

## **Madison Longboard Choosing a Truck**

Samantha Brunhoff, known to her friends as simply “Sam,” and Adam Probes met as juniors in the mechanical engineering program at the University of Wisconsin – Madison. Sam, 21, had always been interested in engineering. Both her mother and father were engineers and she participated in the US FIRST robotics program in high school, making it to the regional finals. The only activity in her life that rivaled engineering in importance was long distance running. Sam ran cross-country in high school and in college she continued her running by participating in organized events, particularly the Madison Marathon which is held each spring. The full marathon is a grueling 42.2 kilometers (26.2 miles) and runs throughout the city of Madison. Sam had completed it four times, during each of her years at UW including last spring, just one week after her graduation.

Adam, 22, came to engineering almost by chance. Adam was excellent at math and science in high school and a counselor suggested he explore engineering. Adam’s true passion was skateboarding and engineering was a way for Adam to better understand skateboarding; the mechanics and material design helped him conceive of what might be possible on a skateboard. After graduation, Adam was looking for some way to combine his love of skateboarding, understanding of engineering, and a job that could support him.

### **Madison Longboard LLC -**

It wasn’t long before an idea for a new company began to take shape. Sam had volunteered at several distance road races and noticed the time and preparation it took to construct the course. Permits, police, barricades, volunteers, water, snacks, and emergency resources were all required to support the course – and once the runners went by it was all over. Some races featured disabled racers, usually in specially designed push-rim and hand-cycle wheel chairs, who would start before the runners. An average wheel-chair racer would complete the course in about 1:45 traveling at about 24 km/h, whereas the fastest runner would complete the course in 2:20 traveling at roughly 18 km/h. Sam calculated that this left a gap in the course for someone who could travel the full marathon distance at roughly 20 km/h ... and the more people you could get on the course, the more people get physically active and the more revenue each race could generate.

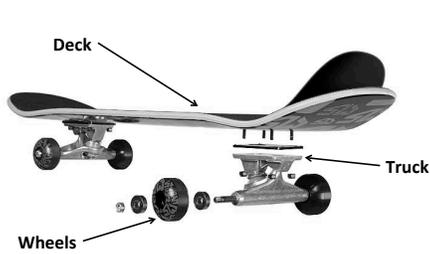
Adam saw the opportunity as well – an entirely new sport ... marathon longboarding. Longboards were a special variation of skateboards that were capable of long distance travel. After a few practice runs on the University of Wisconsin Arboretum walking trails, Adam calculated that he could do about 20 km on a longboard in at least an hour, which fills the potential speed gap in marathon events. Plus the race would be on near ideal surfaces, flat paved roads, and in front of an enthusiastic crowd. Current longboards were not constructed for this type of an event – they would have to design something altogether different than what was on the market today.

Adam sold his car, and Sam invested her savings, and with a little additional help from their parents, they rented a small storefront on State Street and Madison Longboard LLC was born.

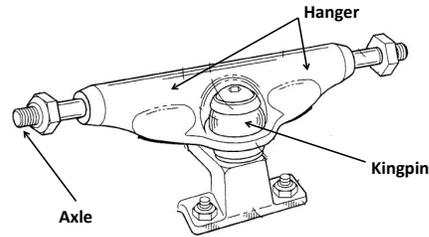
### **Longboard Design –**

There are three major components to a skateboard longboard – the deck, trucks and wheels – as shown in Figure 1. The skateboard longboard, like its surfing sister, has a deck longer than a typical skateboard ranging from 100 cm to 150 cm in length with a width of 22-25 cm. Decks can be made from a variety of materials like laminated maple, bamboo or polycarbonate fiberglass to achieve varying degrees of flexibility.

## Madison Longboard - New Product Decision Making



**Figure 1:** Components of a Longboard



**Figure 2:** Components of a Longboard Truck

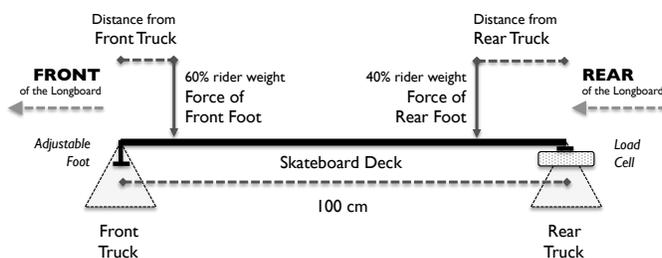
Trucks, as shown in detail in Figure 2 (shown inverted), are three main mechanisms within a longboard truck – the kingpin, the hanger and the axle. The kingpin is a ball-and-socket joint that allows the hanger and axle to pivot as weight is shifted. The hanger is the component that pivots around the kingpin and holds the axle parallel with the ground. The axle attaches through the hanger and holds the wheels, one on each side of the hanger. The hangers on longboard trucks are sized to accommodate an axle length between 16.5 cm to 25.0 cm, with the longer axle sizes preferred by most longboarders.

The final significant component of the longboard is the wheel. Skateboarding wheels come in a variety of sizes and colors, although they are almost exclusively made of polyurethane. Longboards wheels typically have a diameter of 60+ mm with the most popular size being 70 mm and most longboard trucks can accommodate a wheel diameter up to 85 mm. Longboards wheels also come in a variety of hardness, measured on the Durometer A Scale (1-100) with a softer 75a to 78a rating considered good for rough surfaces while a harder 95a to 99a rating appropriate for the fast and smooth surfaces of a skate park.

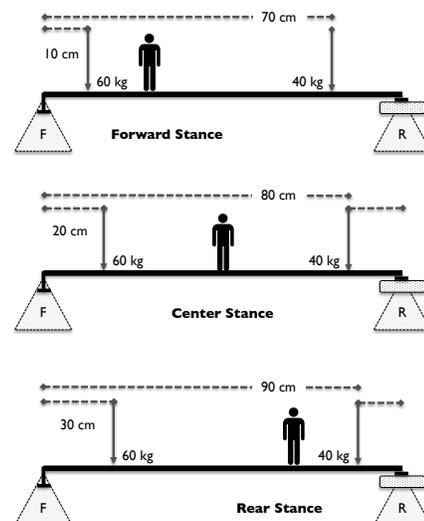
### Default Posture and Rider Stance –

Sam and Adam had learned from industry literature that riders place, on average, 60% of their weight on the front foot and 40% of their weight on the rear foot. This is called the “lean forward” or “**default posture**” within the skateboard industry and is shown in Figure 3.

Rider stance is where the rider places their feet on the longboard deck. Sam and Adam decided to test three basic stances: forward, centered and rear. Some riders like to place their feet forward on the board, some liked to place their feet toward the back of the board, and some were centered in their stance and is shown in Figure 4.



**Figure 3:** Description of weight distribution in the “Default Posture” on a Longboard

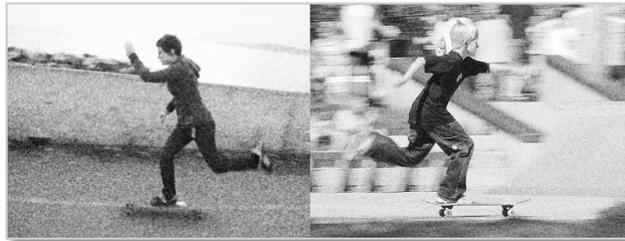


**Figure 4:** The Forward, Center and Rear Stances

## Madison Longboard - New Product Decision Making

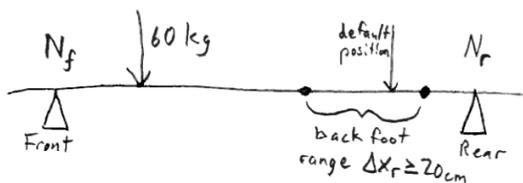
“Of course, we’ll have to consider mongo foot,” said Adam. “Say what?” replied Sam. “What on earth is mongo foot?” “You know, for someone who is so smart, you’ve got a lot to learn about skateboarding!” laughed Adam, reaching for a marker and stepping up to the whiteboard. “Let me show you. Most skateboarders plant their front foot on the deck and push on the ground with their back foot. This is called “normal foot.” (Figure 5)

“Now with mongo foot,” continued Adam, “the rider plants the back foot on the deck and pushes with the front foot.” “That seems awkward,” said Sam. “It’s clearly a minority of riders, but several world class skaters, like Stevie Williams and Eric Kostner, use mongo foot and win championships,” replied Adam.

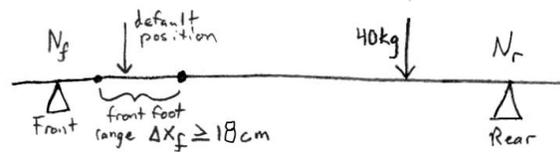


**Figure 5:** Normal Foot, Center Stance (left) and Mongo Foot, Rear Stance (right)

“With normal foot, when the back foot is returned to the deck it can have a range variance of up to 20 cm from the default position,” continued Adam while drawing on the whiteboard. (Figure 6) “You can’t see your back foot, so it doesn’t always end up in the same spot.” Sam picked up the conversation. “This means that we will have to account for a range of positions of the back foot and that will have an impact of the forces applied to the rear truck,” said Sam. “With mongo foot kick style,” continued Adam, “the front foot is returned to the deck with a range variance of 18 cm from the default position,” as shown in Figure 7.



**Figure 6:** Adam’s whiteboard drawing. The “normal foot” kicking style.



**Figure 7:** Adam’s whiteboard drawing continued. The “mongo foot” kicking style.

“While we’re talking about variance, what do you think about a impact load factor for our calculations?” asked Sam. An **impact load factor (ILF)** is a way to adjust a static load calculation to account for the dynamic nature of the real loads. “Our riders, even on a marathon course, will do a lot of bouncing.” “Yeah, it’s important but what factor do we use?” replied Adam. “My dad is an engineer for General Motors in Detroit, working on the Chevy Silverado,” said Sam. “He says they use a impact load factor of 3.0 to account for road generated movement of the truck bed.” “OK,” said Adam, “let’s use 3.0 as a impact load factor.”

## Business Model –

“I think we should go to this,” said Sam, handing Adam a flyer. It was a notice for an event called VentureLab Wisconsin hosted by the National Collegiate Inventors and Innovators Alliance (NCIIA), an organization designed to promote innovation and entrepreneurship in universities and colleges. As recent alumni, they were eligible to attend the three-day workshop at the \$100/team student rate. “I agree,” said Adam, “I’ve got this mountain of parts catalogs and I don’t even know where to begin.”

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Dave Franchello, founder of Design Factory, an engineering design and strategy consultancy located in Madison, WI, hosted the VentureLab. The three-day seminar featured hands on exercises where Sam and Adam could work on problems specific to the Madison Longboard challenge. Dave stressed the importance of understanding the **business model** that he defined as “a set of planned assumptions about how your company will make money.” He provided a simple list of questions that help to define the Business Model, which are shown in Table I.

Topic	Questions?
Customer Selection	<ul style="list-style-type: none"><li>• Who is the customer?</li><li>• Is our offering relevant to this customer?</li></ul>
Value Proposition	<ul style="list-style-type: none"><li>• What are the unique benefits?</li></ul>
Differentiation and Control	<ul style="list-style-type: none"><li>• How do we protect our cash flow and relationships?</li><li>• Do we have a sustainable advantage?</li></ul>
Scope of Product and Activity	<ul style="list-style-type: none"><li>• What is the scope of our product activities?</li><li>• What activities do we do, what do we outsource?</li></ul>
Organizational Design	<ul style="list-style-type: none"><li>• What is the organizational architecture of the firm?</li></ul>
Value Capture for Profit	<ul style="list-style-type: none"><li>• How does the firm capture some total value for profit?</li><li>• How does the firm protect profitability?</li></ul>
Value for Talent	<ul style="list-style-type: none"><li>• Why will good people chose to work here?</li><li>• How will we leverage talent?</li></ul>

**Table I:** Elements of a Business Model

**Source:** Byers, T. H, R. C Dorf, and A. J Nelson. *Technology Ventures: From Idea to Enterprise*. McGraw-Hill, 2011. p.60

Sam and Adam were in complete agreement about the first business model question – *who is the customer?* They defined their target customer as a male between the ages of 25-35, who had been a skateboarder when younger but was no longer attracted to the “tricks” of the sport. Marathon Longboarders were competitive and wanted to participate in public events, but they were not attracted to the drudgery of long distance running. Sam and Adam adopted the phrase “*marathon treks on engineered decks*” to describe the experience of marathon skateboarding.

They were also in agreement about their **value proposition**, the *unique user benefits* of their Madison Longboard. The deck would be 120 cm from end-to-end and with the inset of the trucks; it would be exactly 100 cm from axle-to-axle. The Madison Longboard would be designed for a mix of speed and stability, a first in the long board market. Stability would be achieved through a longer 25 cm axle length, sacrificing turn radius for a more comfortable cruise rate. The Madison Longboard would be unlike any longboard on the market and built specifically for endurance riding.

Sam and Adam did not agree on one aspect of the design – the look. Sam didn’t really think that the decoration of the skateboard was critical. Of course, it had to look professional, “... but we don’t have to take it all the way to crazy!” Adam believed it was worth any investment to make the longboard look like it was from people who understood skateboard tradition. This included radical colors, eye-catching decals and unusual materials. His point was simple, “we can’t come off as posers or sketchy ... the board must be sick.”

## Revenue and Cost Models –

At VentureLab, Dave Franchello encouraged teams to breakdown their business model into a revenue model and a cost model. The **revenue model** is “*the set of assumptions on how your company will generate revenue, or money into your company.*” For a product, this begins with the retail-selling price or the “target price” a customer will pay for the product. Sam and Adam decided to do some internet research to determine how they should price their

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Madison Longboard. Sam checked out the pricing on *thelongboardstore.com* and found that the best selling longboards sold in a price range of \$149.00 to \$199.00 and she concluded that a \$189.00 would be good target price. Adam did his research on *muirskate.com*, the premier-California based custom longboard designer. High performance longboards sold for as little as \$219.00 to more than \$300.00, so Adam chose the \$249.00 target price point which is on the lower end of the range. Sam and Adam's Revenue Model is shown in Table 2.

	Sam's Vision	Adam's Vision
<b>Revenue Model</b>		
Selling Price	\$189.00	\$249.00
Distributor Fee - %	30%	30%
Distributor Fee - \$	<u>\$56.70</u>	<u>\$74.70</u>
<b>Net Revenue</b>	<b>\$132.30</b>	<b>\$174.30</b>
<b>Cost Model</b>		
Deck	\$20.00	\$30.00
Trucks (2)	\$25.00	\$40.00
Front Wheels (2)	\$16.00	\$20.00
Back Wheels (2)	\$10.00	\$14.00
Other Parts	<u>\$8.00</u>	<u>\$8.00</u>
<b>Total Costs</b>	<b>\$79.00</b>	<b>\$112.00</b>
<b>Gross Profit</b>		
GP - % Net Revenue	40%	36%

**Table 2:** Revenue, Cost and Profit Model

The next step was to determine the **cost model**. As Dave said, "A cost model is the set of assumptions on what it will cost for your company to meet customer demand." It includes all costs - cost of materials, labor and other manufacturing costs. Sam and Adam agreed to focus just on the parts needed to build their longboard, ignoring their own labor costs and overhead costs like rent. Sam had spent some time reading through supplier catalogs, choosing solid and reasonably priced components resulting in a \$79.00 build cost. Adam tended toward more performance and top-brand components that resulted in a \$112.00 build cost, \$33.00 more than Sam's estimate. This didn't concern Adam because he felt they could generate \$60 more in revenue for each longboard, more than covering the extra cost.

### Choosing the Truck -

The process of building the first prototypes of the Madison Longboard began by selecting the best truck. Sam and Adam studied the various builder supply catalogs and four alternatives emerged from their search. Sam put the data they collected in an Excel spreadsheet for comparison purposes, as shown in Table 3. They decided that key points of comparison would be price, load capacity, mass, finish, axle length, wheel capacity and the rating of supplier reliability from Hoover's Business. The four brands they chose for comparison are:

- **Hawkwing** – The Hawkwing was Adam's favorite. Hawkwing Trucks was established in 1976 by two of the original Z-Boys for the sole purpose of making the very best skateboard components. Hawkwing components have been on the decks of the past 12 X-Game champions and they are recognized as the industry standard for high performance.
- **Munich** – The Munich truck is made by RolBretz Sport, GmbH, a division of a well-known German company that makes a variety of precision designed mechanisms for the automotive and manufacturing industries. RolBretz Sport recently introduced a line of skateboard and cycling components that use advanced materials such as titanium and nano-fiber lattice steel and advanced stress design. RolBretz is the only supplier of skateboard components that offers a lifetime replacement guarantee.

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- **Road Cruiser** – Larry Cobb of Oceanside, CA first introduced this design specifically for longboards in 1979. Cobb Design was the first to use nylon bushings, graphite fused axles and the flex-kingpin for “extra feel” on the road. This is considered the classic, tried-and-true, old school choice of longboard aficionados everywhere.
- **Mega-T** – Mega-T is a relatively new entrant to the market from a Chinese supplier, Xe-CO. This company makes a wide range of component parts for a variety of industries, from brake components for automobiles to high-capacity motors for appliances to the aluminum baseball bats used by virtually every college baseball team in the United States. They typically offer a very attractive price, with a generous replacement policy, although sometimes supply lead times may be longer.

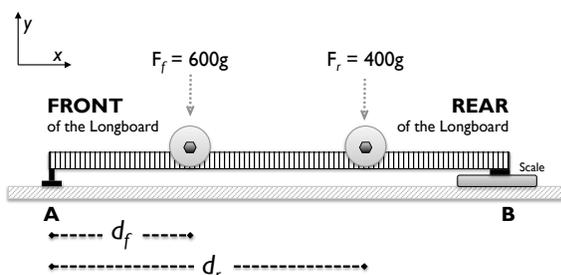
Adam looked over the list, then to Sam and said, “Well, I think the choice is obvious. We need to focus on the Hawkwing. It’s a great truck and once we bolt that on our deck no one will question our commitment.” Sam listened to what Adam had to say but was reluctant to commit to any one supplier. “I’m not sure,” she said. “I like the Hawkwing, but the Road Cruiser looks like it has the specification I think we need.”

“Road Cruiser! The Road Cruiser!” said Adam. “You’ve got to be kidding. They’d just laugh at us. My father rolled around on a Road Cruiser, dodging dinosaurs when he was a kid.” This got a smile from Sam. Adam continued, “Let’s just pick the Hawkwing, order a dozen and get on with the build. We’ve got road testing to do.”

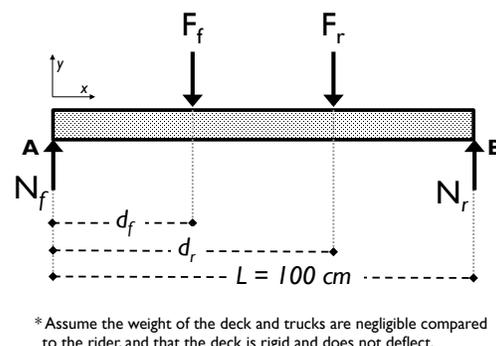
“What if we did a little bench top testing and see what we learn?” Sam reached for her solid mechanics textbook and said, “I seem to remember a lab where we measured static forces and we could adapt it to this problem.”

### Building a Test Rig -

Sam began building a test rig. She used two meter sticks because one meter this is the designed distance between the front and back truck on their longboard design and it would make comparing distance easier. She attached the meter sticks to each side of a wood spacer that creates a small track that could accommodate shifting weights. Sam’s test rig is shown in Figure 8.



**Figure 8:** Sam’s test rig to measure static forces.



**Figure 9:** Sam’s Free Body Diagram.

Using spare bolts, washers and nuts, Sam created two masses; one 600g and one 400g to simulate (at 1/100<sup>th</sup> scale) the mass of a 100kg rider. Under one end of the test rig she placed an adjustable foot to level the surface, while under the other end she place a load cell scale to measure weight. Sam sketched out a free body diagram of her test rig to help understand the calculated forces, as shown in Figure 9.

“Now, let’s do some experiments,” said Sam.