3D-Printed Car: Coast to Coast on 10 Gallons?

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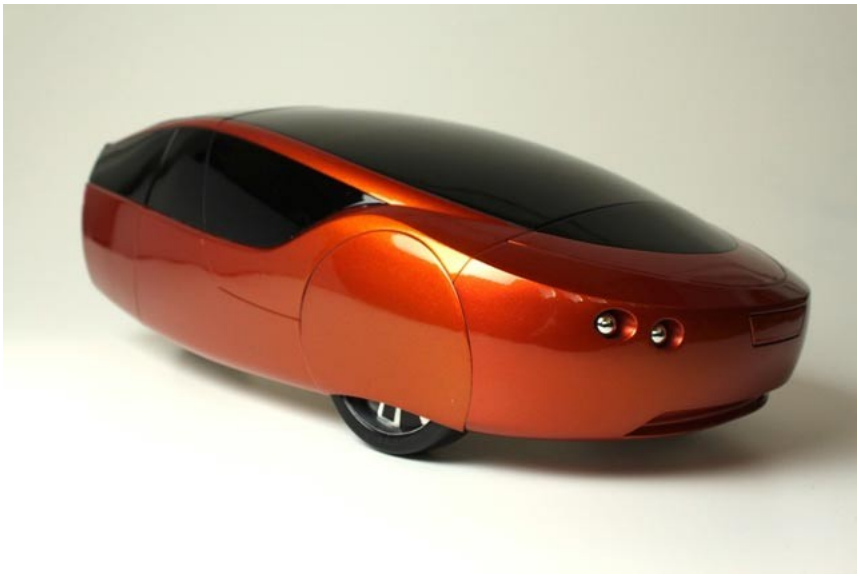

The digital age seems synonymous with change. When it comes to communicating, who doesn't know what an email or a cell phone is, or hasn't heard of Facebook and Twitter?

"In the 21st century, the revolution may not be televised – but it likely will be tweeted, blogged, texted and organized" with digital tools, writes Catherine O'Donnell at the University of Washington.

What is required is a "complete rethink of the automobile," whereby the fundamentals are derived from "a science-based solution to personal mobility that allows movement without damage for centuries to come."

In her article, O'Donnell extensively cites a scholarly report by Phillip Howard, an associate professor in communication at the University of Washington, who was the project lead for a 2011 study quantifying the "use of social media in Arab Spring," Regarding Howard's findings, O'Donnell says the impact of social media in Tunisia and Egypt was nothing short of tremendous, where in the weeks just before Egyptian president Hosni Mubarak was forced to resign "the total rate of tweets from Egypt – and around the world – about political change" exponentially grew from "2,300 a day to 230,000 a day."

Yet great change in communication is not all the digital revolution has brought. Architecture, fashion, visual art and industrial design have also seen some serious transformations, as has one-off fabricating and full-scale manufacturing. Enter the world of 3D printing, where perhaps the most headline-grabbing, haute couture evening gown of 2013 was not handcrafted by Valentino, Givenchy, Prada, Chanel or Versace, but by Michael Schmidt and Francis Bitonti, who designed an iconic dress for Dita Von Teese using CAD software, and thereafter printed the dress out via Shapeways; a cloud-based 3D printing and design service.

And if that's not mind-blowing enough, to accompany her 3D printed dress, Von Teese will soon be able to purchase and drive a super-aerodynamic, 3D-printed car boasting 290 miles per gallon without using any fossil fuel. The car, called Urbee, is the brainchild of Jim Kor and is designed to draw all its energy from renewable ethanol and on-board batteries.

Beyond its striking design, though, the story of Urbee is one that provides an inspiring, best-practice example of innovative grass-roots entrepreneurship combined with renewable energy and sustainable manufacturing.

"Today, 1 billion cars roam the planet, and by mid-century, that number may reach 2.5 billion . . . [but] can the world handle billions of gas-cars roaming the planet?" Kor asks Truthout, adding that "[a]fter 100 years of cheap and plentiful fossil-fuels, the traditional automobile has reached a design that is not only 'faulty' in that it damages the environment, but is grossly mismatched to the traffic patterns within our cities and highways. "What is required, he says, is a "complete re-think of the automobile," whereby the fundamentals are derived from "a science-based solution to personal mobility that allows movement without damage for centuries to come."

Though he does not label himself an environmentalist, Kor says he does "have a deep interest in conserving [the environment]," particularly with respect to climate change. And, as a designer, he says, "If what you work on gets replicated at quite a large number, then that should be done well."

On the subject of 3D-printed parts for his car, Kor says: "My journey into it has changed my way of thinking. It's been a journey for me. It's taken me a long time. These things don't come quickly. Jeff Hanson is the guy at Stratasys who kept saying, 'You should use these for production.' And I remember him saying it almost the first time that I met him, but it took me several years to really understand what he was saying."

Kor says it was the encouragement and sponsorship of Stratasys that got the Urbee team "heavily involved" in the 3D-printing aspect of building the car. Yet, Kor acknowledges that finding funding for his project is a daunting and reoccurring task.

This past July, Kor was invited to speak in Munich, Germany, at the Bayern Innovative conference. There, while talking about Urbee, Kor came to realize, he told Truthout, that representatives of the German car companies in attendance, like BMW, are very much interested in the prospects of implementing 3D printing in the future manufacturing of their cars.

Kor spoke to Truthout by phone from his home town of Winnipeg, in Manitoba, Canada, recently.

Max Eternity for Truthout: When did you initially come up with the idea for the Urbee 2, and what motivated and inspired you?

Jim Kor: I think I've always been interested in energy efficiency, which is a weird thing to be interested in in Canada, because we've got energy just bursting out of the ground here. My dad was always interested in energy, and I graduated in the 1970's during the energy crisis. So, I remember thinking that way. Then, I started designing farm equipment and buses, and couldn't really flex that kind of muscle in those respects.

You eventually started your own company, when was that?

In 1984, and I've been pretty much self-employed since then. One of the things – that in a city of 700,000 people – I've worked with pretty well the same people my whole career – a small group of designers and engineers, and welders and mechanics.

And, how about some backstory before we get into Urbee?

Before Urbee, were human-powered vehicles . . . we got involved with IHPVA (International Human Powered Vehicle Association). This is where they try to make bicycles go faster – peddle in the air, and all this kind of stuff. And what I learned from that whole experience is that you have to really focus on the machine, not the engine, because you can't change the human too much. So, they were all about no rules, try to go as fast as you can on a bicycle, and I really gained an appreciation of trying to manipulate the machine to be more and more efficient.

I got a deep understanding of what energy it takes to move a car around – at the bottom on the earth, below an ocean of air.

From there, I started another project that just sort of started as a story, called Sky Way. And it was like a pedal-powered vehicle in a tunnel system. That was just a story, which gained some publication in bicycling magazines. And then Seattle

Bicycle Expo asked if we could put reality to that, and so we built a huge, full-scale model of this Sky Way vehicle in a tunnel and took it to the Bike Expo in Seattle. That was 1990, or '92.

In 1994, we got asked to put some more reality to that model, and we actually built a working prototype, and called that Solos. It was a railed vehicle that was very efficient . . . aerodynamic.

Now, I think that brings us up to the birth of Urbee in 1996?

Urbee started by just seeing if we could put [Solos] that vehicle on the road, because it's so efficient. And then I thought, well no, because once it's on the road it's got to be heavier, and all this kind of stuff. So very cautiously, we did a lot of analytical analysis. Not visualizing what the car would look like, but did some computer programs on what energy the car would need. That took a long time. And I think what happened in that period is that I got a deep understanding of what energy it takes to move a car around – at the bottom on the earth, below an ocean of air. You know, we forget about the air, and I read often that aerodynamics don't really matter under 30 miles and hours. And I just think: I don't think so. In other words, without any real preconceived ideas we started to analyze this, right? And slowly we started to put pictures to it and some models together, and that was the start of Urbee.

We had finished the Solos project. We had spent a lot of money on the project, and had gone to conferences. And so we thought, maybe we'll start a car.

That's a great story – how it came out of thinking about efficiency and bicycle design, then on to a car. So, let's talk about the issue of sustainability. Specifically, how does Urbee speak to that?

Sustainable development was the first sort of thing, in the beginning. And that's like an oxymoron, people said. Can you really have continued development – continued growth in a sustainable manner?

I was just interested in the environment and stuff like that.

The life of products has to start to increase dramatically.

I wouldn't call myself an environmentalist, but I certainly live in an area that has a lot of lakes. And so I have a deep interest in conserving [the environment]. Let's put it that way, and I realized that my actions are highly destructive as a maker of machines.

I don't think it takes a rocket scientist to come to that realization, or even an environmentalist. But as a designer, I felt that responsibility.

If what you work on gets replicated at quite a large number, then that should be done well.

I was disturbed by all this defining of sustainability, so I just started to articulate what I thought it was.

What I was surprised at was that you couldn't see a car that incorporated everything we knew about aerodynamics.

You just have to be really careful in what you build, and how much mess you make. And . . . I absolutely started to think that long life plays such a huge role in this sustainability.

The life of products has to start to increase dramatically.

That's a little different than what I read in the literature. You mention long life, and it's like a leper walked into the room (Laughs). Well don't you think?

Yes (Laughs).

Yet I am convinced that that's what has to happen.

You have to design things really well, so people really want them, and want to keep them.

That makes sense. So, how much does the car weigh. Do you have a weight right now, or are you shooting for a target weight?

The first car [Urbee 1] is a bit overweight, but with our projections, which are quite detailed, we think we can for sure reach 1,200 pounds.

And how many passengers can ride at one time?

Two people – the first prototype was done for just two people, and now we're putting two people and a dog in there.

How was the structural design for the car chosen? What would you say are some key components, and to what extent has that influenced the outcome of the visual aesthetic?

Well the visual started with aerodynamics. What I was surprised at was that you couldn't see a car that incorporated everything we knew about aerodynamics.

Two of us knew everything that needed to go in the car to be aerodynamic. There were [also] two industrial designers on the team, and they said it can't look like a jellybean; it can't look like a land-speed record car, 'cause no one would buy it. And we are definitely super in tune with that as well.

It has to be aesthetically appealing, but we were also thinking that if we get the aerodynamics right, it will be aesthetically appealing.

The industrial designers said: the eye must go somewhere. There's a lot of emotion there. But it is surprising to me that it's taken so long to put everything we know about aerodynamics into a body and why does it look so unique.

And why is that would you say?

(Laughs) Because, I think that they use aerodynamics as a marketing tool.

I use the example of a glider. I bet when I mention a glider, you have something in head that I can guess to what that is, because they kind of look the same around the world.

So, there's a level of functionality that has to be incorporated in there.

How does this tie in to the actual structural design of the car?

Let's say, you're trying to get your [car] body around two people. The widest point is typically where their shoulders are, and then you try to taper down to induce the tail. That's aerodynamics.

That's the super power of 3D printing. It liberates the designer to think exactly where the molecules of material should go.

Then the structure: typically when you design that last, because it can kind of move around everything. So in other words, we located the engine, the electric motors, batteries, and then made a tubular frame that kind of went around there.

You have the most control over the things you fabricate.

At what point did you decide to incorporate 3D printed parts, and what are the most striking advantages over traditional manufacturing?

Of course with 3D printing, the body is still shaped by aerodynamics. But now, everything inside the car is shaped by it.

So with 3D printing it's a way of eliminating tooling.

With 3D printing it's not even tubing. It's just everything you can visualize, or whatever you can learn with stress analysis or crash simulations. It's wherever you want to put the molecules. That's the super power, in my opinion, of 3D printing. It liberates the designer to think exactly where the molecules of material should go.

On the subject of 3D printing, what would you say are the most striking advantages, or some additional advantages?

Let's just put aside for the moment any economics. So, without any tooling, you can make a part. And tooling limits a lot of things. Number one: It forces the designer to freeze the design and invest in huge tooling. And then, I've worked on many machines where it was so expensive . . . multimillion-dollar tooling, but we were never allowed to change that.

I see – that's a pretty big incentive to scrap tooling for 3D printing.

3D printing allows such flexibility, if the costs are in line. It allows making one, and then a second one slightly differently, and then 10 more that can be different. You know, it does allow that.

So, what I hear you saying is that you can have a lot of different iterations without any new tools – just the 3D printing machine.

Yes, and there was a car in California, called the Aptera. It was a carbon fiber 3-wheeler. I wasn't too much of an industry watcher, but they had a video where they showed all the tooling that they invested in that car, and they tried to sell some. But I could see that the tooling was millions, and millions and millions of dollars. So you're investing all that before you have even sold one.

Wow.

Almost the smallest thing requires tooling. So with 3D printing it's a way of eliminating tooling.

What took me several years to figure out . . . Jeff Hanson at Stratasys had always said, "Think of these [Urbee] in production – as production machines – but, it eliminates production processes." And I didn't quite get it. I sort of knew the words, but I didn't quite get it.

It's so liberating. Before 3D printing I would never have designed something I knew you couldn't make.

What it means is that [non-3D printed] production is so invasive. Like, I just think of sheet metal and tubing. When I mention sheet metal and tubing – we just think of those as the starting points. We're going to design something . . . out of sheet metal or tubing. And even when we think of doing something in plastic, it has to be either injection mold . . . or.

So, it's all the rules. There's so many rules that we have to follow. And, what I didn't realize is that once you learn these rules, you just don't think any other way.

So you think difference in extrusion . . . if it's a rotational molding or a vacuum forming or fiberglass part. These are all rules that you have to know or you can't even make that part.

That goes out the window with 3D printing?

And not only does it go way out the window, I jokingly said that I don't think there's ever been a 3D printer [part manufacturer] who said he couldn't make something. He never phones the guy back and says, "You know, I can't make this thing."

I don't know if that's true, but I know I've never heard of it. And what that means, of course, is that they can make anything. But I see still with 3D printing parts that look like injection mold. So, it's hard to get rid of that in your head. That's what takes all the time.

But I'm not following this because it's the next wave or because it's going to get cheaper. Sure, there are people who would probably say it's going to get cheaper, but that's not the magnet for me.

It's so liberating. Before 3D printing I would never have designed something I knew you couldn't make.

I see. No matter how good of a design it was, no matter how functional, you wouldn't design it, because it couldn't be made.

So, once Jeff Hanson (Stratasys) said, "Use these 3D printers," and then you [I] start thinking. Then you [I] go: okay, I can see it. It would be an amazing, efficient use of material, in the end. So, would that be economic? I don't know, but it sounds unbelievably promising. And it fits this whole sustainability thing, because it does use less material. You know, it's additive. So, you tend to add material, not take it away.

So, you're planning to take the Urbee on a cross-country trip, from California to New York, using only 10 gallons of fuel? That sounds incredibly ambitions – how will this be possible?

Well I kept saying it's two years away from when we get funded, and we still haven't really gotten funded. So, it's a real challenge for us.

> **We just want 2 people to get into a car, and 44 hours later, they're in San Francisco – 10 gallons, 15 gallons – it doesn't even matter. It's just so dramatically less than what it would take any other car.**

We still are highly enthusiastic, and we are continuing with the design.We have lots of sponsors, but to be blunt, we're just missing cash. It's expensive.We managed largely on self-funding. We managed to design and build the first one, but it's going to take a lot more money to [completely] develop and design the second one.

So, let's just say you get this money – whatever that number is – in doing this drive from California to New York on 10 gallons of fuel, to what extent is this the aerodynamics or the fuel efficiency of the engine? How is this possible?

Well it's possible, we think, because everything we've made was to reduce the energy of movement. That is the purpose of the car. Now has anyone taken it to that extreme? There are cars that get 1,300 miles per gallon – those Shell Solar Racers. You know, where one person lies back and they do about 15 miles an hour.

What are your hopes for the Urbee regarding its use in the consumer market?

What we want to demonstrate is that we are a practical car.

A car that could be put into production?

Well yeah, and also a car that you and I could jump in and drive across the country . . . in safety. In other words, it has crash-worthiness. And we're not cheating by going really slow. You know, going slow takes way less energy.

We want to mix with traffic.

What I took as inspiration is Charles Lindberg crossing the Atlantic. He just got into an airplane and flew across the Atlantic, and no one could deny he did it.

Right, empirical evidence speaks for itself.

So,we just want 2 people to get into a car, and 44 hours later, they're in San Francisco. And even one of our sponsors at Autodesk, he said it doesn't even matter: 10 gallons, 15 gallons, it doesn't even matter. It's just so dramatically less than what it would take any other car.

It really hinges on the word: practical. What do you think is a practical car?

So, we tried to define that in our own terms, hopefully not being too eccentric.

In our email, we get a lot of people who want a car like this that contact us. So I think we've touched a bit of a nerve there, but it's a struggle. We have to be way more innovative financially than technically.

To speak to that, what did you, or do you, think is the motivator for investors?

To be honest, I thought the motivator would be global warming, climate change, whatever you want to call it. I believe that's real. I believe that's happening. And I thought there would be solutions that would be wanted, but I don't see personally much evidence of that.

I see evidence on the news that it's happening.

But you don't see financial evidence that it's time for change?

Well, it's too easy to put it off.

I think it's real, and we're trying to offer a solution for change. But, who pays for that? So, it's a struggle . . . yeah . . . who pays for that? And, who's willing to change?

We get seduced by the idea that we can just keep driving and change the car a little bit. We get seduced by that, but I don't think it's true.

It feels like belt-tightening to go to a smaller car that has less power, and all this, but I think it's somewhat liberating to be actually doing something about this impending problem.

Right, and doing something in a way that's really thoughtful and not just depending on methods that we've always used and done?

Yeah, and it's not just tweaking something that might be fundamentally flawed.

I'm not even going to say that Urbee is the solution to all this, but all of us have to attempt – at some point – at really finding a solution, or I think we're in real trouble.

At some point, who's going to attempt the real tough job?

Max Eternity

Max Eternity is a visionary polymath living and working as an artist, writer, architectural preservationist, historian, social critic, transportation and furniture designer, online publisher, inventor and industrial sculptor. He founded the Eternity Group in 2008, an online publishing, advocacy and design consortium, which includes Puget Sound Prototype. And he is a contributing author to a college textbook, entitled *At Issue: Poverty in America*, published by Gale/Cengage (2015). Eternity began writing a new book in 2016, entitled *From Bauhaus | To Black Mountain*, and he's creating a touring exhibition of his artwork to coincide with the publication of the book and the 100th anniversary of the Bauhaus, founded in 1919.