

# **Footwear and Shin Guards Design for Male & Female Mongolian Wrestling**

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## Introduction

As a combat sport with a very long history, wrestling is believed to have originated in the Sumerian era 5,000 years ago and has various forms and genres in ancient Egypt, ancient Greece, and ancient Rome (Pierre, n.d.). Among the different genres, Khalkha bökh, or Mongolian wrestling, is a particular case. Unlike the mainstream form represented by Olympic wrestling, the sport does not limit the participants' weight, age, or competition time, and even there are no rules for the wrestling ring (New World Encyclopedia, n.d.). Contemporary Mongolian wrestling competitions, even professional ones during the Naadam, the most significant traditional festival in Mongolian culture, are still played on outdoor grass covered with sand and stones. Besides that, another big difference that separates Mongolian wrestling from contemporary wrestling is that it falls under the category of jacket wrestling, in which wrestlers wear unique jackets and belts for gripping to pin down their opponents. For thousands of years, the particular arena and climatic characteristics have shaped the unique clothing habits of this nation. Bökh wrestlers still wear almost the same traditional shoes and shin guards as they did in the era of Genghis Khan, which may have severely limited the athletes' performance. However, with the gradual process of specialization and standardization in the era of this sport, we can also see people exploring the modernization of Mongolian wrestling venues in competitions such as the World Nomad Games and the Chinese Minority Traditional Sports Games. Unlike the authentic grassland environment, the wrestling mats of Olympic wrestling, indoor basketball courts with wooden floors, football turf and green carpets that try to simulate the appearance of grasslands are all battlefields for modern Mongolian wrestlers.

This paper will define design opportunities by analyzing the development history of Mongolian wrestling, tracking wrestlers' training and competition behavior, understanding the peculiarities of the competition environment, and investigating competitive products. This design innovation project aims to provide an outdoor performance footwear and shin guard set for Mongolian wrestling's unique arena based on research data, helping wrestlers reduce injuries and have a better competitive experience.

### **History**

Bökh, meaning wrestling in Mongolian, is a traditional Mongolian sport and entertainment activity. This sport has existed in Mongolia in many forms for a long history, and research by historians shows the sport originated 7,000 years ago (New World Encyclopedia, n.d.).

In ancient times, Mongolian Bökh was called "King Sports" by Mongolian ancestors. Many legendary Mongolian leaders like Genghis Khan or Khutulhan were outstanding wrestlers. At the same time, Bökh became one of the primary screening criteria for selecting general sand officers of ancient Mongolian tribes and was applied to the training of the Mongolian army. In addition to being popular among kings and armies, Bökh is also a favorite sport of the ancient Mongolian civilians and nobles and has always played a pivotal and essential role in the Mongolian people. The government of the last feudal dynasty in China, established by the Manchus, the Qing Dynasty (1636-1912), frequently held wrestling competitions, during which the Manchus and Mongolians would compete on the same stage (New World Encyclopedia, n.d.).

The word *Bökh* also means solidarity, solidity, and permanence. Therefore, Mongols regard wrestling as the most important of the Mongolian "three skills of a man (wrestling, horse racing, and archery)." wrestling will become one of the main activities for every major festival or sacrificial event. Mongolia and Inner Mongolia Province in China will hold the biggest Mongolian traditional festival, the Naadam Festival, every summer. Furthermore, the three sports mentioned above will be the climax of the whole festival. For a long time, wrestling has always had an irreplaceable special place in the hearts of Mongolians (男儿三艺系列——搏克- 知乎 [Three Skills of a Man Series: *Bökh*], 2020).

### **Rules & Regulations**

The hallmark of winning a game is trying to get the opponent to touch the ground above the waist, knees, or elbows. In the rules of Inner Mongolia, if the player's body part other than the feet touches the ground, it will be judged as a failure. Furthermore, a match often has no heavyweight, time, or even age limit. Scenes of a child competing with an adult are also typical during the Naadam festival in Mongolia. At a high level during the Naadam festival, wrestlers' *zasuuls* (trainers and field guides) establish a proper grip position between wrestlers and help them move the game forward when the match is too long. Each wrestler plays once per round, the winner moves on to the next round, and the loser is eliminated (New World Encyclopedia, n.d.).

There are subtle differences between Mongolian rules and Inner Mongolian rules. Both use multiple kinds of throwing techniques, trips, and lifts to bring down opponents. Inner Mongolia rules allow hand-to-leg contact, and it is legal to use someone else's leg as a focal point in Mongolia. Knocking, choking, or locking is not permitted in both area.

### **Environment**

The competitive stage of Mongolian wrestling distributes in the vast Mongolian Manchurian grassland, which has a cold, temperate continental climate with irregular low precipitation and significant temperature changes. The eastern part has a semi-humid zone and a semi-arid zone in the west. The temperature difference between day and night usually reaches more than 10°C (18°F). The Mongolian Manchuria steppe covers most of the inland Asian plateau, including Mongolia, Inner Mongolia, and some other provinces in China. The area comprises typical steppe, desert steppe, and the Gobi desert, with sporadic alpine grasslands, sandy land, shrubs, broad-leaved forests, and coniferous forests near the Russian border (Guo et al., 2021, #).

Wrestling competitions are held any time of the year, and the players' daily training also includes frequent switching between indoor and outdoor environments. A variety of indoor surfaces are used to explore the future of Mongolian wrestling amidst the athletes' efforts to professionalize and standardize the sport. It includes the wooden floor of the basketball court, the standard Olympic wrestling mat, the turf court for soccer, etc. The outdoor ground is solid soil covered with gravel and turf most of the year and may be covered with snow or crushed ice in winter. This project will observe complex local climate characteristics and ground surface textures and use them as design guidelines to analyze the factors that affect wrestlers' sole perception and material construction of future innovation.



Figure 1. Mongolian wrestlers competing on multiple types of terrains

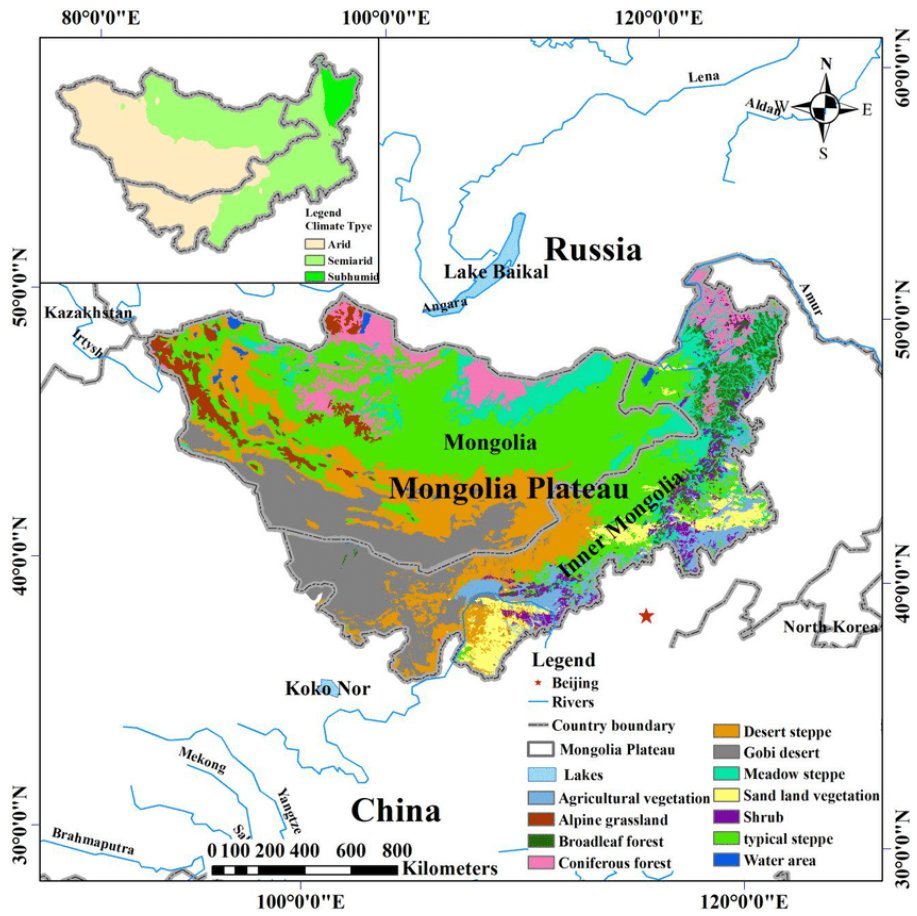


Figure 2. Map of Mongolian Manzhouli Grassland Topography and Vegetation Distribution (Guo et al., 2021, #)

## User & Market

### User

The project mainly aims at professional Mongolian wrestlers aged 18-50. They train regularly indoors for the required on-field performance and compete outdoors in Naadam festival wrestling events and local tournaments of various sizes. Despite the fact that traditional Mongolian culture defines wrestling as one of the "three skills of masculinity," with the progress of this sport and traditional society, there is never a shortage of heroic female wrestlers on the grassland. It is exciting that two of the three founders of Bokin Ayin, the consulting team for this project, are outstanding female elite wrestlers. Therefore, the target population of this project will be the product market for both males and females.

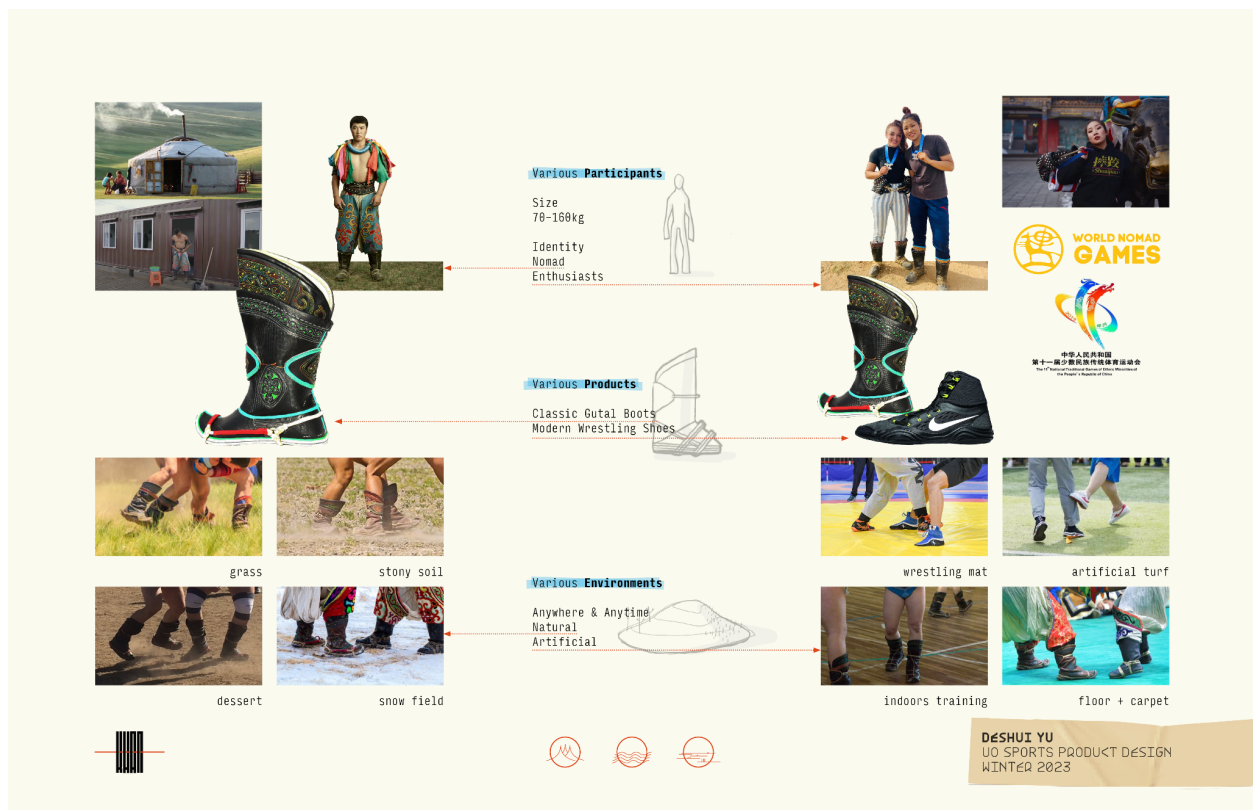


Figure 3. The Variation Types of Users, Products and Environments in Mongolian Wrestling



## Design for Different Genders

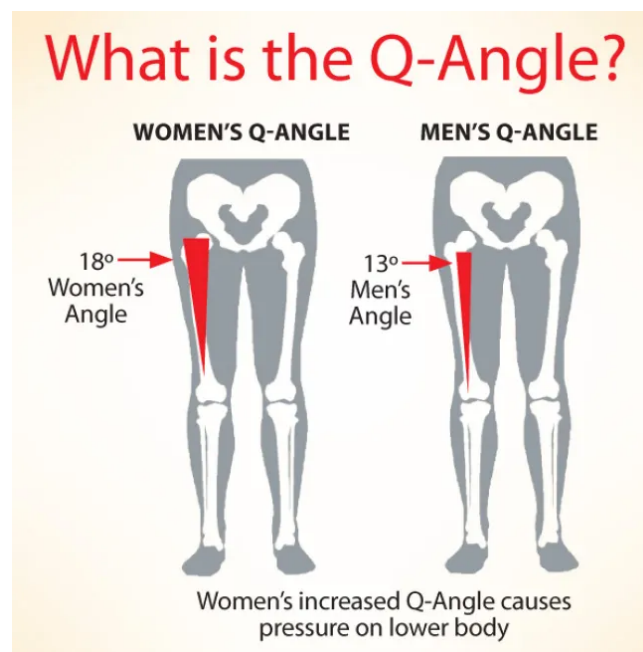
### *Footwear*

The main differences between men's and women's shoes are reflected in the following three aspects:

**Shape:** Women's shoes are wider at the toes and narrower at the heel than men's shoes (Every First Step, n.d.).

**The weight factor:** Since men weigh more than women, the soles of their shoes need to withstand more impact. Because the midsole of women's shoes carries 15% less weight, the midsoles of these shoes will be softer and lighter (Every First Step, n.d.).

**Q-angle:** The Q-angle is the angle of the muscles of the foot, precisely the angle of the quadriceps around the kneecap. Women have a larger Q-angle due to the fact that women have more prominent hips than men. Because of this, they require more support and tend to pronate more. This overpronation could cause women to wear out certain shoe areas (Every First Step, n.d.).



*Figure 4. Q-Angle in Footwear Design***Market**

According to the data in the Fifth Census Report of the National Bureau of Statistics of China, there are 4,247,815 Mongolians in Inner Mongolia, and 30% of them often participate in the sport, which means there are 1.3 million potential users in inner Mongolia (National Bureau of Statistics of China, 2002).

An interesting fact is that the number of wrestlers participating in the Naadam Festival must be a multiple of 8. In Mongolia's summer Naadam festival, 521 athletes will participate. On the unique commemorative anniversary festival, the scale of the competition will be expanded to 1024 players participating in 10 knockout rounds, and only one champion will remain in the end.

**Design Opportunity & Product Classification****Design Opportunity**

As mentioned in previous sections, athletes compete and train in an environment with variable climatic conditions and complex terrain over a year. The traditional leather boots they still wear may hinder their advancement.

Modern wrestling requires athletes to compete on cushioned indoor pads in specially designed wrestling shoes. Wrestling shoes are designed to provide enhanced support and stability for wrestlers' movements, bring better traction to the soles of the feet to prevent slipping due to sweat on the field, and ensure users have a barefoot-like experience. In addition, wrestling shoes can also prevent injuries caused by skin infections and exposed toenails. Since the soft pad in the indoor arena absorbs the impact of the ground, most professional wrestling shoes usually only have an outsole and an insole but no midsole made of foam. In addition, the shoe collar adopts a

high-cut pattern to protect and support the ankle. From the perspective of upper fabrics, flexibility and breathability are the primary features, and warmth retention does not need to be specially considered due to the indoor gymnasium environment with a suitable temperature. But when it comes to open natural terrain, these shoes' thin layers and fragile outsole need more protection and durability. They will break quickly and make the lower limbs of these tremendous athletes bear excessive impact forces, and loads can eventually lead to contusions of the ankles and punctures of the soles of the feet.

Traditional Mongolian leather riding boots are still the only choice for wrestlers today. Made of cotton, felt, and rawhide, these bulky leather boots have roomy interiors, allowing a wrestler's feet plenty of room to relax and promote good ventilation before and after bouts. Wrestlers would use cowhide cords to tie the boot upper to the sole for a better fit and to add traction to the non-patterned flat leather outsole before getting ready to fight. Shoemakers used exaggeratedly shaped symmetrical lasts to apply tension to the pattern, which made the boots not quite fit. In addition, flat soles and lack of ankle support significantly increase the chance of injury.



*Figure 5.* Traditional Mongolian shoe lasts (Inner Mongolia Pictorial, 2019)

To avoid bruises and bone injuries from shin impacts and knee strikes, wrestlers wear leather panels on the lower leg of the boot collar, eventually wrapped with bamboo or wooden strips for protection. Although these additional components provide users with comprehensive and customized cushioning, they invisibly increase the load on the legs and sacrifice much flexibility.



*Figure 6.* Mongolian wrestling boots with shin/knee guards (New Barag Left Banner Culture, Tourism and Sports Bureau, 2020)

### **Golden Circle**

Mongolian wrestling is the only type of outdoor jacket wrestling with shoes. This project will use the consistent approach in my Golden Circle to create innovative, adaptable high-performance protective outdoor wrestling shoes and apparel for athletes.

### **Product Classification**

Indoor wrestling shoe

Outdoor wrestling overshoe module

Protective shin guards

## **Problem Statement**

### ***Footwear***

Utilizing modern construction & technology, how might we make Mongolian wrestling boot adaptive to various environments/calf sizes, and provide better performance in stability, flexibility and traction?

### ***Equipment***

How might we update the shin guards with impact-absorbing material that is lightweight/flexible and integrate them with the wrestling boot?

## **Professional Statement**

The author believes that products and humans should have a symbiotic relationship. To achieve this ultimate goal, the author will devote himself to designing adaptive high-performance wearable products by going deep into the user journey and exploring user behavior/cognitive patterns.

During the development of this and future design projects, the author will organically integrate his five Clifton Strengths into the entire process. In addition, a high degree of completion in Capstone will help him demonstrate to the industry my problem-solving and story-telling skills around design as a graduate of the Sports Product Design program.

## **Clifton Strengths**

The author's 5 Clifton Strengths are:

- Empathy
- Maximizer
- Includer
- Communication

- Connectedness (GALLUP. n.d.)

These strengths will help the author efficiently drive innovation at every stage of the design process. During research and interviews with athletes, Empathy and Includer and Communication will help him put himself in the shoes of users; capture behavioral details that are easily overlooked in the user journey; communicate efficiently through interviews and surveys; and finally, accurately summarize users' insights to locate critical problems and design opportunities. When it comes to the conception stage, Connectedness enables the author to use different products with similar functions as a source of inspiration; Maximizer can push him to conduct practical sketch divergence and prototype iteration.

### **Research Studies & Athlete Skills**

Bökh wrestling is played almost exclusively among Mongolians as a traditional sport with vital cultural attributes. There is very little research into the physiology, biomechanics, and psychology of athletes in this particular genre in the academic field of sports science related to wrestling. Nevertheless, as mentioned in the rules section, like modern Olympic wrestling, Mongolian wrestling is still a sport about keeping balance and the opponent off balance. The most notable difference is in terms of rules. Similarities in movement mechanisms make those studies on Roman wrestling and freestyle wrestling and movement in contemporary wrestling equally valuable to Mongolian wrestling. In the rest of this section, the research and conclusions applicable to the Mongolian genre will be selected from the existing research on modern wrestling, forming an essential reference for later product design.

## **Physiological Research**

### ***Physique and Body Composition***

A significant feature of Mongolian wrestling is that the competition does not limit the weight of the competitors, and the weight of the wrestlers ranges from 60kg to 170kg. The average weight of professional athletes attending the Naadam festival is about 115kg. However, for 2010 All Ethnic Mongolian Wrestling Tournament held in Ulan-Ude, Buryatia, Russia, the organizing committee created two weight classes to divide the competitors: -75kg and +75kg. (*Mongolian Wrestling*, n.d.). Mongolian wrestlers' massive physique and weight place extreme demands on their footwear when competing.

### ***Anaerobic Characteristics***

Strength is the maximum ability to output force independent of exercise time and distance. It depends on the efficiency of the nervous system in mobilizing motor units, the power of the muscle to expend energy [adenosine triphosphate-creatine triphosphate (ATP-PC)] for muscle contraction, and the amount (cross-sectional area) of the muscle contraction. Due to its relationship to cross-sectional area and size, strength is usually analyzed relative to body weight—the relative strength. The absolute strength of heavier wrestlers is greater than that of lighter wrestlers; however, the opposite is true for relative strength (Yoon, 2012). When comparing elite wrestlers to non-professional wrestlers or seasoned wrestlers to novice wrestlers, more power is better. High muscular endurance in an anaerobic energy system is the general physiological trait of a senior wrestler. Anaerobic activity is crucially important, as seen from examining the intensity. In recent years, successful wrestlers' blood lactate concentration has been utilized to measure their anaerobic strength and capacity (Yoon, 2012).



### *Aerobic Characteristics*

Aerobic capacity is an essential physical factor determining whether a wrestler can achieve good results. The  $VO_2$  Max of a wrestler capable of attending international competition is approximately 53 ml/kg/min. During the Seoul Olympics, the typical value for professional wrestlers was around 60 ml/kg/min. However, this value may occasionally exceed 70 ml/kg/min (Yoon, 2012).

**Table III.** Summary of peak oxygen uptake (ml/kg/min) data

Reference	Level	Treadmill	Arm crank	Cycling
Clark et al. <sup>[23]</sup>	23 wrestlers	51.5		
	22 controls	48.0		
Seals and Mullin <sup>[24]</sup>	10 collegiate	62.4	40.6	45.4
Horswill et al. <sup>[25]</sup>	18 high school (adolescent)	53.0	41.0	
Sharratt et al. <sup>[16]</sup>	Canadian freestyle	61.8		
Song and Garvie <sup>[8]</sup>	Seniors			
	15 Canadian			54.5
	19 Japanese			55.6
Yoon and Jun <sup>[12]</sup>	Seniors <sup>a</sup> 21 Korean	60.24		

**a** Mean age 23 years, mean duration of career 9 years.

*Figure 7.* Summary of peak oxygen uptake (ml/kg/min) (Yoon, 2012)

Regarding pulmonary system function in wrestlers, the average minute ventilation of their lungs fluctuated between 129 L/min and 156.6 L/min during maximal aerobic exercise. Wrestlers' lung volume and function are above non-athlete levels but average among other trained athletes. As a kind of martial art, Mongolian wrestling also requires athletes to have considerable flexibility. Flexibility refers to the maximum range of motion of an athlete's

particular joint or joint system during exercise. In addition to helping athletes perform various movements accurately and quickly, flexibility is an important protection to help them avoid injury and pain. Surprisingly, the flexibility of wrestlers is not far above the level of ordinary people. Wrestlers have more muscular shoulder and neck rotation and abduction/adduction than nonathletes. However, wrist flexibility is below the level of ordinary people (Yoon, 2012).

### Biomechanical Research

As mentioned above, Mongolian wrestling has a high degree of consistency with modern wrestling regarding technical body movements. This project investigates the classification of movements in modern wrestling and normative standards in different contexts. In general, wrestling includes 15 movements, divided into four categories according to different wrestling postures and mechanical movement states. In the par-terre position, the defensive wrestler lies on his stomach in the center of the ring, with his arms and feet outstretched, and is pressed against the ground by his opponent. This position does not appear in Mongolian wrestling because the passive side will be directly judged as a failure. Therefore this scenario will not be considered part of the analysis (López-González, 2013).

WRESTLING POSITION	Standing Position		Par-Terre Position	
GROUPS	Shifts	Throws	Turning over exposures	Lifts
<b>TECHNICAL BODY MOVEMENTS</b>	1) Shift forward 2) Shift sideways 3) Shift in rotation 4) Take down	5) Body drop 6) Hip toss 7) Lift and swing 8) Suplex	9) Forward roll 10) Turn 11) Backwards tilt 12) Bridging 13) Arched	14) Lift and tilt 15) Lift and suplex

Figure 8. Body Movements Classification (López-González, 2013)

Strategic techniques are divided into two broad categories, active and reactive, in which they are subdivided into seven different tactical means. Athletes will quickly decide which method to attack or defend by judging the competitive situation (López-González, 2013).

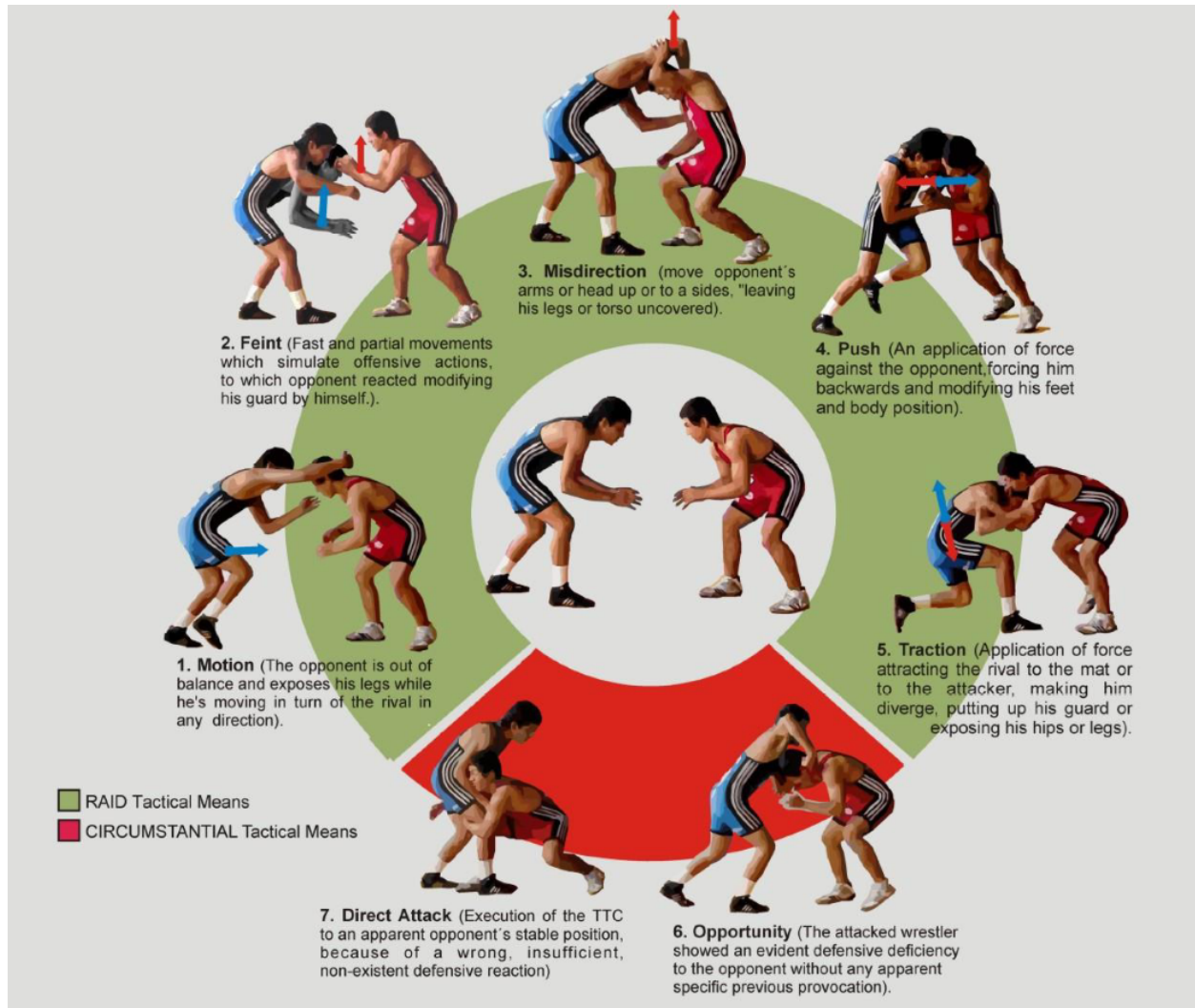


Figure 9. Tactical Means classification (López-González, 2013)

## **Psychological Research**

### ***Quick Response***

Wrestling is a sport that produces frequent and intense confrontations in a short time, which requires athletes to have fast enough reflexes and explosive muscles to switch between offensive and defensive postures (López-González, 2013).

### ***High Concentration***

Due to the limited physical strength of the athletes on both sides, the wrestler will try to seize any openings in the opponent and knock him to the ground. Therefore, wrestlers must maintain a high concentration during the competition and analyze the situation information on the court in time (López-González, 2013).

### ***Energy Management***

Since the competition has no time limit. Wrestlers need to develop enough stamina and use strategic force during the confrontation to avoid exhaustion and loss of balance (López-González, 2013).

### ***Technical Skills***

Field experience and active training are essential for wrestlers to control the game. In addition, they must learn to form sufficient technical knowledge to be well-prepared for different attack styles(López-González, 2013).

### ***Stress Resistance***

Wrestling involves a fierce psychological confrontation between two athletes. Wrestlers must withstand the pressure and make judgments when faced with much information (López-González, 2013).

## **Research Methods**

In order to obtain more specific and reliable sports data and facts related to professional Mongolian wrestling, the research will base on the research tools and methods mentioned in the book "Research Methods for Product Design." (Milton & Rodgers, 2013).

To establish an initial understanding of the current state of the sport as a whole, the research process began with ethnographic research and shadowing methods. This project will observe the daily training life of wrestlers and summarize the differences in wrestling experience in indoor and outdoor environments. The observation will focus on interaction patterns between users and wearable products and the adaptability of the product to the environment. Information and data such as images, materials, and behavior patterns will form a database for problem positioning and design opportunity discovery.

On top of this, athletes will receive product experience-centric questionnaires to provide in-depth user-perspective competitor analysis and expectations for future designs.

In response to the feedback received from the questionnaire, the project will organize further user interviews to more intuitively perceive and record users' positive and negative emotions in the process of using the product to clearly define the real needs of athletes and the design basis.

## **Product Anatomy & Materials & Manufacturing & Jobs to be Done**

### **Traditional Mongolian Wrestling Products Anatomy**

In contemporary times, Mongolian wrestlers wear modern shoes to train indoors on wrestling mats but still wear traditional Mongolian leather boots for official competitions outdoors. In this section, this project will research and analyze the styles, hand-made process,

and composition of conventional Mongolian boots to understand the needs and experiences of the wearers.

Wrestlers' leather boots have two styles: Inner Mongolian and Mongolian styles. Most athletes wear Mongolian boots that have upturned tips. Because Inner Mongolian rules allow athletes to sweep their legs to attack the opponent's lower body, the Inner Mongolian style has a rounded toe section, which allows for more rapid leg movements (Pulido, 2021). In addition, a loose upper fit allows more airflow to keep wrestlers cool on hot summer days. When the game starts, athletes wrap durable leather straps around the boots to tighten around the ankle and instep for traction and more fitness.



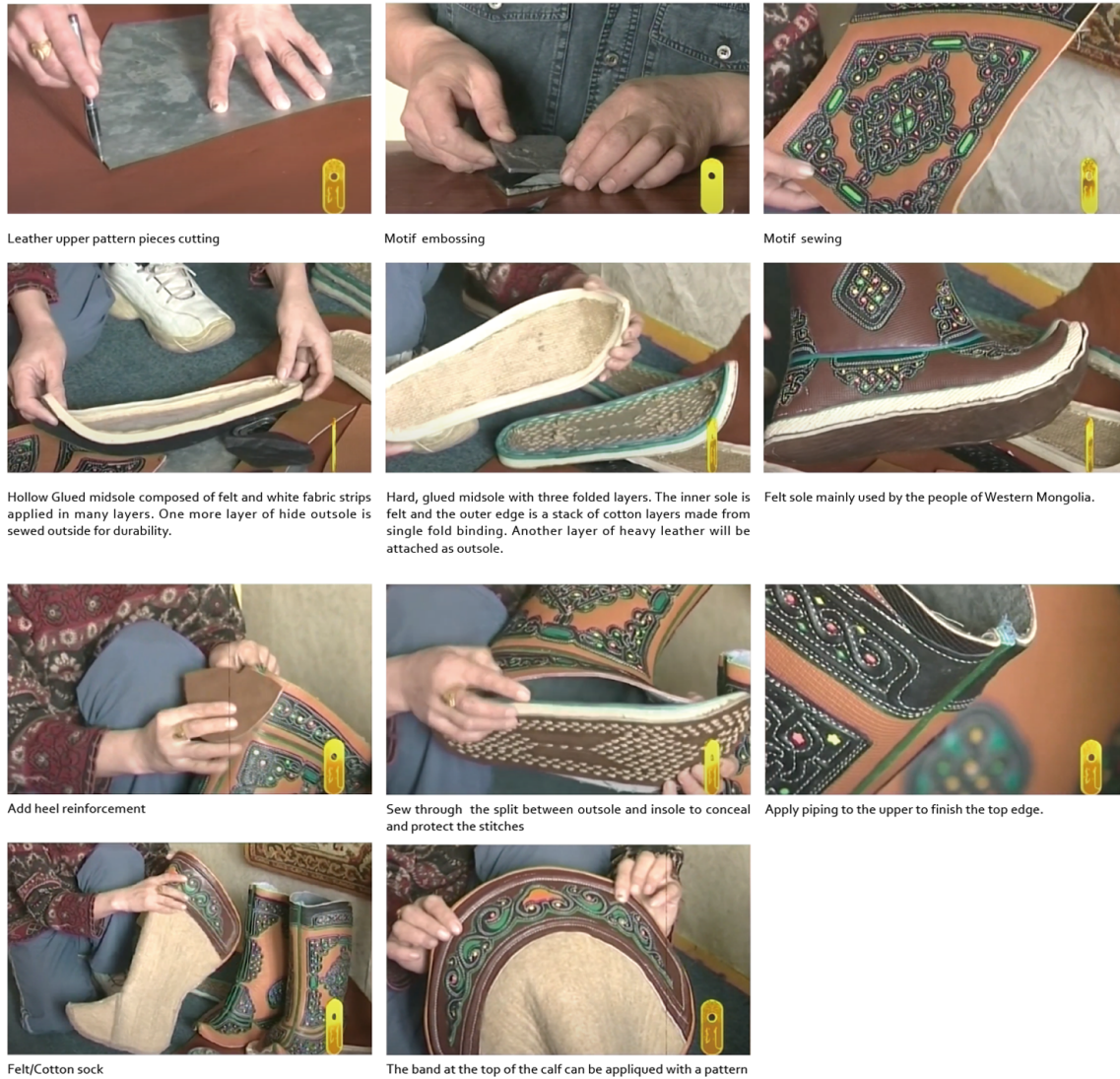


Figure 10. Inner Mongolian Style Boot and Straps



Figure 11. Mongolian Style Wrestling Boot and Components

The artisans mainly handcraft the upper and wear-resistant outsole from raw cowhide, then install them with the midsole composed of felt and cotton layers (MNB WORLD, 2020).



*Figure 12.* Making Process of Mongolian Style Wrestling Boot (MNB WORLD, 2020)

Mongolian wrestling is a form of jacket wrestling or belt-and-jacket wrestling. Both sides will try to grab the other's sleeves and collar edges or waistbands to gain control and eventually throw or trip the other to lose balance (New World Encyclopedia, n.d.).



## **Modern Wrestling Footwear Anatomy & Manufacturing**

### ***Footwear***

As mentioned in the Design Opportunities section above, modern indoor wrestling shoes' design follows a minimalist, lightweight design, and the main components and production processes are no different from mainstream sports shoes. Key components include a breathable and mobile high-cut upper, sewn and glued to a thin outsole for traction. The collar that can be tightened and the heel/toe reinforcement between the upper and the lining provide sufficient ankle support and long-lasting protection for athletes. The cushions used in wrestling or the dojo mats laid in some training gyms have replaced the function of the shoe midsole. A single layer of EVA foam insole is placed over the footbed for comfort. It is a pity that State-of-the-art products related to the ancient sport of wrestling have not seen remarkable innovations in materials and manufacturing in recent years. Even Nike, which has always been known for its bold innovations, only uses Flyknit technology on the Nike TAWA wrestling shoes launched in 2020. The Flyknit knitted upper can provide a variety of required tension and breathing capabilities in different areas (NIKE, 2020). However, it has received few positive reviews since it was on the market. Materials like suede, engineered mesh, and classic rubber outsoles seem more reliable options for wrestlers. This nostalgic market may also be why products in this category are hesitant to promote innovation.

### ***Upper material preparation and cutting***

Rolls of various shoe upper materials are transported to the factory. These natural, synthetic fabrics or polymers are cut into required shapes of different sizes by stamping dies. The notch cut at the edge of the corresponding position can guide the workers to align and assemble the patterns of different layers in the later stage. In the case of wrestling shoes, the thin outsole is

also die-cut from a large piece of rubber and then put into a mold to create the traction pattern (How Products are Made, n.d.).

### *Assembly of upper and sole*

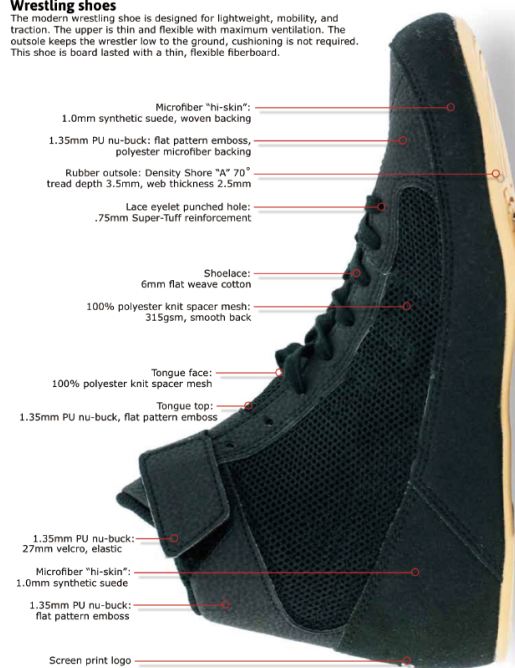
Components such as toe reinforcements, heel counters, and tongues are assembled with stitches and glue to create a flattened upper. The finished upper is heated and stretched to fit on the last. The stamping machine will cut the eyelets on top of the eyestay. The workers will then use a Strobel machine to sew the upper with a paper fiberboard called a lasting board and then glue it to the outsole, and a pair of shoes will take shape (How Products are Made, n.d.).

### *Quality Control*

Finished shoes are tested at the factory using an inspection process developed by the Shoe and Allied Trades Research Association. Factory inspectors will check the shoes for incorrect stitching, loose glue, or deformities. After the defective products are screened, the shoes are packaged and sent to the market and warehouse (How Products are Made, n.d.).

#### **Wrestling shoes**

The modern wrestling shoe is designed for lightweight, mobility, and traction. The upper is thin and flexible with maximum ventilation. The outsole keeps the wrestler low to the ground, cushioning is not required. This shoe is board lasted with a thin, flexible fiberboard.



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*Figure 13. Modern wrestling shoe anatomy (Motawi, 2018, #)*

### ***Shin Guard***

In combat sports such as MMA, kickboxing, or Muay Thai that emphasize kicking attacks, shin guards are essential for athletes. Although the leg-sweeping movements in Mongolian wrestling are not as violent as the kicks in the above-mentioned martial arts, these products can still be used as inspiration for the design (How Products are Made, n.d.).

Shin guards are mainly composed of multiple gel or foam cushioning layers inside, outer fabric or polyurethane leather backing/shell, and strap loops. The preferred strap material is Velcro for quick adjustment and donning by the athlete. These parts are assembled by sewing or heat pressing (How Products are Made, n.d.).

### ***Material Preparation***

A hot die-cutting machine will cut the polyurethane sheets into the shape of backing and shell. Gel or EVA foam for cushioning can be die-cut or cast-molded into more organic shapes to fit users' legs.

### ***Assembly of Parts***

Polyurethane backing and shell will be assembled together by sewing or heat pressing with layers of gel/foam cushioning and velcro straps in the middle.



*Figure 14.* Modern martial arts shin guard anatomy

### **Competitor Landscape SWOT Analysis**

As mentioned in the previous section, Mongolian wrestlers only have Inner Mongolian and Outer Mongolian style boots to choose from, and there are no other traditional shoe competitors on the market. Except for the shape of the outsole, the material production and processing of the two are precisely the same. Most of the shin guards used by Mongolian wrestlers are self-made or in the form of hard leather plates extended on the inner bootie. The SWOT analysis of this will be included in the footwear part.

The main baseline product of this project will only be traditional Mongolian leather boots, but contemporary wrestling shoes will also be analyzed as benchmarking products to provide performance reference for future designs.

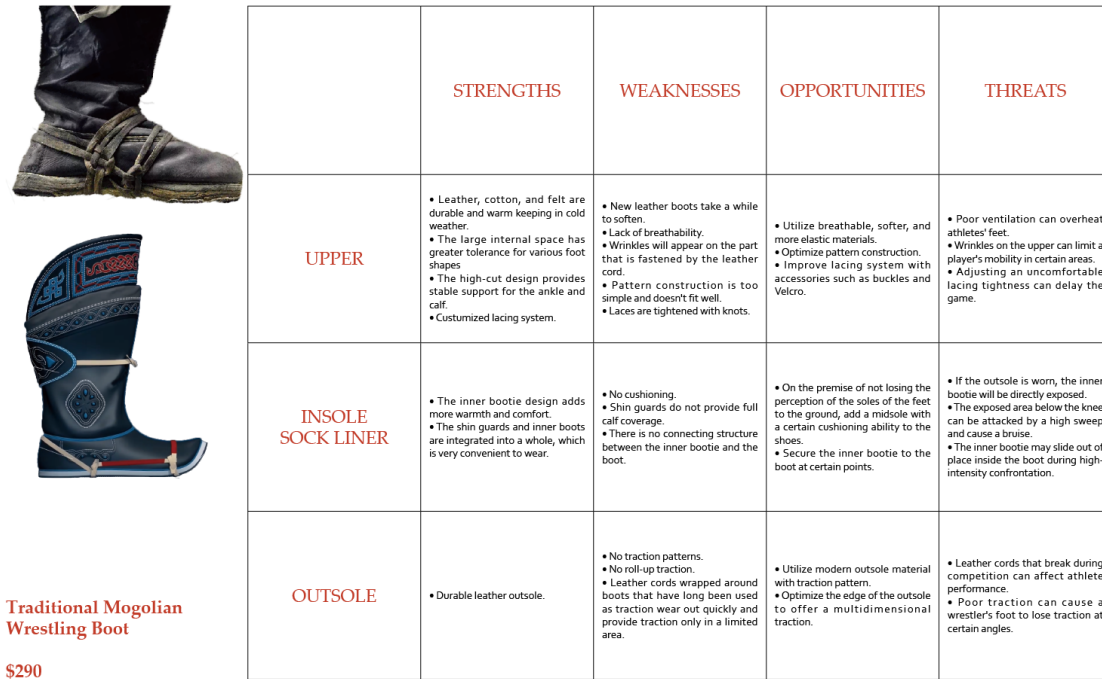


Figure 15. Traditional Mongolian wrestling boots

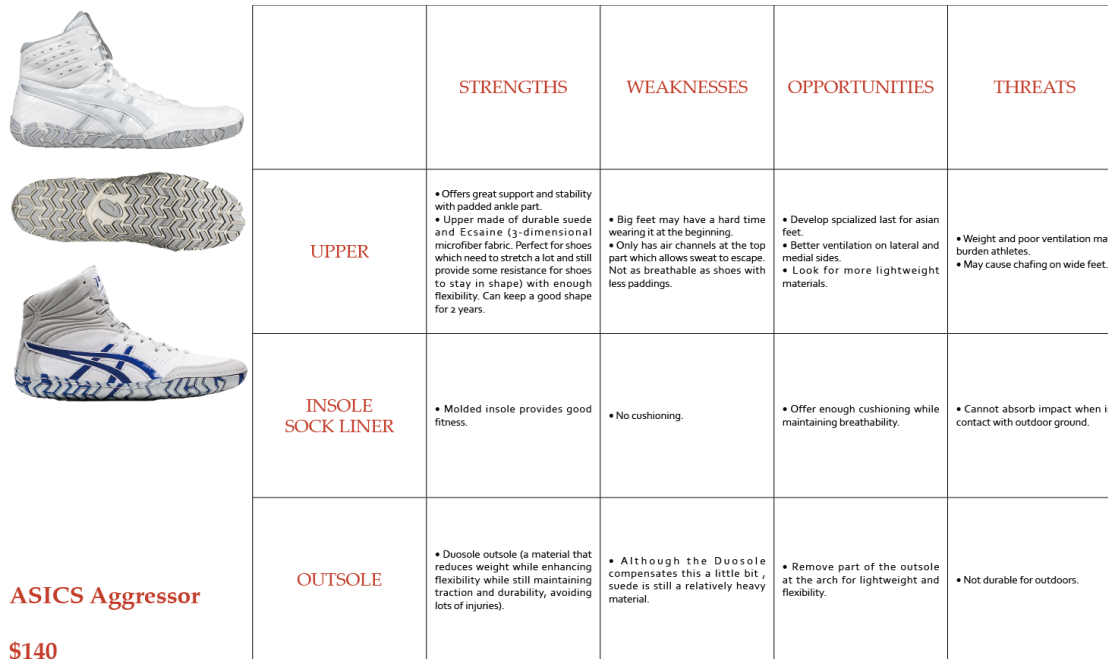


Figure 16. ASICS Aggressor wrestling shoe (ASICS, 2022)



**ADIDAS adiZero**  
\$155

	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
UPPER	<ul style="list-style-type: none"> <li>Lightweight construction great for fast-paced wrestling.</li> <li>Breathable and flexible material.</li> <li>Great for sliding and a fast shoot.</li> <li>The synthetic mesh dries out quickly.</li> </ul>	<ul style="list-style-type: none"> <li>Shows dirt easily</li> </ul>	<ul style="list-style-type: none"> <li>Use easier-to-clean and warm keeping fabrics on uppers.</li> </ul>	<ul style="list-style-type: none"> <li>Too thin material will make the athlete's feet cold and slow down the reaction.</li> </ul>
INSOLE SOCK LINER	<ul style="list-style-type: none"> <li>Molded insole provides good fitness.</li> </ul>	<ul style="list-style-type: none"> <li>No cushioning.</li> </ul>	<ul style="list-style-type: none"> <li>Add midsole or innerbootie for more cushioning.</li> </ul>	<ul style="list-style-type: none"> <li>Not durable for outdoors.</li> </ul>
OUTSOLE	<ul style="list-style-type: none"> <li>Excellent grip on rubber sole</li> <li>Great for sliding and a fast shoot.</li> </ul>	<ul style="list-style-type: none"> <li>Does not have traction pattern for movements of ball of the foot</li> </ul>	<ul style="list-style-type: none"> <li>Redesign the connection part of forefoot and heel.</li> </ul>	<ul style="list-style-type: none"> <li>Upper may wear out before outsole.</li> </ul>

Figure 17. ADIDAS adiZero wrestling shoe (ADIDAS, 2022)



**NIKE Tawa**  
\$155

	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
UPPER	<ul style="list-style-type: none"> <li>Zonal stretch and lockout provides a seamless fit through a wide ranges of motion.</li> <li>Strategically placed ventilations zones offer cooling and lightweight performance.</li> <li>Velcro on the tongue keeps the lace head in place.</li> <li>Flyknit upper with no pinch points at toe area.</li> </ul>	<ul style="list-style-type: none"> <li>Not friendly for wide foot.</li> </ul>	<ul style="list-style-type: none"> <li>Develop specialized last for asian feet.</li> <li>Better ventilation on lateral and medial sides.</li> <li>Look for more lightweight materials.</li> </ul>	<ul style="list-style-type: none"> <li>Weight and poor ventilation may burden athletes.</li> <li>May cause chafing on wide feet.</li> </ul>
INSOLE SOCK LINER	<ul style="list-style-type: none"> <li>Molded insole provides good fitness.</li> </ul>	<ul style="list-style-type: none"> <li>No cushioning.</li> </ul>	<ul style="list-style-type: none"> <li>Add midsole or innerbootie for more cushioning.</li> </ul>	<ul style="list-style-type: none"> <li>Cannot absorb impact when in contact with outdoor ground.</li> </ul>
OUTSOLE	<ul style="list-style-type: none"> <li>Soles are divided into two parts and each part of the sole is made of different rubber. More comfortness and mimics the feel of walking barefoot.</li> <li>Outsole rolls over the toe cap for greater traction.</li> </ul>	<ul style="list-style-type: none"> <li>Toe may easily come unglued/unstitched.</li> <li>Back of the shoe is a little too high. When laced up all the way and snugly, the back top of the shoe eventually feels as if it's cutting into the area above the Achilles tendon.</li> </ul>	<ul style="list-style-type: none"> <li>Separate the heel stabilizer and heel part.</li> <li>Enhance the attachment of forefoot outsole at toe area.</li> </ul>	<ul style="list-style-type: none"> <li>The rigid upturned heel counter and outsole built in one piece can cause heel chafing.</li> <li>The forefoot outsole may trip the athlete if sole comes off during competition or training.</li> </ul>

Figure 18. NIKE Tawa wrestling shoe (NIKE, 2022)



**NIKE Hypersweep**  
\$160

	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
UPPER	<ul style="list-style-type: none"> <li>2 ply large hole mesh to aid in regulating temperature inside the shoe and to aid in drying after sweat workouts. Dynamic Flywire technology that keeps your foot locked down and stabilized during quick moves. Internal ankle support strapping and protection skeleton.</li> <li>Asymmetrical lacing system designed to facilitate easy foot entry and exit.</li> <li>Dynamic Flywire technology that keeps feet locked down and stabilized during quick moves. Internal ankle support strapping and protection skeleton.</li> </ul>	<ul style="list-style-type: none"> <li>Not much room in lace garage.</li> <li>Not friendly for wide foot.</li> </ul>	<ul style="list-style-type: none"> <li>Improve the asymmetrical lacing design according to sweeping movements.</li> <li>Apply padding on medial side.</li> <li>Reconsider the location and form of the lace garage.</li> </ul>	<ul style="list-style-type: none"> <li>Hurts wide foot at first and never breaks in.</li> </ul>
INSOLE SOCK LINER	<ul style="list-style-type: none"> <li>Single layer insole.</li> </ul>	<ul style="list-style-type: none"> <li>No cushioning.</li> </ul>	<ul style="list-style-type: none"> <li>Add midsole or innerbootie for more cushioning.</li> </ul>	<ul style="list-style-type: none"> <li>Cannot absorb impact when in contact with outdoor ground.</li> </ul>
OUTSOLE	<ul style="list-style-type: none"> <li>Made with less outsole rubber than traditional wrestling shoes, the Nike Hypersweep offers enhanced flexibility yet maintains the traction required for the most demanding movements in wrestling.</li> <li>Organic traction pattern for critical launch points.</li> </ul>	<ul style="list-style-type: none"> <li>The thin, lightweight outsole can be broken after 1 year wearing.</li> </ul>	<ul style="list-style-type: none"> <li>Use more durable and thicker outsole material.</li> <li>Enhance the traction zones.</li> </ul>	<ul style="list-style-type: none"> <li>Extremely not durable for outdoors.</li> </ul>

Figure 19. NIKE Hypersweep wrestling shoe (NIKE, 2022)



**RUDIS**  
**Sole Covers**  
\$45

- STRENGTHS**
- Quickly slips over wrestling shoes to save transition time and prevents damage to and from the mat.
  - EVA material stretches for perfect fit and durability.
  - Provides needed traction on hard surfaces to protect against slips and falls.
- WEAKNESSES**
- Without additional attachment on vamp area, shoe may fall off or slip inside the cover.
  - Can be clumsy for sweeping movements.
- OPPORTUNITIES**
- Add more reinforcements on vamp area.
  - Design the form as a frame structure for better fitness and flexibility.
- THREATS**
- Disintegration during games may trip wrestlers

Figure 20. RUDIS Sole Covers (RUDIS, 2022)

RUDIS is an exception among all competitors. Since wrestlers have a variety of venues for daily training, the one-piece overshoe designed by the RUDIS team can save time for changing shoes and avoid damage to or from different kinds of mats (RUDIS, 2022).

**Shin Guard SWOT Analysis**



0.59 Kilograms  
17.2 x 6.6 x 1.8 inches  
Syntek Leather

**Fairtex Competition  
Muay Thai Shin Guards**

\$84.99

	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
SHELL	<ul style="list-style-type: none"> <li>High-quality synthetic leather (comparable to real leather).</li> <li>Excellent protection used by muay thai trainers all over Thailand.</li> <li>Amazingly well-fitting.</li> <li>Wide range of sizes.</li> </ul>	<ul style="list-style-type: none"> <li>Can move around a bit during hard sparring.</li> <li>Doesn't fit the calves of some huge mongolian wrestlers.</li> </ul>	<ul style="list-style-type: none"> <li>Refine the strap loop.</li> <li>Use non-slip material on the interior.</li> <li>Integrate the shin guards into shoes.</li> </ul>	<ul style="list-style-type: none"> <li>Can become misaligned during competition and affect athlete performance.</li> </ul>
CUSHIONING	<ul style="list-style-type: none"> <li>Shock-absorbing, high-density foam core.</li> <li>Separate instep and shin pieces to allow for optimal protection.</li> </ul>	<ul style="list-style-type: none"> <li>The cushion does not have an organic form.</li> <li>Too much cushioning for Mongolian wrestling.</li> </ul>	<ul style="list-style-type: none"> <li>Use injection molded cushioning material to remove bulky parts while reducing weight.</li> </ul>	<ul style="list-style-type: none"> <li>Full tibia coverage may limit muscle contraction and extension.</li> </ul>

Figure 21. Fairtex Competition Muay Thai shin guards



3.8 Kilograms  
10 x 8 x 5 inches  
Leather

**Yokkao Matrix  
Muay Thai Shin Guards**

\$131

	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
SHELL	<ul style="list-style-type: none"> <li>High-quality microfiber leather offers superior tear-resistance, breath ability and easy maintenance.</li> <li>Stress-resistant closure straps.</li> <li>Non-slip interior for secured stability during intense training sessions.</li> <li>Impressive mobility.</li> </ul>	<ul style="list-style-type: none"> <li>Instep can sometimes cause user to trip.</li> <li>Doesn't fit the calves of some huge mongolian wrestlers.</li> </ul>	<ul style="list-style-type: none"> <li>Use lighter materials to reduce overall weight.</li> </ul>	<ul style="list-style-type: none"> <li>Weight may burden athletes.</li> </ul>
CUSHIONING	<ul style="list-style-type: none"> <li>Offers complete protection during contact sports from users' knees down to feet.</li> </ul>	<ul style="list-style-type: none"> <li>Too much cushioning for Mongolian wrestling.</li> <li>Too heavy.</li> </ul>	<ul style="list-style-type: none"> <li>Distribute cushioning material where it is most critical for more flexibility.</li> <li>Use injection molded cushioning material to remove bulky parts while reducing weight.</li> </ul>	<ul style="list-style-type: none"> <li>Less elastic shell may limit ankle mobility.</li> </ul>

Figure 22. Yokkao Matrix Muay Thai shin guards





0.84 Kilograms  
19 x 9.3 x 5.5 inches  
Polyurethane

Venum Elite  
Shin Guards

\$84

	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
SHELL	<ul style="list-style-type: none"> <li>• Eye-catching graphic design.</li> <li>• Streamlined, lightweight build.</li> <li>• Excellent mobility.</li> <li>• Velcro loop and lock system.</li> </ul>	<ul style="list-style-type: none"> <li>• Some people find the ankle strap cuts off circulation.</li> <li>• Slightly uncomfortable for certain leg types.</li> </ul>	<ul style="list-style-type: none"> <li>• Refine the strap attachments.</li> <li>• Make the strap more adjustable.</li> </ul>	<ul style="list-style-type: none"> <li>• Can cause poor blood circulation in the athlete's calf.</li> </ul>
CUSHIONING	<ul style="list-style-type: none"> <li>• Organically placed cushioning offers excellent instep protection.</li> <li>• Full shin protection.</li> </ul>	<ul style="list-style-type: none"> <li>• No knee protection.</li> <li>• Too huge for Mongolian wrestling.</li> </ul>	<ul style="list-style-type: none"> <li>• Raise and extend the upper end of the guard to the knee.</li> </ul>	<ul style="list-style-type: none"> <li>• May cause injuries when a wrestler lands on his knees.</li> </ul>

Figure 23. Venum Elite shin guards

**Jobs to be Done**

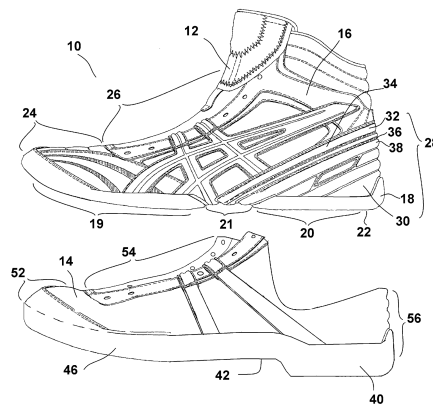
To bring down the opponent in the shortest possible time, Mongolian wrestling includes intense hand fighting, foot movements, and sweeps. In addition, this sport's unique terrain and climate characteristics require all innovative product components to work together. Some potentially critical jobs to be done would be:

**Footwear & Shin guard**

Shoe last	Adjust the shape for Asian foot characteristics
Upper	Ankle support and protection. Utilize breathable, softer, and more elastic materials. Flexibility in bending areas. High tolerance for different calf sizes. Secure the inner bootie to the boot at certain points.
Tongue	Apply gusseted construction to resist the sand and stones lifted by the sole from falling into

	the shoe.
Lacing system	Easy-to-adjust tighten/loosen. Apply laces/straps with enhanced durability. Be located away from the contact surface of the sweeping leg movements.
Midsole	Sufficient energy absorption capacity. Eliminate discomfort from possible stones on the sole of the shoe.
Insole	Arch support. Shape differently for more support and overpronation for female users.
Outsole	High durability. Optimize the edge of the outsole to offer multidimensional traction.
Shin guard	Easy-to-adjust strap system. Lightweight. Flexibility at pinch points. Integrate with wrestling shoes as a whole.

### Intellectual Property and Patent Landscape

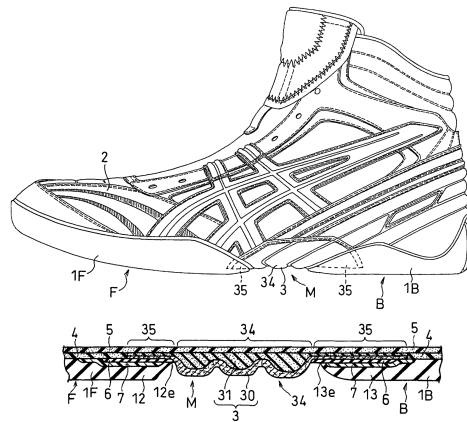


Wrestling shoe assembly that includes an auxiliary overshoe

(U.S. Patent No.: US 9,173,448 B1, 2015)

This patent, published by Eric Knoblauch, contains a specially designed overshoe accessory for wrestling shoes. Wrestlers can wear overshoes with padded midsoles over

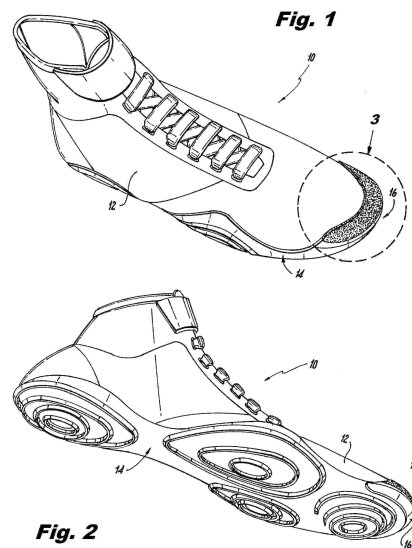
wrestling shoes without a cushioning structure, allowing them to train on softer surfaces without changing shoes. The overshoe's surface precisely engages the wrestling shoe's outer contour and provides enhanced fit and traction (Knoblauch, 2015).



#### Wrestling shoe with separated outer soles

(U.S. Patent No.: US 7,325,336 B2 2008)

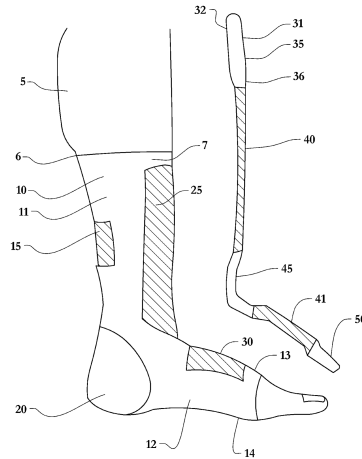
This patent was published by Yoshio Yamashita, Hidenori Yamashita, and Yasuhiro Morikawa. The design is for a wrestling shoe with a separated outsole developed by Asics. The outsole of the forefoot and heel portion protrudes more than the outer surface of the arch to support the front and rear feet when contacting the court floor. Laminated cushioning material is added to the inside near the arch to help absorb the reaction force of the ground (Yamashita et al., 2008).



Wrestling shoe with textile on toe cap

(U.S. Pub. No.: US 2016/0242500 A1)

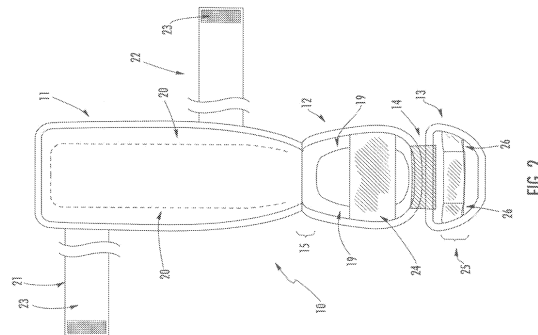
This patent, published by Elizabeth Langvin and Nadia Panian, demonstrates a process for manufacturing a toe reinforcement part. The reinforcing parts can be manufactured integrally with the outsole of the wrestling shoe. After the elastic upper and outsole are integrally molded, a layer of fibers in the form of a mesh is glued to the outer surface of the toe cap under sufficient temperature and pressure conditions. The elastic material near the reinforcing part will be cured. This area allows for better durability when the wrestler's toes rub against the ground (Langvin & Panian, 2016).



### Martial Arts Shin Guard

(U.S. Pub. No.: US 2014/0215678 A1, 2014)

This patent was invented by Eric A. Greenbaum. It covers a two-piece shin guard and martial arts sock system. On the outer surface of the socks, there are connection points corresponding to the inside of the shin guards. The two fixing methods of velcro and straps can make the shin guards fit better on the calf and instep. The specially cut sock shape precisely matches the contours of the shin guard, allowing for more flexibility (Greenbaum, 2014).

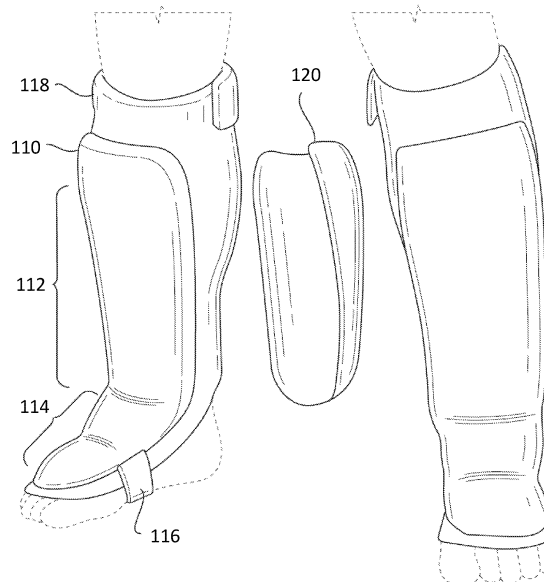


### Protective Article

(U.S. Patent No.: US 2008/0120756 A1, 2008)

This patent, invented by Steven H. Shepherd, covers a three-piece martial arts shin guard. This product mainly comprises a shin protection pad, a midfoot protection pad, and a toe

protection pad. The tibia part is fixed on the user's lower leg with straps; the midfoot and toe part is equipped with elastic straps for the user to step on to ensure mobility (Shepherd, 2008).



Mixed martial arts shin guard and detachable training calf pad

(U.S. Pub. No.: US 2022/0040556 A1, 2022)

This patent, invented by Nabih Barakat, covers a solution that adds EVA or silicon calf cushioning to standard shin guards to prevent back attacks. The calf guard can also be used independently after being detached from the main shin guard (Barakat, 2022).

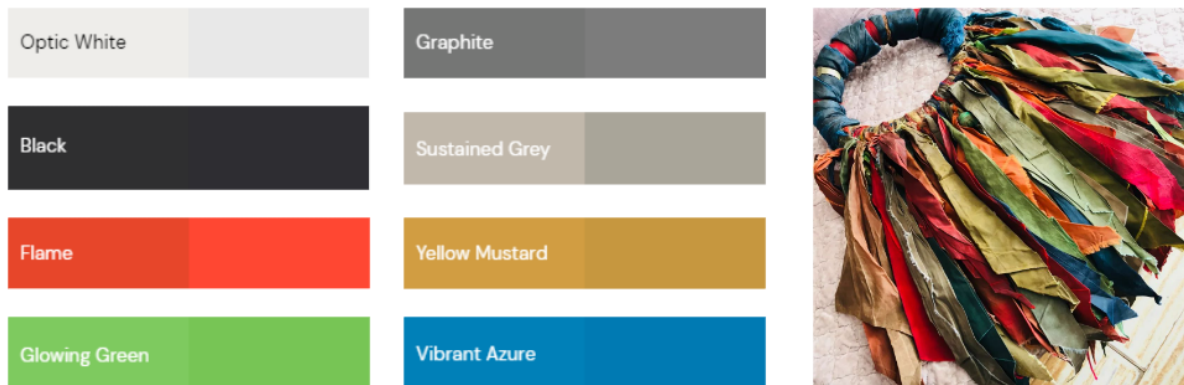
### **Trend Analysis**

#### **Color Trends**

This project will focus on providing a series of modern performance equipment for a traditional minority sport. The aesthetic elements displayed through color, graphics, and branding will try to retain cultural symbols moderately while adding changes that are more in line with the trend. The classic Mongolian boots are made of durable natural leather and felt. Rich and warm earth tones are the perfect base color for the raw strength and earthy solidity of the sport. On top of this, Mongolian traditional costumes are also keen to use high-saturation

colors to show herdsmen's vigorous vitality and enthusiasm. Wrestlers wear necklaces called Jangga, which symbolize their rank, decorated with colorful ribbons representing the number of victories. Bold and bright red, yellow, green, and blue are also used as accent colors to place on the technology area of the product that needs to be emphasized (Bokhin Ayin, n.d.).

In the color forecast 24/25 A/W report of WGSN, the high-contrast vibrant colors coincide with the palette of traditional Mongolian products. These exciting and high-profile colors will be used as the embellishment colors of this project (Kostiak, 2022).



**High-contrast brights**

Ignite energy, creativity and expression through contrasting brights.

**Why are they key?** This palette is exuberant and uplifting, facilitating self-expression and joy in the face of upheaval and uncertainty.

**How to use them:** the combination of multiple strong colours will work for lively prints, ombré effects and layered colours inspired by digital design. Use this palette for endurance sports, snow sports and lifestyle categories.

A. Cyber Lime	E. Electric Kumquat
B. Black	F. Gentian Blue
C. Crimson	G. Gentle Lavender
D. Pollen Yellow	H. Peony Pink

Coloro - A: 051-76-36, B: 153-19-00, C: 010-38-36, D: 037-77-37, E: 028-67-41, F: 118-30-29, G: 138-81-07, H: 150-65-19  
 Pantone - A: 13-0651 TCX, B: 19-4203 TCX, C: 18-1657 TCX, D: 13-0752 TCX, E: 15-1164 TCX, F: 19-4056 TCX, G: 14-3710 TCX, H: 16-2614 TCX



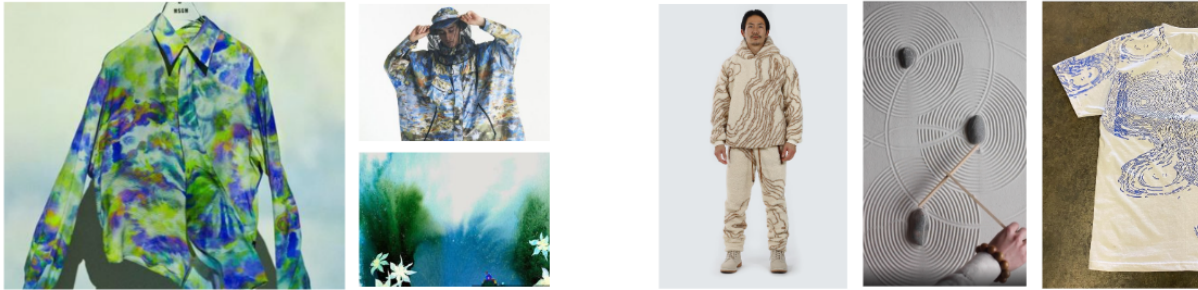
## Graphic Trends

As mentioned above, nomadic life and nature worship are the core of Mongolian culture. Mongolian wrestling competitions are still played on the most primitive grass outdoors. In addition to being a sport, Mongolian wrestling can also be seen as a form of training for herders to practice their survival skills in subduing livestock such as sheep, which contains ancient survival philosophies. For the printing graphic design of this project, camouflage patterns in the natural landscape will be selected to create the impression of grassland. The calming curves and swirling lines drawn from the organically flowing landscape contours also reflect the serene and timeless side of the sport.

On traditional leather products, the maker will cut out a hollow structure imitating the multi-curved, interlaced, and geometrically beautiful national patterns and then embed colorful decorative pieces as the background to set off the pattern (Gerelee, 2020). This project will try to combine future pattern designs with this craft to ensure cultural inheritance and innovation.







### Branding Trends

In current products, artisans will emboss patterns or signatures representing personal brands on the hard leather badge on the back of the jacket and boot decorations. In recent years, deconstructed and reconstructed logo design printing has become mainstream. The classic pattern is recreated by means of repetition, gradient, and contrast through the principle of plane composition, which brings a new look and feels to the brand image. At the same time, since the advent of the first generation of Airmax running shoes, sports companies have been using a high-profile way to intuitively present the technology used in the product to users. For example, design dedicated fonts and flat icons for different technologies to improve recognition or cut small windows on the outsole to guide users to feel how soft the midsole cushioning material is with their fingers. These practices provide marketing topics and make it easier for brands to spread.



### **Avoidance of Cultural Appropriation**

Since the research object of this project has a strong connection with the culture of a specific ethnic minority, it is very important to prevent the problem of cultural appropriation during the design process. According to the explanation of Wikipedia's definition of cultural appropriation:

Cultural appropriation is the inappropriate or unacknowledged adoption of an element or elements of one culture or identity by members of another culture or identity. This can be controversial when members of a dominant culture appropriate from minority cultures (Shriver, n.d.).

This project will follow the 5 Ways to Avoid Cultural Appropriation for design mentioned in “How to Avoid Cultural Appropriation & Promote Cultural Awareness Instead” (Culture Vulture, n.d.).

### **Research the Culture**



### **Avoid the Sacred**



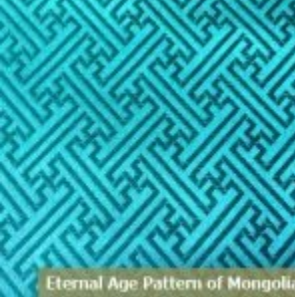


### **Don't Stereotype**



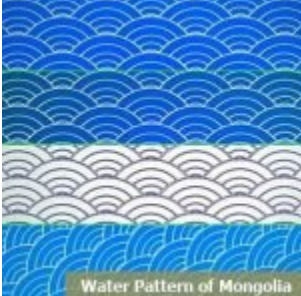
### **Promote Diversity**

### **Engage, Promote & Share Benefits**

This project investigates Mongolian motifs that may be used for inspiration in the graphic and branding design process, and sacred graphics with religious attributes will be avoided. Some common graphics that are often used in people's daily life and have other rich connotations include (Gerelee, 2020):

<p>Ulzii pattern – Represents the growth of knowledge, wealth, happiness and good karma</p>	 <p>Ulzii Pattern of Mongolia</p>
<p>Horn pattern – Symbolizes growth of livestock and happiness of nomadic people</p>	 <p>Horn Pattern of Mongolia</p>

<p>Hammer pattern – Represents endless motion and eternal life</p>	 <p>Hammer Pattern of Mongolia</p>
<p>Khorol pattern – Represents sturdiness</p>	 <p>Khorol Pattern of Mongolia</p>
<p>Tumen nast or eternal age pattern – Represents unending eternal happiness of the people</p>	 <p>Eternal Age Pattern of Mongolia</p>
<p>King bracelet and queen carriage – Represents loyalty and eternal love of husband and wife. Wedding rings in Mongolia have these patterns</p>	 <p>King Bracelet &amp; Queen Carriage Pattern</p>
<p>Fish pattern – Represents good deed, cheerful and resourceful attitude</p>	

<p>Patterns of lions, tigers, dragons and garuda— Represents spirit of a man, power, knowledge and good deed</p>	
<p>Flower pattern – Represents eternal peace and happiness</p>	
<p>Water pattern – Represents happiness and evergrowth of livestock</p>	

Cultural appropriation occurs when cultural imagery and materials are **removed** from their **cultural context** and used in ways they were **never intended**. For example, a dress from the high street brand Top Shop featuring a graphic of a Palestinian black and white scarf was withdrawn because the graphic represented the culture's history of suffering.





The core difference from the above-mentioned typical cultural appropriation cases is that the starting point of this project comes from Mongolian culture, and the final submitted product still serves Mongolian wrestling itself. This project does not conceal the fact that the aesthetic elements used come from Mongolian culture, which means that no cultural imagery is removed from their cultural context and used in ways they were never intended. These graphics and colors aim to preserve and celebrate this traditional culture on innovative products and even enhance the world's awareness of this culture. A typical case with a similar positioning as this project is the Shaolinquan kung fu shoes launched by Nike during the 2008 Beijing Olympic Games. In this pair of shoes, Nike uses the classic color palette and traditional cloud patterns in Chinese culture to convey the aesthetics of this Chinese martial art (Culture Vulture, n.d.).



### **Athlete Insights**

#### **Mongolian Wrestling Equipment Survey**

17 professional wrestlers from Inner Mongolia participated in the questionnaire survey, and 15 valid responses were returned.

**What brands and models of wrestling shoes are you wearing during training indoors?**

**Do you wear one-piece shoes or split-sole shoes?**

**Do you wear modern wrestling shoes outdoors?**

**How does it feel when wrestling in traditional boots?**

**Will outdoor ground cause severe wear and tear to your boots?**

**What training shoe is your favorite and least favorite?**

**Where do you think the traditional boot needs to be improved?**

Material

Lacing system

Volume

Other

**Where do you think the traditional products need to be maintained?**

Material

Lacing system

Volume

**Have you ever hurt yourself with traditional equipment (boots, jackets, or pants)?**

**Does Mongolia's weather affect your Experience wearing traditional gear?**

**What aspects of shoes do you think affect a wrestler's performance?**

Stability

Durability

Fitness

Flexibility

Breathability

Difficulty of adjustment

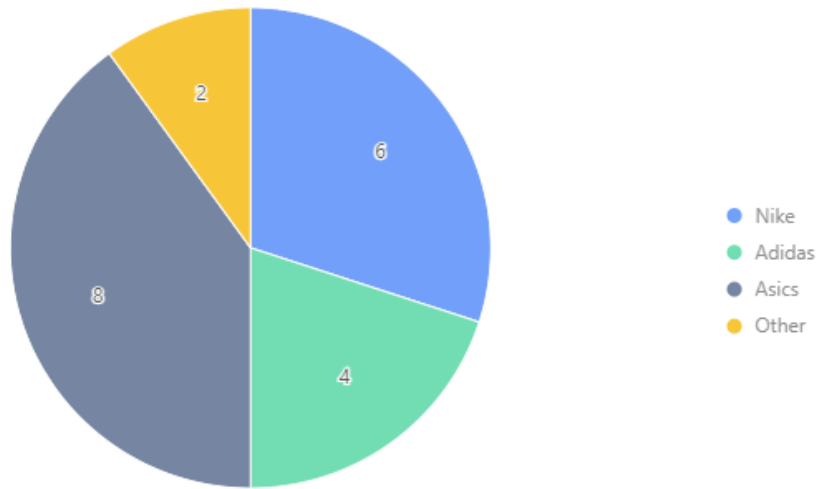
### **Noteworthy Responses**

Survey Respondents Provided Valuable Insights and Feedback on Training Habits, Traditional Product Experience, and Expectations for Innovation. Users' perceptions of traditional products, product damage characteristics, usage habits, and injuries will provide a reliable data basis for the later stage of design ideation and iterations.



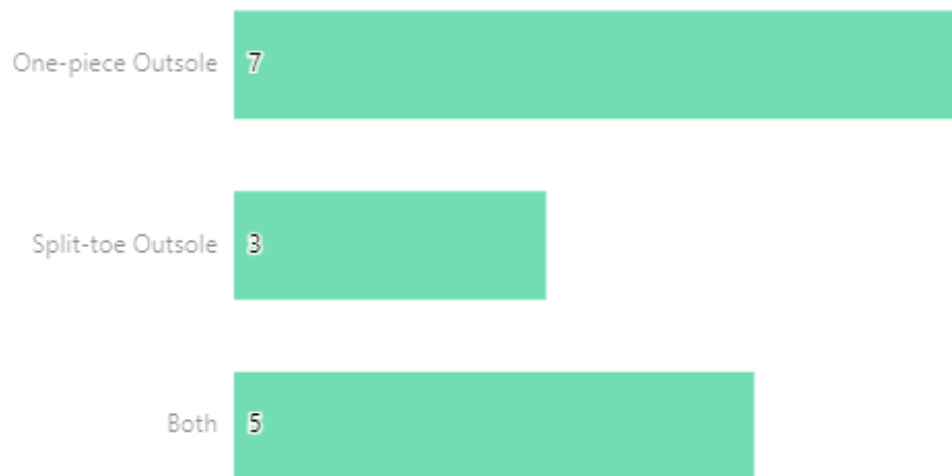
### Brands

Wrestling Shoe Brands You are wearing



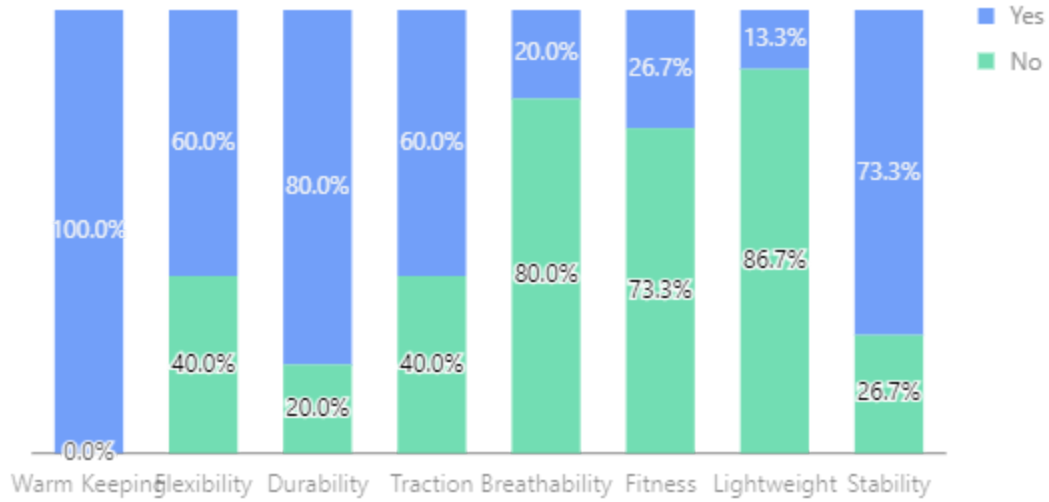
### Outsole Types

Do you wear one-piece shoes or split-sole shoes?



### Traditional Product Insights

How does it feel when wrestling in traditional boots?



### Training Habits

Do you wear modern wrestling shoes outdoors?



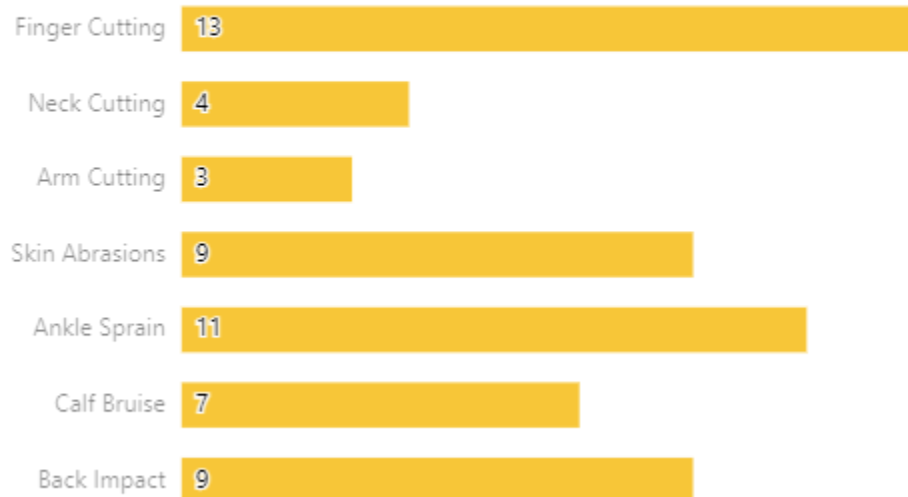
## Durability Insights

Where do your traditional boots get worn out?



## Injuries

How did you get hurt by traditional products



### Insight Takeaways

Wrestlers train in modern wrestling shoes and change to traditional boots outdoors.

Wrestlers tried to wear modern shoes outside, but these shoes lack shin protection and cushioning and end up breaking easily.

Wrestlers wear soccer shin guards in training.

The traditional wrestling boot slips on artificial grass.

Fit, traction, ankle support, and lightweight are primary features wrestlers value.

Wrestlers are expecting for new products.

Wrestlers are promoting the professionalization of the Mongolian Wrestling League.

The process of putting a felt sock liner over a modern sock and putting on a boot and tying the straps is time consuming.

Wrestlers, even professional ones, go back to their own life after game seasons.

### **Travel Research Questions**

#### ***Manufacturing of traditional products***

How do traditional materials feel?

What is the performance of the functional components they are using?

Which parts are outdated, and which parts can be preserved and innovated?

#### ***Use of current products***

What are the characteristics of different terrains that affect wrestlers' footwork?

Where do traditional wrestling shoes get worn and damaged?

How different seasonal weather can affect a wrestler's wearing experience?

How different seasonal weather can affect the feeling of leather products?

#### ***Daily training of athletes***

How do modern wrestling shoes fit Mongolians' feet?

What modern wrestling shoes do athletes wear while training indoors and why?

Will wrestlers do anything to improve the wearing experience of traditional wrestling shoes?

## Methods of Data Collecting & Analysis

### WORN PATTERN DATABASE

Take photos of wrestling gear worn out by athletes and highlight the broken parts to summarize Mongolian wrestlers' behavior patterns.



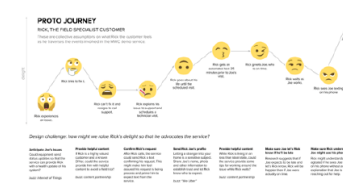
### 2D/3D MOTION CAPTURE DATABASE

Build up a database of wrestlers' movements by photos and video. Try to enable 3D motion capture apps on smart phones to collect 3D data.



### INTERVIEW & QUESTIONNAIRES

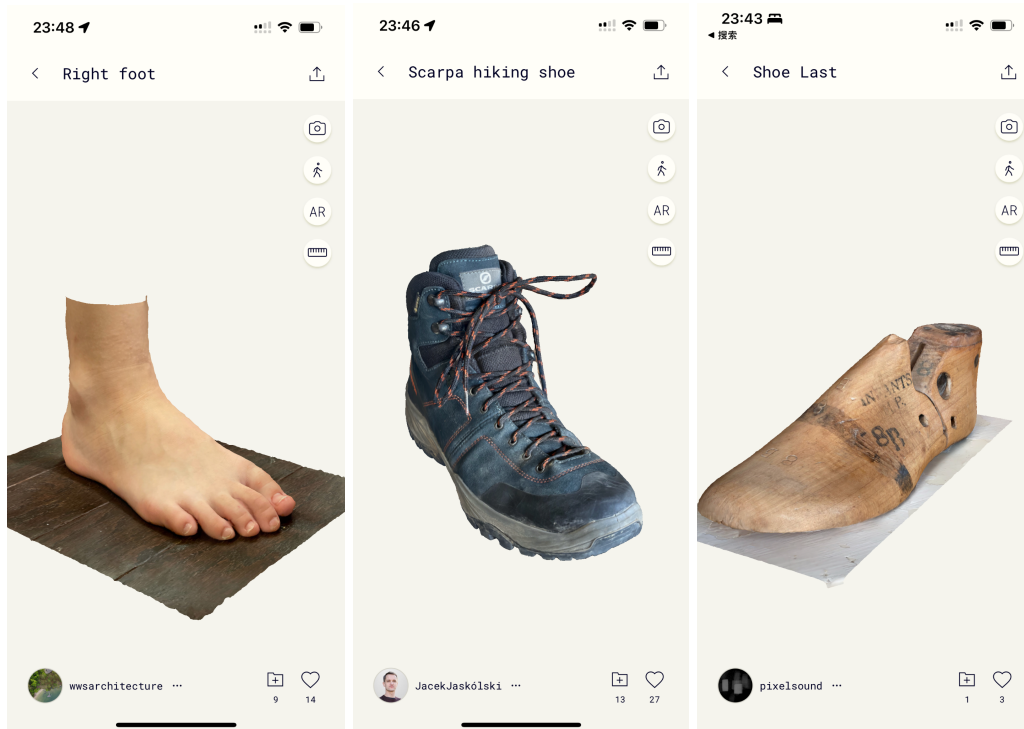
Communicate directly with athletes for more intuitive and reliable feedback. Perceive and record the user's emotional changes while interacting with the shoe and jacket through observation and interviews. Then create emotion graph to visualize customer sentiment and locate design opportunity.



Based on the wear pattern database established by using photos, this project will evaluate where the product is frequently damaged and summarize its reasons, providing a reliable reference for material selection and product composition.

On the basis of the athlete's movement pattern database established by the motion capture camera, this project will combine the existing research on the general wrestling physiology, biomechanics, and psychology mentioned above to observe the athlete's experience of using the product in a deeper level, and conclude Potential user needs that are easily overlooked. Motion capture will be performed through the XSENS application in the IOS system, and the built-in lidar scanner in the smartphone can create 3D representations of close-range objects (up to 5 m away). Motion capture data can replay 3D actions in stereo space whenever needed. Some visual blind spots that may not be observed in 2D video materials can also be recorded. On top of that, the 2D video will also be recorded at the same time to complement each other with the 3D mannequin data.

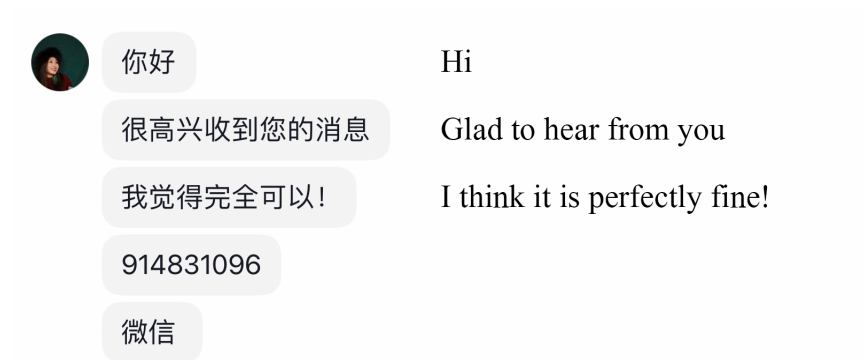
In order to allow future shoes to have a better fit, the foot size data of Mongolian wrestlers established through 3D scanning technology will be used to develop shoe lasts that are more suitable for this population. The scanning is completed on the smartphone through the 3D scanning application Polycam, which can upload dozens of photos taken continuously by the user around the scanned object to the cloud processor, and then send the high-precision model back to the smartphone. The overall time takes about 10 minutes. Afterward, the foot model file database is imported into the 3D modeling software Rhino or Gravity Sketch. A shoe last tailored to the target group will be built from these data.



Photos and video data obtained through on-site interviews will be analyzed and made into a user experience map. The ups and downs of positive/negative emotions accompanying each touch point of the user's interaction with the product will be recorded and visualized. The project will study how products can innovate at each touchpoint to stimulate positive emotions and eliminate negative emotions.

## Consultancy & Mentorship

### Bokhin Ayin Team



Bokhin Ayin is an online community website for Mongolian wrestling enthusiasts founded by American wrestlers Lavell Marshall, Ariela Pulido-Westlake, and Inner Mongolian local wrestler Oyuntana Tongshnar. They spread and promote Mongolian culture and wrestling to the world by reporting wrestling news and journals and selling local clothing and utensils to the international market. Performance Footwear and Apparel Design for Mongolian Wrestling.

Bokhin Ayin team was founded and run by elite Mongolian wrestlers who have close ties to the local athlete community and manufacturers of wrestling supplies. These connections will provide the project with a large number of expert-level interviewees, valuable insights and feedback, access to local suppliers and designers, and a unique understanding of the competition environment and climate.

The Bokhin Ayin team can meet me in person during field trip research and meet online monthly.

## Stefán Cristobal



Stefán Cristobal <stefancristobal@gmail.com> 

To: Deshui Yu

Cc: Erick Ikeda

Hey man-

[Congrats](#) on the award. You Deserve it.

If you don't mind meeting over zoom / sometimes weird hours, I'm down for the mentorship.

Lmk

.stefan



Stefán is an experienced footwear designer who has worked at Nike for eight years and is an alumnus of the University of Oregon in the Product Design program. He designs in the Nike Kids department, focusing on hands-free/easy-on innovation, skateboarding, and Airmax.

Stefán's work content and process highly align with the structure of the industry standard design process required by this project. His job is project-based, so he is at different points of the design process depending on the footwear category he is working on. His job could include researching, inspiration gathering, sketching, prototyping, rendering, tech packing, and revisions.

Stefán's professional perspective and experience will significantly support this project. At the same time, his insight into easy-to-wear and take-off products will bring valuable input to this project regarding adaptive apparel and footwear design.

Stefán can critique the project monthly online and provide feedback by email anytime.

## Ryan Foust



Ryan Foust <ryanfoust@gmail.com>

To: Kylie Everill

Cc: Aarya Rohan Ghule; Deshui Yu; Domenic Rehm

Hi everyone,

It was a pleasure speaking with you last week and learning more about the U of O program and your needs as students. I would happily meet with the four of you as a group over a Zoom call or meeting in person. Let's set up a time soon that works for everyone. Please work out several times and dates amongst yourselves that work for the group, and I will see if I'm available—looking forward to getting started.

Best regards,  
Ryan



Sun 11/27/2022 7:02 PM



Ryan is a footwear designer with a rich experience in the outdoor footwear industry. He has worked for LaCrosse Footwear Incorporated and KEEN as a senior footwear designer and is now the lead footwear designer and developer for Bass Pro Shops. In 2020 he founded his own brand Trail United to create innovative footwear combining hiking performance with casual city style.

I believe that Ryan's rich experience in outdoor shoe design can bring much valuable inspiration to this project's research on outdoor wrestling products.

Ryan can meet with me monthly in person or online and provide feedback by email anytime.

### **Works Like Prototype & Comparison Test**

#### **Baseline Product Testing**

Baseline product testing objectives for this program will focus on the donning and doffing times of the wrestling shoe, the traction performance of the outsole, and the impact absorption of the shin guard. As mentioned above, based on the fact that the user's personal favorite shoes in an indoor environment include traditional leather boots, regular wrestling shoes, running shoes, vulcanized shoes, and even casual shoes, the baseline products are only traditional Mongolian boots and shin guards. A video recording of the whole process of an elite wrestler wearing traditional Mongolian boots will be compared with the design prototype to show the simplification of the overall steps and the reduction of time spent by the design concept.

To keep the variables under control, a laminated swatch with the same structure as the Mongolian boot was used to simulate the outsole of a leather boot. The swatch is also wrapped

with a leather strap that increases the outsole's traction. The cross-sectional area of the baseline product swatch and the design prototype is 10cm x 10cm.

Based on the same principle, shin guards made of wooden strips with the same shape as the design prototype will also be used to simulate a homemade baseline product wrestlers use.

Wooden shin guards will be used to test impact absorption performance against design prototypes.

The test results and process will be compared and presented in the prototyping section later.



## **Ideation & Prototyping**

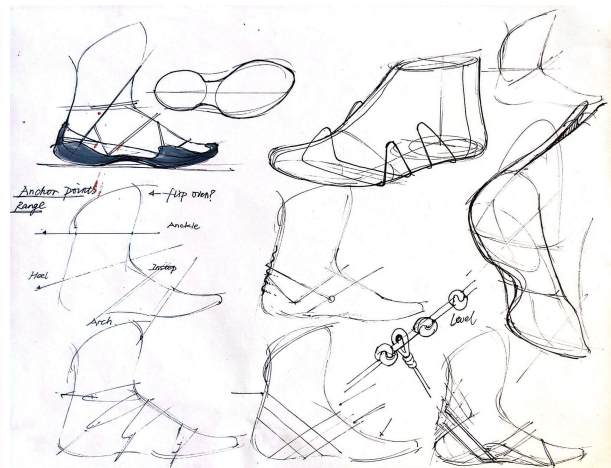
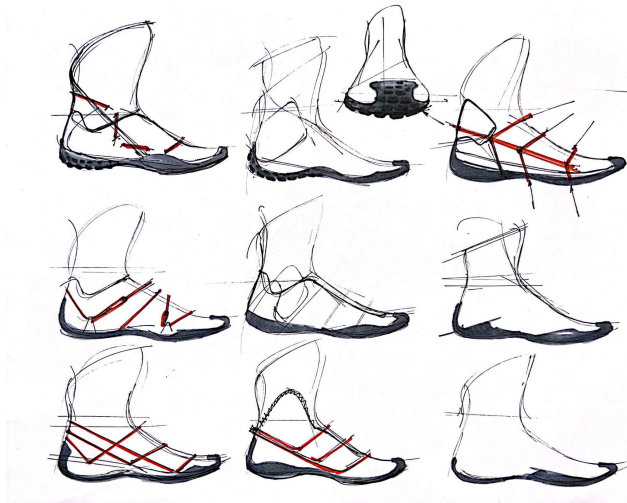
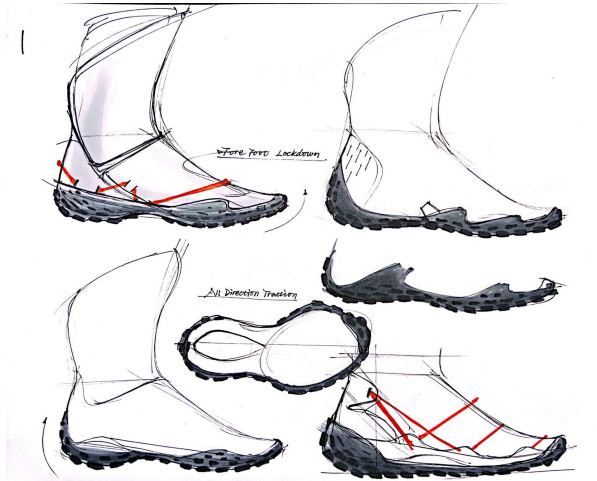
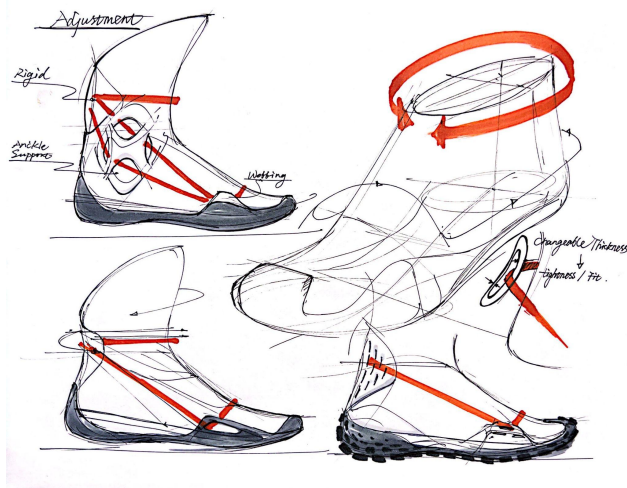
### ***Upper Construction & Lacing system***

In the first stage of ideation, sketches and prototypes of the footwear focus on how the lacing system tightens in key locations for ankle support, better comfort, and a wider range of size

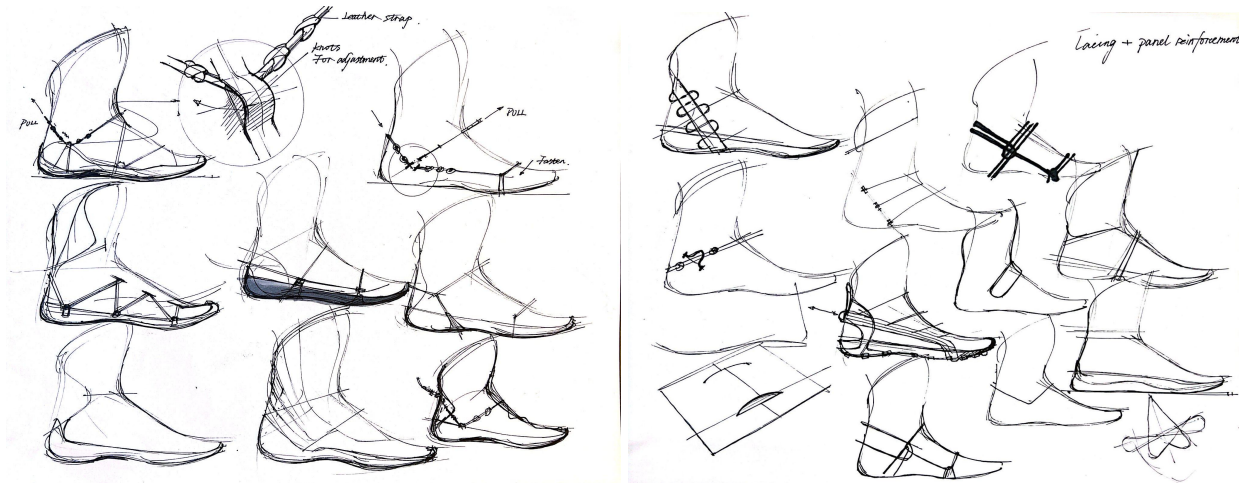
tolerance while retaining the silhouette of a classic wrestling boot. Adjustability and ease of operation are also important basis for the easy donning & doffing feature.

After communicating with the instructors, the final solution used a double-lacing system. The upper built-in lace is distributed on the instep through a preset pattern to provide even compression. The second lace will pass through the loops left by the built-in laces at the heel, arch, and forefoot anchors, and the ends will be joined at the heel by the lace toggle. When pulled back by the user, the shortened portion of the second lace on the upper pulls the built-in lace down to tighten the entire shoe and is eventually secured to the heel by the toggle.

Since Mongolian wrestling includes kicking attack techniques, the final design decision was to place the closure at the heel and add a heel tongue structure to the inner lining to have a clean upper. The opening at the heel will adapt to the change in the size of the user's calf to adjust the opening and closing scale.





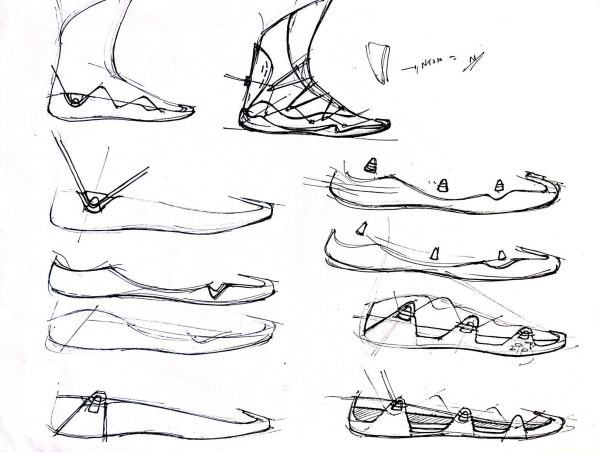
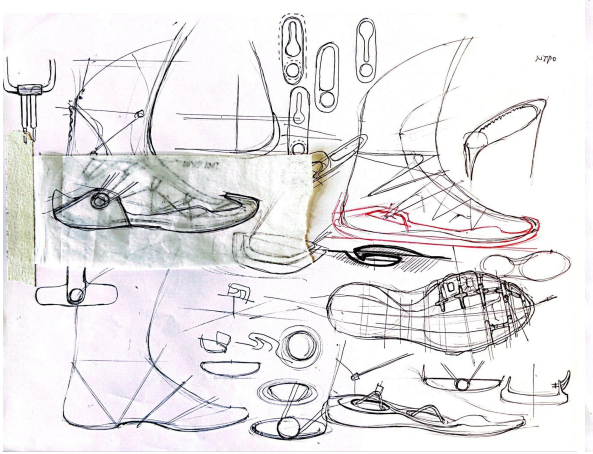
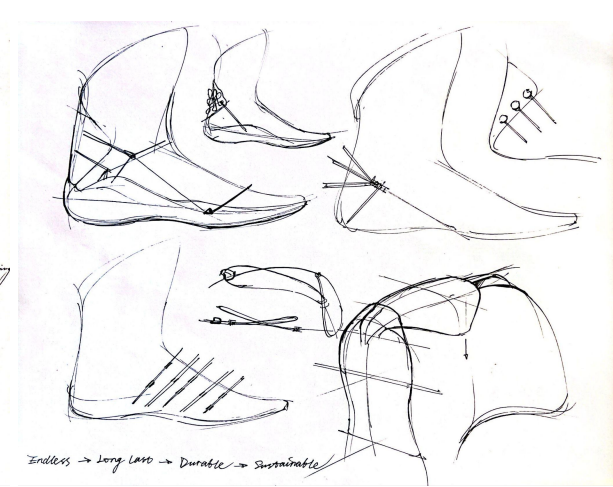
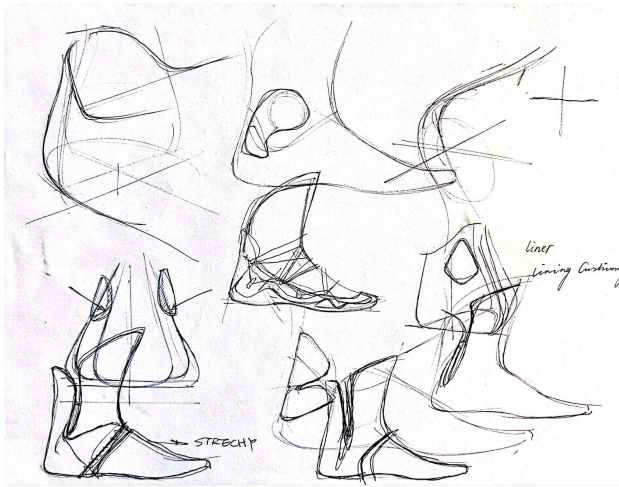
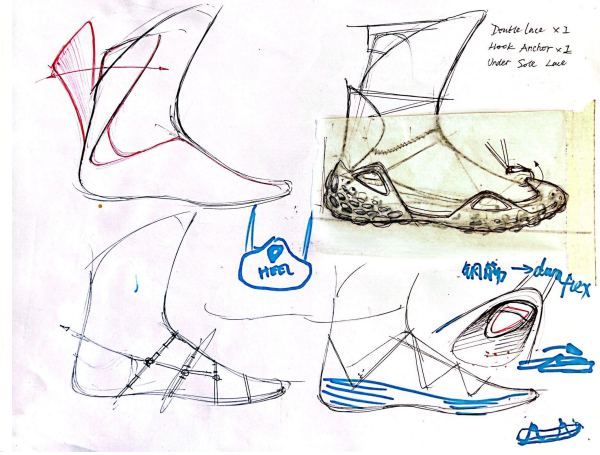
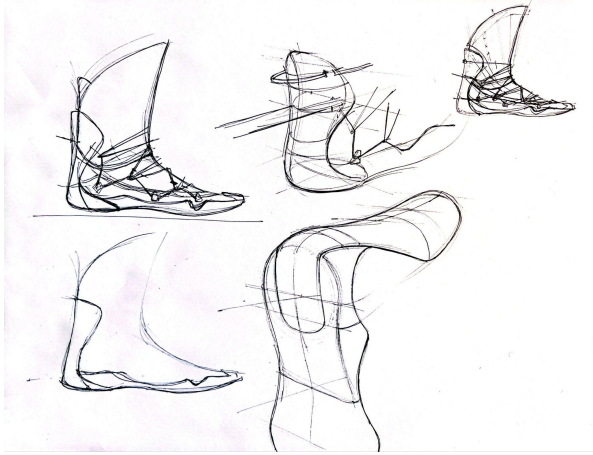


### ***Heel Reinforcement & Hook Set & Soles***

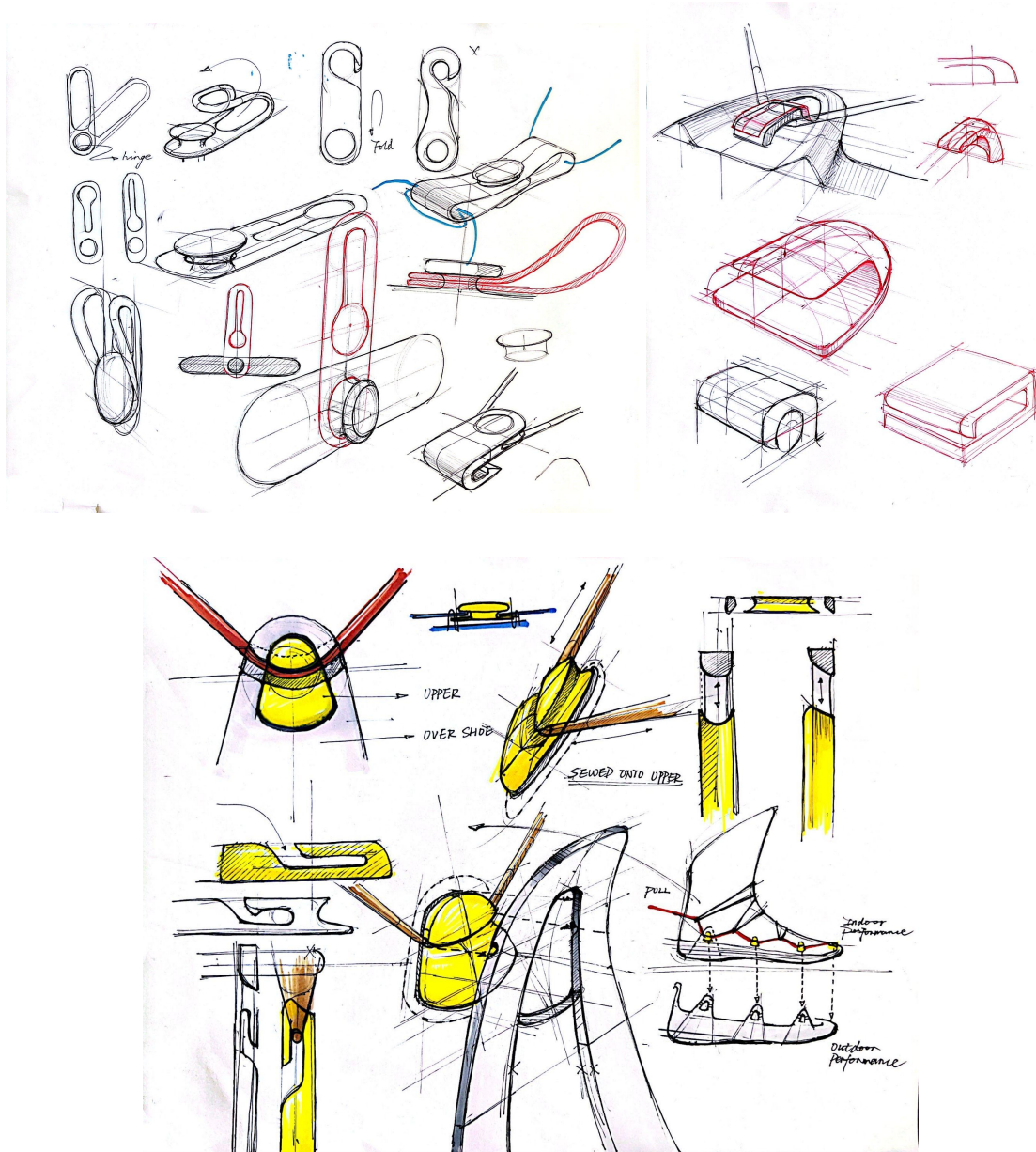
On the basis of establishing the design of the lacing system, the goal of ideation in the second stage is to develop heel reinforcement parts, shoelace fixing parts, and the form of indoor outsole + outdoor overshoe that cooperate with shoelaces.

The heel reinforcement part is inspired by the highback structure of the snowboard binding system. A piece of molded TPU that is similar to the contour of the heel tongue covers the heel closure. The two laces can be threaded through the holes in this part to secure it by pulling it taut over the Achilles tendon.

To secure the laces to the upper, a special set of lace hooks was developed and tested. The biggest challenge in this part is how to fix the overshoe at the same point and keep the adjustability of the original system under the premise that the position of the shoelace fixing point has been determined. The final lace hook set resembles the metal hooks commonly found on outdoor hiking boots. Unlike shoe eyelets, the user can remove or hook the shoelaces at any time through the opening of the hook to adjust the fit. The kit contains one inner hook and one outer hook. Two hooks work in a nested structure, and their complementary shapes allow them to be combined into the same hook. The inner hook is attached to the upper to provide the lace attachment point, while the outer hook is part of the overshoe. When the user needs to wear overshoes, he or she only needs to remove the shoelace from the inner hook, put on the overshoe, pop the inner hook into the outer hook, and hook the shoelace again to restore the entire lacing system. The whole process does not require taking off the shoes or pulling out the shoelaces. The contour of the indoor and outsole echoes the position of the inner hook, while a gap is formed at the toe for better forefoot flexibility. The overshoe design at this stage did not take tooling into consideration and was mainly devoted to determining the contour and testing the usability of the inner and outer hook system.







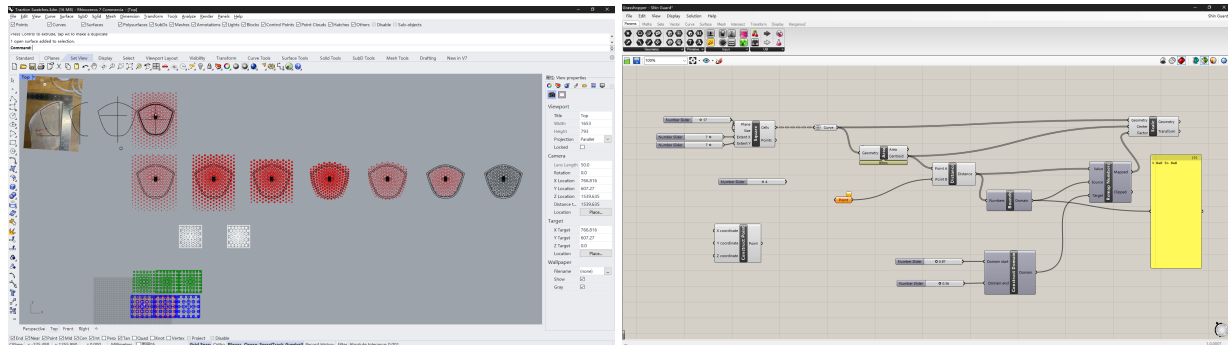
### ***Traction Pattern Swatches & Shin Guard***

Three different basic traction patterns (circle, square, and hexagon) are distributed with the same density on a square plate of the same size as the baseline product swatch, and the size of the gradient is adjusted through the attractor points in parametric modeling software grasshopper to



simulate the final outsole design. The 3D model was finally printed using TPU filament for testing.

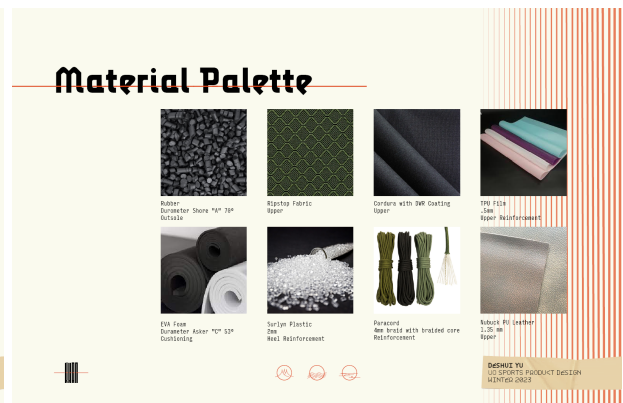
Using the same method, a similar hexagonal pattern was applied to the shin guards. The path drawn in Rhino will guide the laser cutter to cut grooves in the Poron Xrd foam so that it can be easily bent to fit the shin curve.



### *Final Works Like Prototype Assembling*

The upper of the final works like prototype mainly consists of three layers. The first layer is an elastic lining with a heel tongue, and the thickened foam of the heel part at the cuboid can lock the heel better. The stretchy material provides a great fit and isolates the instep from the built-in laces to eliminate the discomfort of being cut. The middle layer is the first shell of the upper and is sewn together with the lining and collar to hold it in place. The outermost shell is made of durable Ripstop fabric and Cordura fabric with DWR coating. The shape of the pattern refers to the minimalist four-piece construction used in traditional Mongolian boots. The instep of the outer shell creates a larger cavity than the inner shell for inserting the shin guard module. Finally, the three layers are sewn on the same piece of strobel board and assembled with the outsole through shoe glue.

The heel reinforcement parts, indoor and outdoor soles, and outdoor overshoes mentioned above are all printed with TPU filaments with rubber-like properties. The shoelace hook kit that requires stronger rigidity is printed with PETG filaments.



**Comparison Test**

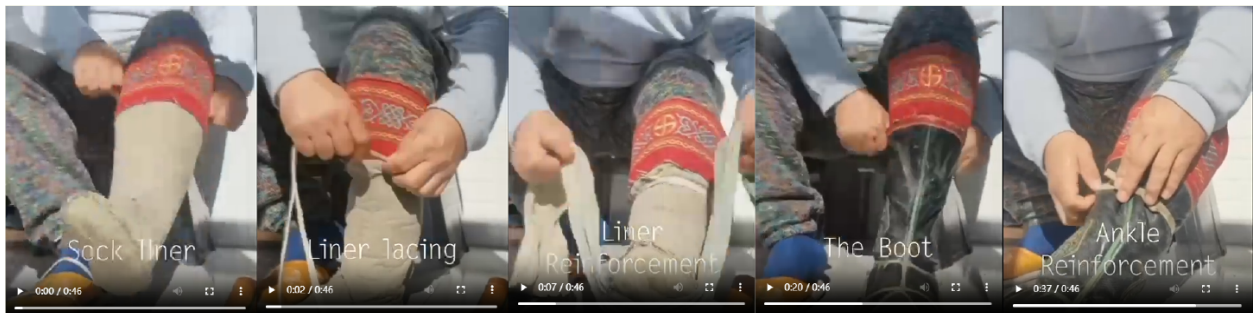
***Donning & Doffing Test***

As mentioned above, the test of the easy donning & doffing feature of this project is to compare the time and steps of putting on and taking off the baseline product and the prototype. An expert user (master Huhe from bokhinayin team) was asked to record and time the overall process of putting on Mongolian leather boots. The test results are as follows:

	Baseline Product		Prototype
--	------------------	--	-----------

00:10	Felt sock liner	00:05	Loose the whole shoe
00:21	Sock liner lacing	00:09	Step in
01:15	Liner reinforcement	00:12	Fasten the lace
01:31	Put on the boot	00:13	Insert the shinguard
03:00	Ankle reinforcement	00:20	Unhook the lace
03:03	Overall fit adjustment	00:22	Step in the overshoe
		00:26	Attach the hook set
		00:31	Fasten the lace

An elite wrestler took 3 minutes to don a traditional leather boot, compared with 30 seconds for a prototype. The overall speed is 600% before the design.



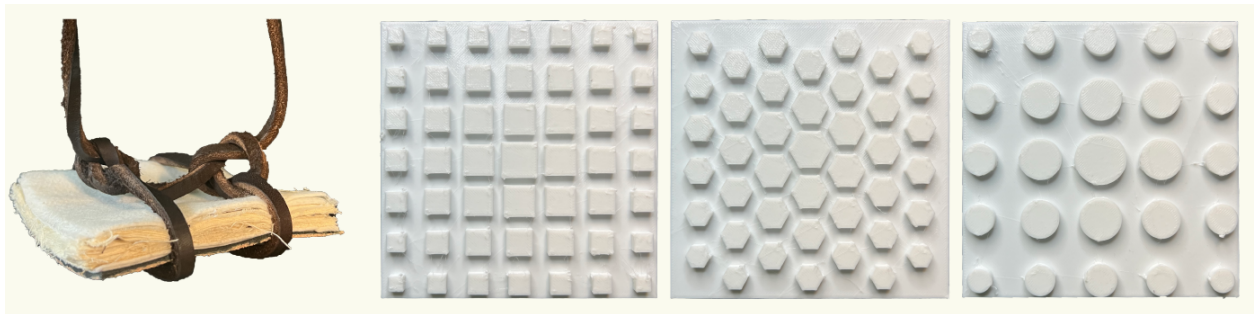
### ***Traction Performance Test***

Traction performance tests were conducted outdoors on grass. The test object is connected to the dynamometer through a wire, and the tester pulls the dynamometer and records the maximum static friction force when the test object produces sliding displacement through a slow-motion

camera. The wire remains parallel to the ground throughout the test, and the two ends of the dynamometer are on the same line as the wire. Each test subject carried the same weight to obtain the same vertical pressure. The test results are as follows:

Baseline Product	13.2 N
Prototype A (circular pattern)	18.6 N
Prototype B (square pattern)	20.2 N
Prototype C (hexagon pattern)	21.8 N

The traction performance of the prototype is 65.2% better than the baseline product.



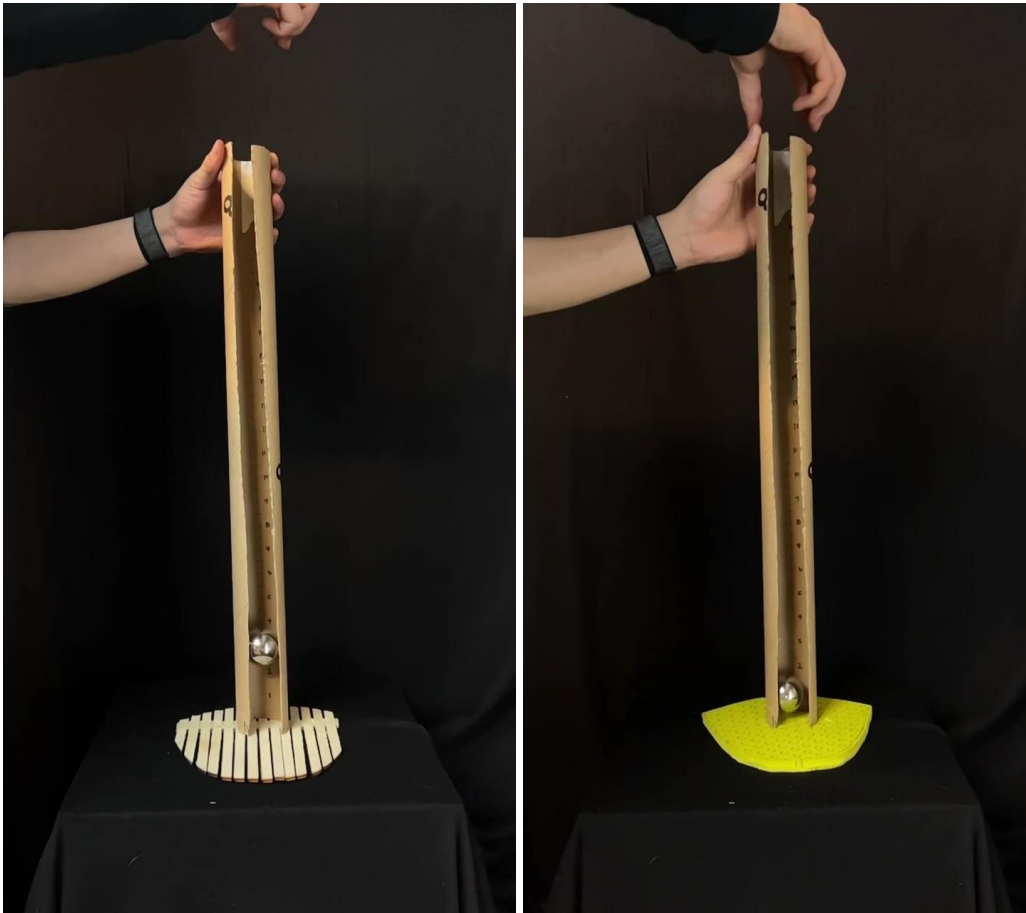
### ***Impact Absorption Performance Test***

Ball bearing tests were conducted to test the impact absorption capabilities of the baseline shin guards and prototypes. The metal ball was released at the same height to impact the shin guards

lying flat, and the height at which the ball bounced was indicative of the impact absorption properties of the test subject. Test results are as follows:

Baseline Product	81.0 mm
Prototype	30.5 mm

The impact absorption performance of the prototype is 62.3% better than the baseline product.





Platform Technology & Branding

**Technology**

- MOVE**  
Lacing + upper system for better upper support & ankle lock down & customized design options
- MOVE**  
Insole + midsole outsole for balance of structure & flexibility
- MOVE**  
Outsole pattern & construction for grip performance in all terrains

DESIGNER: YU  
UO SPORTS PRODUCT DESIGN  
WINTER 2023

# Lunatic 0T 72PT

STRENUOUS 24PT

Input Mono Compressed 12pt  
The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog.

the shoelace

mountain stability

river flexibility

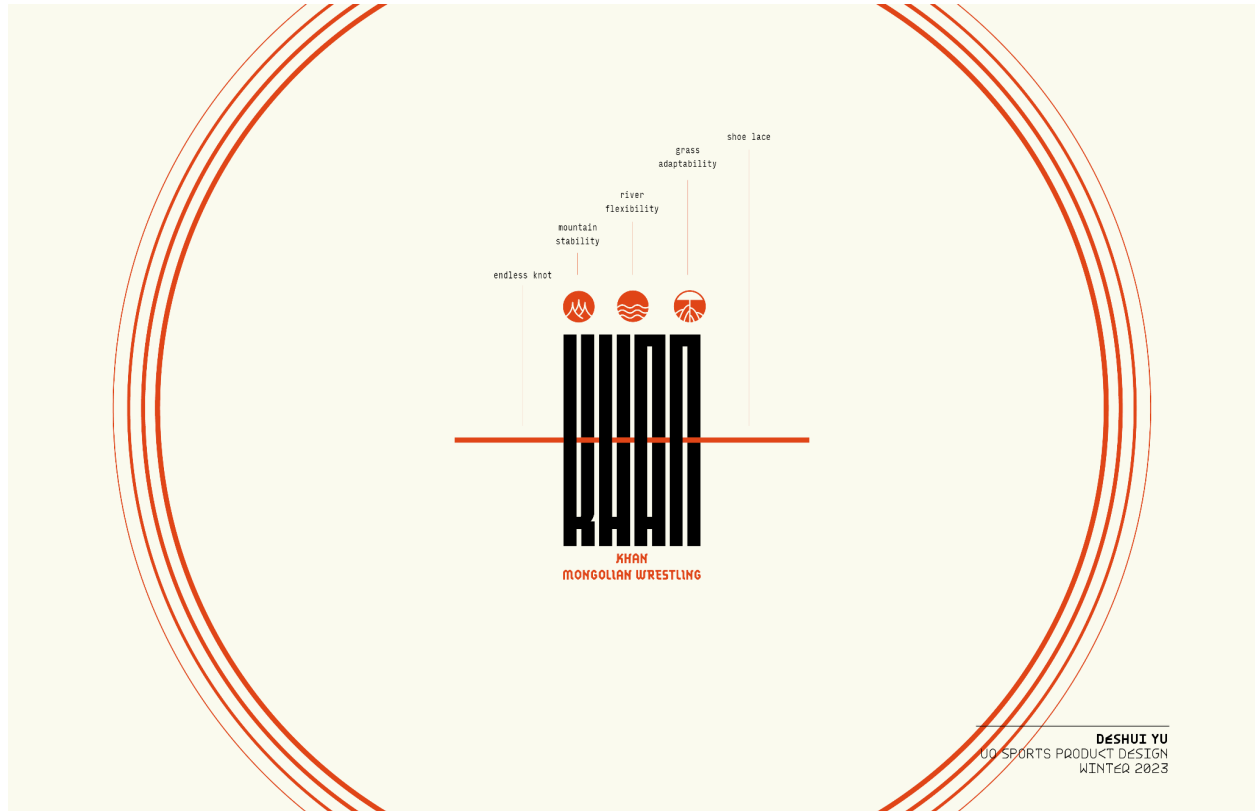
grass adaptability

**KHAN**

**KHAN MONGOLIAN WRESTLING**

**KHAN MONGOLIAN WRESTLING**

DESIGNER: YU  
UO SPORTS PRODUCT DESIGN  
WINTER 2023



### Final Prototype

Based on the feedback on the work like prototype received at the end of the winter term, Work for the fall semester will focus on the following:

Inner and outer hook set material, structure and reorientation of position;

Material and construction updates for the sock liner layer;

Pattern updates for specially crafted high top wrestling lasts sponsored by Jones & Vining;

Construction and tooling design of outdoor wrestling overshoes;

Indoor wrestling shoes and outdoor overshoes outsole traction pattern design;

Shin guard material and structure update.

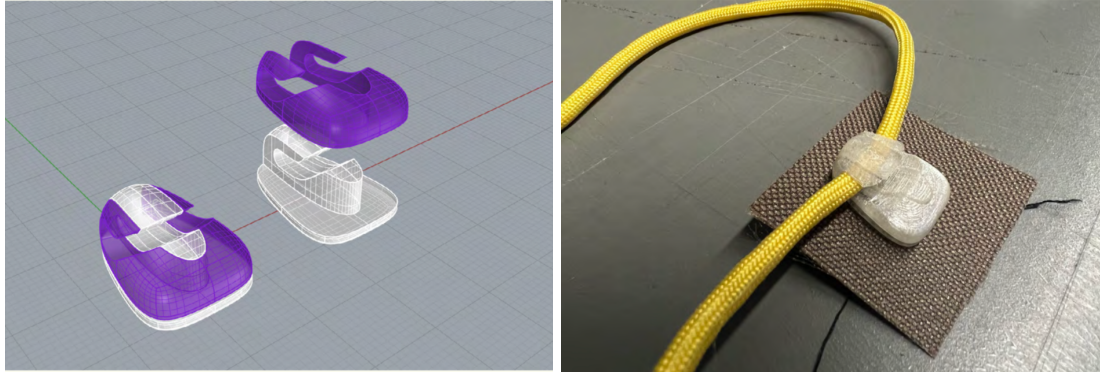


### Inner and outer hook updates

Based on the feedback given by the consulting team, the construction of the shoelace hook directly installed on the outer surface of the shoe upper adopted in the previous scheme may cause discomfort when kicking. After multiple rounds of 3D printing tests, the prototype material of the Hook set was updated from a hard resin material to a more flexible Ninjatek Cheetah TPU material. The overall structure has also become smaller and can be sewn directly on the surface of the fabric through the groove design.

At the same time, to improve the shoelace system's compression efficiency, the inner hooks are relocated to the innermost sock liner layer. When the shoelace is tightened, the shoelace hook will be lifted together with the bottom of the liner to wrap the user's foot tightly.



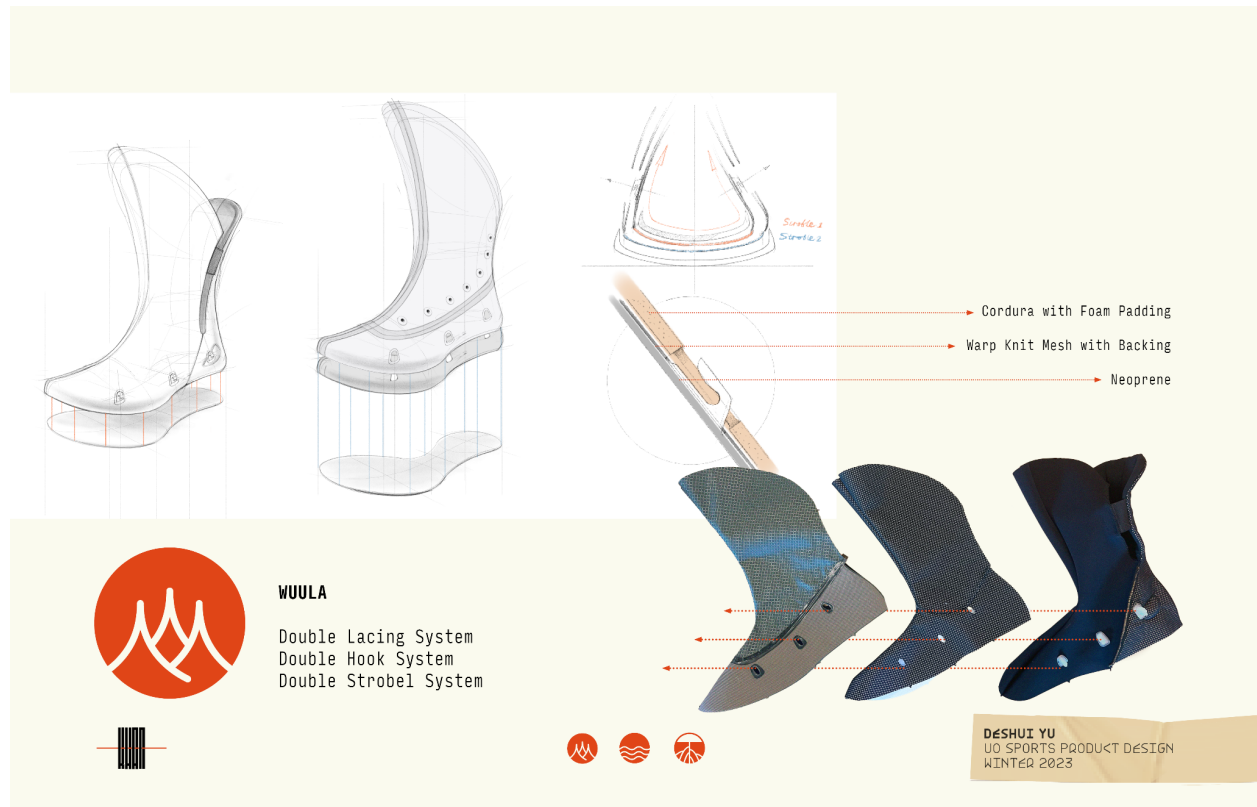


### Material and Construction Updates for the Sock Liner

The sock liner material used in the previous prototype was updated from rib knit to neoprene for better multi-directional elasticity and comfort. On this basis, the inner hooks sewn on the liner will pass through the corresponding openings on the middle and outer shell layers for shoelace installation. The shell layer made of Cordura fabric adds open cell foam padding to make the outer surface and the inner hook sewn on the liner at the same height and eliminate the discomfort of the instep when kicking to attack.

Unlike the first-stage prototype, the sock liner in the final prototype is sewn onto a separate layer of strobel board, rather than using the same board as the other two layers. This allows the sole of the sock liner to be pulled up for better contraction when the laces are tightened.





## Pattern Updates

A pair of specially designed high-top wrestling lasts funded by Jones & Vining were used to create the final pattern and prototype. The updated last is scanned as a digital 3D file and

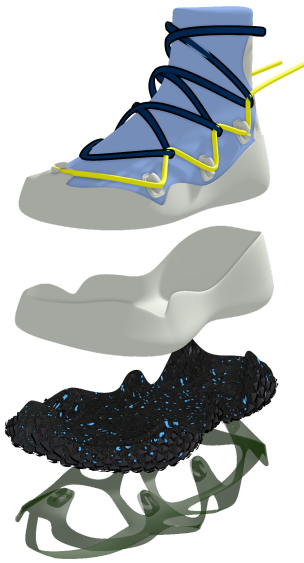
imported into 3D software platforms such as Rhino and Gravity Sketch as a reference for tooling.



### **Construction and Tooling Design of Outdoor Overshoes**

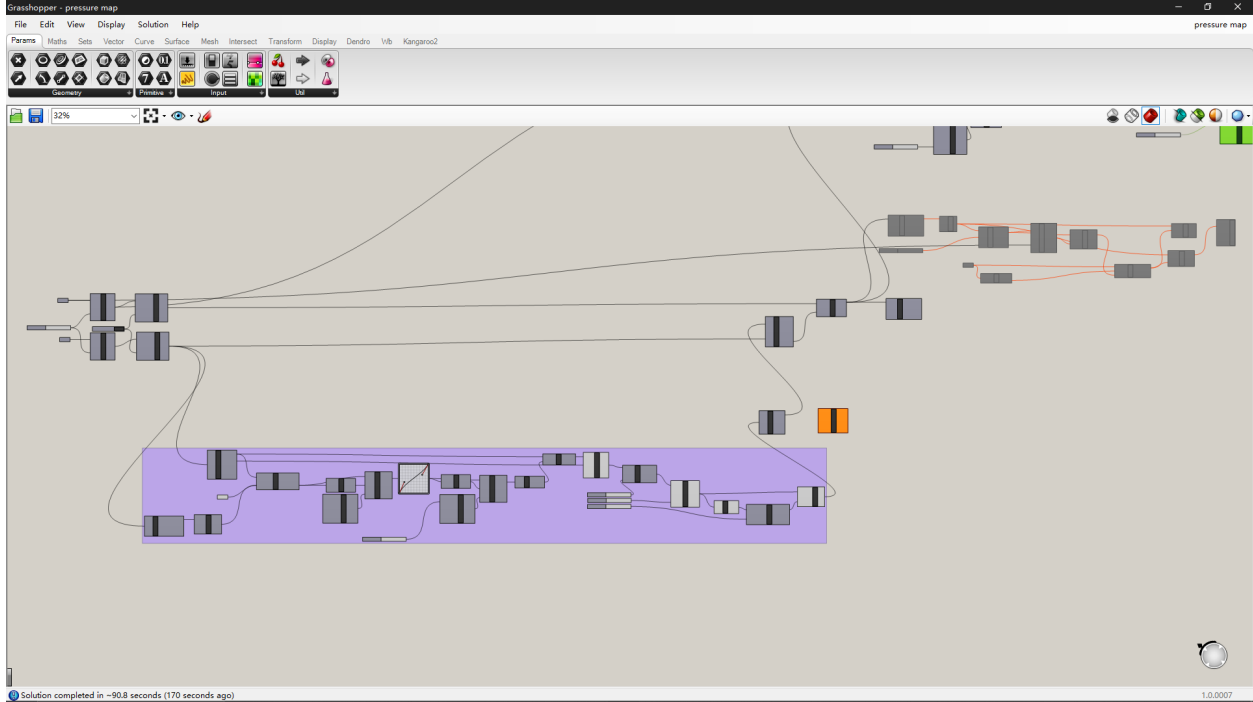
After multiple rounds of sketches and 3D ideation, the construction of the overshoe adopts a three-layer design: the traction outsole with outdoor performance; the EVA midsole with cushioning performance; the TPU cage that surrounds the midsole and the outsole combined with outer hooks.

gravity sketch



### **Indoor Wrestling shoes and Outdoor Overshoes Outsole Traction Pattern Design**

The design of the outsole of indoor shoes uses the method of parametric design. In Rhino's Grasshopper modeling platform, attractors are placed at the rotation and center of gravity points of the wrestler's foot: the five toes, the ball of the foot and the heel. The resulting pattern of concentric circles and magnetic field lines spreading outward from a central point helps the user eliminate friction in the tangential direction of rotation and provide traction in the normal direction.



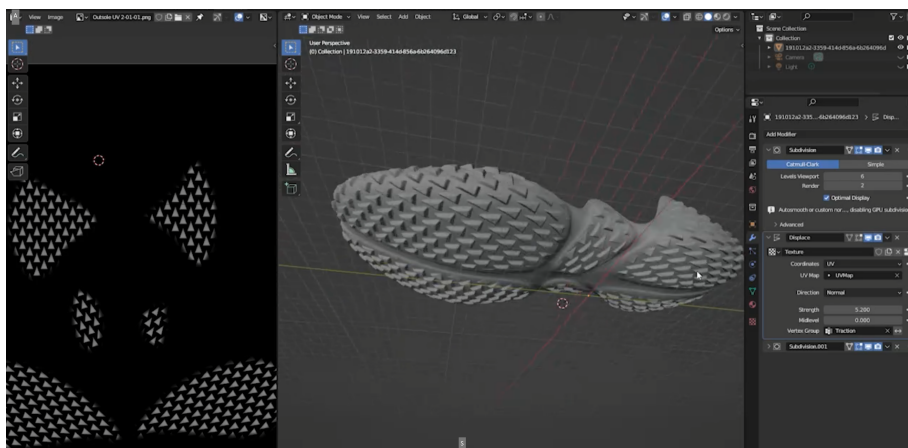
Perspective ▾







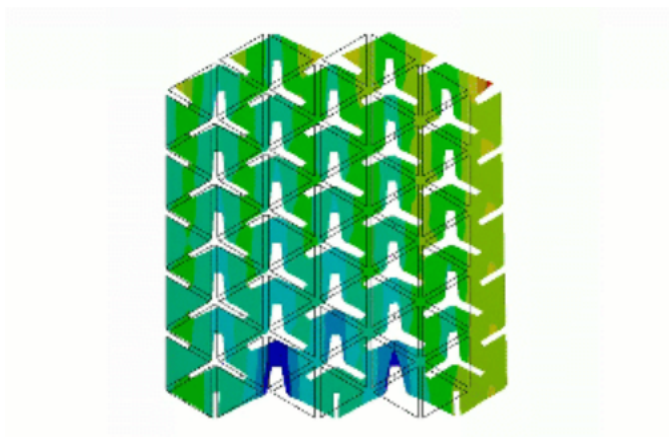
The traction pattern of the overshoe outsole is made up of multiple gripping units. The shape of the traction unit is a triangular prism with an inclined upper surface. When moving, the sharp edge at one end can efficiently break into the outdoor ground. The steeper flat on the other end allows for gripping when planted in the ground. The traction units are distributed in opposite directions according to the push and pull zones of the forefoot and heel. This allows the user to slide quickly in the direction needed to push or pull when the sole hits the ground but grip in the opposite direction for traction.

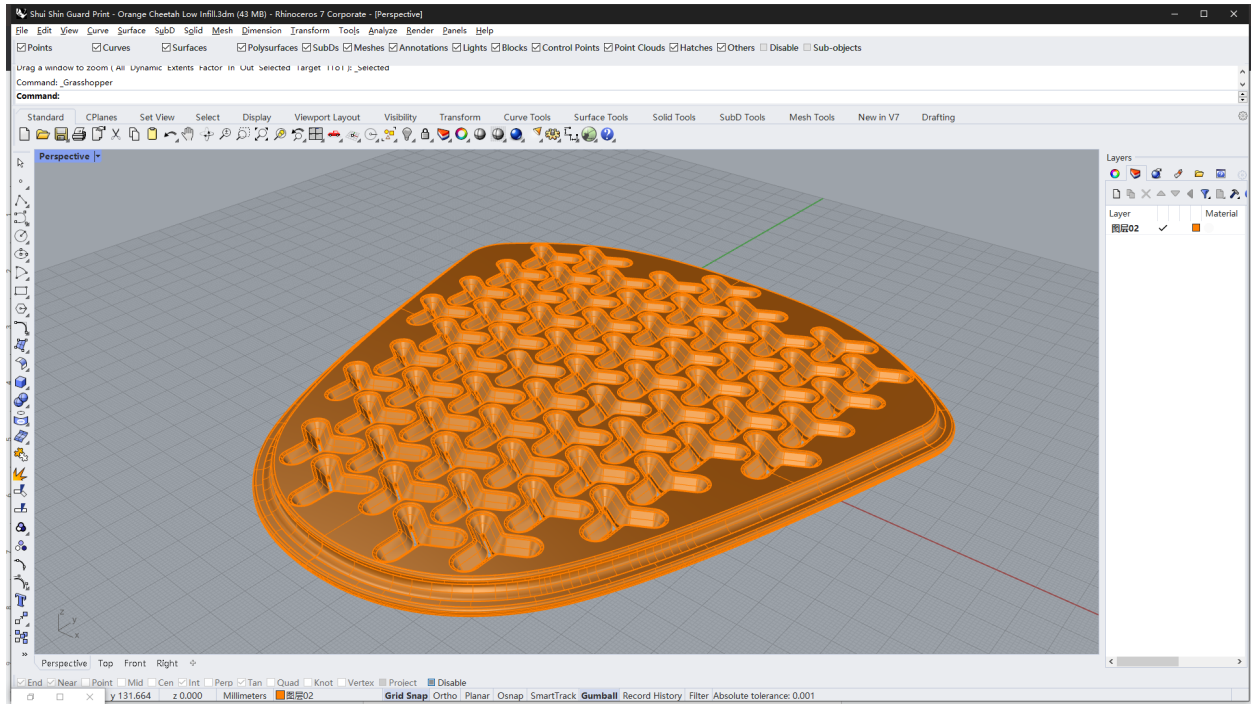




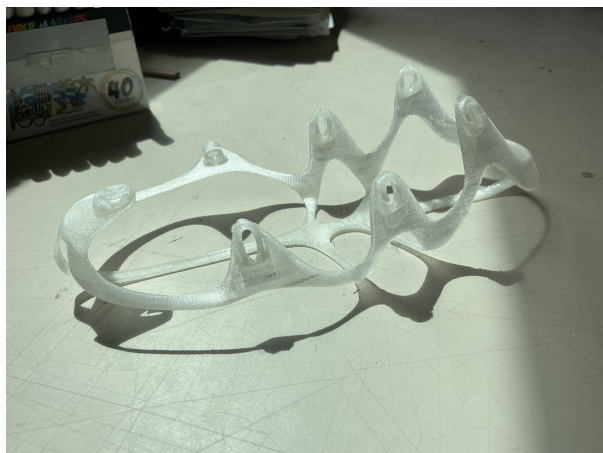
### Shin Guard Material and Structure Update

The final material for the shin guards ended up being D3O Aero for Defense foam. The structure adopts an auxetic structure that can be extended in multiple directions to ensure that the module can be dynamically stretched with the movement of the athlete when assembled.

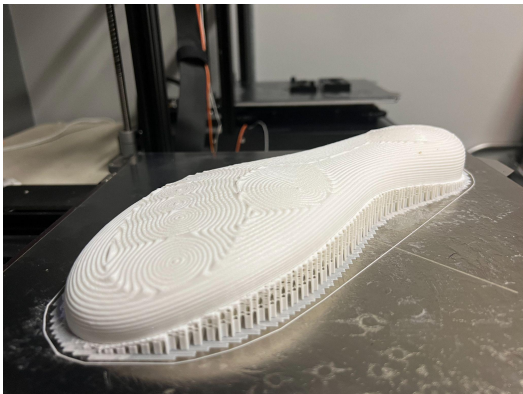
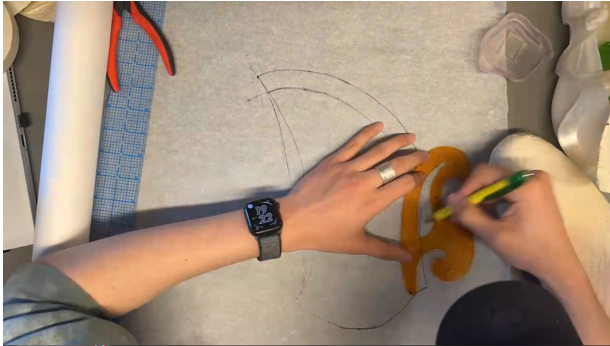




### Final Prototype Making & Assembling























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