



*“ SOLIDWORKS gives you a great deal of confidence and ability to move forward at a speed that in the past has not been possible.”*

Chris Parker, Director, Inspired Cycle Engineering

## First Bike To Cycle To South Pole Is Designed On SolidWorks

Inspired Cycle Engineering (ICE) was started in 1998 by cycle enthusiasts Chris Parker and Neil Selwood. Having bought the rights to the original trike design, the company based in Cornwall, design, develop and produce bespoke recumbent trikes for those seeking adventure and adrenalin, whether its conquering the Himalyas or touring the globe.



The company originally started using 3D CAD software Alibre in 2007 and switched to SOLIDWORKS in 2011. They have two seats of SOLIDWORKS Premium. “We had been looking at other 3D CAD systems for sometime but SOLIDWORKS was a natural choice for us,” says ICE Director Chris Parker. “Our suppliers use it, which means we don’t have to go through any data translation. What we are looking at is exactly what our suppliers are looking at which means there is no chance for errors. Given the two month time scale we had for Maria - it was absolutely crucial for us that we would get the prototype right first time. SOLIDWORKS gives us a great deal of confidence and ability to move forward at a speed that in the past has not been possible.”

### Challenge:

**British adventurer Maria Leijerstam needed a bike that could withstand extreme polar conditions in a 400mile cycle race to the South Pole. The bike had to carry 55kg of luggage and would be travelling on unknown terrain in -40C temperatures. Starting on the Ross Ice Shelf at the edge of the Antarctic continent, Maria wanted to try a shorter but steeper route than her competitors by going over the Leverett Glacier and decided a recumbent trike would offer her the best chance of success. ICE were the people to build it.**

### Antarctic Conditions

“The hardest challenge was designing for the unknown,” says Chris. Although Maria had researched her intended route, the only real known for the ICE team was that it was going to be cold with lots of snow, steep climbs and bad weather. The first part of Maria’s ride was up a glacier called the Leverett Glacier through the Transantarctic mountain range, where she would be climbing 1:3 gradients. “This race wasn’t going to be won or lost on a top speed but on whether you can keep going,” explains Chris. “We consciously decided from the start that we would only use materials that we had tested and trusted. Only things that were bomb proof went anywhere near this machine. We felt like we had Maria’s life in our hands.”

### The Design

Climbing up to heights of 8700ft (2650metres), the biggest challenge was to design a bike that required minimum effort. “The first rule of exercising in the Antarctic is not to sweat,” says Chris. “If you sweat, it evaporates as it would normally through your clothing and it will freeze. As that outer garment freezes, it loses all its thermal properties and then you will be a layer down. There is no way you can get the ice out of it because you will never get the air temperature high enough to do that.

“The biggest change we did was to the gears, fitting a 2:1 reduction drive in the middle of the trike so she could climb these steep mountains. A standard mountain bike chain is in the front with standard mountain bike derailleurs at the back, but here in the middle we put in another chain set without any pedals. The front set drove a large chain ring which was connected to the small chain ring and that was what drove the back end.

Everything was reduced by half, including the effort that Maria would've had to put into getting the bike moving. On a flat cycle path without its luggage on, the machine required no effort to make it go forward, of course Maria didn't find it so easy making headway in 50mph winds and in powder snow. But our design meant with a specialist chain she could climb up and over obstacles while carrying 55kg of luggage, sometimes going at just 2mph."

#### Freezing temperatures

Although there was no danger of the gears freezing because there was no water, the ICE team had to second guess what was going to happen to the grease and bearings at -40C. "Nobody tests their stuff at -40 degrees," says Chris. "Only with industrial freezers do you get fairly standard tests down to -20 degrees. So here we had to make some educated guesses. Fortunately, I've been designing these machines for 20 years and over that time I've built up an understanding of how strong stuff needs to be. We weren't trying to build to an optimum weight. We didn't want it to be stupidly heavy but we knew it had to be tough and the conditions it was working in would be very harsh so we had to have a very large safety margin, because the machine wasn't going to be repairable where it was going. If the grease did freeze we just had to make it strong enough to push the frozen grease out of the way and work with what we had."

#### New Wheels

ICE departed from their standard wheels to source the biggest land mountain wheels you can buy: Fatbike tyres, which are 4.5 inches wide and allow for inexorable progress. "Nothing is going to get in their way," says Chris. "How to make these enormous tyres, with enormous great wheels fit into the rest of the trike is where SOLIDWORKS 3D CAD came into its own. We knew if they were going to fit or not, long before we started making the prototype."

#### SOLIDWORKS

"There is no doubt that SOLIDWORKS helped us get the Polar Cycle made on deadline," says Chris. "The ability that SOLIDWORKS has to give you the cross section instantly was crucial in moving forward. Rather than spend a day to produce a cross section, I could press a button and have it there in front of me immediately, which was vital for seeing how much metal I needed. By the time we had finished designing the prototype we pretty much knew it was going to work because it did in the programme and that is where SOLIDWORKS 3D CAD really scored for us."

#### Maria's World First

Despite setting off three weeks after her rivals, American Daniel Burton and Spaniard Juan Menendez Granados, Maria competed the gruelling 400 miles race in 10 days on December 27, 2013 and became the first person to cycle to the South Pole. She was back in her hometown of Llantrithyd, before the other two had finished. Maria said of the Polar Cycle, "The trike is amazing. It's completely stable, even in extreme winds and I can take on long steep hills that I'd never be able to climb on a bike."

#### Moving Forward

ICE's video of the Polar Cycle being assembled has received more than 250,000 hits on Youtube and the company is reaching new markets, with orders for Q1 2014 seeing a 40 per cent increase. "The success of our design and Maria's achievement has definitely raised our profile," adds Chris. "SOLIDWORKS did exactly what we need it to do. We couldn't have asked for better support from NT CAD/CAM and the software continues to improve its offering, SW14 is just that bit snappier, which is key to our constant desire as cyclists to always wanting to go faster."

#### Benefits:

- Delivered a working prototype in two months - 66 per cent reduction in time to market
- ICE's Polar Cycle won the race to the South Pole

#### Industry:

- Design Engineering Services

#### Product Used:

- SOLIDWORKS Premium



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