UNIVERSITY OF OREGON

Portland, OR

HURRIYYA COLLECTION
Equity and Inclusion: Cycling in Saudi Arabia & Muslim Female Traditional Dress; with a Focus on Professional & Pedestrian Cyclist

Thesis Capstone 2020/21

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1.0 Abstract

In many Muslim cultures women remain suppressed from basic human rights, how do we design for cultural needs to create a path of entry into sport? The understanding how cycling has held barriers to entry for women, in Muslim culture women remain suppressed of basic human rights, how do we design for cultural needs to create a path of entry into sport? Many issues that create this barrier are rooted in traditional garment of the Muslim faith and culture that are either legally restriction or systemic norms. The scope that will be further examined will look at both pedestrian and professional women cyclist needs with the lens of keeping with traditional and legal boundaries in Saudi Arabia. The target market will be aimed for women 18-35 years of age given the population and user growth in cycling. This will be done by unpacking Competitive Goals and Cultural Goals as a vehicle for women's freedom and liberation via cycling.

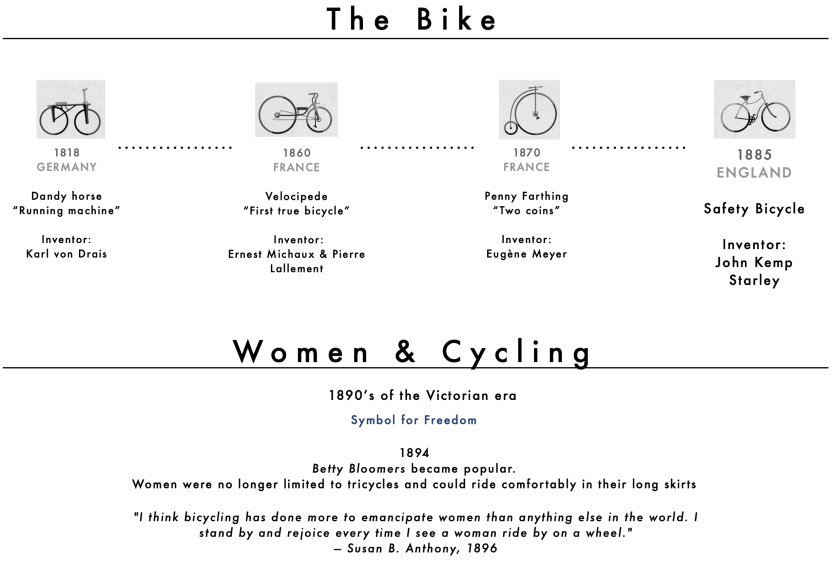
2.0 History of Women in Cycling

Historically women have gained freedom and access to independence through the use of bikes, today we still witness many women lacking access to bikes due to cultural and religious beliefs (Neejer, 2011). During the decades-long suffrage movement, late 1800's -1920's, in the United States and United Kingdom the bike stood as a symbol for political and cultural shifts of women's rights (Neejer, 2011). A shift in apparel took place in 1894 to accommodate the need for women to ride with more efficiency, this took the form of the Betty Bloomer, allowing women to ride upright bikes comfortably in their long shirts (Ro, 2018). "Bloomers, essentially voluminous trousers tied at the ankle and often worn under short skirts, had been popularized back in the 1850s by the women's rights activist Amelia Bloomer" (Ro, 2018). This was a powerful innovation and juxtaposition to clothing worn by women at the time, which was designed to enhance their shape; tight corsets and heavy skirts which would trail on the ground.

A central way female cyclists were able to perform within the confines of Victorian respectability, and thus blend into the activity of the public streets, was through their clothing

choices. Upon the invention of the women's safety bicycle, thousands of women throughout the country were both drawn to cycling but also had virtually no existing conceptualization of what to wear (Neejer, 2006). Women began to design and create their own outfits, share these ideas with friends and weigh the pros and cons of various options (Somers, 1967).

This included short skirts of various lengths of bottom garment, typically no shorter than one foot above the ground; shorter shoes instead of high boots; less fabric overall (typically weighed in pounds); elastic inlets to keep the dress from catching in the wheel; use of a belt for accessories; and for more radical women, some sort of knickerbockers or divided skirt underneath a shortened dress (Hargreaves, 1994).

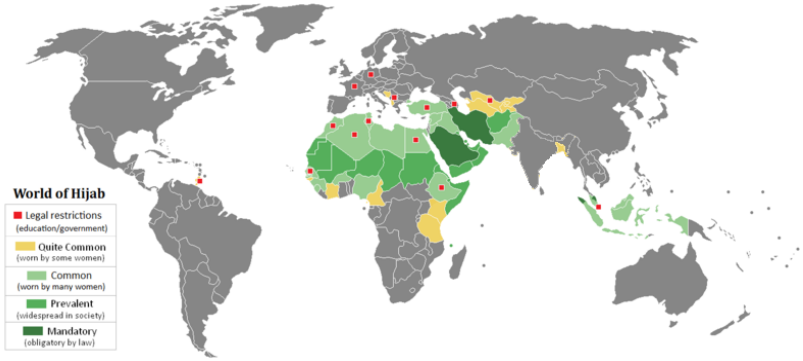


After a brief examination of the Suffrage Movement in Western culture, there is a direct correlation between cycling and shifts in women's dress during the turn of the century. Parallels can be made to current suffrage that women are still suppressed under due to dress, this can be seen in the Muslim women's comunity and the tradtional wear of the Hijab. How can dress be a vehicle for liberation and freedoms that open doors to more growth and opportunity?

2.1 Muslim Women & Cultural Dress

Muslim women cultural dress is deeply rooted in the history acording to the Quran, were the hijab acts a protective barrier for women (Lamrabet, 2019). Although the use of the word Hijab is not used in the Quran to

identify a women's clothing, today's cultural use of the word is synonymous with a headscarf or covering (Lamrabet, 2019). Other dress types that will be used as a baseline for this project will be the Abaya (Chador or Jilbab, these terms are synonymous and interchangeable in cultural use and hold more regional vernacular to dress style) these are long loose fitting cloak like outer garments that are worn to cover the body head to toe (Lamrabet, 2019).



Clothing should not be tight or reveal the form of the body underneath. The design, texture, or scent of clothing should not attract undue attention. Modesty is appropriate at any age, but particularly important after a girl or boy has reached puberty (Islamic, 2020).

This practice is falling out of favor, as many young women prefer to wear the *chador* or the style of *niqab* that is common in Saudi Arabia. These forms of dress are generally made out of wool or cotton cloth and are not only modest but offer protection from the piercing sun and blowing sand (Islamic, 2020).

2.2 Muslim Women in Sport

Depending on the country, women in Muslim parts of the world have varying experiences; they face different obstacles in trying

to participate in sports. Even so, these female athletes have a few things in common. They all must try to navigate the complexity of their identities. Individually, girls and women make decisions for themselves based on their values, obligations, expectations, affinity to sport and whatever else it is that makes them who they are (Wales, 2013). Below, further exploration in some of the ways girls and women in Muslim countries might experience sport. Keeping in mind that there is no single female Muslim experience and the varilable of relations to the Hijab/Abaya has a large range.

Muslim women's sportswear, has obstuvtive limitation and restrictions when it comes to preforming the sport due to the covering of head to toe. This cloth is meant to protect Muslim women from men's harassment as well as Muslim women's specific identity (Quthb, 2004). Until now, Indonesia athletes wearing jilbab were having difficulties being able to participate in competition, moreover in international events because of the regulation (Damayanti, 2017).

"'Why is this controversial?' they'd say things like, 'It goes against our traditions.' Or, 'Women just don't do that.' You'd hear these blanket statements. Juie Browns, personal opinion is simply that bikes give freedom and independence to someone. Bikes are all over that country. Boys ride them everywhere because it is an affordable vehicle that can get you around faster. But for women, you're just not seeing it" (Brown, 2020).

2.3 Barriers to Entry

Today many developed and developing countries women still lack access to education, healthcare and economic opportunities. Access to cycling comes with a duality to self sustaining transportation; greatly increasing independence and opportunities to higher education, along with more sustainable long term health benefits (Sutton, 2016) . Deterrents for people of Muslim Women to cycle look like; a lack of visibility of peoples they relate to one bike, inclusion of women led cycling groups and lack of knowledge in the field of biking (i.e safety on the road and general maintenance of the bike).

Due to a lack of transportation in many countries this causes a barrier to education, being that many have to travel great distances, which is a concern for the safety of students, being more efficient with how long they have to commute, and the social stigmas around women of bicycles. The social factor of women on bikes and visibility has had many negative effects on women. Exhibiting the state of Iran in 2016, many women were arrested failing to meet the dress code while riding bicycles. Other countries which have strict dress code laws in place for women are; Saudi Arabia, Egypt, and Afghanistan, which discourage women from riding bikes (Alexander, 2018).

Furthermore, these women are not being designed for to compete

3.0 Environment of Cycling

The breakdown of the environment for this section will be done in 2 sections; the professional and pedestrian. Given the scope of the project it is important to understand the key differences in each environment and how that could hinder or help the performance of an athlete/user. The professional will spend more time in a controlled environment and will more than likely be riding with a team (group), which can provide protection. The pedestrian on the other hand will have more variables, given they can be riding alone at times and in denser urban environments.

Other considerations, weather, this can be a major deciding factor in how you dress (Professional or Pedestrian) when getting out on your bike. The scope will look at the climate of Saudi Arabia as a whole and then dial in on Jeddah, due to the location of women's cycling races and cycling groups. Under the umbrella of Saudi Arabia as a whole the climate is generally warm annually, given it is the desert, highs can reach 100+ degrees Fahrenheit and drop as low as 50 degrees Fahrenheit (Weather, n.d). Dialing in on Jeddah, in the western seaboard of Suadi Arabia on the Red Sea, the average annual maximum temperature is 95 degrees Fahrenheit and average annual low of 74.3 degrees Fahrenheit. The warmest month of the year is July and the months of January and February tend to be the average 85 degrees Fahrenheit (Average, n.d.).

3.1 Professional Environment

As a professional cyclist is a full time job, you train daily riding 6 days a week anywhere from 4-6 hours a day including time spent in a gym weight training. Weight training/conditioning is no more than 1 hour and is designed to develop strength in the core and leg muscles. Special attention is required to the fuel they are putting into their bodies, getting a balanced nutrient rich diet is vital to recovery and lean muscle growth. Sustenance during training is also required due to the mainy hours of the day and the gross amount of calories a professional cyclist is burning on rides (Seehafer, 2015).

Environmental conditions to consider during the race series held in Jeddah (western seaboard of the Red Sea) is held October- February an Amatuer Cycling Tournament under the SFA (Suadi Arabia Sports For All). Conditions to consider the race in Jeddah; air quality, wind speeds, humidity, and surface temperatures.

Considerations to Air Quality, there has been a harmful/health advisory due to an increase in particulate matter in the air in the past decade in Jeddah, this is due to dust storms spreading harmful sulfur dioxide that has been emitted by coal burning power plants (Underground, 2020). This is due to the large oil industry, 2nd largest in the world, oil reserves increased from 35 billion metric tons in 1990 to more than 40 billion metric tons in 2019 (Puri-Mirza, 2020).

The quality of air is understood to be a by-product of wind storms blowing harmful particulate matter across the desert swath of Saudi Arabia (Puri-Mirza, 2020). It is important to note annual wind conditions tend to be rather stable throughout the annual year in Jeddah, wavering right around 10 mph (miles per hour) and the summer months can experience winds up to 16 mph and the winter months hover right around the average annual speed (Spark, 2020).

Finally environmental considerations that will affect the cyclist will be humidity and surface temperatures. Jeddah experiences extreme seasonal variation in the perceived humidity, April-December are the most humid months where the average is 38%, the month of September tends to be the highest at 91% and January/February are the lowest at 21% humidity (Sparks,

2020). The muggier (higher % humidity) conditions can not only be dangerous to ride in but will also slow down the riders performance (Irons, 2020). The riders ability to cool down their system in relatively high humidity conditions becomes more difficult due to the moisture in the air combating the sweat process (Irons, 2020).

3.2 Pedestrian Environment

Environment for pedestrian cyclists will fall under the lens of the urban setting, this will look vastly different depending on what part of the globe you are in. For the sake of clarity I will cover two urban settings; heavily dominated cycling culture (Portland, OR, will be the baseline) & Jeddah, Saudi Arabia (little infrastructure).

Portland, Oregon is ranked one of the highest for bike friendly cities in the United States, this does not limit the number of injuries or deaths that come with the risk of riding in an urban setting, “as of 2017, 6.3% of Portland commuters go by bike” (PBOT, 2019). The infrastructure for bike lanes in Portland is ever growing to make it safer to ride while protecting you from other street traffic. There are cycling only traffic lights that give the cyclist the advantage when commuting via bike. As well, there is a large community of women cyclists giving exposure to women more women on bikes as a choice and as an environmental choice to ride over other means.

In Jeddah there is little to no cycling infrastructure, the rider is at a higher risk of riding on the road with traffic. In said communities the language between the driver and cyclist may not be clear or understood, creating an anxiety driven environment for the cyclist causing distractions for the rider (Aljoufie, n.d.).

The environmental weather conditions the pedestrian cyclist will be subject to are the same as the professional, but less controlled given the use of a bicycle year around versus a isolated event during a specific time of year. The pedestrian rider may be riding during the hotter summer months when the temperatures are hotter, the humidity is higher and the air quality can be extremely harmful due to a slight increase in wind conditions (Sparks, 2020).

4.0 Sport Rules (UCI)

Other attributes a professional cyclist needs to take into consideration are the ever changing UCI (international cycling governing body) rules and regulations, with the accelerated technologies that are coming out of the market to make riding more efficient, UCI is having to annually modify the gear and clothing regulation. This brings up the amount and expense that travel to races will consume you, typically a professional cyclist is on a team or aiming to get on a team, this is highly competitive and can be morally conflicting. On the Olympic circuit many countries do not have a womens cyclist team. Under the UCI, Code of Ethic, it is stated: “The persons bound by the Code shall not undertake any action, use any denigrating words, or any other means, that offend the human dignity of a person or group of persons, on any grounds including but not limited to skin colour, race, religion, ethnic or social origin, political opinion, sexual orientation, disability or any other reason contrary to human dignity” (Union, 2020). This is best practice and allows for women within the Muslim religous belief system to be covered during a UCI sanctioned event.

Women now compete in the five Olympic disciplines – Road, Track, Mountain Bike, BMX Racing and BMX Freestyle and other disciplines – Para-cycling, Cyclo-cross, Trials and Indoor Cycling, under UCI, union cycliste international governing body (Regulations, 2019)

UCI regulations on road cycling clothing, these garments are made of drag-resistant materials such as Lycra or Nylon to help reduce the racers wind resistance during the race (Regulations, 2019). According to UCI rules, all uniforms must have sleeves and the shorts must not extend below the knee. This poses a point of contention for women of the muslim faith, who wear hijabs (headscarves) and jilbabs (full boy covering). An example of how some teams have adapted or worked around these rules and regulations is to wear what they have on hand and the furthest thing from aerodynamic (Hurford, 2020). The Afghanistan women's national team rides with their chamois under track-suit pants, and their cycling jersey over a long-sleeved shirt, they also wear a head scarf tied at the base of their neck and wear a helmet over that (Hurford, 2020).

4.1 Pedestrian Rules

In accordance with the Saudi Arabia law of King Salman, cycling was legalized for women in 2013, this had limits and constraints as to where and when women could ride (Vice, 2018). According to the 2013 fatwa, the Religious Police say, they're happy for women to ride bikes and motorcycles wherever they want, "provided they are modestly dressed" (covered head to toe, not revealing or drawing unwanted attention to themselves) and don't use riding as an excuse to remove their abayas (Vice, 2018). The government also recommends that women cycle in the company of a male (husband, father or brother) and avoid areas where young men may be gathering to avoid conflict (Vice, 2018). As well, when the law was first passed in 2013, women were only allowed to bike in parks with a male escort, today the law has loosened giving more freedom for women cyclists to bike without borders in Saudi Arabia (Vice, 2018).

5.0 Athlete/User Data

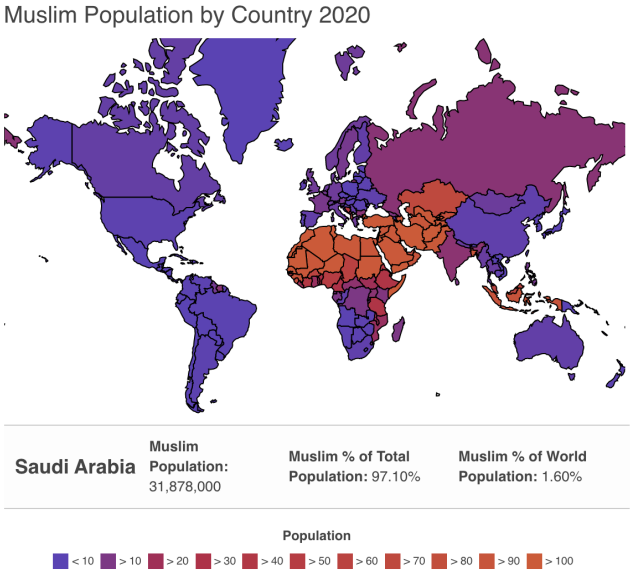
For the purpose of this study and exploration of the Muslim Womens cycling world, the focus will be on gender identifying women between the ages of 18-35 based in Saudia Arabi. The current market is limited for this Athlete, but is growing with the birth of a women’s cycling group, Jeddah Woman Cyclist, which has 7,887 followers on Instagram (Yeager, 2020). As well

Saudia Arabia hosted the first female cycling race, in Jeddah where 47 women lined up to start the 10k race presented by Be Active, an organization to bring women cyclists together (Harrison, 2018). This race has grown drastically, the most recent racing series drew in 1,000 plus women entries to the start line during the three race series that spanned October 2019-January 2020 (Bashraheel, 2020).

Cycling as a sport is growing in popularity across the Kingdom, according to the SFA (Saudi Sports For All), which estimates that about 1.1 percent of the population of Saudi Arabia cycles weekly, an estimated 30 percent of those cyclists are women (All, 2020). “We will continue to stage activities under the Quality of Life program, and work toward our goal to get people involved in sports and activities of all types” said Al-Husseini. The SFA is striving to “mandate” physical activity by 2030, hoping to grow the weekly activity to 40 percent in this time (Saudi, n.d).

5.1 Market Size/Potential

The sample focus for examining market size and the potential for growth of a women’s cycling garment within the Muslim women’s community we must first understand the community at large and dial in on, Muslim Women 18-35 years of age. As well, when considering the potential mark, which will also be unpacked in this section, there are economic and educational considerations to take into account, such as likelihood of being able to afford a bike, access to a bike and willingness (monetary means) to afford garments that are focused on cycling. The focus will continue to dial in on Saudi Arabia, which has predominantly Muslim culture and has seen a growth in acceptance of women on bikes and a movement towards women on bikes.



Focusing the lens on Muslim global population as a whole will take into consideration all ages and genders across the globe. According to a study in 2015, Islam has 1.8 billion adherents, making up about 24.1% of the world population. Most Muslims are either of two denominations: Sunni (87–90%, roughly 1.6 billion people) or Shia (10-13%, roughly 180–230 million people) (Cornell, 2017). From this we better understand that the Muslim population as a whole is about a quarter of the worlds populaiton, validating that the market is quite large drawing attention to potential high demand for Muslim women's cycling apparel.

In Saudi Arabia, as a whole, the population is 34,813,871 and median age is 31.8 (25-54 years: 50.2%, male 10,350,028/female 6,804,479), this indicates that over time there has been a steady growth and the average age is growing older, in part to a drive in physical health initiatives (Saudi Arabia, 2020).

Population of Saudi Arabia (2020 and historical)

Year	Population	Yearly % Change	Yearly Change	Migrants (net)	Median Age	Fertility Rate	Density (P/Km²)	Urban Pop %	Urban Population	Country's Share of World Pop	World Population	Saudi Arabia Global Rank
2020	**34,813,871**	1.59 %	545,343	134,979	31.8	2.34	16	84.0 %	29,255,576	0.45 %	7,794,798,739	41
2019	**34,268,528**	1.68 %	565,772	134,979	30.3	2.64	16	83.8 %	28,700,362	0.44 %	7,713,468,100	41
2018	**33,702,756**	1.82 %	601,577	134,979	30.3	2.64	16	83.5 %	28,133,138	0.44 %	7,631,091,040	41

6.0 Athlete Experience

To better understand the athlete experience with the lens on both the pedestrian and professional level. To begin with the pedestrian scope taking a closer look a native Saudi woman who has faced adversity within her community and has found the means not only to get on a bike but also create a women center cycling community to encourage other women like herself to cycle. Before 2013, women were not allowed to ride bikes as adults, this was a religious and political based policy that went hand in hand with women not being allowed to be out of the home unaccompanied by a male (Ramdani, 2013).

Nadima Abul- Enein grew up in Jeddah, Saudi Arabia, hearing the same stories, bikes are not for women, when she told people she wanted to take up cycling. But with the support of her family, not only did she get a bike, the 18-year-old started Saudi Arabia's first women-only cycling club, Bisklita (Vice, 2018).

Nadima is quoted saying: "When I was a child, I used to ride my bike around my neighbourhood, but I stopped when I got older because of all the negative social pressure," she tells me. "But my mum and sisters encouraged me to pick it up again. When I did, I started posting pictures of my rides on Instagram. It shocked me to see how many Saudi women eventually got in touch to say they wanted to come on the ride. So that's when I decided to start an amateur cycling club for girls" (Vice, 2018).

Furthermore, the professional women cyclists who competed in the 2018 SFA (Saudi Sports for All Federation) series (20 km race), have found that this has been a major step in the right direction for the sport of cycling, participants' entry has grown from 47 to 1,000 (Yeager, 2020). This indicates that there is a growing market and desire for more professional women's cycling events in the Kingdom of Saudi Arabia.

As well, in the scope of professional racing, four women became the first Saudi female cycling team to join the Global Biking Initiative (GBI) European tour, an annual seven-day ride charitable race (Kutbi, 2018). "Sisters Fatimah and Yasa Al-Bloushi, Dina Al-Nasser and Anoud Aljuraid — founder members of the HerRide cycling group — joined hundreds of cyclists from all over the world earlier this month when the tour kicked off from Gothenburg in Sweden before heading through Denmark and on to the port of Hamburg in northern Germany" (Kutbi, 2018). Although this is a benchmark for Saudi Arabian women cyclists, the challenges remain for those joining the sport (Kutbi, 2018). "I mostly trained at home, but it's hard for me to train in areas where men usually train, such as Wadi Hanifa and Ammariyah," she said. "However, I was able to get over my fear and by the third day on the tour I was riding alongside trucks and didn't even notice" (Kutbi, 2018). Dina Al-Nasser sees this not only as a challenge Saudi Arabia women but for professional female cyclists in general (Kutbi, 2018).

Other accounts of women's progress and struggle in the professional circuit stemming out of the U.S., are accounts mirroring that of the growing Saudi women's community. "As female riders continue to voice their opinions, rise through the ranks and strive for equality, change is inevitable. Luckily, the heart of the story will ultimately stay the same: Girl meets bike. Girl loves bike" (Bertine, 2012). To better understand the current state of professional female cycling in

the U.S., as few as seven professional teams are fully funded and fewer individual female cyclists are earning a living wage (combining; salaries, prize winnings and endorsements) (Bertine, 2012). “The majority of U.S. female racers earn well below the poverty-line income of $11,170 for a single-person household. Couple that with any unforeseen setbacks, and the dream of racing professionally becomes extremely fragile” (Berntine, 2012). On top of that, the amount of racing that needs to be done and successfully can range anywhere from 20 to 50 event days per year, international competitors (racing a longer “off” season Oct-Feb) can double in the number of races (Bertine, 2012). Based on the examples displayed of both native Saudi women and rather progressive U.S. professional female cyclists, it can be seen that they found their way to a bike as a child and over time have faced an uphill struggle to strive for equality matched with mens cycling.

7.0 Competitor Product Landscape

A brief of background on the pedestrian side of the competitor and product landscape. While most Muslim women wear the hijab for religious reasons as an expression of modesty, other Arab or Muslim women choose to wear it to express cultural identity. Twenty-five-year-old Baraah Luhaid has always loved cycling. Although women’s cycling was legalised in Jeddah 2013, it is only allowed in parks or on beaches, and only with a male guardian present. Saudi Arabia’s first women’s gender identifying cycling brand/community was born, Spokes Hub, this started in 2017 in one of the only cycling shops in Jeddah, which also housed a cafe and hosted workshops for women new to cycling (Heremy, 2017).

Outside of the brick and mortar in Jeddah, Suadi Arabia, there is a competitor market in the ecommerce world globally. There is a vast Ecommerce landscape for the Abaya and Jilbab, the price points can range from $150.00 - $30.00 US dollars. A major direct competitor will be offered for purchases on Etsy, ScarfTurbanHijab, this company/maker has 4,533 sales at a 5 star rating (Black, n.d.). Item description; “The Harem pants complete with a long hijab outfit ideal for sports, walks and picnics. This burka does not hinder your movements, lifting the leg or arm you will not be afraid to expose the body, as all the limbs are fixed - band and cuff. For young mothers the good news is that this costume is very easy to breastfeed and chase children on the playground. And the best part is that this khimar is worn in just 1 minute. Does not require pins” (Black, n.d.). This Mulsim sport suit is priced at $100.00, selling over 788 items. The closest place this item will ship to is the UAE, United Arab Emirates, at a cost of $20.00 (US dollars) in 1-3 business days (Black,n.d.).

Another direct competitor in the pedestrian landscape will be a company is Moultazimoun, Muslim fashion designer, offering the Ensemble Tuniqu Papillon Strass Et Panton, priced at 44,90 euros, and ship worldwide (Ensemble, n.d.). This item has very little detail on the webpage and no review but at its price it bridges the swath of what the market has to offer at this time.

Shifting gears to the professional competitor landscape, the focus will be on the top performing kits which the most elite women’s teams are wearing. The top of this list is London based Rapha Performance Roadwear, worn by Canyon women’s elite team, is a sportswear and lifestyle brand focused on road bicycle racing, clothing and accessories (Cycling, n.d.). Canyon’s elite women’s team is wearing the Pro Team Kit, dual fabric design ideal for summer racing, again considering the average temperature in Saudi Arabia is 85 degrees Fahrenheit. The Pro fit jersey cost 145,00 EURO and Pro Team Bib (bottom) 230,00 EURO, ships globally, a brief description of the garmen; “Designed to sit close to the skin, with a high stretch fabric that hugs the body. Pro fit is applicable to our Pro Team, Shadow and Souplesse ranges” (Cycling, n.d.).

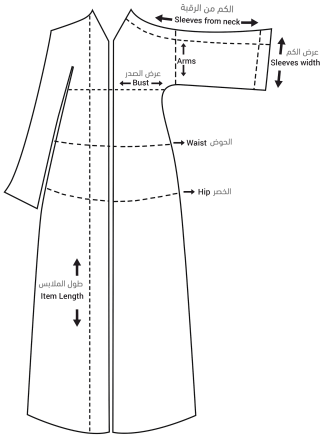
Another competitor to consider on the professional side, ASSOS, a Switzerland and USA based company started in 1976 with the invention of the first Lycra cycling short. Today, the

USA national road cycling team is fitted out in the SS. Jersey and T.Equipe_S7 Bib (USA, n.d.). These Kits cost upwards of 160.00 USD for the jersey and 226.00 USD for the bibs ranking towards the highest end price point for cycling kits (USA, n.d.).

To note here that that Nike Pro Hijab has made a positive impact on the market in regards to mass media exposure and the athlete notablitiy, at the same time this product holds controversy within the Muslim community (Dawling, 2018). Given that the athletic hijab has been around for over a decade, the well done marketing of Nike is poinnet for the root design, most of which has been made and modified by the athlete. As for, dutch designer Cindy van den Bremen, designed hijabs for athletes in 1999, studied at Design Academy Eindhoven during which she heard of a Muslim girl being removed form a gym class for wear a hijab (Weiner, 2017). Van den Bremen claims to have brought her prototypes to Nike and many Athletic brands globally in the late '90s (Weiner, 2017) . "I had designed the hijabs to fit in the collections of leading brands in the first place, so I thought with all the publicity I got when I first started that I should go to them," she says. "But they told me to do it myself—they never gave me a reason, but I assume it was the sensitivity of the topic"(Weiner, 2017). Due to the blurred lines of the origin of the athletic design and the sake of this research, the athletic hijab is highly considered but will not be incorporated into the scope of this document, more due to the landscape for the abaya characteristics of being a lower body garment.

7.1 Anatomy of Product

An abaya is a free flowing total body concealing garment consisting of a long-sleeved, black in style, floor length cloak. The abaya may slip over the chest, but will usually open at the front, close with snaps, zippers, or layers that overlap (Sheikh, 2019). The Abaya is composed of 4 panels and the sleeves are part of the body panel, sleeves are not stitched on separately.



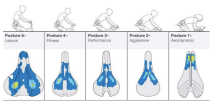
The professional cycling kit has more moving pieces and requires more engineering. The jersey can come in a variety of cuts and fits and does not have a standard for women sizing, varying brand to brand. As well, the cycling short, which also houses a chamois, has minimal seam construction to avoid rubbing in sensitive points of contact. The shape and cut to the cycling jersey (top) is longer in the back and shorter in the front, this is to optimise the bent over position when reaching the handlebars. There are varying factors when it comes to the neck and tightness of this fit, this can be a reflection of the type of riding the user will be doing. The tighter the fit in the body the more aerodynamic less wind resistance the jersey will have. Sizing again as mentioned is not congruent across brands, this can vary by country of origin and manufacturing distributor. Other compositions and features a cycling jersey can have are UV protection, which is in the form of SPF, sun protection factor, based on the same rating factor as sunscreen (Stevenson, 2020). Other cuts of the jersey can come in the form of

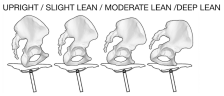
rain/wind shell and winterized long sleeves, which will be significantly articulated in the arm region, allowing the handlebars to be reached without resistance. On the back side of the jersey you will find a pocket with three compartments that house an elastic band along the top to secure personals while on a ride. The composition of the cycling short or bib is made of a Lycra athletic material allowing for more stretch,a chamois padding insert for protection against vibration, road noise through the frame. The chamois is a 2/3/4 density antimicrobial foam pad that consists of both open and closed cell foam structures bonded together, which both mimics the anatomy of the bike seat and that of the groin region.

8.0 Biomechanics and Physiology of Cycling

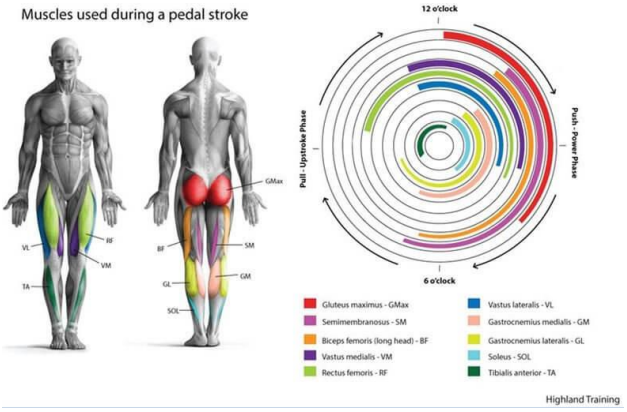
“Biomechanics of riding a bicycle; there are 3 points of contact in cycling. Meaning 3 points of the body that make contact with the bike” (Pioneercyclo, 2015):

- Pelvis on the saddle
- Hand on the handlebars
- Foot on the pedal (Pioneercyclo, 2015)





Based on stress and repetitive strain that these areas wear on there is cause for concern when it comes to injury, such as pain, swelling, weakness and numbness. The riding position plays the next most important role when it comes to the biomechanics and injury prevention of riding (Pioneercyclo, 2015). Overuse and correct positioning go hand in hand, a proper fitting can lead to not only a more comfortable ride but allows the rider to maximize power output allowing the rider to improve splits in the saddle. What is correct can vary rider to rider, age, type of riding, and other physical attributes (flexibility and anatomical veriables) (Pioneercyclo, 2015). Breaking down the biomechanics further into two sections, phases of the stroke (what muscles are activated) and joints.



The stroke has two phases Top Dead Center (TDC) the power phase and Bottom Dead Center (BDC) the push phase. The TDC is activating first the gluteus, second the quadricep and finally the calf during the power (down ward) phase of the stroke. The BDC is activating first the tibialis anterior, second the hamstring and finally the hip flexor heelside (back end) of stoke (Pioneercyclo, 2015). Key joints of the lower limbs that are used during cycling, pelvis-hips (socket joint), allows the and guides the flexion of the hip through the stroke. The knee acts as a hinge lever for the femur, which is the monster of torque during the stroke. Lastly the ankle, responsible for the dorsiflexion and plantarflexion at the bottom of the stroke (Pioneercyclo, 2015).

The above biomechanical factors of cycling require the rider to have full range of motion, stemming from the three points of contact, this is a reflection of the close to body garments that are worn while cycling. The flexion of the joints at the hip and the extension of the arms to the handlebars require the garment to expand and recoil, other considerations are aerodynamics and safety requiring the clothing choices to fit close to the body allowing for little wind resistance, clear visibility to the lower limbs and safety from being caught in the chain stay. This poses a problem for women cycling in loose fitting abaya cloaks, given the biggest concern is the garment getting caught in the chain stay, as well, aero dynamically speaking would create drag making riding more difficult.

The physiology, with consideration to thermoregulation, the body functions in a heat exchange equilibrium with the environment, giving off heat and efficiency of heat loss is dependent on temperature and humidity (Heat, 2016). Evaporation accounts for the majority of heat loss during exercise, functioning as an output of heat (Heat, 2016). Perspiration (evaporation off put), the water contained in sweat goes through a chemical phase change (liquid -> gas) (Heat, 2016). There are several areas of the body that are primary sites of heat gain and loss; palms o, head/face, and respiratory system play major roles in maintaining temperature homeostasis (Heat, 2016). “As heat is generated during exercise or other mechanisms, your body’s response is to shunt blood toward the periphery and increase vasodilation of superficial blood vessels close to the skin” (Heat, 2016).

Again to reiterate, thermoregulation is a process that allows your body to maintain its core internal temperature, this is a state of equilibrium done through sweating and vasodilatation (Holland, 2017) Vasodilatation is the act of blood vessels under your skin getting wider, increasing blood flow to your skin where it is cooler, allowing the body release heat through heat radiation (Holland, 2017). Managing homeostasis, heat regulation, when sweat builds up on skin it needs to be removed, through a wicking process, this provides comfort and regulates body temperature (Bowers, 2020). The lighter and looser the garments, the more effective core temperature regulation becomes, the loose clothing allows air to pass along the skin and exit, speeding evaporation and carrying off excess heat (Palca, 2012).

A study was done to measure the core temperature and perceived comfort under a variable of different ambient temperatures (ranged from 23 to 33 °C with 5 °C intervals for the operative temperature) under two controls of thermal resistance being, amount of clothing they were wearing (0.5 and 1.39 clo) (Liu, 2013). Under control 0.5 clo; women wore T-shirts, pants, female briefs, sandal and bra (total clothing thermal resistance) and under control 1.39 clo; women wore underwear with long legs and sleeves, ankle-length athletic socks, shoes, jacket, pants, female briefs and bra (total clothing thermal resistance) (Liu, 2013). Finding from this

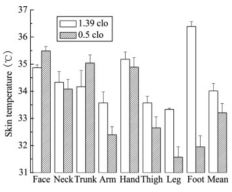


Fig. 4. The effect of clothing thermal resistance on female skin temperature for operative temperature 28 °C.

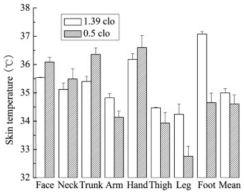


Fig. 5. The effect of clothing thermal resistance on female skin temperature for operative temperature 33 °C.

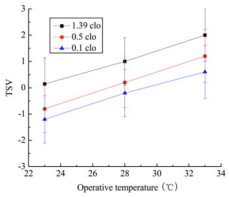


Fig. 12. The effects of clothing thermal resistance and operative temperature on thermal sensation.

study found that as ambient (operative) temperature rose, skin temperatures dropped noticeable when wearing more (1.39 clo) clothing in the neck and hand as more clothing was added, this closed the differential gap (Liu, 2013).

From these findings, it could be believed that there is a relative benefit to wearing more clothing in hotter climates to assist with moisture management and UV (ultra violet, radiant heat) protection to manage homeostasis. In other findings the insulation is dependent on the thickness of the material (i.e. the enclosed air layer) and less on the fibre type (Havenith, 2003). “The fibres mainly influence the amount of radiative heat transfer, as they reflect, absorb and reemit radiation” (Havenith, 2003). Clothing choice consisting of several material layers the total insulation will be much higher than could be expected from the insulation of the material layer alone, apart from its effect on heat exchange, which affects metabolic rate and is increased by the weight of clothing (Havenith, 2003). Things to note and consider, textile composition (fabric choice; thickness, open or closed cell), tightness to the body and color selection, which will be unpacked in coming sections. Both finding yield results that indicate that moving moisture

away from the body is key to thermoregulation, in Havenith the emphasis is layering and weight management (progressive phase-change materials, which have a structure that absorbs and releases heat given moisture levels) (Havenith, 2003). In consideration to the abaya, weight and material compassion will be the point of focus to manage homeostasis.

9.0 State of the Art Materials

Traditional fibers used to compose the Abaya are typically; cotton jersey, linen and polyester. Examining the compositions of each material to better understand how it is being used and potentially a better use. All textiles are fibers made under two classifications non synthetic and synthetic, in the Pedestrian scope of Mulsim womens clothing there is a heavier (weight) used textile, opposing in the Professional scope more synthetic fibers are used for performance needs. Breaking down the four step process as seen above into spinning, weaving, dyeing/printing/finish, and manufacturing.

The first step in the process is spinning to transform the fibrous material into yarn, the fibrous material goes through a drying and shrinking phase called carding (Textile, 2020). The carding process involves the material being attenuated in a spinning mill, the rover is then spun on to a spindle (Textile, 2020). In a carding machine the fibres are combed by a series of rotating drums and moving carding bars are equipped with metal combing teeth. As a result, a soft uniform fibre band is formed. In the fibre band, called sliver, the fibres lie parallel to each other (Bullon, 2017).

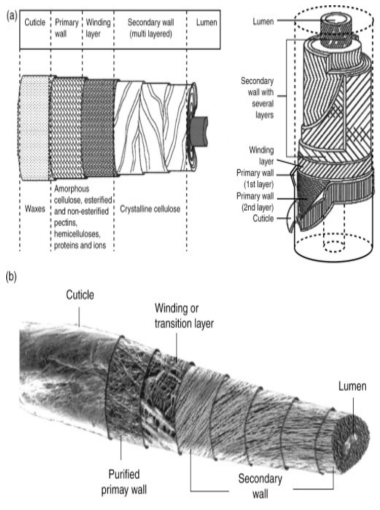
Exploring the weaving process, knitting will be the focus, an interlooping of the yarn in a warp and weft manner. Qualities of the fiber best suited for knitting are fine, smooth, elastic and strong yarns, weaved together through the warp and weft process (Bullon, 2017).

“Weft knitting is a one fibre technique, which means that only one fibre is needed to build the stitches. The needles are moved separately, whereas the warp knitting needles are moved simultaneously. Therefore, all needles need the fibre material at the same time. For this reason, the yarn is supplied with the help of warp beams. The most important knitwear fabrics are

circular knitted, warp knitted, flat-knitted fabrics and fully-fashioned fabrics. Weft knitting is the more diverse, widely spread and larger of the two sectors, and represents around one quarter of the total of apparel fabric compared with about one sixth for warp knitting" (Bullon, 2017).

The finishing stage of the fabric will either/or all chemically treated, dyed, or printed, this is the superficial stage where treatments are specified for the end use purpose/function of the textile/garment (Bullon, 2017). These processes in the finishing stage are divided into two categories, chemical and mechanical processes (Bullon, 2017). "Chemical finishing covers those treatments that alter the performance of the textile fabric where the chemical is the major component of the change. Mechanical finishing refers to certain types of mechanical devices that physically alters the fabric" (Bullon, 2017). The finishing stage is the last and prep stage before the textile goes to production for market and end use. Lastly the textile is shipped to an assembly manufacturing factory, this is where patterns are cut, samples and final go to market products are produced.

Cotton (non synthetic/natural) fibers have a multilayered structure, the structure of the primary cell wall of the cotton fibre, and the outer surface layer (the cuticle), has a major influence on fibre properties (Dochia, 2012). "Cotton fiber has a fibrillar structure which consists of a primary wall, a secondary wall and a lumen, under a microscope a cotton fibre looks like a twisted ribbon or a collapsed and twisted tube. These twists are called convolutions: there are about 60 convolutions per centimetre. The convolutions give cotton an uneven fibre surface, which increases inter-fibre friction and enables fine cotton yarns of adequate strength to be spun" (Dochia, 2012). Cotton fiber is one of the highly acclaimed natural fibers under the genus of *Gossypium* made up of cellulose with 1,4-d-glucopyranose structural units. Finishing on cotton has various techniques, coatings can be applied over the surface of fibers through methods such as chemical vapor deposition, physical vapor deposition, electrochemical deposition, plasma polymerization, UV irradiation–induced polymerization, and admicellar polymerization (Dochia, 2012).



Linen (non- synthetic/ natural) , like cotton, is a natural fiber, lightweight and sourced from the stem of the flax plant (Marroquin, 2020). Flax fibers are very strong and durable (3x stronger than cotton), due to their crystalline structure that transforms into a linen fabric that is strong and durable (Marroquin, 2020). “From linen thread or yarn, fine toweling and dress fabrics may be woven, fabric is a popular choice for warm-weather clothing, also feels cool in the summer but appears crisp and fresh even in hot weather (Linen, 2006). Linen production starts by separating flax fibers from the woody interior of flax stems, soaking raw flax stalks, manufacturers may use chemicals to achieve the same effect (Hodakel, 2019). Before flax fibers are spun into yarn, these chemicals are washed away, but residual toxic substances may remain on chemically-separated flax fiber (Hodakel,2019). Finishes of linen flax manufacturers dry the finished yarn and reel it onto bobbin, yarn is then ready to be dyed and treated (Hodakel,2019).

Linking the pedestrian and the professional is polyester, a synthetic man made polymer PET (polyethylene terephthalate) (Sewport (Ed.), 2019). This synthetic polymer is formed by combining terephthalic acid and ethylene glycol to create a compound, called polymerization, this filament can then be spun into a yarn (Sewport, 2019). This process happens before the

yarn is dyed or post processed (same base as plastic) for other uses such as, homeware or industrial applications (Sewport, 2019). Different types of polyester fabrics can range from ethylene (most used), plant based (biodegradable) or PCDT (not as popular) (Sewport, 2019).

“The fabric used in bicycle shorts usually consists of a blend of polyester, cotton, spandex, and nylon. Regardless of the materials used, they are usually spun and then combined into a single fabric. In spinning, filaments are drawn out of a spinneret, a device that works much like a shower head. Some filaments (such as spandex) are spun into an acid bath, while others are spun into open air. After combining the threads into a single fabric and then washing and dyeing, the fabric is cut into various panels” (Made How (Ed.), 2006).

Bicycle short fabrics considerations include; water-resistant wicking capabilities, drying time, breathability, and windproofing (Made How (Ed.), 2006). Synthetic fabrics are mainly used for the short such as elastane/spandex (stable fabric), a polyurethane fiber that returns to its original shape after stretching, today there is a blending of these fabrics with natural fibers like cotton (Made How (Ed.), 2006).

Invented in Germany in 1937 to replace rubber, later this technology was adapted by DuPont to create Nylon and Polyester, brand name Lycra, for a more dynamic textile (Norway, 2019). The composition of elastane which is never used on its own but blended with other fibers, is a polyurethane base formed by a chemical reaction with diisocyanate, its ability to recoil and hold shape refers to its elastomer character (Norway, 2019). Other characteristics that are valued in elastane are its abrasion resistance, lightweight and tactile smooth/softness (Norway, 2019).

The inner liner, chamois, is usually made from synthetic open cell foam, EVA, which is mechanically pressure molded to match anatomical contours, containing a petroleum-based fiber such as polypropylene, which enhances its wicking capabilities (Made How (Ed.), 2006).

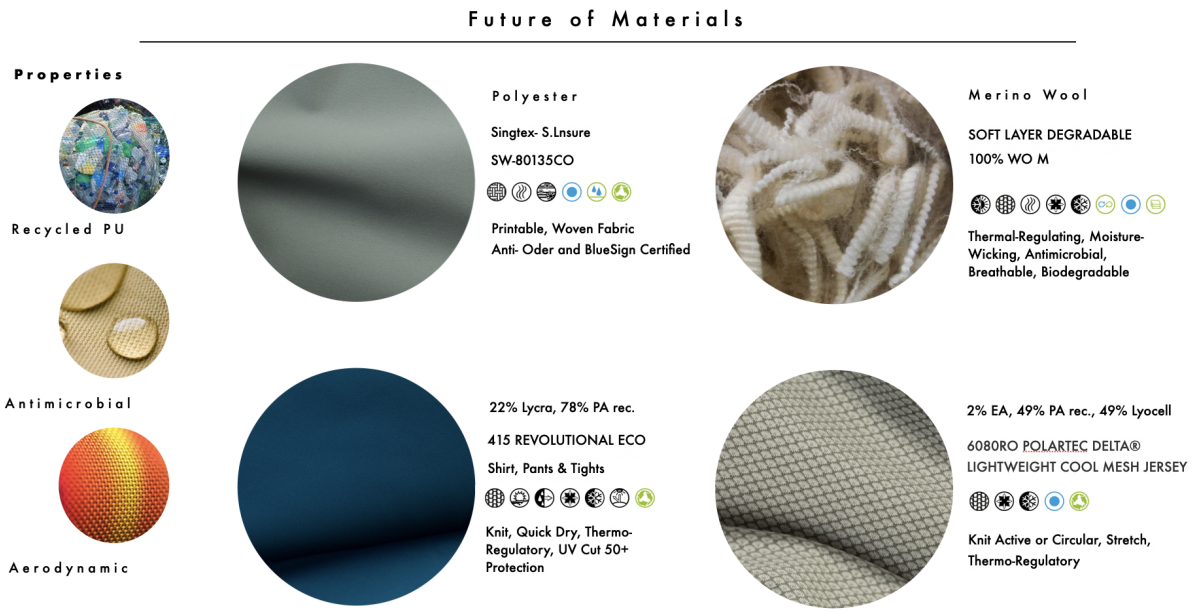
The Cycling jersey is made of synthetic fabrics that are designed to move sweat away from the body and help cool the core body temperature, these are mostly made of a blend of polyester and spandex, which has been detailed above (Label, 2020). Lightweight, antibacterial, wicking

properties, breathable fabrics under armpit for better ventilation. High quality and performance fabrics made to meet your needs” (Label, 2020).

Future materials can look like a few shown above, the objectives of the materials are to be more recycled (sustainable), antimicrobial (hygiene/self cleaning) and aerodynamic (articulated and fitted to the body). Moving over the first two large swatches are base materials for the professional cyclist, these are a Polyester and Elastane/PA blend.

Although these are the traditional materials that already compose the kit, the manufacturing and limiting color can champion a more sustainable approach to the kit. Qualities of the 415 Revolutional Eco Elastane/PA blend is its thermo-regulatory and UV protection properties, as for the Singtex- S.Leisure it's printability allows for the fabric to be more articulated with less seem construction and it anti- odor properties allows you to go longer with less washes (water waste) (Manifattura, 2020 & ISPO (Ed.), 2020).

Future material prospects for the pedestrian, abaya, will stay in the same lane with sustainability and have a unique patterning to the knitted fabric for an advanced moisture control. Above on the right in the larger circles, a merino wool and a jersey blend are featured.



Merino wool has many great attributes, some of which can keep you both warm and cool given its moisture management properties, as well it can be harvested in a sustainable manner. Directly below is the Polartec Delta, a jersey blend (2% Elastane, 49% Polyamide and 49% Lyocell) the blending of these three fibers allows for this meshing to keep the body cool by harnessing the body's natural sweat behaviors (Polartec, 2020).

9.1 Materials and Sourcing

Product ex: Elite Jersey			
Part	**Performance goals**	**Material that will solve this**	**Ideas of where to source the material**
Jersey Body	Breathability UV protection Anti-Microbial	Poly/blend knit Moisture Wicking Knit	- Look in bins for scrap - Look in labs/studio - Contact Supplier Schoeller for coldblack and 3xdry - Mill End for proto material
Hijab	Breathability	Dry Fit (Poly/Spandex Blend) Laser Etched/Perforations Textured Mesh Knit Pique Knit	- Look in bins - Look in Labs under tables - Contact Supplier - Test Lab materials for best etching of knit textile - Mill End
Zipper	Closure/Fixture	Injection Molded Zipper	- Contact Supplier YKK, fpr VISLON® Standard - Look in Labs, see if the lengths are correct for the Jersey and back pockets - Mill End selection for more accurate length for proto
Pockets	Storage	Mesh Knit Poly/Spandex Blend Elastic Bands	- Look in bins - Look in studio - Contact same suppliers as jersey materials - Mill End
Sleeves/Under Arm	UV protection Aerodynamic Mobility Breathability	Mesh Knit Poly/Spandex Blend Textured Nylon/Spandex Mesh Knit	- Look in bins - Look under tables in studio - Contact suppliers Denver fabrics/fabrics.com

Product ex: Elite Bibs			
Part	**Performance goals**	**Material that will solve this**	**Ideas of where to source the material**
Bib Leg	Breathability Mobility Coverage Anti-Microbial	Poly/blend Knit Moisture Wicking Knit	- Look in bins for scrap - Look in labs/studio - Contact Supplier Schoeller for coldblack and 3xdry - Mill End for proto material
Boby Straps	Fit Under Jersey Mobility	Poly/Bend Warp Mesh Elastic Bands	- Look in bins - Look in NucLab - Mill End for different widths - Contact Supplier @ Aixi or
Back of Knee	Breathability	Textured Nylon/Spandex Textured Mesh Knit Mesh Knit	- Look in bins - Look under tables in studio - Contact suppliers Denver fabrics/fabrics.com
Ankle fixture	Stay in place	Silicone Tape Grip Elastic Band	- Look in 4th floor studio back wall - 3D or sublimation printer on Elastic - Laminate Heat transfer (?)
Chamois	Portective Cushion Anti-Microbial	3 Dimensional, 10 mm High Impact Foam, 6 mm Air Mesh, 4 mm Open Cell	- Lab in bins - Lab 3rd floor - Mill End - Contact Supplier - Organic grow options… (mushroom or other foam subs to inoculate)

Product: Pedestrian Top			
Part	**Performance goals**	**Material that will solve this**	**Ideas of where to source the material**
Top Body	Breathability Light Weight Aerodynamic	Polyester Knit Laser Cut Perforations	- Look in bins - Lab 4th floor - Mill End - Contact supplier @ Mehler for

	Anti-Microbial		the Airtex-classic 100% polyester
Hijab	Breathability Mobility	Microfiber Polyester/Nylon(polyamide) Knit blend	- Look in bins - Lab 4th floor - Mill End - Contact supplier @ Mehler or Schoeller
Articulation Straps	Adjustable Secure	Textured Mesh Knit Webbing Fastener Clip/Buckle Velcro	- Ask Boqi - Andy and Bax - Mill End
Pockets	Hidden Secure	Mesh Knit	- Look in bins - Look under tables in studio - Contact suppliers Denver fabrics/fabrics.com

Product ex: Pedestrian Bottom			
Part	**Performance goals**	**Material that will solve this**	**Ideas of where to source the material**
Base Legs	Anti-Microbial	Polyester knit Laser Cut perforations	- Look in bins - Lab 4th floor - Mill End - Contact supplier @ Mehler for the Airtex-Classic 100% Polyester
Waist/Ankle	Secure Breathability	Silicone Tape Grip Elastic Band	- Look in 4th floor studio back wall - 3D or sublimation printer on Elastic - Laminate Heat transfer (?)
Articulation Mechanism	Adjustable Secure	Webbing Fastener Clip/Buckle Velcro	- Ask Boqi - Andy and Bax - Mill End

10.0 State of the Art Manufacturing

Textile manufacturing involves a number of processes: fibre production, yarn (spinning) production, fabric production (weaving), pretreatment of fabrics, dyeing, printing and finishing treatments (Keycolour, 2016). The textile industry uses extensive machinery to produce the textiles (fabrics), these pieces of equipment greatly vary in robustness, being they are heavy-duty industrial machines (Keycolour, 2016).

Breaking down the construction of the manufacturing for the cycling short is as such; the fabric (usually a blend of polyester, cotton, spandex, and nylon) is produced, spinning and combining into a single fabric, followed by washing, drying and dyeing (Made How, 2006). Followed by, spraying with a H2O resistant finish before being cut to the specs of the patterns by designer (Made How, 2006). These patterns are then single straight stitched together (finished with a coverstitch) , seams may be offset for a smoother finish due to the chafing that occurs when riding (Made How, 2006). Lastly, the elastic waistband and thigh grips are sewn with a coverstitch into the short of the assembled short, cuffed and hemmed, with a coverstitch(Made How, 2006).

The chamois liner's are cut according to pattern specs, bonded or laminated together, next they are zig-zag stitched along the outer edges to the interior of the short with a strip of tape for securing placement (Made How, 2006). Similarly the cycling jersey is manufactured and assembled in the same way, a pattern is made, cut to specs and assembled with the process of bonding or sewing with a single needle straight stitch finished with serger overlocking stitch the pattern pieces together (Label, 2020). Zippers and elastic bands will then be added to the jersey and finally the back one piece pocket will be added and sewn, with a single needle straight stitch, in the 3 part pocket to the body of the jersey (Label, 2020).

As for the construction and manufacturing of the Abaya, little to know information was documented, this led to refining the search to the closest thing which is an outer garment. Taking a coat manufacturing step by step the understanding of what it would construct a Abaya can be clearly understood. The pieces that make the body of the coat are cut by a

computer-operated cutter or large electrical cutter. The fabric is cut according to patterns that have been graded to each size the raincoat will be made in.

“The interlining (which makes collars, cuffs, front facings, sleeve straps, and pocket welts stiff) is put inside the appropriate parts. Each part that contains interlining is fused by an automated fusing machine. An industrial sewing machine, single needle straight stitch, operator uses an industrial machine to sew all the small parts of the coat, including the collar, sleeve and pocket welts. The large parts of the shell of the coat are assembled on an industrial sewing machine by a worker. First the right back panel and left back panel are joined together, creating a back seam. Then the rest of the large parts of the coat (the front of the coat, the sleeves etc.) are created in similar fashion. It is sewn, single needle straight stitch, into the appropriate pieces of the shell by a person. All the large pieces of the coat are now assembled and sewn, serger overlocking stitch, together by a worker using an industrial sewing machine. An automated machine makes button-holes and sews the buttons on the raincoat. Using an industrial sewing machine,serger overlocking stitch, the trim and sleeves are sewn on by hand. The finished coat is examined by an inspector for quality control purposes. A worker puts tags on the coat and puts it on the hanger. A polybag is put over the coat, usually by a machine called an automatic bagger. The bagged coats are loaded into the shipping container by a worker” (Coat, 2006).

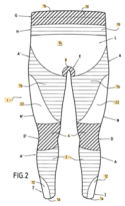
11.0 Patent Landscape

The exploration and focus of the patent/intellectual property investigation was geared to look at a variety of material technologies that contribute to thermo-regulations, cooling systems. Theois was the focus due to two major factors, environment and traditional garments requirements. These searches were done under the scope of cycling and evolved into a larger theme of athletic wear and materials. In the diagram each patent features an abstract, which goes into the general details of the contributing factors as to why this would be a garment and technology to consider. Further, this explores long cycling pants, a long sleeve baselayer, cycling shorts with a unique fabric technology, an athletic top ventilation system, a bi-pattern

bonded cycling jersey, and a tri-pattern cycling jersey. To note on the pedestrian landscape of the abaya, there is a lack of patent information accessible. There are hijab (headscarf) patents, although the body and scope of this project is focusing on the lower body garment and not of the headscarf. Through further investigation, convertible clothing patents have been uncovered and at this stage in the research it is not yet relevant to include those explorations of design until further work like models and more user insight can be unpacked. The value of the hijab patents are insightful, speaking to the quickness and versatility of the headscarf garment, but again will not serve this study due to the nature of the abaya at this time.

Intellectual Property

Pant

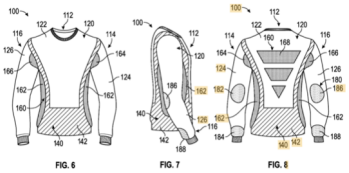


US7945970B2
United States

Inventor: Nicolas Belluye, Aurélien Bringard, Grégory Bayart
Current Assignee: Decathlon SA

The present invention relates to tights, i.e. to a garment covering at least the bottom portion of the body, from the waist down to the ankles, and possibly also part of the top portion of the body. The invention relates more particularly to tights having localized zones that present a compression effect and that are specially designed for practicing a sport in which the legs move repetitively, in particular running or cycling (Belluye, 2005).

Top/ Base layer

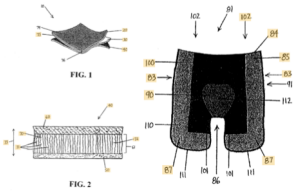


US20180279694A1
United States

Inventor: Jake Theno, David Durham, Jillian Miranda, Tom Burgher, Lindsay Mellen
Current Assignee: Fox Head Inc

A base layer of a garment includes a waist section, an upper leg section, and a lower leg section. The waist section is positioned to correspond with and receive a waist and crotch region of a wearer. The waist section includes a base portion, a mesh portion, a compressive portion, and a durable portion (Theno, 2017)

Cycling Short/ Fabric



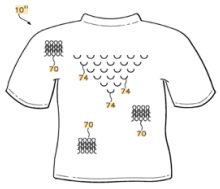
US6918140B1
United States

Inventor:Shane Kevin Cooper
Current Assignee: DeFeet International Inc

A multi-layer protective fabric includes an inner layer, an middle layer, and an outer wicking layer. The outer fabric layer includes an inside layer of hydrophobic material, an outside layer of hydrophilic material, and an intermediate layer of hydrophobic monofilament yarns extending between and knitted together with the outside and inside layers, and promotes wicking of moisture from a wearer's skin to the outer layer (Cooper, 2003).

Intellectual Property

Ventilation



US10463097B2
United States

Inventor: Michael R. Baron,
Karin E. Carter
Current Assignee: Nike Inc

An article of apparel is disclosed that includes zones with a textile having a structure than changes or is otherwise modified by a physical stimulus, such as the presence of water or a temperature change, to modify a property of the textile. The zones may be along a center back area and/or side areas of the apparel, and the textile may increase in air permeability when exposed to water. In some embodiments, slits are formed in the textile (Baron, 2005).

Bi-Pattern/Material

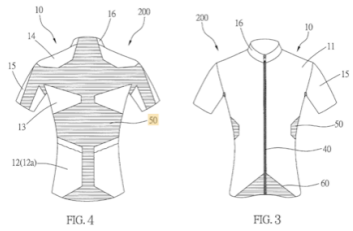


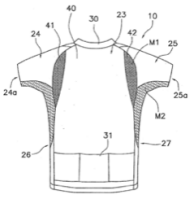
FIG. 4 FIG. 3

US20180332906A1
United States

Inventor: Chris Lintaman

A jersey is disclosed, which includes a first portion made of a first material, and a second portion bonded to the first portion. The first portion comprises a main fabric, which is adapted to cover at least a chest and a stomach of the user. The peripheral sub-portion is made of a second material, which is more flexible and more breathable than the first material. Whereby, the jersey could better fit the body shape of the user (Lintaman, 2017).

Tri-Pattern/Material



US20070271671A1
United States

Inventor: Shinpei Okajima
Current Assignee: Shimano Inc

A cycling garment or bicycle jersey is provided with a front panel, a back panel, and a pair of sleeve sections. The back panel has a first back section at least partially made of a first fabric, and a pair of second back sections attached to the first back section in first and second regions being at least partially located outside of first and second areas corresponding to a wearer's shoulder blades when the cycling garment worn (Okajima, 2006).

12.0 Graphics

Professional graphics can range from team to team and country to country (national representation). The Saudi Arabian Countries graphics seen here are fast darting lines evoking a sense of speed and power. This is juxtaposed with the professional kit of a privately sponsored team which will be logo filled and can be more on trend with the color of the forecasted season. On the other hand if it is a private team sponsored by a more branded logo, the kit will follow suit and conform to the graphics that are top of mind for the general consumer.

The pedestrian side of the graphic lens has seen many changes and freedoms of expression when it comes to the traditional abaya. The modern abaya is still generally neutral in its appearance and construction but women have been customizing their abaya finding ways to ornament or decorate in recent years (Pournelle, 2004). “The ornamentation is often located along the cuffs, necklines, front or back of the jacket. To add flourish and glitter, beads, sequins, painted yarn, ribbon, crystals, lace, etc” (Pournelle, 2004).

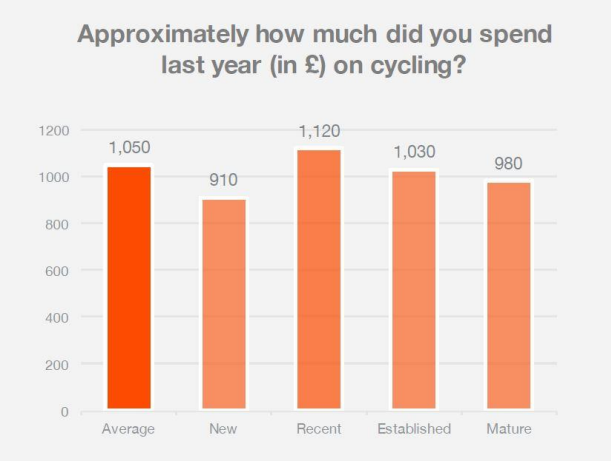
12.1 Color

Professional color consideration will be determined by country of origin and the team logo or brand that they are sponsored by or representing. Saudi Arabian national colors are, Cadmium Green (Hex: #006C35, RGB: 0,108, 53) and White (Hex: #FFFFFF, RGB: 255, 255, 255) (Flag, n.d.). As of now the color scheme would be based on the current market and forecast for the winter season 2022/2023, based on WGSN, honeycomb (coloro 034-76-27), jade (coloro 062-57-10), dark oak (coloro 017-23-07), lazuli blue (coloro 122-25-24), orchid flower (coloro 150-38-31) (WGSN, n.d.).

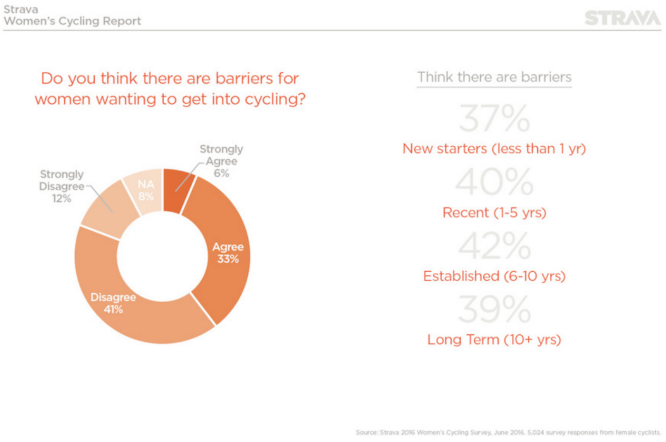
Pedestrian consideration to color is not a rule, but the traditional abaya is black covering the whole body except the head, feet, and hands. The black color of the abaya has also been a topic of discussion. “I’ve heard a story about a merchant who sold abayas. Right now, we know that black is not the best color in the heat, but during that time the merchant was mainly intent on gaining a profit, so he sold black abayas to everyone, and it became popular in this region,” Al-Mutawa said (Gazelle, 2013) “Black is still the traditional and most common base color, but abayas can also be found in other colors such as dark blue, brown, green, and purple.”(Sheikh, 2019) Future colorways will be in the neutral family, bringing to mind the average annual temperature and to remain non threatening to the legal authorities while cycling in public and feeling protected form harassments not to draw too much attention to oneself.

12. 2 Current Product Space

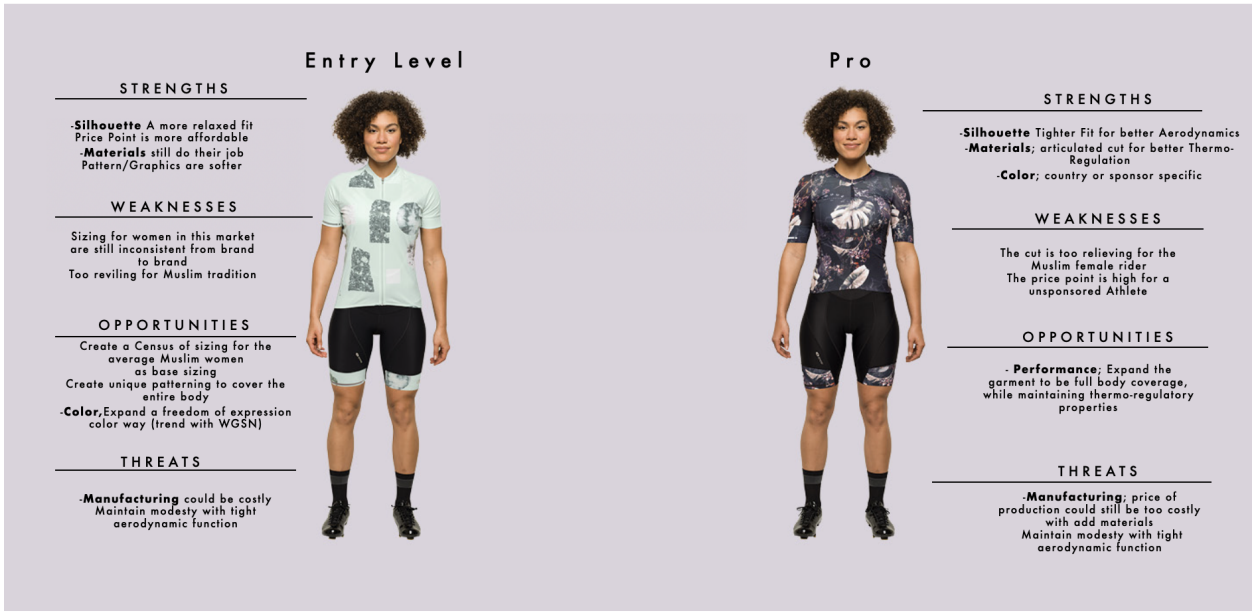
Given the current state of a global pandemic and the one brick and mortar in Jeddah, Saudi Arabia, e-commerce is the current platform for the aya and cycling kits. E-commerce is the buying and selling of goods on the internet, that can look like business to business, business to consumer, consumer to consumer, and consumer to business (Bloomenthal, n.d.). Most of the buying of active Abaya is done on the internet, through Etsy or newer companies taking action in the gload situation. As for the shift to e-commerce amongst larger companies on the professional scope of things, ie Rapha and Assos, who have always had a large ecommerce presence not selling in larger cycling stores, but rather out of brand specific brick and mortar.



To better get an understanding on a whole of womens trending in spending in the space of cycling, Strava (fitness app) conducted a survey on women and cycling, which had a sample size of 5,000 women based out of the UK, (Clarke, 2016). “The industry should further take note of the dataset, which reveals the average spend per year to be £1,050 in 2015. This figure is made up of all purchases, including event participation and other expenditure. When buying cycling apparel, female cyclists considered performance (92%), style (89%) and price (88%)” (Clarke, 2016). Other considerations the Clarke unveils are the data driven barriers to entry to make a point on what the spending trends are in the market, which informs what type of products the survey sample group would be purchasing.



13.0 SWOT Analysi



Findings from the SWOT analysis for the Pedestrian user; what is on the market for an athletic abaya vs. what is on the market for a western user based on the same function for cycling. The sport abaya offers a free flowing traditional covering garment with more of a pant look and

feeling allowing for greater mobility, although when it comes to riding a bike this will still hinder the riders visibility and depending on the bike they choose to ride the pant may not allow for enough from to step over the crossbar and pedal. In the western pedestrian appearing cycling kit, far too much skin is being shown to keep with the tradition and legal restriction in Saudi Arabia. As well it is too form fitting, where it does outperform the sport abaya in its field of visibility the rider has while functioning the bike in an urban environment making it a safer kit to wear.

Findings from the SWOT analysis for the Professional user; had some overlap, the biggest takeaway is that the kit is far too revealing and the cost for adding higher thermo-regulatory material can be costly. The goal of the professional kit based on the SWOT analysis is to maintain and secure full body coverage allowing the rider to be more at ease in the kit without worries of being harassed if the garment starts to shift and move on the ride.

13.1 SWOT FOR BASELINE PRODUCTS & IDEATION PLAN

PRODUCT: Women's Cycling ELITE Jersey, UV Sleeves & Hijab	
Part Name: Body of Jersey	
Problem Identification from Research	Ideation path
SWOT (Back Panel) **Thermo Opportunity:** Zoning of a Textured Mesh and a Poly Panel, a lighter mesh for breathability would work under the back pockets as well line the pockets. **Mobility Opportunity:** The silhouette and cut/seam line can wrap around the back panel becominging more ergonomic when in the riding position and staying in place when performing dynamic movements on the bike.	- Create a One panel back panel of the Jersey, break down the pattern into heat zones - Use these zones to integrate a textured mesh and other mesh textiles to assistant in the evaporative process - Connection point of front panel to back panel and bring the seam line construction just onto the back
Thermo Weaknesses: All one material, does not fit the needs of the Muslim women rider due to length, pocket placement and the heavy weight of material choice. **Mobility Weaknesses:** Fit of baseline is quite tight around the hips, both providing stability but also becomes quite restricting in other parts of the body, creating stress and strain.	- Test the pocket placement (as is from baseline garment) to evaluate how the new multi pattern back panel works - Use a variety of seam sewing construction, flatlock and single needle stitch with overlocking stitch)
Thermo Strengths: Limiting the amount of seam lines and zoning to avoid the riders hot spots on the body. The shoulder yoke allows for the rider to take advantage of aerodynamic seam lines which in the long run would have a cooling effect. **Mobility Strengths:** Silicon bonding on the lower waste of the back panel increases stability of the jersey by allowing it to stay securely in place.	- Zone the texture meshing fabric to match the results of the Thermoregulation testing and retest with new iterations of back panel patterning - Test tensile strength and silicon compatibility for mobility - Analyse stress and strain on the back panel and where pulling may be
Thermo Threats: By adding more panels to the back panel, shifting away from a one piece construction, this could create more perceived heat drawing attention to the seam lines joints of the new meshing textile. **Mobility Threats:** Adding a lighter meshing	- Understand Riders perceive heat and comfort of new patterning - Motion Capture Stress and Strain of new Jersey

bottom panel to the back, the fabric has greater stretch and is more porous.	
SWOT (Pocket) **Thermo Opportunity**: better breathability on the back (upper and lower pocket region) Zipper bunching and movement **Mobility Opportunity**: placement on lower back to shift silhouette to two pocket instead of three, room for a bridge between pocket for extra layer storage if needed	- Moisture wicking bi-component textile that pulls and disperces sweat - Mesh knit (under back pockets) - Zippers on pockets lightweight and floating - Floating Pockets on back to vent moisture - One continuous long sleeve
Thermo Weaknesses: pocket placement and zipper placement on current garment add extra layer of material that is typically the same as jersey base material. Current ideation could create extra seam line of alter the idea of having a venting system under the pocket **Mobility Weaknesses**: the ideation on having a detached pocket could pose problems when reaching and finding the pocket	- Pocket material (mesh and/or moisture wicking) - 2 or 3 sections - Venting system separating pocket from base - How does that move when removing items from pocket
Thermo Strengths: light weight, breathable, minimizing the amount of material needed for the function of the pocket **Mobility Strengths**: placement of pockets just offset the middle of the back wit take pressure off of the riders spine and make it easier for the rider to reach the pocket	- Structurally hhaveing the exterior of the pocket structural (ripstop/poly blend) - Inside of pocket breathable mesh - 2x larger offset pockets off the spine moving outward - Seam Construction is single needle zigzag - Vacuum Mold(?) - Flat Knit into body of back panel
Thermo Threats: Zipper placement will depend on riders needs and wants. Venting system may not work in the event that the back pockets are too heavy once they are full. **Mobility Threats**:Pockets could be too large not holding objects in place allowing for the body of the garment to move/shift	- Exploring venting systems and intersections - Breathable functions perforated pockets that old objects at the same time - Systems that allow you to reach or retract
SWOT (Shoulder Region) **Thermo Opportunity:** Arm hole area reduce moisture making it more breathable **Mobility Opportunity:** a more dynamic shoulder	- Polartec's Delta fabric for underarm and back of shoulder - Single stitch with coverstitch - Zoning Upper back (shoulder blade) with underarm - Potential gusset for mobility

region when reaching for the back pocket and down to water bottle,	- Floating shoulder
Thermo Weaknesses: Potentially too many seam lines that could not moisture wick as well as single back/shoulder panel **Mobility Weaknesses:** Seam lines could bunch or stress/strain when reaching and then leaning forward in riding position	- Mitigate a dynamic seam that is strong enough to move with the delta fabric and old poly blend inplace
Thermo Strengths: Allows for the sweat zone of the shoulder and upper back to moisture manage better to cool the rest of the body **Mobility Strengths:** puts less strain on the M1/M2 movements	Zoning options could look like a flat knit of a pattern shift to eliminate seamline - Continuation of aero material further on to the back - ZigZag stitch for stretch - Combination of raglan cut on back panel for increased mobility and straight seam on front body panel f
Thermo Threats: There may be other areas that require more moisture management, is this **Mobility Threats:** the shift in material could stretch over time not recovering becoming stretched over time	
SWOT (Sleeve) **Thermo Opportunity:** breathability in the upper arm, eliminate the overplan of material where the UV sleeve meets the jersey. Zoning of lower arm and upper arm for evaporative process, lower arm to hand needs mgmt for hotter temps **Mobility Opportunity:** focus on the elbow articulation, eliminate bunching at the elbow when in reaching motion and drinking movement	- Poly blend knit inside arm - Aero knit on the outside - Articulation (darting or seam line ergo) in elbow area
Thermo Weaknesses: zoning of the upper and lower are with limited seam lines, silhouette inline with the Rapha aero jersey **Mobility Weaknesses:** placement of seam line and darting could cause rubbing and movement	- Seam construction - Sweat mapping for upper and lower arm
Thermo Strengths: over time allows for sweat to act as a cooling system, aero knit will help moisture mgmt	

Mobility Strengths: assist with the pull and stress from shoulder region, elbow articulation can help from material bunching during testing of M1/M2 (Movement 1 and 2)	
Thermo Threats: Fit and silhouette, what are are size (length and diameter) from upper arm to lower arm, collect data to develop fit standar for long sleeve **Mobility Threats:** seam line or dart may not function effectively enough	- Fit test and silhouette sketches
Part Name: Hijab	
Problem Identification from Research	Ideation path
SWOT (Top of head) **Thermo Opportunity:** Breathability, while providing the coverage that rider would need if the helmet is removed at any time rider is out of the home **Mobility Opportunity:** stays in place, benchmark product functioned well for this	- Mesh knit - Seam construction - Silhouette to benchmark - Laser cut micro perforation
Thermo Weaknesses: providing proper coverage when the helmet is removed, **Mobility Weaknesses:** mesh knit will stretch over time	- 4 silhouettes for testing with a variety of helmet - Chin strap tunnel systems
Thermo Strengths: breathability, one of the hottest regions at all temperatures (75-95), integrate into body of the jersey **Mobility Strengths:** strap integration ease of visibility	- Limit the amount of seams in garment - Considerations to pressure points and restricting seam-lines - Ease of function (on/off)
Thermo Threats: does it work with all helmets, can it provide proper coverage **Mobility Threats:** strap system versatility between helmet and hijab	- Prototyping out the kinks - Testing Iterations of Proto in the Lab to measure perceived comfort of rider
SWOT (Neck/Chin) **Thermo Opportunity:** allow chin strap of helmet to thread through the hijab to relieve material from being stuck against chin, mesh on sides of neck for evaporation mgmt, integrate in to jersey	- Mesh knit (sides of hijab on neck) - Flat seam coverstitch - Hook system/weaving system for hijab/jersey attachment

Mobility Opportunity: seam line and construction (cover overlocking stitch) to allow for ease of 180 blind spot check when the cyclist is moving head left and right	
Thermo Weaknesses: baseline product, did not allow for material to breathe under strap **Mobility Weaknesses:** baseline product, stretched and moved when looked left and right during M3	- Attachment hood integration - Laser cut perforations on sides of hijab - Tunnel under chin for strap
Thermo Strengths: breathability, under the chin, material could be mesh/laser cut **Mobility Strengths:** extra stabilization for the hijab integrated with the helmet	
Thermo Threats: laser cuts allow for breathability, seam lines working with the materials **Mobility Threats:** universal fit with face shapes and sizes, along with helmet preferred tightness.	- Prototyping interactions of the chin strap & how that mechanism functions with the hijab and zipper placement - Fit testing - Laser cuts patterns (speed up the time between iterations and manipulation of patterns to understand what works best)
PRODUCT: Women's ELITE Cycling BIBS	
Part Name: Bibs/Shorts	
Problem Identification from Research	Ideation path
SWOT (Thigh) **Thermo Opportunity**: breathability and panel construction of the of the short, extend the short panel to knee **Mobility Opportunity:** seam/pattern construction (overlocking cover stitch) in line with benchmark with extensions of the thigh piece cutting down to the knee	- Poly blend for base material - Polyester has natural UV protective properties
Thermo Weaknesses: based on baseline product the overlapping of UV sleeve and short was causing most heat on leg **Mobility Weaknesses:** adding more paneling can create more seam construction which can cause more discomfort to the rider over time	- UV Knit (with denser poly fibers) - Colorway exploration - Pigment refraction - Flatlock and Overlock stitch to avoid rubbing and discomfort - Seam construction linear to the movement of the stroke avoiding placement on the back of knee

Thermo Threats: Addition of more poly blend that is more insulative than the UV sleeve will not manage the heat well enough **Mobility Threats:** stress and strain over time, baseline UV sleeves stretched considerable during the 3 testers rides	- Options for flat knitting a transition material (UV protecting on the thigh)
SWOT (Knee) **Thermo Opportunity:** mesh knit on back of knee for breathability **Mobility Opportunity:** flexion and extension not hindered by the addition of this mesh knit	- Textured Mesh knit for back of knee/moisture mgmt - Over locking Cover stitch- Seams stay flat and don't fold during the flexion phase of the stroke
Thermo Weaknesses: seam line at the top of knee or extending the front leg panel down to ankle **Mobility Weaknesses:** stress and strain on the knee form a more rigid poly blend, how could this affect the patella over longer periods of time on the bike	- Test work like model for longer periods - Measure stress or strain - Identity cuts/seam lines that relive
Thermo Strengths: allows for the silhouette to fully protect the rider from the sun and with mesh knit help with the evolatrative process **Mobility Strengths:** flexion and extension not hindered by the addition of this mesh knit	- Measure is the rider sweating less
Thermo Threats: over heating, the material does not protect the rider enough from the sun and mgmt of sweat is worsened **Mobility Threats:** resistance in the knee during flexion of the pedal stroke	
SWOT (Lower Leg) **Thermo Opportunity**: breathability on back of leg (muscle/calves) mesh knit **Mobility Opportunity:** flexion and extension not hindered by the addition of this mesh knit	- mesh knit - Laser cut perforations - 4 way stretch poly blend
Thermo Weaknesses: baseline product held moisture during as the temperature rose	- Test stress/strain - Material testing of modest coverage and visibility through the garment
Thermo Strengths: allows for breathability and	

moisture mgmt	
Thermo Threats: mesh will be see through not covering the cyclist in a modest way	
SWOT (Chamois) **Thermo Opportunity:** breathability, antimicrobial properties, perforation to assist in evaporation process **Mobility Opportunity:** specific for each riding style, Elite cyclist in an aggressive position with have pressure on the sits bones where the force in pushing back on the as opposed to straight down on the sits bones	- laser cutting and vacuum form - 4 foam density thickness -open cell foam structure for better breathability -2x silhouette (pedestrian, less pelvic lean/sits bones and breathability) (elite, greater pelvic lean/more support needed to cradle labia)
Thermo Weaknesses: baseline was inconsistent rider to rider hard to pull data	

PRODUCT: Women's Cycling PEDESTRIAN Top	
Part Name: TOP	
Problem Identification from Research	Ideation path
SWOT (Built in Hijab/Hood) **Thermo Opportunity:** Allow for more volume in the hijab, creating more volume in the hijab/hood will create a cooling barrier activating the evaporation process. Material (polyester) will benefit the wick and UV protection necessary. **Mobility Opportunity:** Easier on/off of the hijab/hood with a half zip from the midpoint of the front panel, will allow for quick adjustments and ease of dressing. A tightening cord can be tunneled through the hijab/hood to make fitting more universal	- Intersectional cross between the sports Hijab and a jacket hood - Find the baseline pattern that meets the needs of Traditional dress and begin to implement into the body of the top - Mobility of ease of dressing, test zipper and other variety of opening/closure mechanisms - Explore Placement of tightening cord/mechanism tunnel - Questions to ask; how does it allow for security and visibility for the safety of the rider
Thermo Weaknesses: The volume of the hijab without venting system could allow for the air to act in the inverse way trapping the heat in the Hijab **Mobility Weaknesses:** A zipper closure on a looser fitting garment may create discomfort,	- Test volumes needed to create a cooling system - Could a venting system be integrated into the Hijab/Hood in a discrete way while covering all hair - Mobility of zipper will be explored through

visibility constraints with a zipper closer becomes a concern	size of zipper and other fastener mechanism such as snaps or velcro
Thermo Strengths: Baseline testing showed that the perceived heat was less in the areas were the garment was looser fitting **Mobility Strengths:** Perceived comfort during baseline testing and after adjustments to the garment the rider made ease of mobility increased	- Test these theories on the prototype - Record Data - Overlay data and plot findings
Thermo Threats: Fit of the hijab will not be compatible with a variety of helmets **Mobility Threats:** Is the ability of adjusting with ease effective enough	
SWOT (Sleeves) **Thermo Opportunity:** Add volume and shorten the sleeve, findings examined that the volume in the sleeve had a cooling effect. By shortening the sleeve and using a UV under sleeve for coverage. This allows for more venting and full coverage **Mobility Opportunity:** Ability for the rider to clearly see their hands and communicate to the drivers what direction the are going in increase by the shortening of the sleeve with additional reflective properties **Aerodynamic Opportunity:** Detaching the sleeves from the body of the garment allows for air to cut between the arms (in riding position) and the rider's body.	- Intersect the pattern of the baseline abaya top with a western hooded windbreaker - Where is the intersection, in the sleeve construction? - Test lengths and find length that allows the cyclist to have clear visibility to their hands while riding and while signaling - The Aerodynamics of the sleeve only need to increase/improve a small margin to be an improvement. - Motion Capture the Sleeve Under control and measure for drag/movement
Thermo Weaknesses: will a one way ventilation system be effective enough, moisture management at the top of sleeve, seam joint to the body, still may produce a hot spot. Perforations to UV sleeve at the top of arm could be necessary **Mobility Weaknesses:** UV sleeve worn under the top potential could rub and cause resistance **Aerodynamic Weaknesses:** Only increasing performance by a small margin	- Consideration for ideation, be able to not and implement changes as Testing proceeds

Thermo Strengths: Mimicking the benefits of the first garment, which was draped and allowed for volume/breathability **Mobility Strengths:** Visibility to bike functions while riding and Communication with other traffic on the road **Aerodynamic Strengths:** Margin although small is creating a more enjoyable and efficient experience for the rider	- Small scale volume studies - Test in Lab what volume that gives the rider perceived comfort and cooling effects
Thermo Threats: The shorter cut of the sleeve may not be appealing for more traditional Mulism Women, Potentially causing them to be uncomfortable in public spaces **Mobility Threats:** As stated about the shorted ¾ cut of the sleeve will not appeal to a larger spanning community	- Survey the Consumer to get findinging around the out of home safety and interest in wearing said ¾ sleeve
SWOT (Front Panel) **Thermo Opportunity:** Increase the evaporation process through the use of hidden venting systems on the from panel of the top **Mobility Opportunity:** integration of easy zips to allow for quick adjustability and venting when moisture management becomes necessary **Aerodynamic Opportunity:** Cut the front Panel to be more ergonomic with the rider, as to not get in the way of the legs while riding	- Pull inspiration from over garments that have venting systems - How is the venting system activated? - Can the venting system be deployed or is it fixed at all times? - Explore through sketching how length and cut of the front system could have venting systems and integrate the zip fixture for the hijab/hood
Thermo Weaknesses: how will the venting system work with the baselayer garment worn under the top, with there need to be more or less to have an effective cooling mechanism. **Mobility Weaknesses:** how does the base layer material interact with the tops front panel textile, could the be resistance or pulling **Aerodynamic Weaknesses:** if articulation is not effective enough will the loose fitting front panel balloon to sleeves creating more drag	- Test proto with a base layer that will be worn by tester consistently throughout the study - Confirm that this is a base layer that is worn within the community
Thermo Strengths: The innovation of venting	- Test the front and back system together in

systems from front panel to back panel can create a vacuum system allowing for air to move efficiently through the garment **Mobility Strengths:** Placement and direction of the side venting zippers and the orientation of the zippers will allow for the rider to utilized with on hand both open/close **Aerodynamic Strengths:** In the riding position (over handle bars) the front panel will have limited seams allowing for maxing air flow over the garment	full scale with air pumping at the rider from head on - Apply a variety of zipper systems and back up system to best tested with one hand application/function
Thermo Threats: The venting system on the front may not be appealing or feel too revealing for more traditional Mulism Women, potentially causing them to be uncomfortable in public spaces **Mobility Threats:** The venting system on the side may be perceived as too revealing for the more traditional muslim women **Aerodynamic Threats:** The side venting system when deployed can create more drag	- Consumer feedback as the testing and integration progresses - Test may result in not needing the perforations, consumer consideration should still be considered to move forward
SWOT (Back Panel) **Thermo Opportunity:** Venting, Biomimicry of armobilla and accordion style venting systems. Holistic system with front panel to have an in and out put of air flow and evaporation **Mobility Opportunity:** Space for the rider to potentially carry a bag and not have the back panel be invasive or bunch up. If integration of a back pocket (for keys and small accessories) in the garment reachability and garment shifting will be key considerations **Aerodynamic Opportunity:** Allowing for more volume to be held in the back panel of the top garment due to the largest part of the body being exposed while riding, Aerodynamics and margin of improvement will not be held to great importance.	- Intersections of a top coat to the baseline abaya that was tested in the initial study. - What is on the market for the cycling poncho, what is working and not working for that? (Aero, Mobility , Fit) - Explore back panel tail lengths, test a variety of 3-4 lengths and move forward with the top 2 - Mobility test a cut in the tail center bottom for restrictions - Mobility test how the volume of the back panel functions with the side venting and a a pack on
Thermo Weaknesses: The balance of what is enough and what is too many back panel venting systems (spaces, slots) i preferoations with a	- Explore and compare side by side venting system and laser cut perforations system with mesh backing

mesh backing a more effective route to go without damaging the integrity of the fabric, allowing it to be at risk of ripping or creating more drag **Mobility Weaknesses:** If the venting system is on the back how will the rider ramain cool on the back if transporting a back on their backs?	- What doe thi then look like when the rider is wearing a pack
Thermo Strengths: Allowing for venting in the garment either through a flap venting system or a perforated on, venting on the back panel with allow for the fully covered Muslim women to ride with a maintained evaporative cool mechanism in place **Mobility Strengths:** Back Panel volume allows for the body to move without restrictions, also the volume to be mostly on the back of the garment will protect the riders form/shape outside of the home	- Consumer feedback on Prototyping, would you wear this garment and would you feel safe leaving the house in it?
Thermo Threats: The Consumer will be able to find a large ventilated windbreaker that with do the job of venting but will not have a cycling cut **Mobility Threats:** Does the Muslim rider need to be conserned with carrying bag while riding, if this a future ideation to be designed for	

PRODUCT: Women's Cycling PEDESTRIAN Bottom	
Part Name: Bottom	
Problem Identification from Research	Ideation path
SWOT (Wasit) **Thermo Opportunity:** Minimal approach, shift from a heavy elastic bank to a lighter weight fastener system. Venting back pocket with envelope pocket function. **Mobility Opportunity:** A lighter system with webbing and silicon or plastic buckles, or a PALS system with a notch and hook, would make the	- Exploreintersetions and how fastener systems function with ease - What is on the market for waist systems now, how could this perform the same or better - Sketch the ideation process - Prototype 4 functioning iterations - Pleating to add Volume during pedal stroke and to relieve the force of the pulling on

riders ability to adjust the garment with ease and comfort on the bike.	garment during extension
Thermo Weaknesses: The adding of a fixed system may not function as desire and will have a combination of both a elastic waist and a buckle system creating more bluck and less breathability in the waist (garment and textile overlapping each other) **Mobility Weaknesses:** There potentially may need to be a yoke installed in the back panel of the pant to allow for greater flexion of the hip and not imposing on the waist mechanism	- Explore buckle systems with elastic to be prepared if the need to have a larger fit scope requires this function to be put in place
Thermo Strengths: Ability to quickly envelop pocket venting system along with quick adjustability to breather in the waist when needed, As well less material is a benefit for less overlapping of textiles **Mobility Strengths:** Adapted systems from packs and other pieces of equipment that uses the quick and secure fasteners	- Test the envelope pocket and intersections with origami to see if there are systems that will open on their own given the angle of the rider position
Thermo Threats: Will not be as utilized as possible, potential moves away from the simplicity of the garment making it unattractive or intimidating for the user **Mobility Threats:** The need to adjust may work well for some riders but be unnecessary for over and find that it is bulky and to robust for their needs	- Consumer feedback and testing in the riding position to understand how robust or bulky the buckle system feels and if the consumer needs this function - How minimal can the system be while still functioning
SWOT (Leg/Pant) **Thermo Opportunity:** Allowing for the pant to still have volume but not hinder the rider, darting and pleating will create volume along with a gusset system (which will be discussed further down). This rider could also have venting on both right and left thigh sides with mesh backing and a micro zipper system to quickly vent the upper leg. **Mobility Opportunity:** Adding reflectivity to the garment for safety, Darting and articulation at the knees for better ergonomic function, ¾ cropping the pant for protection of getting caught in the	- How can volume be kept while remaining aerodynamic? - Idea of convertible and versatility, agreement remains deceptively simple not drawing to it undue attention

chain stay while riding	
Thermo Weaknesses: If the opportunity to open venting on the sides doesn't arise how practical is the rest of the volume at provident a cooling mechanism **Mobility Weaknesses:** The Darting could not be the correct fit for every rider, making it challenging to come up with the proper placement for the darts.	- Test with venting systems closed to better understand the perceived heat if the are not about to be opened - How could the darts move up or down or be adjustable or have larger fit range
Thermo Strengths: the ability to had venting when the riders needs gives back some of that control to the rider to use the venting when they need it **Mobility Strengths:** The ¾ pant leg allows for a worry free ride of getting cough in the chain stay and allows for the rider to be seen with greater visibility with reflective accents.	- Test and validate the function of these claims
Thermo Threats: the Community of Mulism women in high restricted areas may not be able to use these functions on the garment, deeming the useless **Mobility Threats:** the Community of Mulism women in high restricted areas may not be able to use these functions on the garment, deeming the useless	- Consumer Feedback
SWOT (Crotch) **Thermo Opportunity:** The greatest opportunity here is with the addition of a breathable gusset and potential to be compatible with a chamois **Mobility Opportunity:** Shifting away from a hammer pant deep drop crotch will allow the rider to bike with less interference and shifting of the pant leg. This could look like a 2-3 inch drop from the crotch allowing for a free forming appearance while still providing the	- Fit and cut verse the baseline hammer pant - How to work backwards from the draped pant to more of a athletic cut
Thermo Weaknesses: Moisture management, and chamois integration if rider wanted to wear under the pant	- What antimicrobial textiles are current on the market? What is the goal weight of the textile?

Mobility Weaknesses: There potentially may need to be a yoke installed in the back panel of the pant to allow for greater flexion of the hip and not imposing on the waist mechanism	- What current Mountain Biking Pants/Shorts are doing to integrate with the use of a Chamois while riding?
Thermo Strengths: The potential to add a expandable gusset if the needed to be more volume in the crotch off the bike, as well could a system of laser cut perforations and a mesh backing provide coverage and allow for proper ventilation in the the inner thigh region **Mobility Strengths:** Lifting the Hammer drop crotch to a more practical length while still providing modesty will allow the rider to reach the water bottle from Test M1/M2 with more ease. As well, the higher crotch will allow the rider to visibility see more of their surroundings and importantly their feet. When a Rider is new to riding this tends to be where their gaze drifts (although not recommended, it could nonetheless be a hazard)	- Test the desired perforations and integrity of the gusset, How much and what size perforation is needed and how much mesh backing out be needed? - Does this double layer create more thermo heat that it does evaporate the moisture? - Mobility, how low or high in practice does the critch need to be, test in 3-4 lengths once desired length is found how will a guest further function.
Thermo Threats: The crotch region is a larger religious reason that the women in the Muslim comunity for many years has been looked down upon, how could the venting system here cause greater concerns for the female to leave the house in said garment . **Mobility Threats:** The seam construction could be stress and strain affecting the integrity of the garment instilling fear in the surer that the garment will not adequately provide protection	- Consumer feedback, how would this be perceived in the middle east? - Could there be different cuts for different regions depending on needs and safety
SWOT (Ankle) **Thermo Opportunity:** ¾ and eliminating the elastic band at the bottom. The gusset/accordion panel on the back of the ankle will allow for volume to be handled when off of the bike creating a straighter look to the pant, concealing the form of the body and also functions as a venting system. **Mobility Opportunity:** A system to close the venting system when riding the bike could be put into place given a piece of webbing tunneled into	- Test lengths, and what dimensions the accordion expansion would need to be given the riders comfort and it being now an extra layer near the lower leg. - How much stretch so the deployable webbing need to keep the venting system closed - As well how much velcro needs to be attached to the exterior of the pant for this to be fully functioning

the lower part of the mant leg that can be deployed to snitch down onto a piece of velcro **Aerodynamic Opportunity:** Creating a UV Sleeve or sock to bridge the gap between shin and ankle the tightness of the sleeve will naturally act aerodynamically. Replacing pant elastic the system with a single layer UV sleeve or potentially a UV sock that will reach up under the pant leg to provide full coverage	
Thermo Weaknesses: When riding and the accordian is concealed what is the predicted heat **Mobility Weaknesses:** Potential for the tightening system to fail and the venting accordion to get caught in the chain stain	- Test failed systems - How little and how much elastic/velcro for the system to fail
Thermo Strengths: Adaptive venting system, giving the rider full control over their experience and cooling system **Mobility Strengths:** Allows for the system to be as tight or as loose as the riders desires and needs creating a safety mindset in it own right	- Test how easy it is to control the system while riding or in the midst of a bike ride
Thermo Threats: Consumer and Market needs **Mobility Threats:**Consumer and Market needs	- Consumer feedback, how would this be perceived in the middle east?

13.2 Testing Plan Baseline Products

Testing took place in a 16 foot storage container, a total of 8 subjects took place in the testing experience. Below you will find the process that took place when beginning the testing and what needs to be met where per each tester. As well you will find the consent form the was considered given the nature of high temperatures each rider would be subject to. Each Subject willing to test for the Hurriyya Collection would either be testing in the elite kit or in the pedestrian kit, each test would take up to an hour and a half. The subject was welcome to bring water and snacks and anything else to make themselves more comfortable. As well below you will see a brief that was sent before they agreed to the test allowing them to have a better understanding of what to expect during the testing process.

TESTING BRIEF

HURRIYYA - LAB

Research goal: understand how the elite and pedestrian cycling kit **performs** and **functions** under a **controlled environment**. Testing for thermoregulated balance will be tested in environment as close to Jeddah, Saudi Arabia through heat and humidity simulation to understand sweat patterers and comfort levels. Testing for Mobility will be under a set of dynamic movements that a cyclist (either elite or pedestrian) will have to under go to understand strain/stress of garment and comfort levels performing each task. Testing for Aerodynamics will be set under a controlled environment with calibrated wind simulation to understand movement of garment under each bench mark speed.

What to bring:

- [ ] Bike
- [ ] Bibs/Shorts
- [ ] Summer Jersey
- [ ] Helmet
- [ ] Shoes (sneakers or clips)
- [ ] Mask
- [ ] Water
- [ ] Jacket for between rides
- [ ] Change of clothes for post ride
- [ ] Snack (if you think you'll need it)

What to Expect during testing.

Riding on a stationary bike (either on rollers or fixed stand), if it is possible to bring your own bike that is preferred!

Rider will be riding in a Shipping Container, this is a temperature controlled environment.

PHASE 1:

Rider will be asked to ride for 3x10min intervals.

First 10 minutes, temperature will be set to 75 degrees, followed by photo documentation and Q&A (this will take place outside of the container)

Second 10 min, temp will be set to 85 degrees & followed by photo documentation and Q&A

Third 10 min, temp will be set to 95 degrees & followed by photo documentation and Q&A

PHASE 2:

Motion Capture Study, rider will change into RAPHA AERO JERSEY and asked to preform 3 dynamic movements (M1-M3) while riding. Photo and video documentation will take place during this study & followed by a Q&A.

M1: Reaching for back pocket on jersey placing object and removing it, repeat 3x

M2: Reaching for water bottle and placing it, repeat 3x

M3: 180 blind spot check, rider will look at targets on the wall marked at 0,45,90 degrees, repeat 3x

PHASE 3:

Feed back and over all experience Q&A

Phase of Study	Procedure	Data Collected	Timing
Subject Recruitment	Outreach to subjects via text message, DM instagram & “word of mouth”	NONE	NA
Subject Sign-up	Subject confirms (via text/DM) if they are interested in joining the study. Then once confirmed asked to fill out apparel size	Name, telephone, email & apparel size	<5 minutes
Data Collection (Subject is at the Lab)	Subjects need to read and sing consent form, agreeing to a 6 part physically engaging study (a scanned copy will be emailed), acknowledging Covid-19 UO protocol will be upheld during testing (tester &1 subject masked in Lab once)	Consent form completion: printed name, signature & date	5 minutes
	Subject fills-out Subject general background info to data collection (confirming age/ gender identity/ experience)	Subject’s name, address, telephone, email, date of birth, gender identity, height, weight (if wish to disclose), medical history, current injuries, experience level, exercise day/weekly/monthly, brand loyalty	7 minutes
Elite Kit & Bike fitting	Subject changes into Elite Kit for 3 test T/M/A (Bibs, jersey, arm/leg UV sleeves,	NONE	10 minutes

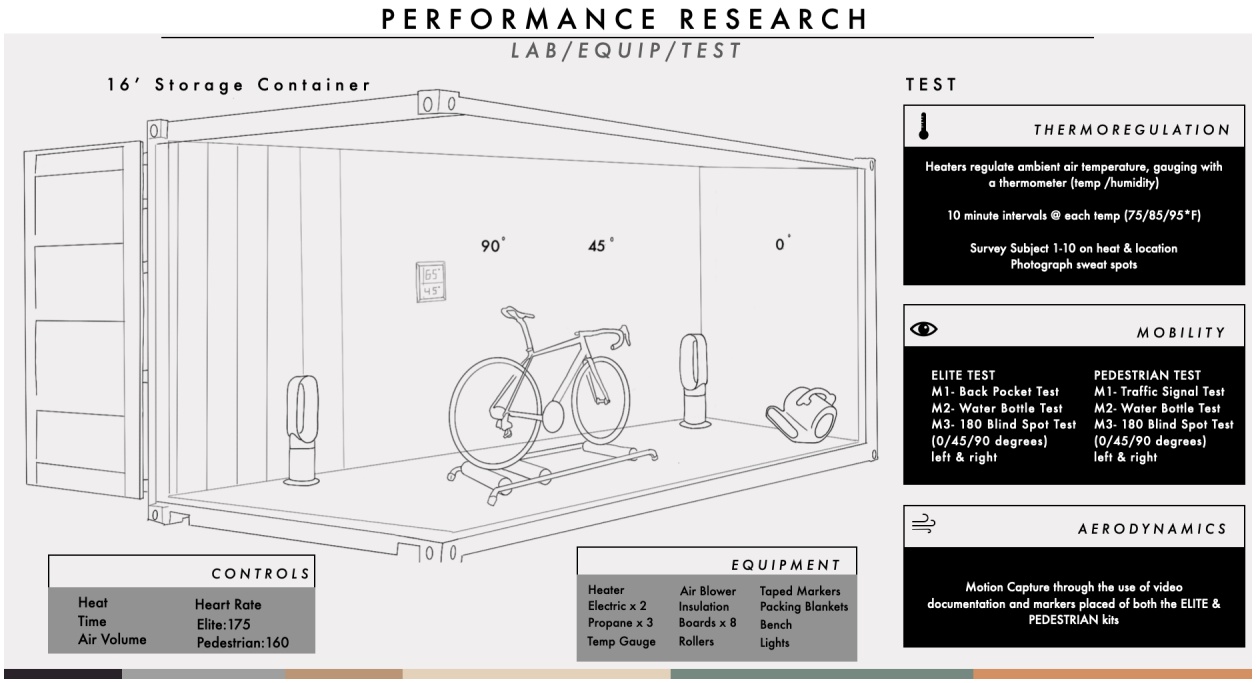
	hijab, helmet) subject is asked to bring their own bike/shoes/helmet (have/want)		
Phase of Study	Procedure	Data Collected	Timing
Data Collection (Subject is at the Lab)	Photograph subject prior to test T/M/A	Front view Side view Back view	2 minutes
T1-T3 Elite test	Perform Elite Kit test T (thermo) 3x 10 minute ride (75/85/95 degree controlled ambient air temps) Photograph subject between each set Survey between each set Video documentation for analysis	Front view Side view Back view Scale 1-10 comfort for each set Map where the felt the most hottest on diagram Video Documentation	40 minutes
M1-M3 Elite test	Perform Elite Kit test M (Mobility) M1- reach for back pocket placing object and removing object M2- remove water bottle/ place water bottle M3- 180 blind spot check (0/45/90 degrees) perform left & right Video documentation for analysis of stain stress on garment	Scale 1-10 comfort for each set Map where the felt the most strain on diagram Video Documentation	20 minutes
A1-A3 Elite Test	Perform Elite Kit test A (Aerodynamics)	Scale 1-10 comfort for each set	20 minutes

	Place markers on Subject for motion capture analysis Wind Gauge to measure air speed (W1/W2/W3) Subject will ride for 5 minutes in each wind condition Survey between each set Video documentation for analysis of motion capture in slow motion to measure changes in garment movement	Map where the felt the most strain on diagram Video Documentation Analysis	
End of Data Collection Session	Collect Elite Kit from Subject weigh garment for sweat water weight Subject will change back into their own clothes	Weigh Kit	5 minutes
Data Collection (Subject is at the Lab) Pedestrian Kit	Subject changes into Pedestrian Kit for 3 test T/M/A (Abaya, Hammer pants and cloaked top) subject is asked to bring their own bike/shoes/helmet (have/want) Photograph subject prior to test T/M/A	Front view Side view Back view	2 minutes
T1-T3 Pedestrian Kit	Perform Pedestrian Kit test T (thermo) 3x 10 minute ride (75/85/95 degree controlled ambient air temps) Photograph subject between each set	Front view Side view Back view Scale 1-10 comfort for each set Map where the felt the most hottest on diagram	40 minutes

	Survey between each set Video documentation for analysis	Video Documentation	
Phase of Study	Procedure	Data Collected	Timing
M1-M3 Pedestrian Kit	Perform Pedestrian Kit test M (Mobility) M1- Traffic arm signals M2- remove water bottle/ place water bottle M3- 180 blind spot check (0/45/90 degrees) perform left & right Video documentation for analysis of stain stress on garment	Scale 1-10 comfort for each set Map where the felt the most strain on diagram Video Documentation	20 minutes
A1-A3 Pedestrian Kit	Perform Pedestrian Kit test A (Aerodynamics) Place markers on Subject for motion capture analysis Wind Gauge to measure air speed (W1/W2/W3) Subject will ride for 5 minutes in each wind condition Survey between each set Video documentation for analysis of motion capture in slow motion to measure changes in garment movement	Scale 1-10 comfort for each set Map where the felt the most strain on diagram Video Documentation Analysis	20 minutes

End of Data Collection Session	Collect Pedestrian Kit from Subject weigh garment for sweat water weight Subject will change back into their own clothes	Weigh Kit	5 minutes

13.3 HURRIYYA LAB (build out and data collection format)



HURRIYYA TESTING

HOW/WHY

THERMO/MOBILITY/AERO

How do we improve cycling performance for elite and pedestrian female athletes through easy of mobility, aerodynamics & thermoregulation management, while keeping with the traditional Muslim dress code.

PURPOSE

Research goal is to understand how the elite and pedestrian kit **performs & functions under a controlled environment**. Testing for thermoregulated balance will be tested in environment as close to Jeddah, Saudi Arabia through **heat and humidity** simulation to understand sweat patterers and comfort levels. Testing for Mobility will be under a set of **dynamic movements** that a cyclist (either elite or pedestrian) will have to under go to understand strain/stress of garment and comfort levels performing each task. Testing for Aerodynamics will be set under a controlled environment with calibrated wind simulation to understand **movement of garment** under each bench mark speed.

ATHLETE'S

NAME	AGE	HEIGHT
TESTER 1	34	58"
TESTER 2	35	57"
TESTER 3	32	57"
TESTER 4	27	54"

Performance Research

DATA COLLECTION: 1-10

Thermo	75/15min	85/15min	95/15min
Lisa	NA	NA	NA
Aleisha			
Kaitlin			
Liz			

Heat Comfort

Heart Rate: 175/160

Elite:
Weigh Kit before & after

Pedestrian:
Weigh Garment before & after

Body Temp: Take temp after each interval

Photo: Sweat Marks

Mobility	M1	M2	M3
Lisa	5	7	8
Aleisha			
Kaitlin			
Liz			

Strain Garment

Heart Rate: 175/160

Elite Movement:
M1(Reach Jersey Pocket)
M2 (Remove/Place Water Bottle)
M3 (180 Bind pot Check L/R: 45/90)

Pedestrian Movement:
M1(Traffic Arm Signals)
M2 (Remove/Place Water Bottle)
M3 (180 Bind Spot Check, L/R: 45/90)

Aero	W1	W2	W3
Lisa	NA	NA	NA
Aleisha			
Kaitlin			
Liz			

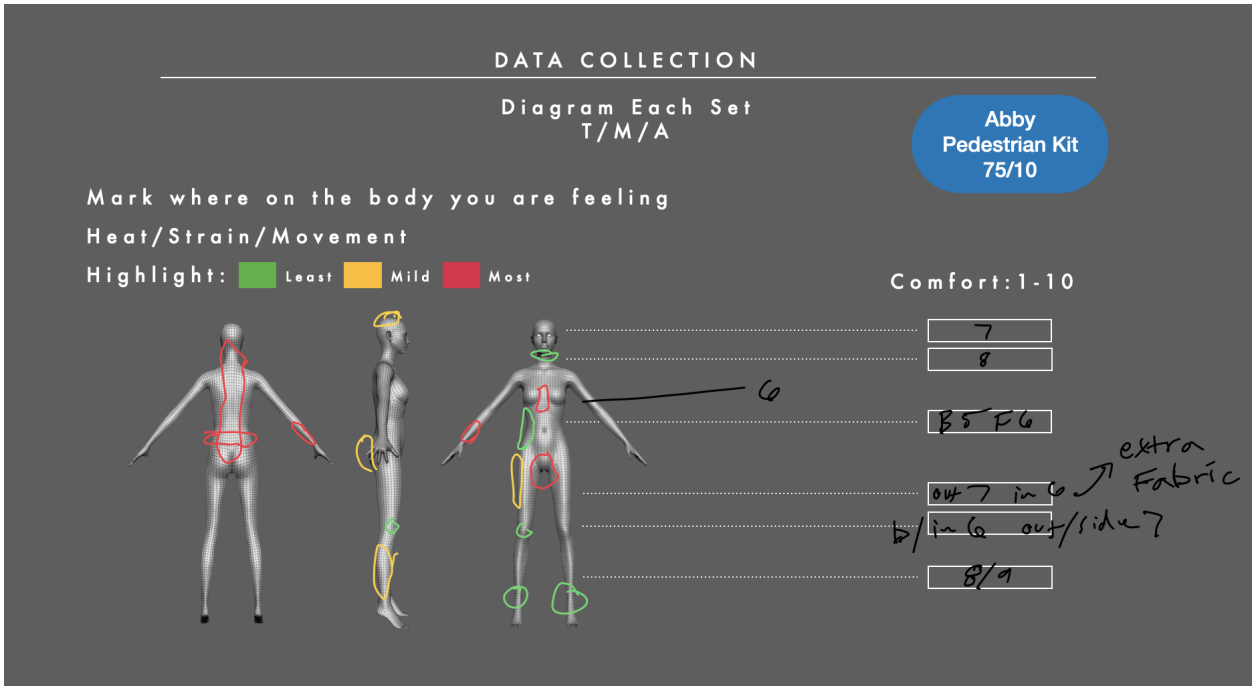
Degrees of Movement

Heart Rate: 175/160

Wind Speed Gauge: W1/W2/W3

Motion Capture: Tape Markers on Garment

Video Analysis: Plot Map Change



13.4 Results and Findings

The results and finding from the Elite yielded a trend in the thermoregulation test that, as all four of the subjects reached 95 degrees on the 3rd 10 minute interval their ability to articulate where precisely the heat was coming from and how hot it felt compared to the first two sets increased. Not only did this thread from subject to subject, the scale in which they felt heat also increased (1 being the least amount of comfort and 10 being the most/total comfort). Given these findings, as well as video and photo documentations, I was able to conclude that the areas experiencing the most and most articulated perceived heat were the areas extra garments where being worn and overlapping. This mirrored the Pedestrian test results in regards to the thermoregulation test, concluding that single layer and constructions would be key takeaways to consider in my ideation process. As for the Mobility test and the Aerodynamic test, these findings were not as overwhelmingly sysmetric. The Mobility test became more informative for the pedestrian kit, as well the aerodynamic test, both of these tests were documented through motion capture and photography. It is shown below how the stress and strain of the garment is a hindrance on the rider, mitigation in the ideation phase to solve for this problem took the main stage.

MOBILITY

Motion Capture Stress/Strain

TIGHT/PULLING

When reaching for back pocket the jersey felt tight and resistant

SEAM LINE ARM SLEEVE

The elbow stretch on the reach felt good but bunched if not in riding position

GATHERING

Fit was loose bunching in the riding position and creased

THERMORGULATION

HEAT ZONES

Sweat Mapping

75 Degrees	85 Degrees	95 Degrees
Little to no markings on the garment Across the board for all 4 testers	Abdominal Markings, Back and Pit marks visible	Sweat in same Zones now spans across entire midsection, upper/ lower back & pit region

PEDESTRIAN LAB TEST

Mobility Water Bottle Reach

With no wind the garment hangs & obstructs the view of the water bottle cage to the rider.

Water Bottle Reach

When rider reaches for bottle the garment can be grabbed and caught with the bottle (becoming dangerous)

Traffic Signaling

When rider performs proper traffic signaling the garment opens up and could potential become dangerous (not MODEST)

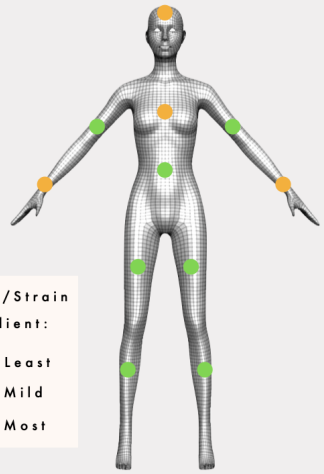
PEDESTRIAN KIT

COMFORT SCALE 1-10 (1 Least Comfortable - 10 Totally Comfortable)

75 Degrees

Score 8 - 6

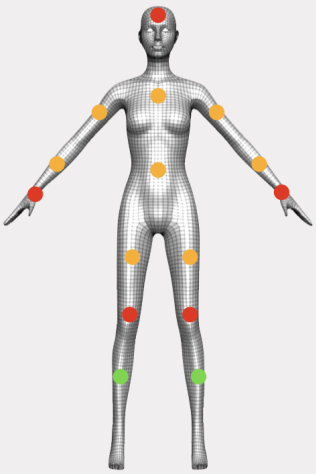
Testers found that the compressed areas of the garment generated most heat, the flow = breathable



85 Degrees

Score 6 - 4

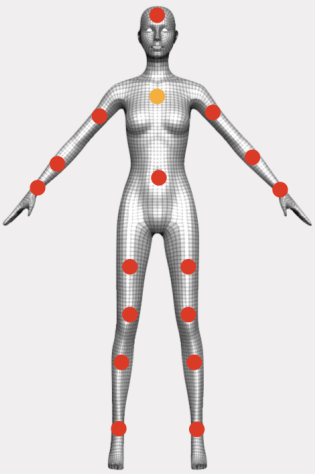
Second round findings, the garment became heavy. Layered areas and rubbing issue.



95 Degrees

Score 3 - 1

Everything is hot point of contact where the garment is tight or layer most discomfort



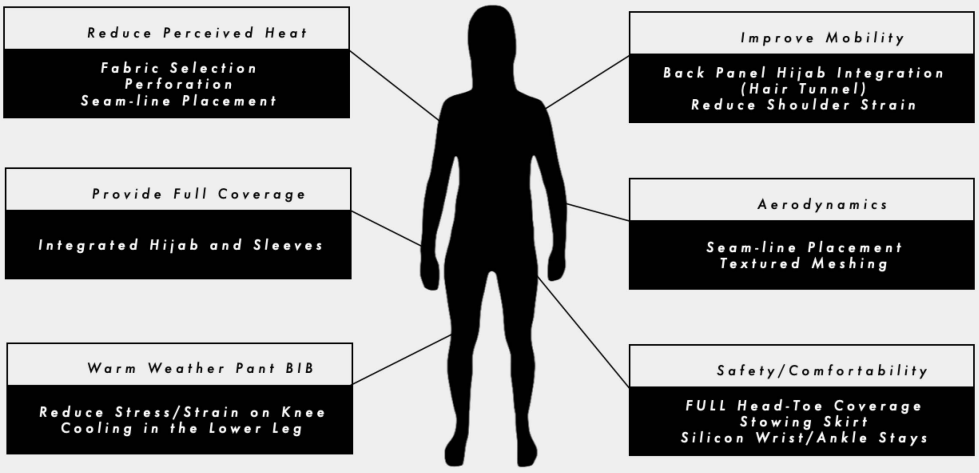
Heat/Strain Gradient:

- Least
- Mild
- Most

13.5 Prototyping and Ideation

GOALS

Elite KIT

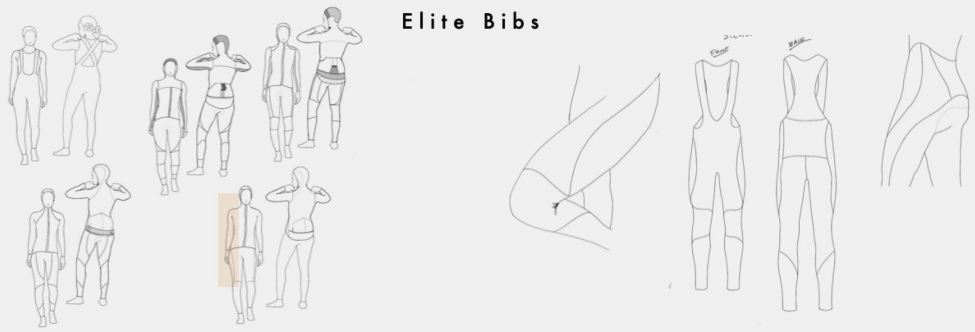


IDEATION

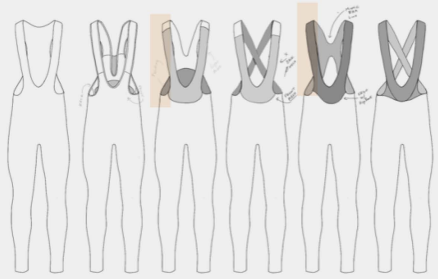
Elite Jersey

IDEATION

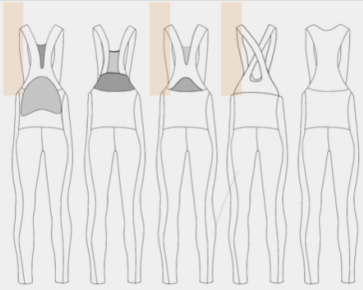
Elite Bibs



FRONT



BACK

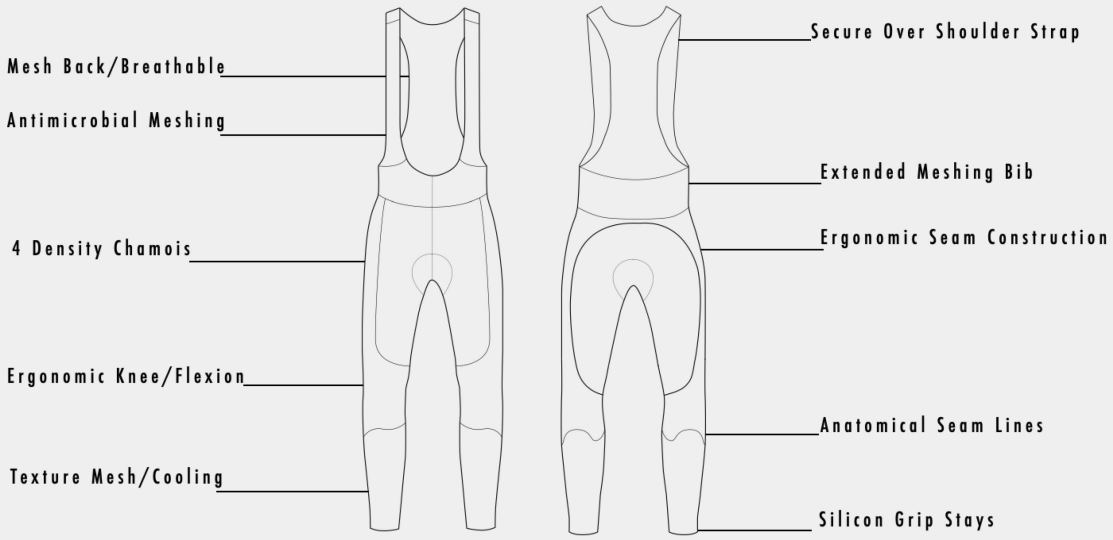


FEATURES/BENEFITS

Elite Jersey

FEATURES/BENEFITS

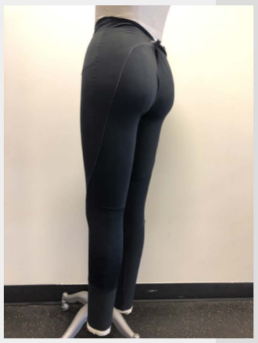
Elite Bibs

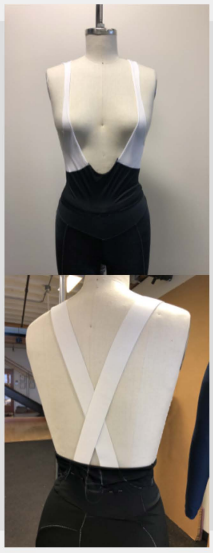


PROTOTYPING

Elite KIT

PROCESS PHOTOS

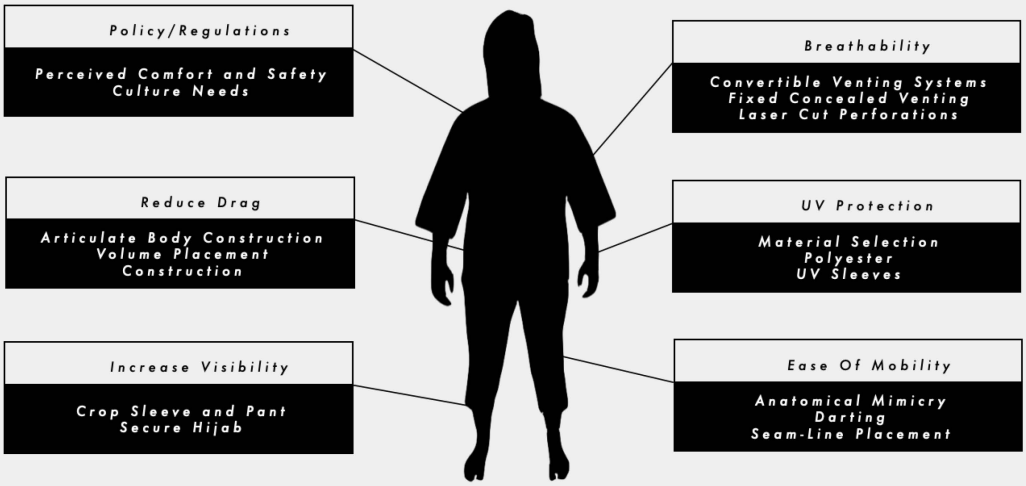




ELITE KIT

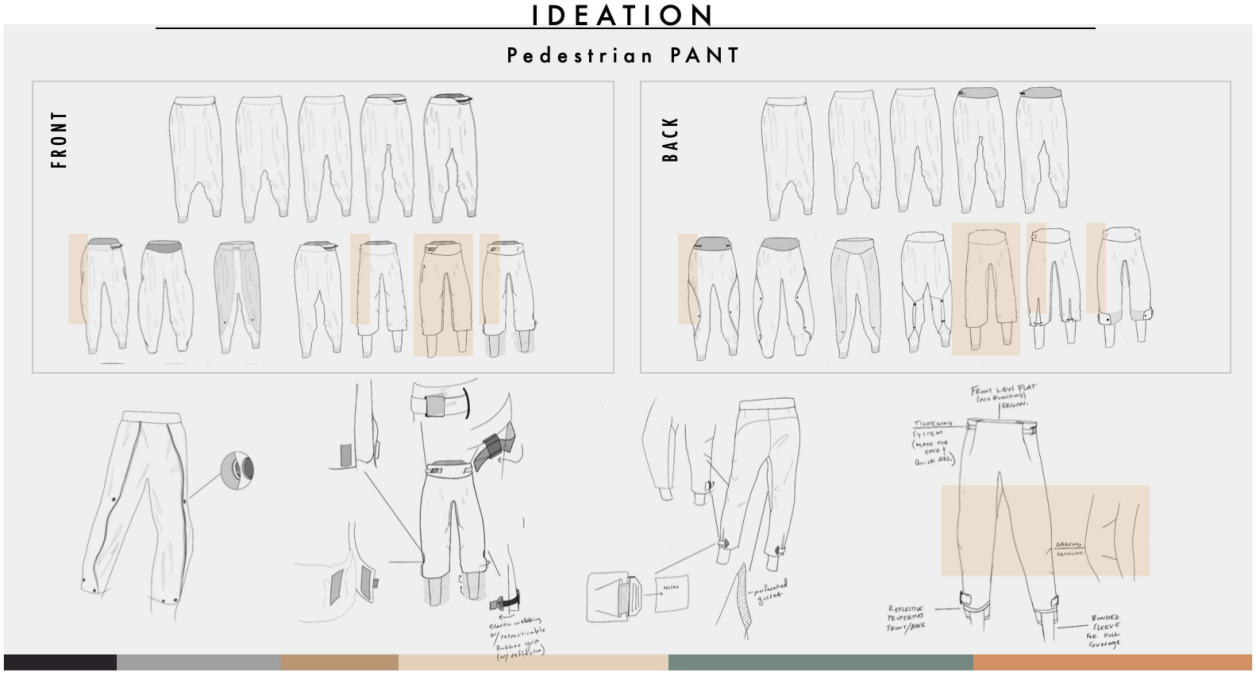
GOALS

Pedestrian KIT



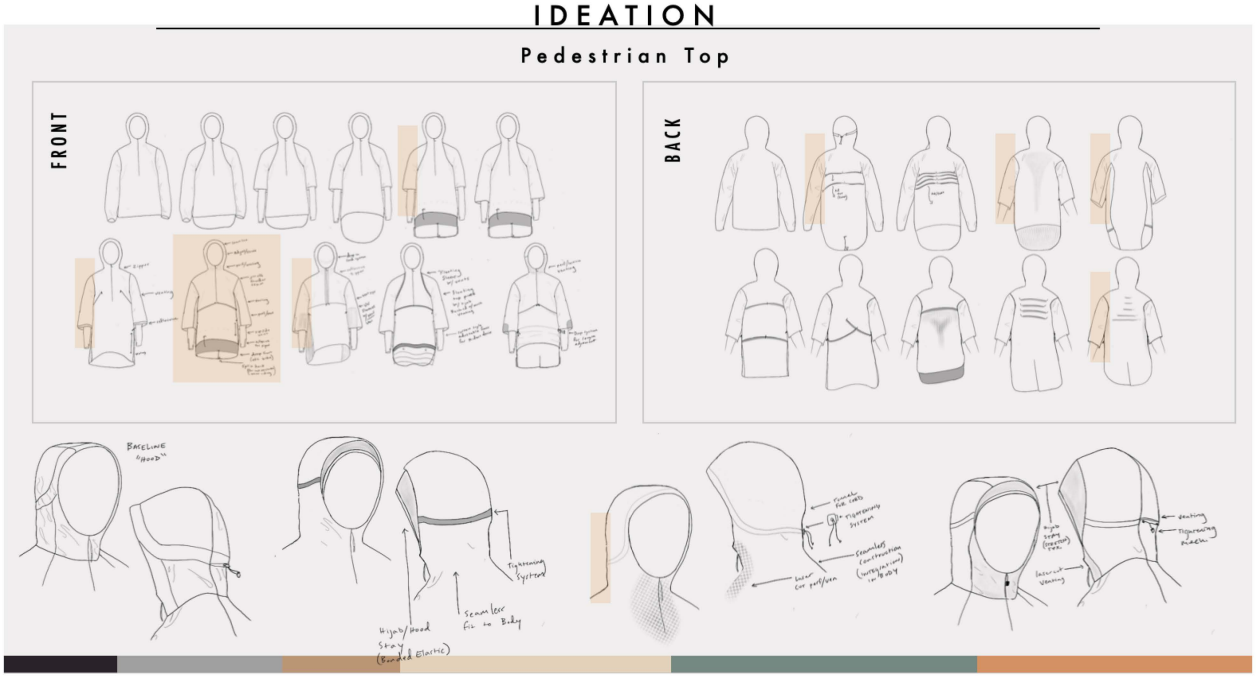
IDEATION

Pedestrian PANT



IDEATION

Pedestrian Top

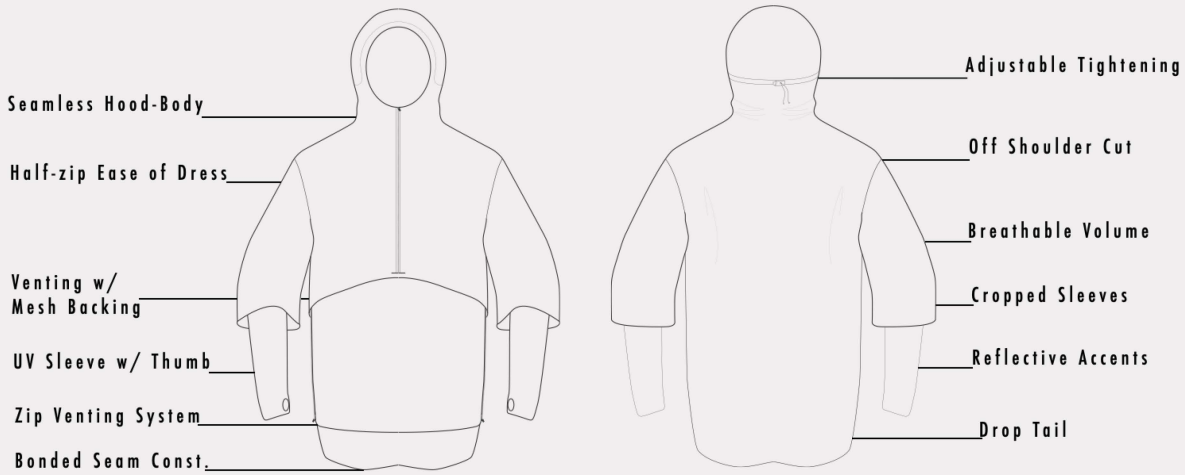


FEATURES/BENEFITS

Pedestrian Pant

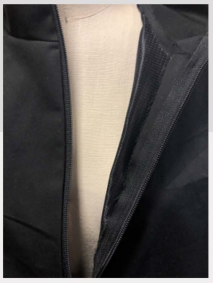
FEATURES/BENEFITS

Pedestrian Top



PROTOTYPING

Pedestrian KIT



PROCESS PHOTOS

PEDESTRIAN KIT

PROTO TESTING PLAN

Metrics to Measure

Back to the LAB

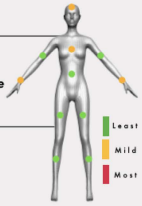
THERMOREGULATION

Heaters regulate ambient air temperature, gauging with a thermometer (temp /humidity)

10 minute intervals @ each temp (75/85/95°F)

Survey Subject 1-10 on heat & location
Photograph sweat spots

Less Perceived Heat During Intervals
Findings shift into the Green - Yellow as Time and Heat increase



MOBILITY

ELITE TEST	PEDESTRIAN TEST
M1- Back Pocket Test	M1- Traffic Signal Test
M2- Water Bottle Test	M2- Water Bottle Test
M3- 180 Blind Spot Test (0/45/90 degrees) left & right	M3- 180 Blind Spot Test (0/45/90 degrees) left & right

Elite/ Stress & Strain rank 1-3 on the scaling system (not a perceived issue)
Pedestrian/ Ease of visibility to the Feet, Water bottle and Garment Covers during all movements

AERODYNAMICS

Motion Capture through the use of video documentation and markers placed on the PEDESTRIAN kit

Motion Capture and Nodes Show Less Movement in Garment

FINAL PRESENTATION & TECH PACK WITH PACKAGING

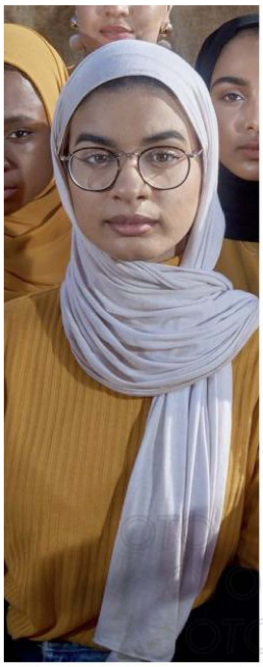
HURRIYYA

HOW CAN WE...

How do we improve cycling performance for elite and pedestrian female athletes through easy of mobility, aerodynamics & thermoregulation management, while keeping with the traditional Muslim dress code.

Women's Suffrage

The understanding how cycling has held barriers to entry for women, in **Muslim culture women remain suppressed** of basic human rights, how do we design for **cultural needs to create a path of entry into sport?** Many issues that create this barrier are rooted in the **traditional garment of the Muslim faith and culture that are either legal restriction or systemic norms.**



HURRIYYA

ATHLETE EXPERIENCE

CULTURAL DRESS

HIJAB / ABAYA / JILBAB

Clothing should **not be tight** or **reveal the form of the body underneath**.

ENVIORNMENT

Jeddah, Saudi Arabia
Middle East

ANNUAL AVERAGE TEMPS
(RANGE 75-100+)

NOTABLES

In Jeddah there is little to **no cycling infrastructure**, the rider is at a higher risk of riding on the road with traffic.

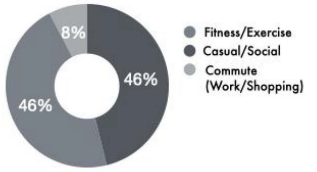
As **2013** women have been allowed to ride a bike, these laws have changed intros short time.

TODAY women are free to ride on their own (This is still not a safe activity)

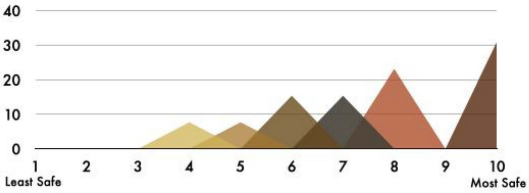
MUSLIM WOMEN

WHY DOES THIS MATTER

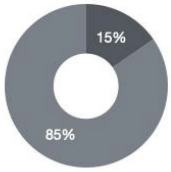
What kind of riding do you do?



How comfortable do you feel cycling in you clothing choice?



Do you feel safe riding in the clothing ?



What do you wear while riding?

What are the issues with you options ?

BASELINE GARMENTS

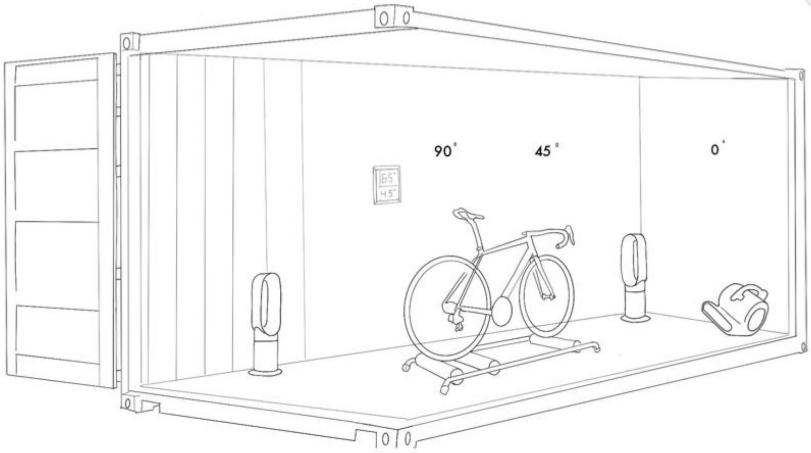
FULL BODY COVERAGE

PearlIZUM // UV Arm & Leg Screens
RAPHA // Pro Team BIB
NIKE // Pro HIJAB 2.0

SCARFTURBANHIJAB //
MUSLIM SPORT SUIT
- Hammer Pants
- Draped Abaya w/ Hijab

TESTING LAB

16' Storage Container



CONTROLS

Heat Time Air Volume	Heart Rate Elite:175 Pedestrian:160

EQUIPMENT

Heater Electric x 2 Propane x 3	Air Blower Insulation Boards x 8 Rollers	Taped Markers Packing Blankets Bench Lights

BASELINE PRODUCT

TESTING/FINDINGS

ELITE KIT

Perceived heat became more articulated as temperatures climbed and activity level increased after 30 mins

sweat mapping feedback

PEDESTRIAN

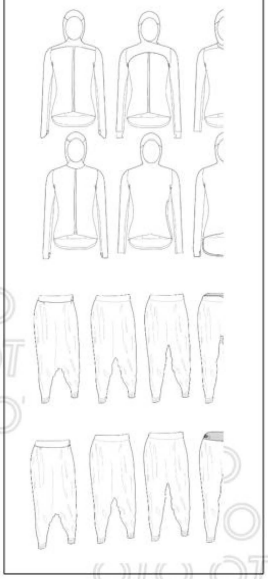
The garment is restricting, creating lots of drag, shifting around during the ride.

motion capture feedback

IDEATION

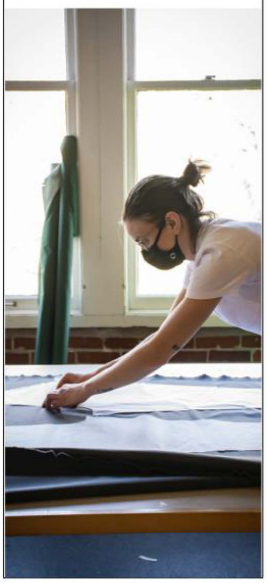
THE PROCESS

SKETCH

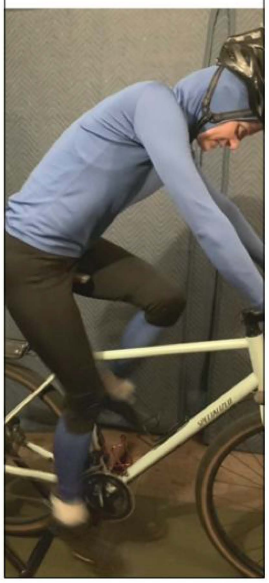


PATTERN

PROTO



TEST



MOOD

HURRIYYA

THE COLLECTION

ELITE KIT

THE COLLECTION

VEST

JERSEY

BIBS

VEST

Nylon w/ Reflective Accents

Viscose Binding

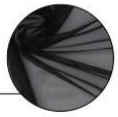
3M Reflective heat transfer vinyl Logo

Articulated Ergonomic darting

JERSEY

Polyester Pique Knit
/Light Weight/ Breathable/

Polyester Cooling Ribbed
Aerodynamic structure
Tight fit/Secure



Power Mesh

4 Panel Hijab
Elastic Binding
Helmet Comfort

Accordion Back
Pockets

Integrated Hijab
Ease of Pressure
Hair Tunnel

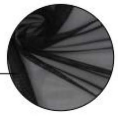
Bonded Silicon
Breathable/
Secure

Zip Pocket
Secure Storage

Pique Mesh
Articulation

BIBS

Polyester Cooling Ribbed
Aerodynamic structure
Tight fit/Secure

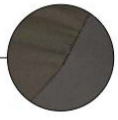


Power Mesh

One Panel Back
Two front

Polyester/Spandex
UV protection/Mobility

Elastic binding
Heavy Elastic Reinforced
shoulder/comfort



Aero Bottom Leg
Ergonomic Design Lines/
Construction

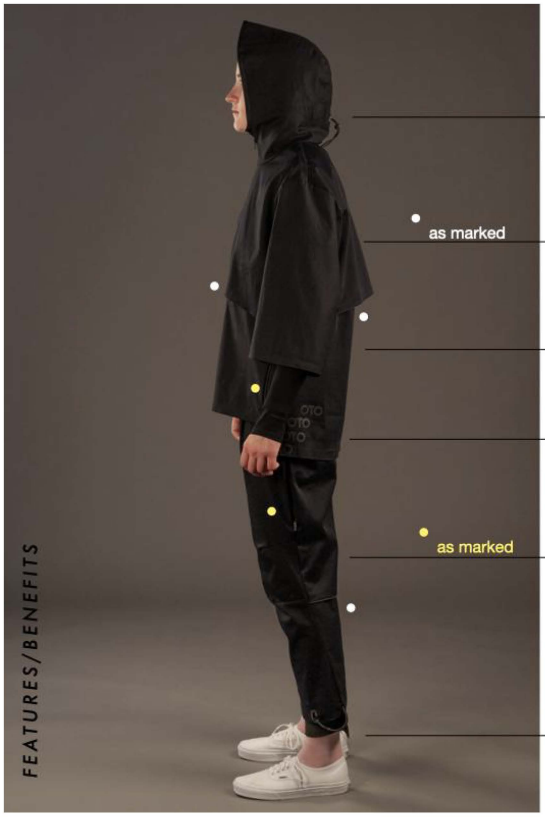
TOP/BOTTOM

Polyester/Cotton Blend
UV protection
W/Reflective piping

3M Black reflective
heat transfer vinyl

Moisture Wicking
Mesh Knit

Nylon Webbing
Buckle for Waist
adjustment




Shock Chord
Hood Stabilization


Venting w/
Mesh Backing &
Reflective Piping (Back of Kit ONLY)


Double Cuff with
Reflective piping


Black Reflective LOGO


Quick Zip Vent
Lined w Reflective Piping

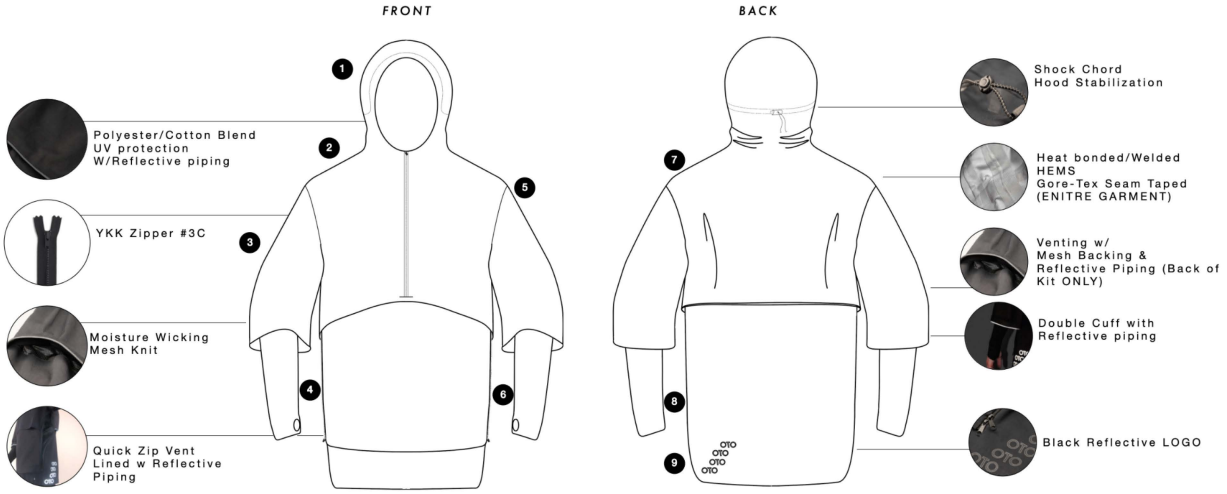

Shock Chord
Chain Stay Safe System

PEDESTRIAN KIT

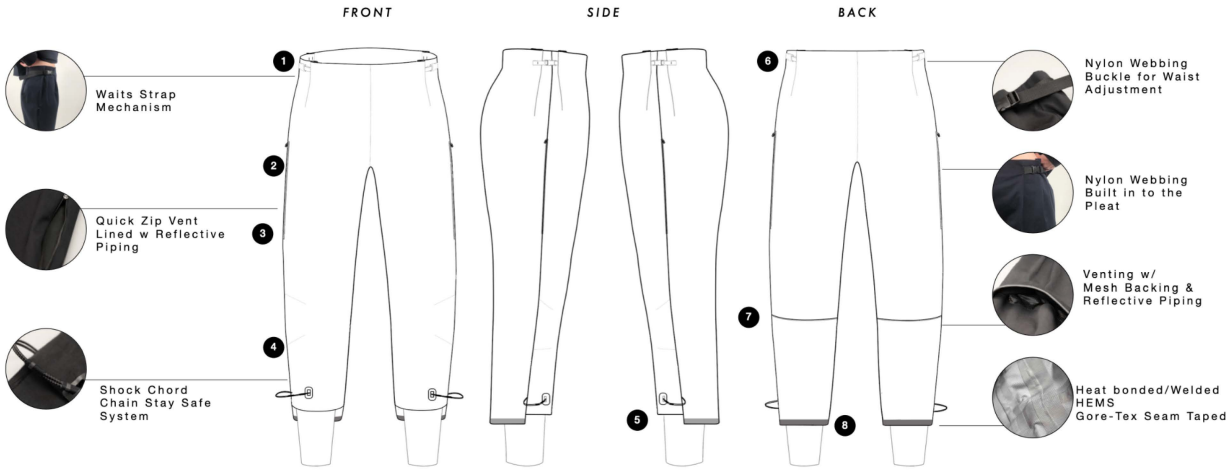
REFLECTIVE HIGHLIGHTS

HURRIYYA

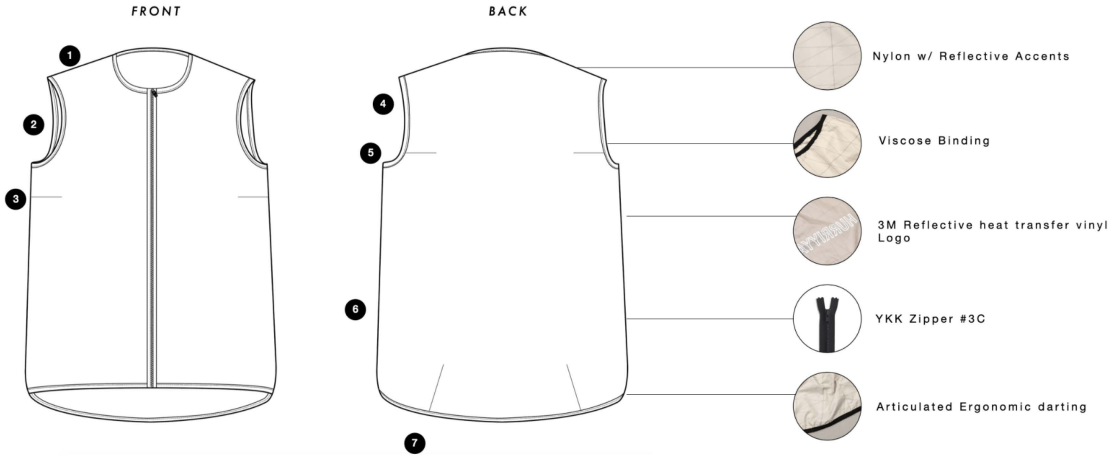
TECH PACK
2021 Collection



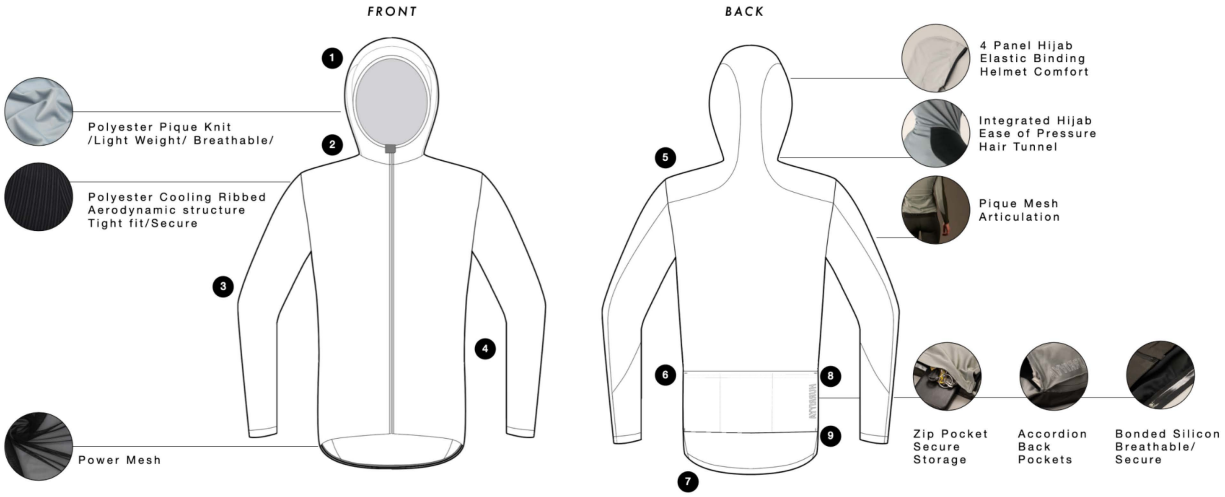
HURRIYYA		MEASUREMENTS: SA 1/4"		5 ZIPPER FRONT	18 "
		1 HOOD OPENING	22 1/4"	6 2 WAY ZIPPERS L/R	15 "
		2 FRONT PANEL L/R	15 1/4"	7 BACK PANEL UPPER	15 "
PEDESTRIAN	TOP	3 SLEEVE	16 "	8 BACK PANEL LOWER	14 "
TECH FLAT	2021	4 FRONT PANEL LOWER	11 "	9 LOGO	H 4 1/2" W 5"



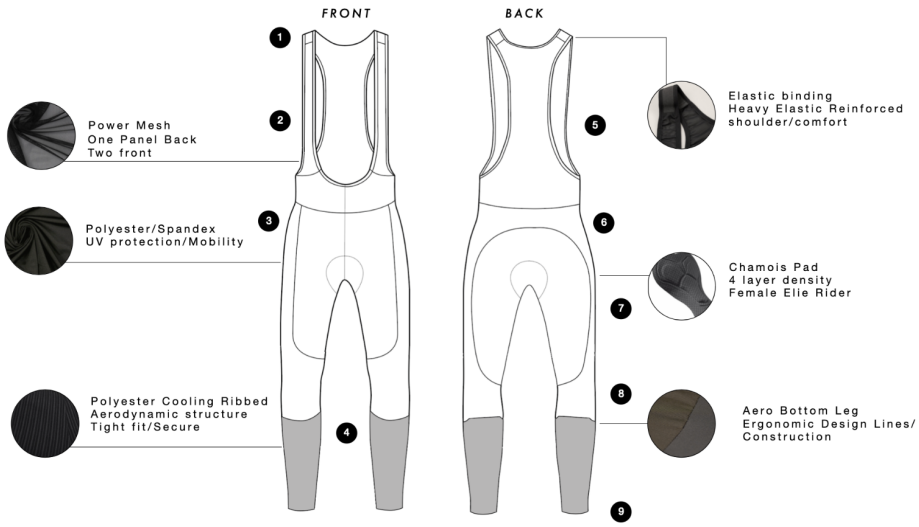
HURRIYYA	MEASUREMENTS: SA 1/4"		5 SHOCK CHORD	22"
	1 WAIST PLEAT TO PLEAT	8"	6 WEBBING	FRONT 2" BACK 9 1/2"
	2 SIDE ZIPPER	8"	7 BACK OF KNEE VENT	2"
PEDESTRIAN BOTTOM	3 DIM VENT	W 2" L 7 1/2"	8 BACK PANT DROP	2 1/2"
TECH FLAT 2021	4 DARTS	TOP 4 1/2" BOTTOM 4"		



HURRIYYA	MEASUREMENTS: SA 1/4"		5 DART BACK	2 1/4"
	1 FRONT PANEL	22 1/4"		
	2 ZIPPER	20 1/4"	6 BACK PANEL	27"
ELITE VEST	3 DART FRONT	2 1/2"		
TECH FLAT 2021 Collection	4 LOGO CB	W 1 1/2" H 7 1/2"	7 DART BACK LOWER	4"



HURRIYYA		MEASUREMENTS: SA 1/4"			
		1 HOOD OPENING	19"	5 WIDTH OF HOOD-BACK	3 5/8"
		2 ZIPPER	22 1/4"	6 POCKET DIM	W 14" H 6"
ELITE	JERSEY	3 SLEEVE	24"	7 SILICON/ELASTIC	12"
TECH FLAT	2021	4 FRONT PANEL	22 5/8"	8 SIDE ZIPPER	5 1/2"
				9 LOGO	W 3/4" H 3 /2"



HURRIYYA		MEASUREMENTS: SA 1/4"		5 1 PART CONSTRUCTION	
		1 ELASTIC BAND	6"	6 RISE TO MESH	CB 12"
		2 2 PART CONSTRUCTION	TOP 10" BOTTOM C 3 5/8 "	7 CHAMOIS DIM	6 x 2 x 6"
ELITE	BIBS	3 WAIST TO KNEE	16"	8 BACK OF KNEE	5"
TECH FLAT	2021	4 ANKLE TO KNEE	12"	9 ANKLE OPENING	10"

HURRIYYA		MEASUREMENTS:	
		BAG DIM	W 14" H 19"
		1 LOGO	W 2" H 10"
PACKAGING		2 LOGO	W 1" H 5 1/2"
TECH FLAT	2021	HANGTAG DIM	W 2 1/2" H 4"

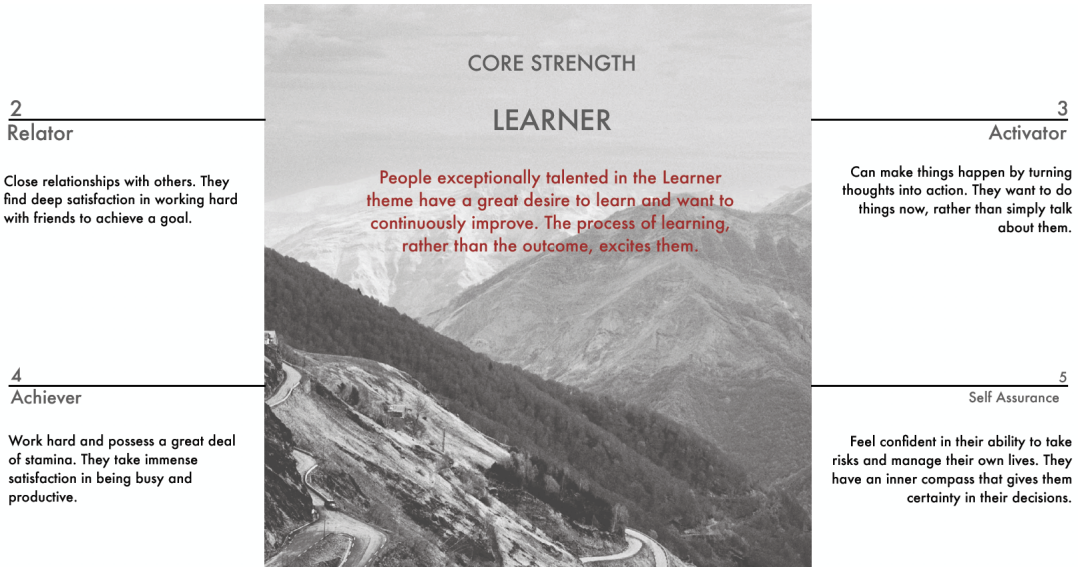
14.0 Project Alignment to Design Strengths

Reflecting back on the problem to solve for; understanding how cycling has held barriers to entry for women, in Muslim culture women remain suppressed of basic human rights, how do we design for cultural needs to create a path of entry into sport. Many issues that create this

barrier are rooted in traditional garment of the Muslim faith and culture that are either legally restriction or systemic norms. Is the link between social equity and sport, in the lane of cycling as the vehicle to drive the change.

The intersection of being a designer for sport blurs the line between social needs, functional needs & science. With this study of Mulism Women in cycling two tracks are explored giving opportunity to reach a larger audience of underserved peoples and facilitate a platform for informed design, opening doors to the many joys and freedoms that cycling can bring.

14.1 Strength Support Innovation



Considering the core strengths listed above, based on the Strengthsfinder test, this exploration of the Muslin and Persian culture seem to be quite fitting. The core strength is, Learner, given the entry of unknown waters open to exploring and digesting a wealth of multi faceted layers of culture and product information. The ability to relate will be one of the most crucial strengths allowing/ making space to understand new cultural practices and etiquettes. Given the many demands and hurdles sourcing information halfway across the world in another language can create, the activator will find a way to stay patient, while continuing to push the design process.

As an innovator the strengths that are harnessed here make for a dynamic balanced detail oriented producer. Conducting a larger body of work that allows for more product testing and user insight will be the champion of this line. Over the term the role that has the best fit would be one that is in a director role or lead design role, being able to manage others with

democracy and out the overtime to see the project through. The ability to network, task manage, see the plan step by step and understand all the moving pieces.

14.2 Project Support Career

In the women's cycling world there has been a call to arm for more females on the design team to create products for women. With each year we see more women stepping in to lead and director roles at major cycling companies to guide the women's line, this is strikingly fitting. The body of work here is not only root in women's liberation but also in the field of cycling. The future of womens cycling is vastly growing and still young, opening doors for forward thinking designers, the time is now to start to think globally and socially with women in mind, bridging the gaps between gender and socioeconomic gaps.

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