new creatives that will work in future design spaces

Description

The traditional approach to vehicle design in industry departs from a defined technical package and research about vehicle users, brand character, and aesthetics. This process has responded to stable vehicle configurations for decades, enabling creative design to focus significantly on visual and tactile aesthetics. But future megatrends are disrupting this outlook. This new state of the art widens the influence of design, requires new types of creatives, and demands new, more effective creative design workflows. The Transportation Design program at the University of Cincinnati has tackled these challenges by creating the Future Mobility Center, a vision of future-vehicle creative design spaces, with virtual reality applications from early creative development to final design validation, in tandem with rapid physical validation. This Autodesk University class will describe how the space was developed, and will provide examples of projects that have come out of it.

Speaker(s)

Juan Antonio Islas Munoz is an Assistant Professor of Industrial Design at the University of Montreal. Previous to this appointment, he led the Transportation Design program and co-founded of the Future Mobility Center at the Ullman School of Design (University of Cincinnati). He played a major role in developing new design workflows for the automotive industry, in collaboration with leading automotive companies in the USA. He has also pioneered the use of new technologies in the field of transportation design that are now increasingly becoming the new standard in the field. Over the years, Juan Antonio worked has led numerous design-led strategic foresight projects for companies such as P&G, Pfizer, Boeing, Ford, Fiat Chrysler Automobiles, General Motors, and Hankook Tire and Technology.

Opportunities for VR workflows in the creative transportation design process

The status quo

Today, the discipline and practice of Transportation Design responds to a decades-old paradigm of the privately-owned car, composed by an internal combustion engine, a cabin, and a cargo areas. These vehicles are usually the second most expensive thing to own after a house, and thus, must be emotionally connected to their buyers, perhaps as a symbol of status and a reflection of their personality. That is how the paradigm of developing driveway trophies was created, with beautiful moving sculptures of vehicle exteriors being a very powerful purchase decision factor. Today's design process and its workflows, set in the 1950s by Harley Earl's work in General Motors, followed this paradigm. Designers were given a brief with a technical packaging to "dress" with compelling design. They translated the likes and wants of their target market into aesthetic directions in terms of proportions, surfaces, materials, colors, and more. These aesthetic directions were further explored through 2D sketches and then ended as impactful photorealistic renderings that, if selected, were translated into 3D form by sculpting and refining small scale clay models, and then full sized ones which were also constantly massaged until reaching perfection before becoming approved for prototyping. In 2021, not much has changed inside the automotive companies' creative design studios, bar the addition of digital drawing and rendering, CAD, 3D scanning, CNC milling and other rapid prototyping technologies, finalizing with virtual reality for final reviews.

The personnel of today's creative automotive design studios are composed in a very similar fashion across companies: creative designers (interior and exterior), digital sculptors, clay sculptors, color and trim designers, component designers, studio engineers, and more recently, UX-UI and HMI designers and developers. They all have one mission: designing a desirable car.

The coming future

Megatrends are changing the game. The XXth century paradigm of the personally-owned car with an ICE+CABIN+CARGO formula is evolving. Clean energies and electrification are changing powertrains and thus, vehicle architectures. Connectivity and the slow-to-come but still advancing autonomy is also transforming the vehicle from a simple A to B transport into a livable space while commuting from A to B. The shared economy will eliminate the driveway trophy factor, and the deciding factor will be the best ride experience inside the car. Megacities and the rise of the urban world will demand inter-modal mobility. This means new vehicles, with new architectures need to be created. Design teams will need to expand their current area beyond dressing a technical packge, and into the realm of innovation. Creative design spaces will need to evolve to be more flexible, with new workflows that depart from the ones established in the 1950s.

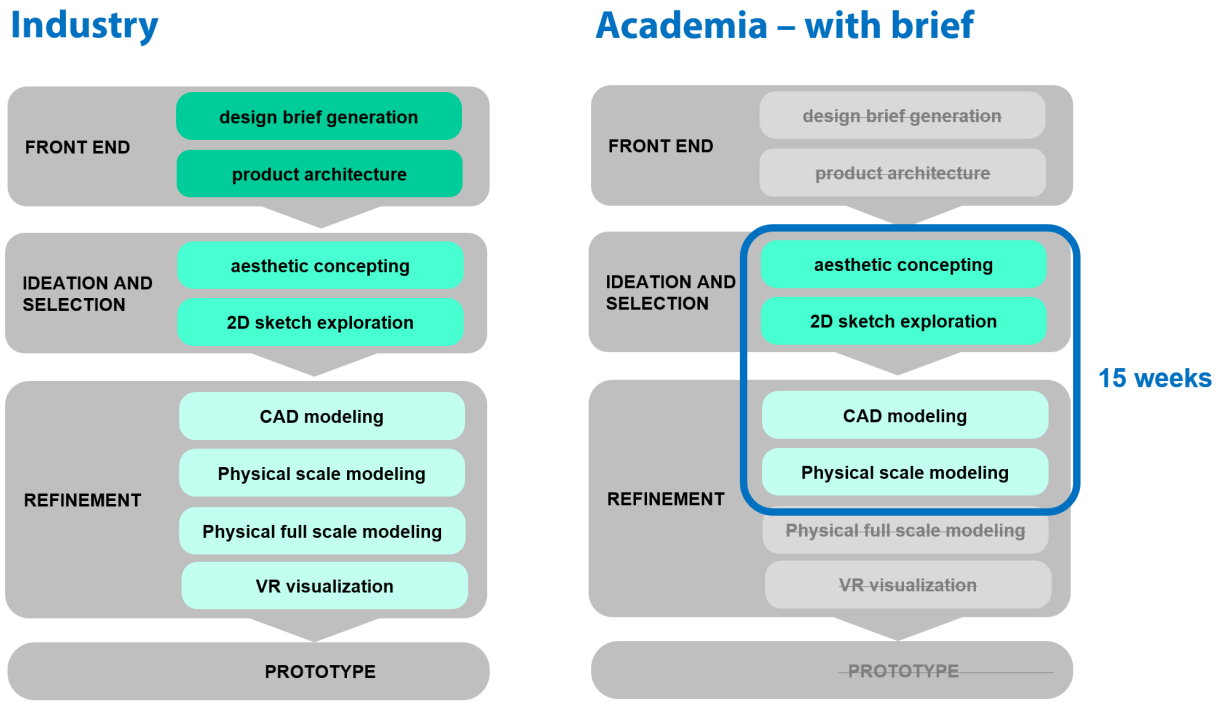
Virtual reality in the transportation design process

Until recently, virtual reality was limited to the very end of the design process, to visualize final proposals and make final decisions before prototyping. This was viewed in high tech VR rooms within the design studios, with a team of expert technologists to run them. However, after 2016

with the arrival of the HTC Vive and the Oculus Rift, the technology was democratized. Today, a few hundred dollars are enough to purchase a capable device.

The program I led at the University of Cincinnati was the first one to formally embrace the technology. The VR headset in the corner of a room quickly became the driver for the creation of the Future Mobility Center, as we developed workflows and applications that made the design process more efficient and effective.

The design process in industry takes many months to a year or two, plus a large team to arrive at a prototyping approval stage. Projects in academia are subject to an academic term, which at the University of Cincinnati was composed by 15 weeks of work and are carried out individually or with a small team of students. Before our implementation of the VR workflows, projects that started with a defined design brief (i.e. design the next generation of "X"car), a physical 1:5 scale model was a common final deliverable. A third of the semester was used in building, refining, and finishing that scale model.

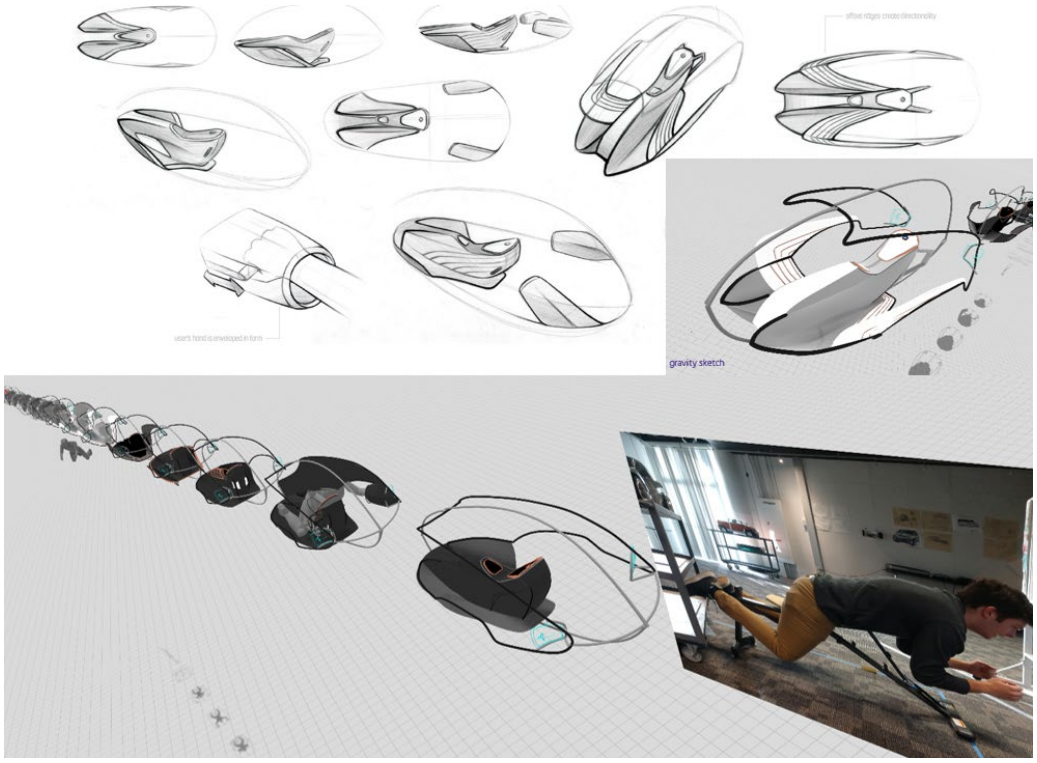


Transportation design process in industry and academia

Virtual reality accelerated the process while enhancing the quality of the results in several steps of the process, or creating new approaches to design or present design altogether:

- **VR for the early creative design process:** using Gravity Sketch, an immersive sketching app, the design students could create their concepts directly in 3D. This made the tri-dimensional understanding of the proposals more accurate from the get-go, as creating a virtuous cycle that accelerated and deepened the ideation process. The 3D

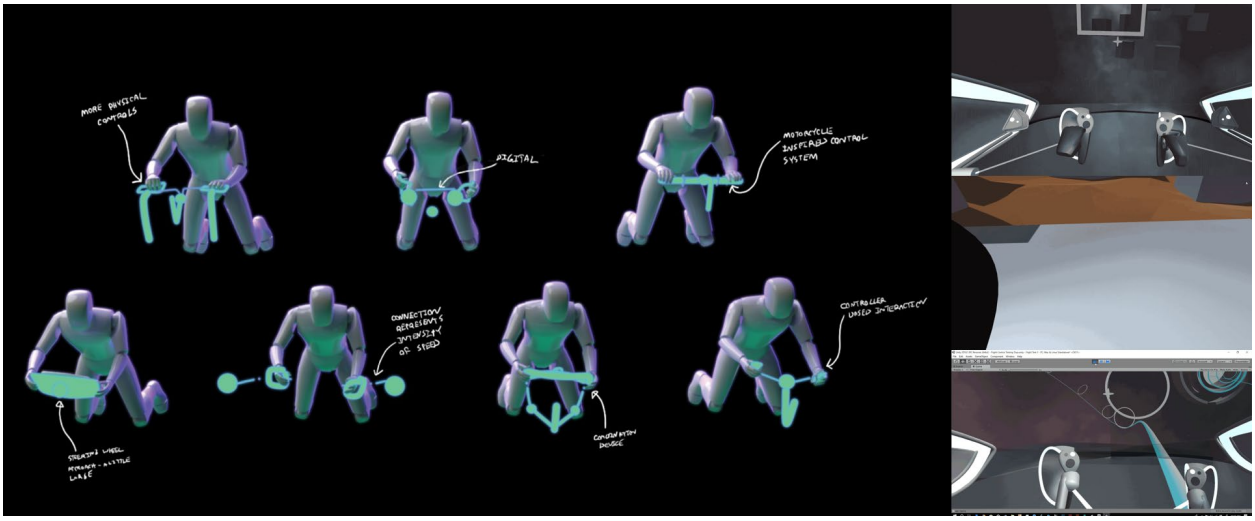
sketches became underlays for new ideas in 2D sketching, which then could be integrated directly in 3D again.



Hunter Elmore's work using Gravity Sketch and traditional 2D sketching in tandem. The images at the top show the 2D work while the bottom shows diverse iterations in the immersive sketching app.

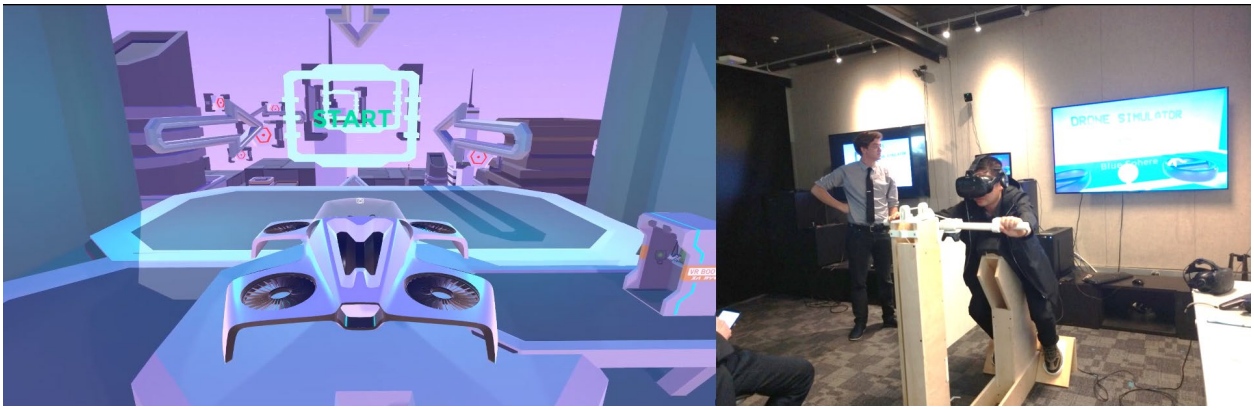
- **VR and CAD development:** the geometry created in the immersive sketching app can be exported as IGES or an OBJ to any CAD application that supports those formats. Rather than having to translate a 2D sketch to 3D from scratch, the imported geometry can become an underlay that is to a real scale, with minor dimensional refinement tweaks required. This shortened the time required for CAD development in the academic term.

- **VR for the creation of HMI and UX design:** an activity little explored in industry design studios is to have designers that focus on the operation of the vehicles beyond screen, buttons, or dial solutions. Using game engines such as Unity or Unreal, it is possible to explore, test, and simulate new ways to control a vehicle.



Matt Whitby designed different ways to fly a passenger drone using Unity to test the most intuitive way to control it by creating an immersive experience.

- **VR for simulation and final design experiences:** in addition to exploring and creating new interactions, it is possible to create a use experience with a high-fidelity CAD model. This allows for the presentation of final design assets to go beyond posters and scale models, allowing viewers to, for example, take the vehicle for a ride. To enhance the experience, it is possible to create physical mock ups. It does not matter that they are in low-fidelity, since the viewer is immersed in VR and perceiving a highly detailed virtual model.



Matt Whitby created a simulation using Unity in which a guest in the final critique could wear the VR headset and fly the drone.

The value of working in VR in high fidelity with physical mockups in low-fidelity

While the virtual reality workflows that I have described make the process much more streamlined, physical models will still be a crucial part of the vehicle design process. So, where to draw the line between working in virtual and physical reality? Here is what we learned through our experiences at the Future Mobility Center:

- **During the early creative process:** traditional sketch work was limited to 2D representations without dimensionality. Immersive sketching in VR in applications such as Gravity Sketch overcome this obstacle. Thus, it presents the opportunity to mock-up the designs being explored virtually in the physical world, with just the necessary fidelity to validate that the exploration in VR matches physical reality. For example, bucks for developing the right posture of the drivers or passengers, validating the correct visibility from the driver's seat, or locating knobs, buttons, or screens to operate the vehicle fitting the required percentiles.

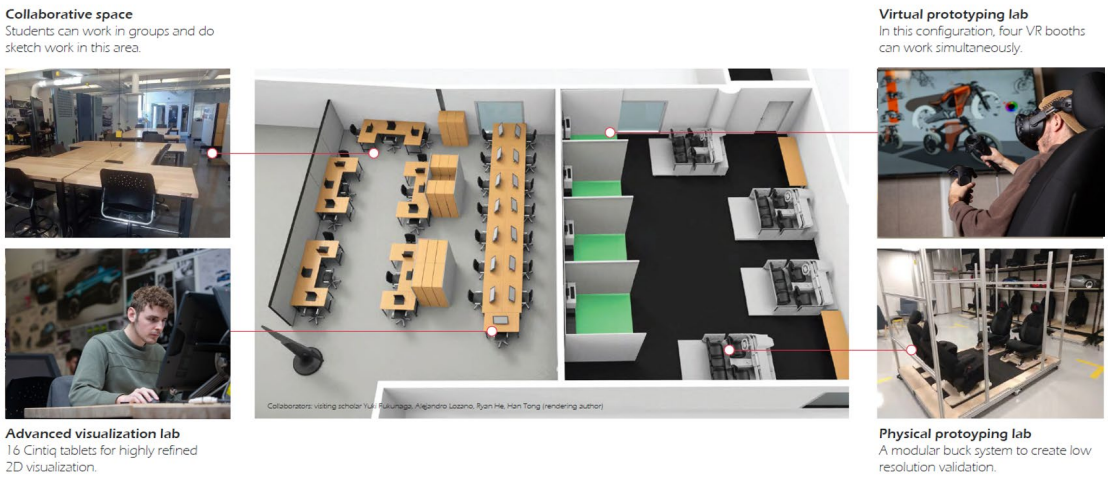
Hunter Elmore parallelly working with 2D sketching,
immersive sketching, and low-fidelity physical prototyping.

- **During CAD development:** by the time the final theme has been selected and CAD development has begun beyond immersive sketching, the virtual models have become high-fidelity representations of what is intended to become physical in the real product. At this point, VR reviews can happen either with VRed or Alias in high fidelity, even with visualization of final materials. Low-fidelity models can still be used to validate the CAD model in the physical world to validate the usability and visuals of the projects, catch problems, and make modifications in a cost-effective and time-efficient way. This can reduce the amount of high-fidelity physical models that are more expensive and resource-consuming. Those resources can then be reallocated to other areas of the program.

- **At final design presentations:** at this point, in addition to today's presentation assets such as posters, physical models, videos, and more, it is possible to develop an immersive experience to, say, take the vehicle for a spin. This will involve the use of video game engines to create a scene, import CAD with the final design, and program it so the user can interact with it. At this case, the physical model that needs to be created will need to have the required sensors so that its operation matches that of the virtual reality. In addition, the materials and finishes used in this buck could be created to match those of the virtual model. In the image below, the buck created by Matt Whitby to fly Hunter Elmore's drone virtually is shown. The buck, made of plywood with upholstered cushions works with a 3D-printed handle bar with the HTC Vive puck and another button. The handle bar is tied to a pulley system that carries a weight to add a little resistance to the motion and make it feel more realistic.

Matt Whitby's buck with sensors to fly a virtual passenger drone.

Envisioning a layout with VR applications for creative design spaces



The Future Mobility Center at the University of Cincinnati

The Future Mobility Center at the University of Cincinnati was created to support the workflows and realities that will change the traditional vehicle design process. It is composed by four areas:

- **A space for multidisciplinary collaboration:** rather than working in private cubicules, designers, engineers, sculptors, marketing staff, and other profiles described in the next section should have a common space to develop solutions and produce holistic thinking.

- **An advanced visualization space:** the traditional 2D visualization workflows with digital tablets are maintained, but with the added need to or enable the virtuous circle of immersive sketching with the headset and traditional sketching to work in tandem. It is recommended that both spaces are adjacent.

- **A virtual prototyping space divided into booths:** should be sized for work on the largest item to design and could be reconfigurable by the addition of roll-down walls. Tactile surfacing should be used on the floor to ensure VR users where they are in the space. It should also have a large screen to see what the person with the headset is working on, as well as a powerful VR ready workstation to handle big complex models.

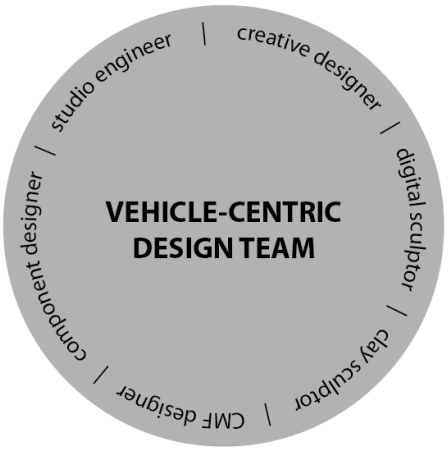
- **A physical prototyping space:** it should be a space to assemble low-fidelity and rapidly-prototyped mock-ups, equipped with modular rolling platforms so the models can be moved in and out of the virtual reality booths as needed.

A virtual reality booth at the Future Mobility Center (left),
and a vehicle interior buck in the physical prototyping area (right).

The new creatives that will work in future design spaces

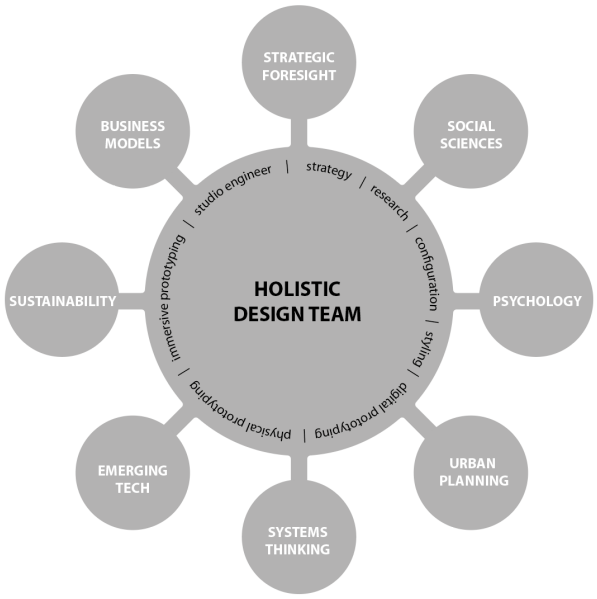
Flipping the script

Today's creative automotive design studios have fantastically-skilled designers who are specialists in creating emotion through the physicality of the vehicle. Each designer works individually, competing with their peers so their proposals are selected to move ahead into development. As a consequence, today's creative automotive design studios, in addition to designing wonderful proposals over a technical package, will need to greatly expand their range to create vehicles never seen before. While de design of vehicle interiors has become more and more important over the years, if you were to visit a transportation design program today, most of their students still aim to become part of the exterior design team, thus, still within the driveway concept paradigm.



Compositions of today's vehicle creative design teams

Today's vehicle-centric design teams are composed with little variation of the image above. However, with the looming changes brought by the megatrends such as autonomous mobility, the shared economy, new powertrain technologies, and new vehicle architectures and types, this team will need to have to grow to cover this upcoming complexity.



Proposed holistic design team

The following figures will take on crucial roles in future holistic mobility design teams:

- **The foresight strategist** will aim to future-proof the company by understanding the complexity of the coming futures, detecting disruptors in advance, creating and identifying scenarios and recommending what to do according to trend indicators.
- **The design researcher**, already mainstream in product design studios will become crucial in the auto and mobility industry, identifying insights and pain points by using human-centered methods of analysis, and validating design proposals with an evidence-based approach.
- **The configurator**'s job will be to develop new vehicle architectures with an innovation approach. This figure will need to be an expert in human factors, vehicle operation, usability, activity simulation and analysis, and cognitive aspects. This role will be needed both for the design of physical vehicles and HMI and UX-UI assets.
- **The transportation designer** (including exteriors, interiors, and CMF), remains with its current task of creating emotion through design, but now within the holistic thinking framework.
- **The entrepreneur:** identifies new business ventures for the company. For example, an automaker could have cities as clients (rather than people), to supply shared-mobility solutions, move on to subscription models, or create experience-specific vehicles.

- **The activist** will be a profile dedicated to advocating for social and environmental responsibility in the design studio, resonating with the values of new generations.
- **The immersive prototyper** is a new figure, a mixture of video game, UX-UI, and industrial designer. This is a major new figure in design studios that will become a must.
- **The physical prototyper** will come in two categories: the current high-fidelity sculptors and modelers, and the new addition of quick-mock up makers, more akin to the discipline of scenic design than to beautifully-finished delicate models. Their job will be to create low fidelity iterative mock ups to validate or enrich the VR creations of designers.

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