Bike Wheel Came to Life

An interview with Christine Outram, who shepherded the Copenhagen Wheel's development.

Can a student design change the world? Absolutely, and the Copenhagen Wheel -- a hybrid-electric wheel you can bolt onto almost any bike -- might soon prove how fast that can happen.

Developed by a student team out of MIT's SENSEable City lab, the wheel recently won the U.S. round the James Dyson Awards. Even Sir James lauded the design's versatility and elegance, telling us, "It's a well thought out design in that it addresses a number of problems beyond tired legs."

Co.Design recently talked with Christine Outram, who, as a graduate student, led the effort to bring the Copenhagen Wheel from a mere drawing to a full-blown working product. Here, she talks about the criteria the team laid out to guide the product's development, and how the wheel is "more than a piece of transportation," and could lead to full-blown carbon credit programs.

Let's start at the beginning. How did the idea came about?

The project started at the SENSEable City Lab at MIT, which usually collaborates with cities and telecoms and other places with extra data lying around, with the goal of creating a vision for the city in 15 years. The city of Copenhagen saw something called the Real-Time Rome, which used cell-phones and GPS monitors on busses to look at how people and public transport are interacting. They wanted to buy it, but being a university, the lab couldn't really sell the project to them. So we agreed to take a look at Copenhagen, to see how technology could improve on the city.

And so, what issues did you look at once the student workshop began?

Initially there were five students involved, including myself. And the most striking thing you notice about Copenhagen is all of the bikes -- 36% of people in Copenhagen bike to work. That trend began in the 1970s, with roads being strategically cut off, and cars being taxed 180%. The city mentioned that they wanted to reach 50% by 2015, but they weren't coming close. That figure had actually plateaued some time ago.

So then we started thinking: Why wouldn't someone get on a bike? It comes down to distance, topography, safety, and infrastructure.
pretty early on, the idea of putting an electric wheel on a bike came about, because it could help put people on bikes that live further out or live below big hills. One of the students in the workshop created a really nice rendering, but we didn’t have any idea at that point about how it would actually work. And that’s when the lab went into the second phase, with a new batch of students — the “urban demo” phase. This was focused on choosing the batteries and the motor, and making the design real.

So how does the wheel work?

Inside of the hub, there’s a 250 watt motor. And when you pedal, there are sensors in the wheel that detect torque. So once the torque sensor detects a certain amount of exertion, it knows to supplement your pedaling. So if you’re going up a hill, you get more an assist. The idea is not that you stop pedaling and the motor takes over -- you’re always pedaling, and the feeling is like having a friend pedaling with you.

You brake by pushing back on the pedals, and much like a Toyota Prius, the motor converts the friction created into electricity, which charges the battery. Also, when you’re going downhill, the gears in the hub switch so that they can recover energy there as well.

As far as engineering goes, the main thing is that you don’t want the batteries or the motor to spin with the wheel, creating
Finally, you choose how much assist you want through the iPhone interface. You can choose from low to high amounts of assist — so anywhere from 100% boost to a 300% boost.

It seems like the real insight was creating a wheel that can attach to any bike. How did that idea come about?

The idea was generated in the student workshop and was then explored on a more technical level as the project progressed. Early on, we also worked with the Smart Cities Lab at MIT. Their projects - the RoboScooter and the CityCar - really inspired us.

From there, we really treated it like a design project and we weren’t interested in an incremental improvement on electric bikes, since they’re all pretty chunky with hard-wiring and external batteries. So we started with a design brief, that had four main criteria: 1. All of the components should fit in the hub. 2. It should be easily retrofitable and modular, so that you could plug in different components such as a bigger battery if you live near hills or environmental sensors if you’re a city looking to gather data. 3. It should be your friend, and be able to tell you how well you’re doing. 4. It should have a social component that connects with your
You student team at MIT was pretty multidisciplinary. How did that affect the product that ultimately emerged?

I should say that the guidance came from the leader of the lab, Carlo Ratti, who has a background in civil engineering and architecture, and Assaf Biderman, who was a physicist and works on tangible interfaces. Multidisciplinary backgrounds like theirs are really the key. When you including an electrical engineer and an electrical engineer and an architect, all these people have to speak the same language. It can’t be that you create something that works and put a pretty case over it. For instance, we could have easily hardwired a battery into the thing, but we wanted the battery to removable. The glue among everyone was an end-use focus. And that's a design way of thinking.

So what did an architect like yourself contribute to the process?

The skill that architects bring is being able to think top down and bottom up at the same time. You have to have vision for an overall building design, but also be able to think about the design of a doorjam to prevent leaks when it rains. That sort of simultaneous thinking helps in these types of projects, and I think it helped that I continued with the project between both the brainstorming and the building.

Anything more you’d like to add about the product?

What I really like is that it's not just a piece of transport. By including environmental sensors in the hub, you can use this to gather fine-grained data from a fleet of bicycles, just as a byproduct of people taking a normal route everyday. Moreover, you can also gather data about how many cycle miles are being logged over time, so you could watch whether the wheel is having an impact on a city's carbon emissions. You can even imagine the wheel becoming the basis for carbon credits awarded to cities, or even competitions between cities across the world.

So is there VC backing? How are you guys staying in business? And what’s next?

We're actually funded right now by the ministry of the environment in Italy, which is paying for the material cost of the 12 prototypes we've build. Those will soon go into a serious phase of beta testing, for example, riding up hills in San Francisco to see if they survive. Then, we're looking to go commercial in 10-12 months. We already know that the final version is going to be far smaller and lighter that what you see now, thanks to custom motors and better battery selection.

And the cost?

It'll be about $600 retail, which we think is pretty reasonable, once
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Thanks for stopping by Fast Company’s Co.Design. Here, we try to bridge the fuzzy border between design and business. We started this site with a few simple premises in mind. First, design is a window onto the world at large, and the culture we live in. When a designer sets down to make something new, she can’t help but have some idea about how some object could be so much better than ever before...read more »

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