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BA Outdoor Adventure Education

Improving the sustainability of production methods for equipment in surfing

By

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Dissertation submitted in partial fulfilment of the requirements for the degree of Bachelor of Arts

Undergraduate Dissertation Certificate



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DECLARATION

I certify that the whole of this work is the result of my individual effort, and that all sources have been acknowledged.

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DECLARATION

I am satisfied that this work is the result of the Student's effort.

Signed (Lecturer)

Date

Acknowledgement

I'd like to thank my supervisor Graham Harvey along with my study support Karen Houser, my Parents Robert and Lyndsey Miles and last but not least my friends for all the support they have given me throughout the process.

Abstract

This research was undertaken to evaluate sustainable production methods of surfing equipment by highlighting the environmental impact current mass-produced petroleum-based products have in relation to alternative, more environmentally friendly solutions. The research has identified a slight shift away from neoprene to a natural rubber alternative for the production of wetsuits with some leading manufacturers. The increased cost implications of this product are being redressed through rental agreements by some suppliers but not all. Advances into the recycling of neoprene wetsuits, including linings, to make new ocean-going garments have been evidenced but, repurposing old suits into bags or crumb for playground surfaces or similar remains the norm. The use of Bio-resins are becoming more prevalent in the manufacture of surfboards and a number of smaller manufacturers are adopting natural substances such as expanded cork and Ecovative Grow Material (EGM), a foam-like material produced from growing fungal mycelium on agricultural waste as skins and cores respectively. 3D printing of boards has also been academically and commercially evidenced but only in the minority. The sustainable production of surfing equipment remains a decentralised process that in turn has increased cost implications pricing out the majority of users. Furthermore, the review suggests that equipment performance takes precedence over environmental credentials and as such there is still development required to close the cost versus performance gap to make sustainable surfing equipment mainstream for all.

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1.Introduction

1.1 History of surfing

Felipe Pomar, a legendary surfer from Peru, is adamant that the Caballitos de Totora are responsible for the birth of surfing in Peru. The World Surfing Championships winner from 1965 argues against the common misconception that surfing originated outside of the Polynesian islands. Felipe Pomar further stated in his interview with BBC News that fishermen in pre-Incan communities surfed these boats like surfboards, standing up when they came to shore with their catch (BBC, 2016).

The origins of surfing can be argued to date back to around 4000 years ago, specifically to a Peruvian empire known as the Moche, and then later the Chimú. The sport, as known today, began as a method of transportation for the fishermen to break through waves to get out to sea. They would then use the waves to efficiently carry them and their catch back in, conserving energy in the process. The craft which the Chimú used was known as a Caballito de Totora which originated in Humenaco, a historic surf town in Peru. The Caballito de Totora are small vessels made out of woven reeds (Rondón et al, 2003). They showcase an elongated design, totalling around 12 feet in length, with a pointed nose that the Peruvians have used for more than 4000 years. The crafts average around 40 kilograms and can be built in around 2 hours, however due to the natural composition, the dried Totora stalks begin to decompose about a month and a half after use in the water.

The ancient practice of wave riding and the fact that surfing originated from fishing practices are demonstrated by rock art paintings, pieces of pottery and other Incan artefacts. Pottery from the Chimú region is specifically known as Huacos. This is the general term used in Peru to refer mostly to earthen vessels and other handcrafted pottery artworks created by the native American tribes that are evident in pre-Columbian sites including cemeteries, temples, burial sites as well as other historical ruins. According to historians, reed boats have long been utilised by coastal communities for both leisure and professional purposes (Shimokawa Shiguiyama, 2017).

Jose Antonio del Busto, a historian from Peru, hypothesised that an Incan from Peru visited Polynesia in about 1500 and interacted with the inhabitants through trade and cultural exchange (Ganster and Antonio, 1981). During his famed "Kon-tiki expedition" in 1947, Norwegian

explorer Thor Heyerdahl proved this idea by travelling from South America to Polynesia using a traditional raft (Heyerdahl, 2014). This trip provided evidence of Polynesians and Peruvians' historical exchanges and interactions across cultural divides.

In the middle of this debate about surfing's origins, the majority of historical records have revealed that the sport's roots may be found in Polynesian culture from the 12th century; Polynesians are the people who live in the Polynesian Islands spread throughout the Pacific ocean. Interestingly, surfing was referred to as a "sport of kings" and a "royal sport" in the 20th century since it was believed to be closely linked to the political and religious traditions of ancient Hawaii (Davis, 2023).

1.2 Hawaiian culture

Hawaiians, strongly associated with the sport, discovered surfing through Polynesians. As time went on, surfing became deeply ingrained in Hawaiian culture. It began to be acknowledged as a holy and pious activity rather than just a sport. Choosing the right trees, typically Koa, for surfboards was crucial since the boards were meant to be used in cohesion with religious rituals to invoke the blessings of the gods and assure safety.

When Westerners arrived in Hawaii in 1778, surfing was outlawed because the Christian priests saw it as a sinful activity (Parker, 1962). However, surfing was more than simply a pastime for the Hawaiian people, it was a way of life. From a linguistic perspective, "surf" in Hawaiian is defined as "he is nalu" which roughly translates to "sliding on a wave." A lower-class Hawaiian's ability to surf served as a method to rise to the upper class by showcasing their strength, skill, and artistic ability to take on the ocean's massive waves (Davis, 2023).

According to historical records, the three Hawaiian princes J.K. Kataniana'voi, E.D. Keliiahonii, and D. Kawanakoa introduced surfing to the United States in 1885. (Minatodani, 2023). Eventually, in 1907, Oahu Island and Hawaii native George Freeth brought surfing to the US mainland as a gimmick. In the USA, Freeth gained notoriety as the "Man Who Can Walk on Water" and the "Hawaiian Wonder" because of his extraordinary mastery of this sport (Moser, 2022).

When Duke Kahanamoku succeeded in freestyle swimming at the 1920 Olympic Games in Antwerp, Europe saw the emergence of surfing. Duke Kahanamoku is regarded as the person who popularised surfing and is honoured globally (IOC, 2020). Nevertheless, according to another historical record, the first surfboards were brought to Europe by Ignacio de Arana, the

Spanish consul in Hawaii between 1911 and 1914 (Esparza, 2014). That being said, there's no proof that these two surfboards were ever used in European waters.

In 1890, two Hawaiian princes and their English instructor went surfing in the resort town of Bridlington on the northeast coast of England. This was the first known instance of wave riding in Britain (MoBS, 2019).

1.3 Surfing links with UK

The UK's history with surfing, however, dates back to at least 1769, according to the Museum of British Surfing, when figures such as Captain James Cook, who landed in Hawaii, and Captain James Edward Alexander, who discovered surfing in West Africa in 1850, were involved. Because of its connections to London and the vogue of sea bathing in the 1800s, several researchers assume that surfing may have originated on Britain's wealthy south coast. In Brighton during the middle of the 19th century, swimmers used to aid them swim and body surf waves utilising leather and wooden gloves strapped to one hand (MoBS, 2019).

Up to the start of World War II, Portugal was the only place in Europe where surfing was commonplace. However, Biarritz became the premier surfing destination in Europe when US servicemen brought surfing to the French people during the war.



1.4 Surfing and the environment

Surfing is widely accepted to be a green and environmentally sustainable recreational activity and sport whose participants advocate the protection of blue spaces (Langseth and Vyff, 2021; Holland-Smith, Love and Lorimer, 2013). However, it has become evident in recent years that the conventional modern manufacturing processes used to make both surf boards and surfing apparel have a detrimental effect on the environment with regards to the sourcing of raw materials through production and end of life recycling limitations of the resultant equipment. This is predominantly accepted to be a result of their respective dependence on petroleum-based products (Johnstone, 2011; Majumdar et al, 2020). Furthermore, there are wider sustainability implications born from the interrelationship of carbon emissions generated by surfers through national and international travel (Román et al., 2022) and the more frequent disposability of equipment that no longer has the inherent strength and durability of historical manufacturing processes.

Very Good!

1.5 Sustainability

Research into the sustainable manufacture of surfboards and surfing apparel has been catalogued in academic journals for many years but as technology has changed, so effectiveness of the solutions derived and subsequent measurements of performance. In this paper I will research the body of academic and complementary literature to qualify the evolution of sustainable production of equipment in surfing along with its recycling potential, as well as commenting on the implications such developments have on the culture and ethos of the surfing community.

I have a strong affinity with blue spaces and regularly surf using conventional modern made wetsuits and surfboards. From my research I would like to determine the effects the production of surfing equipment has on the environment and how any innovations in sustainable manufacture can help reverse or slow down the detrimental effects of a sport dependent on petroleum products.

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2.Literature Review

2.1 Development of surf boards

The Australian surf business saw a boom in the 1930s as a result of its use as a life-saving aid. Sydney hosted the founding of the first life-saving club in 1907.

Australian surfers exhibited fibreglass and balsa wood boards to visiting lifeguards from Hawaii and Central America during a 1950s surf carnival (MoBS, 2019). Because these boards were shorter and lighter than regular hardwood boards, the Australian surfers were able to demonstrate higher performance levels than they could have with traditional boards. These versions, with their fins and less weight, could be steered and accelerated over the wave face. During this period, these boards were becoming more and more common on America's west coast.

In the 1950s and 60s surfboards began to be made out of fibreglass, foam, and wood by Australian surfers which led to them dominating the sport.

Whilst surfboard manufacturing technology was evolving at this time, surfing and swimming apparel was still predominantly a mixture of wool or synthetic materials such as nylon that offered little in the way of performance enhancement or personal protective quality (Reis, 2020).



2.2 Surf wear

2.2i Neoprene

In current times, neoprene is the material that is now frequently associated with outdoor water sports. As a fabric, it provides scalability in terms of use and adaptability but it took a number of years post its invention for it to be a mainstay of the surfing and cold water sports community.

Immediately following World War I, scientists from French chemical company DuPont created neoprene as a synthetic substitute for natural rubber. This was a direct reaction to the organic material's rising expense and the growing demand for rubber-based products. The material's

early iterations lost their elasticity, but as science advanced, the material was able to acquire new properties including resistance to UV light, air, and oil, and most importantly, it gained elasticity (Circular Textiles, 2022).

Neoprene, a polymer of chloroprene molecules, is also referred to as polychloroprene. There are multiple methods for making chloroprene. The most widely used technique is dependent on the petrochemical sector, where molecules are taken out of butadiene or acetylene. Similarly, Chloroprene is created when limestone rock is mined for its calcium carbonate and processed, as well as when seashells like oyster shells are crushed. Additives like carbon black are added to a completed material and baked or processed with foaming agents to produce a foamed rubber. (McCutchion, 2023). Neoprene is non-biodegradable and extremely difficult and costly to be recycled back into a raw neoprene product.

good but needs ref

2.2ii Modern wet suits

The modern wet suit was initially invented by Hugh Bradner, a UC Berkeley physicist, who was working on developing a suit to prevent Navy divers from getting hypothermia. The first wetsuit was made of a thin layer of neoprene packed between two layers of nylon. With the help of Willard Bascom, a colleague at UC Berkeley, the first neoprene wetsuit was made in 1952 (Rainey, 1998).

The suit was the first practical design that worked in keeping divers warm whilst in the water, and although it was lighter, more flexible, and more comfortable to wear; it was rejected by the navy due to its resemblance to a flight suit and because it made the navy divers more visible to the enemy. Another unfortunate outcome was that because it was designed for Navy divers, the suit was too bulky to be worn by surfers in the water and as a result was not adopted until later on in the same year when Jack O'Neill made some revisions to the design. These being glued seams and zips, which in turn gave the suit greater flexibility, along with making it lighter and easier to be put on and taken off. This new design was released in O'Neill's first line of commercially available suits in 1959 (Epic Tide Social, 2022; Carlson, 2017).

According to Bendón et al (2003), the earliest surfing equipment was made of woven reeds but this was long before the more well-known wooden longboards that were made popular by Polynesian culture took over. Due to the Koa tree's abundance throughout the islands, these boards were usually manufactured from it. They could measure over 15 feet in length and weigh as much as 45 kg (Warren and Gibson, 2014).

2.3 Sustainability of manufacture

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Since the 1960s there has been a transition away from the use of natural wood and an uptake in the use of synthetic materials in the manufacture of surfboards. The construction of post-mid-century surfboards typically consists of a polyurethane core, encased in a glass fibre and polyester resin laminate (Johnstone, 2011).

Considering sustainability in surfing, there are many difficulties to overcome. Recycling old wetsuits to create new ones is challenging due to the presence of numerous components and cross-linking in the polymer chains, which hinder the remelting of rubber foam into the same material. This raises the issue of recycling and end-of-life solutions. To create new rubber products, a variety of devulcanization techniques can be employed to break the cross-linking and add some used material back into a mixture of virgin material. Other alternatives include chemical recycling to attempt to return the material to its original molecular components, or pyrolysis to make carbon black from the rubber products or turning it into a rubber crumb that may be blended with other materials for use in road surfaces for playgrounds (McCutchion, 2023).

Wetsuit liners present yet another level of environmental concern. Usually, polyamides like polyester or nylon are used to make liners (Majumdar et al, 2020). Even though these components are frequently obtained from recycled materials, the problem arises when trying to separate them from the rubber when the suit's usable life is coming to an end. Adhesively joined to the rubber, the removal process can be expensive and time-consuming as it usually calls for the use of solvents (McCutchion, 2023).

It is recognised that there is a shift towards more distributed manufacturing techniques in several industries, including the outdoor water sports sector. This lowers the need for products and resources to be transported. Since a small number of big manufacturers, most of which are situated in Northern America (Metoree, 2024), control the majority of the supply of materials used to make wetsuits, logistics will remain a challenge for the wetsuit sector until other manufacturers or facilities are established worldwide.

Explain further

2.4 Raw materials

When considering the utilisation and application of wet suits, much thought has been given to user comfortability and performance. To avoid damage and skin adhesion, traditional wetsuits are constructed from a neoprene sheet that is double coated with nylon or polyester fibres. As discussed, the production of neoprene, a synthetic rubber type, involves the polymerization of

extremely hazardous chloroprene monomers. They require a lot of energy to manufacture and are resistant to natural deterioration. Drilling and prospecting for crude oil, the raw material for neoprene, has a detrimental effect on the environment because these resources are finite and non-renewable and therefore carry a high carbon footprint. Chemically speaking, chloroprene generated from limestone or petroleum is equally harmful to the environment (U.S. Environmental Protection Agency, 2015; Sanots ¹⁵ Dated literature; latter is often termed as Geoprene (Wetsuit Megastore, 2017) ¹⁶ and supports benefits such as better impermeability than a standard neoprene suit. ¹⁷ poor source

In comparison to Neoprene, natural rubber is a milky liquid with minute pieces of rubber that is made from latex from the *Hevea brasiliensis* tree. The primary constituents of natural rubber are cis-1, 4 polyisoprene, which are diluted with trace amounts of lipids, proteins, inorganic salts, and various other substances. Natural rubber can be made more tensile by using a technique called "vulcanization," which involves gently reacting it with sulphur at temperatures between 100 and 200 °C. To reduce the curing time in this process, additives including plasticisers, fillers, and antioxidants with accelerator chemicals are utilised at high temperatures (Bhowmick, Mukhopadhyay and De, 1979; ¹⁸ Maria, 2017). ¹⁹ Dated literature The strength, flexibility, low internal friction, and resistance to the majority of inorganic acids, salts, and alkalies make natural rubber compounds remarkable. It is also relatively simple to manufacture into products because of its excellent adhesive qualities, which enable it to attach to both itself and other materials. It also produces a good water barrier and has a strong resistance to tearing, cutting, and piercing.

2.5 Development of surf wear for the athlete

The thermal interaction between the surfer and the surrounding water is an important factor to take into account when surfing. Heat is absorbed by water more effectively, and because of the movement of the water, heat is quickly removed from the body. In order to protect themselves from the stress of cold water, the majority of modern athletes use wetsuits. Three important factors are taken into account while creating wetsuit materials: warmth, flexibility, and durability. The ideal wetsuit strikes a balance between these three characteristics (Naebe et al., 2013). ²⁰ The material of the inside lining is crucial in maintaining the user's warmth. Generally speaking, ²¹ good water temperatures above 24 °C demand a thickness of 2 to 4 mm, whereas ²² temperatures below require a thickness of 5 mm. ²³ textile's flexibility; its capacity to flex repeatedly without rupturing, is crucial. The thickness of the wetsuit has the biggest impact on

flexibility; the thicker the wetsuit, the less flexible it is. However, there are various degrees of stretch in rubber foams. fabric linings that often are part of a wetsuit also reduce flexibility (Navodya, Keenawinna and Gunasekera, 2020).

Although, durability of the wetsuit is another major requirement, thickness plays a small role in the longevity of a wetsuit where thicker wetsuits with more material are less prone to tearing. As a rule, the high stretchability of the rubber makes a wetsuit less durable, but it is not always 100% true. Smooth skin rubber is prone to ripping when tugged on, especially with fingernails which is why fabric linings tend to be used to avoid that. The study showed that by utilising locally accessible raw ingredients and current technology, it was possible to successfully produce a non-toxic natural rubber compound with surface-covered polyethylene terephthalate. Compared to neoprene material sold in stores, the new material is more durable and has superior thermal insulation qualities. Compared to materials now in use, the novel composite has a higher density and a lower stretchability, suggesting that more study is necessary to improve these two qualities, which are crucial for creating a comfortable material (Navodya, Keenawinna and Gunasekera, 2020).



3. Methodology

In order to identify literature to investigate the research question the following key words were used in the online searches: Sustainable Surfing - Wetsuits - Neoprene - Natural Rubber - Surfboard Manufacture - Recycling. Further words such as Petroleum - Cork - EGM - Bio-Resin - 3D Printing followed as the research progressed. These key words were entered into search engines Google Chrome, Google Scholar and Microsoft Explorer to identify academic literature from platforms such as ResearchGate, Science Direct and Sage Journals as well as a number of independent University studies. Very Good! relation to material sciences. Surfboard and surfing apparel manufacturers have been researched using independent academic literature to complement and justify statements and commitments made in organisational literature. Explain further

Determining the suitability of a paper or article in relation to the areas of research would first require reading of the abstracts of identified papers and followed by further interrogation searching for the key words within them. The ages of the respective papers were considered, and it was considered appropriate not to specify a date range for the Literature review. Whilst keen to have access to most current commentary it was also deemed appropriate to capture the evolution of production techniques and thought process over the years, therefore older papers were not discounted as they would help contextualise the research. As an example, the chemical composition of Neoprene has not changed since its invention but the manner in which it has been used has. Any paper or source that did not meet the research criteria or that was ambiguous in relation to the queries were discounted. Some 38 academic papers were catalogued along with 40 other scholarly sources along with websites and industry commentary. 20

The Literature review will help identify current manufacturing techniques for surfing equipment and determine whether they are unsustainable and will allow for identification of more sustainable alternatives therefore allowing for recommendations to be made.

4.Results



The initial search for key words including surfing, surfboard manufacturing and wetsuit manufacturing.



From the initial search, the papers were categorised into sections including history of surfing, development of surf boards, sustainability of manufacture and innovation in manufacturing.



It was found that some subject matter was encompassed by more than one heading making it difficult to categorise. Surf wear and development of surf wear for the athletes, natural rubber and plant-based alternatives and sustainable alternatives, fibreglass and commercial production were used in a variety of papers. These sources were further scrutinised in order to categorise them more accurately within the aims of the research study.



Upon further analysis, the papers were then categorised and ordered for the discussion.

Figure 1 – Flow diagram of the review process.

4. Discussion

4.1 Sustainable Manufacturing

4.1i Patagonia

Leading outdoor equipment and clothing manufacturers are now recognising the detrimental impact their material choices and manufacturing processes have on the environment and are seeking ways to redress the balance. In a 2018 case study prepared by Berkley Haas, University of California on behalf of Patagonia, a B Corporation accredited company, the organisation's leadership team set out a road map to achieve carbon neutrality by 2025.

Certified B Corporations are companies verified by B Lab to meet high standards of social and environmental performance, transparency and accountability. B Lab is the non-profit network transforming the global economy to benefit all people, communities and the planet (B Lab UK, 2024).

Patagonia identified initiatives such as the use of renewable energy at its owned and operated facilities. Furthermore, the organisation stated a desire to expand its reach and include its full value chain to include emission targets not directly controlled by Patagonia and implement policy and strategy that would enable its carbon footprint to diminish even as the company grew. However, the primary focus remained on achieving carbon neutrality for a specific range of apparel and equipment manufacturing processes (Kammen et al, 2018).

Of particular note, Patagonia switched from using petroleum-based material for its wetsuits to a natural rubber with the trade name Yulex. Yulex is 100% pure natural rubber latex with 99% of impurities removed via a proprietary water-based purification process (Yulex, 2023). Yulex products are compliant with the EU Deforestation -Free Products Regulation (EU2023/115) (Council of the European Union, 2023). In partnership with Yulex, Patagonia developed their first neoprene free wetsuit using closed cell foam sheets.

4.1ii Natural rubber and plant-based alternatives

Natural rubber is largely produced from clonal plantations of *Hevea brasiliensis* in southeast Asia. Rubber-producing crops are greatly desired as they increase biodiversity and promote strong social, economical sustainable growth (Cornish et al., 2008). However, there remains a dependency on inefficient carbon transportation to either transfer raw materials to local manufacturing plants or finished materials to end user consumers.

Closer to home, cold water surf brand Finisterre, also a certified corporation B company, based in Cornwall have adopted a different approach to the environmental problem of Neoprene. They too have experimented and advocate plant-based neoprene alternatives and have undertaken research and development focused on non-chlorine-based fabric treatments, but they have really focused their energy on wetsuit recycling.

4.1iii Recycling wetsuits

In partnership with the Wetsuits From Wetsuits (WFW) programme being run with the support of sustainable material design from the university of Exeter along with the UKs Knowledge Transfer Partnership (KTP) (Knowledge Transfer Network, 2024) they have developed a method for creating recyclable wetsuits. According to Finisterre (2018), 380 tonnes of old wetsuits end up in landfill every year in the UK alone.

Finisterre recognised that bio-rubber, Yulex, retains the same performance benefits as traditional neoprene but with a significantly reduced environmental impact. However much like Neoprene Yulex is very difficult to recycle as it is a thermoset elastomer material just like neoprene. Furthermore when breaking down old wetsuits into a crumb or similar, it will produce a low grade material due to various inner and outer layers of material other than Neoprene used in their construction (Remington, 2019).

Through rigorous research, the R&D team identified that smooth skin neoprene had similar properties and performance characteristics to that of conventional material coated neoprene. The manufacturing trials of smooth neoprene showed that an outer skin is formed during the process forming an effective seal without detriment to elasticity.

Furthermore, the team have created a stitch less seam as the sole use of neoprene negates the need for stitching and further moves away from conventional glue and blind stitching of seams. This enables the whole suit to be recycled without the need to delaminate. Finisterre are currently focusing on their work with a chemical recycling partner, Renew ELP and Circular Flow (Mura Technology, 2024; Circular Flow, 2022), because their process also has the capability of taking existing old wetsuits from any brand, as well as their recyclable one (Remington, 2019). Such developments are captured within Finisterres ESG reporting which compliments the UK' sustainable development goals (gov.uk, 2023) along with meeting science based targets in line with both the Paris agreement and greenhouse gas protocol (UNFCCC, 2024; World Resources Institute and WBCSD, 2011).

4.2 Surfboard manufacture

4.2i Fibreglass

In terms of how surfboards are now made, materials like polyester resin, glass fibre, and polyurethane are difficult to safely discard and are bad for the environment (Johnstone, 2011). According to Wallenberger and Weston (2011), Dated literature use significant environmental contamination when disposed of in landfills since it can take a very long time for it to break down. This becomes more common with realisation that modern surfboards are thin and light, which makes them more likely to break easily. As a result, rates of failure are high, particularly in the higher-performance surfboard market. According to Correia et al., (2022) even a recreational surfer can go through up to 3 PU (Polyurethane) surfboards a year.

The most common type of composite reinforcement utilised in surfboard production is glass fibre. Johnstone (2011) states that a significant amount of carbon dioxide is produced during the heating and melting of glass due to the use of fossil fuels. A total of 8611,000,000 kWh of energy, including electricity and 1.8 million tonnes of carbon dioxide emissions from burning fossil fuels in factories, were used by the glass sector in 2002. The industrial production of glass has resulted in an increase in global emissions to 95,000,000 metric tonnes of carbon dioxide as of 2022 (Statista, 2023). Glass Fibre Europe states that the energy needed to make glass fibres and the resin used in the matrix is 13–45 MJ/kg and 76–137 MJ/kg, respectively. This energy requirement comes with a large environmental impact due to the need to use more fossil fuels (Norton and Hill, 2019; Karuppannan Gopalraj et al., 2021).

Very Good!

The surf industry has high levels of glass fibre disposal, either from waste material in the building process, or trying to dispose of broken, out of date or damaged boards. Asokana (2009) explains how 55,000 tonnes of glass fibre waste are produced annually in the UK, increasing by 10% each year. However, a 2023 paper by Pender and Yang (2024) suggests that the estimated current end of life annual glass reinforced waste generation sits between 50 and 60Kton, challenging the 10% year on predicted growth rate by Asokana. The most common form of disposal is landfill or incineration, with 90% of the UK glass fibre waste being sent to landfill. This is largely because processes such as pyrolysis which can be used to recycle glass fibre are heat intensive and therefore considered a very expensive process thus making landfill a cheap alternative (Pender and Yang, 2024; Asokan, Osmani and Price, 2009).

4.2ii Sustainable alternatives

When comparing the carbon footprint of a standard Polyurethane surfboard consisting of polyurethane resin and a polyurethane blank with that of a sustainable alternative made with plant based resin and recycled content expanded polystyrene (EPS) blank, PureStrategies (2024), a sustainability consultancy firm and Ecoboard (The Eco Board Project, 2024), an organisation solely committed driving sustainability in the surfing community determined that the whole life carbon commitment of a PU board amounted to 47.63Kg of Co2 as opposed to 33.57Kg Co2 in the sustainable version. Furthermore, the life cycle study was able to demonstrate that a standard polyester board weighing 2.6 Kg produces an additional 4.53Kg of waste material which was nearly double the 2.67Kg of waste produced making the more sustainable version. Wasted resin and foam are the biggest contributors in total carbon footprint consumers with the polyester board accounting for 40% as opposed to 22% for the more sustainable board.

Grees (2014), Hole (2011) and Johnstone (2011) / Dated literature / and the alternatives available to reduce the emissions and the dependence of non-renewable sources. Piovesan et al. (2013), Tiptipakorn et al. (2009), Grijó, Brügger (2011) / were concerned / Dated literature / with waste treatment and proposed techniques for the reuse of polyurethane, resins, and resins. Environmental management systems have been discussed by Grijó, Brügger (2011), and Grees (2014). Grijó, Brügger (2011) and Grees (2014) have indicated the manufacturers should be blamed for the concentration of residues in the production of surfboards due to the vertical business model, thus discarding other actors that could possibly also emit residues. The available data on the production, reuse, and recycling of waste from the surfboard industry indicate that about 50,000 surfboards were produced in Brazil in 2001, and 50% to 70% of the material used in the manufacturing process was discarded in dumps, or simple landfills, without adequate treatment (Grijó, Brügger, 2011; Barcelos, Magnago and Leripio, 2018).

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4.2iii Commercial production

Surfboards were traditionally manufactured by hand using power tools like planers and sanders. Local authority organisations in Brazil gathered all waste goods produced, usually for burning or landfilling. (Barcelos, Magnago & Leripio, 2018) investigated the impact mass-producing surfboards has on the creation and disposal of waste. They determined that the implementation of block machining technology of the foam core boards through Computerised Numerical Control (CNC) has been seen as a pivotal change in surfboard manufacture. This is because modern construction methods have emerged in an attempt to produce products faster and

possibly more profitably. As a result, businesses now have extremely linear business models and specialise in particular aspects of building surfboards, such as laminating, machining, or applying fibreglass and resins.

Small, independent businesses typically take on the later stages (Barcelos and Leripio, 2017). Based on the study, it was found that larger organisations, primarily CNC operators, produce more waste than independent, smaller outsourced businesses. The centralisation of waste generation, which was formerly dispersed throughout the manufacturing communities, was, it turned out, the fault of the larger corporations. Furthermore, the study found that technological innovation had little effect on waste reduction, reuse, or even improved waste disposal management (Barcelos and Leripio, 2017).

4.3 Innovation in manufacturing

Being aware of the well-established negative effects that the production of contemporary surfboards has on the environment in terms of long-term pollution, embodied and whole-life carbon, and the sustainability of the materials used to make wetsuits, what does the surfing industry's equipment production look like in the future, and how will it strike a balance?

4.3i Black cork

As an experiment, expanded black cork has been tested by a team from the University of Aveiro, Portugal, in the development of a sustainable and environmentally friendly surfboard. They talk about earlier alternative ecological surfboard production methods, for example, glue containing more than 90% linseed oil and foam cores created with 40% castor oil (Staiger & Tucker, 2008). Another study conducted by two brothers, Rey and Desi Banatao, examined the use of sugar beetroot oil in place of polyurethane and substituting fibreglass with hemp in an attempt to replace the chemically harsh modernised materials with less harmful ones (Forbes, 2008).

It is important to note that California has been at the forefront of ecologically friendly surfboard innovation due to the state's strict enforcement of environmental regulations, particularly over the usage of dangerous chemicals like toluene diisocyanate in the manufacturing of polyurethane blanks. Unbeknownst to the surfing communities, this 2005 crackdown exposed a number of upstream environmental and economic problems in the surfboard business (O'Brien and Martin, 2017) which greatly affected local manufacture.

Being One hundred percent natural, cork has unusual qualities including low density and multifunctionality. Because cork is a cellular substance, its internal space is filled with an interconnected network of cells that optimise load resistance while reducing density. Known as the "green foam," this substance acts as an internal mattress for the surfer's heels in addition to being a great shock absorber due to its softness (Mateus, Bordado and dos Santos, 2017).

Nowadays, cork is utilised in the production of certain surfboards; the material is primarily employed as a skin over a traditional foam block. Since cork does not rot when exposed to moisture, the material eliminates the need for glass fibre. The surface that cork provides is non-slip, non-abrasive, and ultimately all-natural due to its composition (Lost Surfboards, 2015).

The material known as black cork, or expanded cork agglomeration, is created when virgin cork grains that are stuck between them expand. Because of its superior acoustic and thermal insulation qualities, expanded cork is frequently used in the building sector. The substance, which has little commercial value, is extracted from the outer bark of oak tree branches and contains significant concentrations of suberin, or resin. To convert the base material from its unprocessed state into a bonded product, it must go through multiple pressure and steam-based processes (Correia et al., 2022). Although it is acknowledged that heat is necessary to make steam, the energy needed to do so comes from burning natural waste products from the cork industry in biomass boilers. Up to 93% of the total energy needed is produced by burning cork dust, a carbon neutral energy source (CORTICEIRA AMORIM, 2014).

Furthermore, when bark is extracted, the tree produces more bark thus locking in more CO₂. It is recognised that for each kg of cork extracted, 0.379 kg of CO₂ is emitted. However, it retains approximately 4.8 times that value (1.833 kg of CO₂) (Pereira and Baptista, 1993). Expanded cork board has a negative value of equivalent CO₂ emissions of -116.229 kg CO₂/m³, considering the embodied CO₂ in the cork at the end of the production cycle. Compared to other insulation materials such as polyurethane (PU), Extruded polystyrene (XPS), Expanded polystyrene (EPS), lightweight clay aggregates (LECA) and stone wool (SW), EC is the only one with a negative carbon footprint (Tártaro et al., 2017). The authors of the study concluded that the mechanical properties of the board including tensile and compression performance, when sandwiched between wood and polyester resin/glass fibre was good as it could hold substantial loads whilst reducing the overall weight of the board. Moreover the finished product has a 62.8 % lower environmental footprint than composite equivalents.

4.3ii 3D printing

There have been experiments with additive manufacturing and three-dimensional printing to produce surfboards. According to Hoffmann (2017), there is high potential for surfboards to be manufactured this way, especially for those looking at customisation but at present there would be a need to identify a more environmentally friendly material with which to print with. Moreover, the research into utilising this methodology has been more focused on the ability to print a board and not on the performance or intrinsic capabilities of the board thereof. To this end 3D printing is largely seen as complementary to manufacturing surfboards.

4.3iii Research and development

As an alternative to the standard foam core of conventional surfboards, a study by the UNH Surf Initiative investigated the potential of Ecovative Grow Material (EGM) as the core material for a surfboard (Mistretta and Moore, 2018). EGM is a foam-like material produced from growing fungal mycelium on agricultural waste, and can be shaped into furniture, flower pots, or packaging material (Ecovative, 2023). EGM degrades quickly when wet so a board made from it must be waterproofed. In continuing the environmental theme, the study used a leading bio-based epoxy resin (Entropy Resins, 2024) to oblige this requirement.

Strips of Paulownia wood was used to encase the EGM core grown around a wooden frame. Fibreglass had to be applied to the wooden surfaces with Bio resin to maintain water integrity. Whilst the constructed board was field tested, the results were qualitative only. Unable to substitute more sustainable materials for the outer waterproof coating, fibreglass has been shown to only contribute to a tiny portion (around 5%) of a traditional surfboard's carbon footprint (Schultz, 2009). However, the use of EGM and a bio resin removed the need for a conventional foam core and petrochemical products which form the majority of a surfboard's carbon and toxic footprint.

The Paulownia wood used in the construction of the board is also considered to have positive environmental impact as it is one of the fastest growing hardwood trees, it produces flowers which support local wildlife and allows for a relatively large portion of light to pass through its canopy to provide energy for life below (Gordon and Newman, 1997, pp.170–172). However, the tree grows predominately in China and as such there are carbon implications in its transportation to nonlocal surfboard manufacturers. A significant benefit of this construction methodology is that EGM has a negative carbon footprint, less transport, and that it does not rely on adhesives as it has self binding properties. According to the authors, the marketability

of such a board is promising but further research and testing would be required to make sure performance characteristics are satisfied (Almeida et al., 2013).

5. Conclusion

It is evident from the research that the outdoor sector is aware of the impact its material choices and manufacturing processes have on the environment and as such industry leaders are making strides to amend the negative impact their products and downstream consumerism have and continue to have on carbon emissions and sustainability goals.



When one considers the likes of Patagonia, whilst their intent is very much reported they have very little, if any control of the emissions generated by their supply chain. As an example, the company controls how much product it orders and, to some degree, how that product is made. However, Patagonia does not own the factories that produce its goods, many of which are located in Asia, where coal and other fossil fuels are the primary energy sources and as such it will struggle to influence change (Kammen et al., 2018).

The leaders of Patagonia do however recognise that exemplar products must have quality, durability, and multi-functionality. Such characteristics relate directly to minimising the overall environmental impact of Patagonia's products because the longer a product is in use, the smaller its total environmental footprint, and the more uses a product serves, the fewer total products a person needs to purchase (Kammen et al., 2018). Similarly, Finisterre have created a mission statement based on making a product that will last the test of time through the identification of better ways of manufacturing both products and materials. However, they recognise that people will not buy a wetsuit or similar simply because it is more sustainable. Performance will always remain a key differentiator.

The introduction of Yulex has seen the product win multiple surf industry and environmental awards as well as receiving international recognition. However, the findings from the wetsuits from Wetsuits research (Finisterre, 2018) argues that even though the raw materials are plant based and sustainably sourced, the finished product is difficult to recycle and therefore adds to the landfill problem. That said, Yulex Foam is now considered the first choice by global brands looking for high performing, responsible replacements for neoprene and geoprene and remains the current wetsuit material of choice for Finisterre.



Whilst the manufacture of renewable rubber produces 80% less carbon dioxide and uses 10 times less water than the production of conventional Neoprene, it does not address the recycling issue (Finisterre, 2018; Finisterre, 2023). One step in the right direction is emerging technology developed by Circular Flow. Over the past six years Circular Flow has developed new technology and manufacturing processes that bonds the particles from the shredded wetsuits

without removing the textile laminate. This enables them to process 100% of the returned neoprene items and produce a stable and durable recycled material that can be used to manufacture a wide range of new ocean-going products. Every component of the suit is recycled, including zips and plastic elements, so that no waste is generated (Circular Flow, 2022).

Such an approach is a step change from previous recycling initiatives which has seen old neoprene wetsuits being repurposed into other outdoor apparel such as kit bags and wallets (Circular Textiles, 2022).

The manufacture of sustainable surfboards has become a decentralised cottage industry harking back to the days when the material for boards were sourced locally and shaped and finished by time served by craftsmen and artisans. Much research has been undertaken in reducing some or all of the toxic materials used in the production of modern boards whilst reducing waste and emissions with the likes of cork, wood or hemp along with plant based resins. Although proven viable, the cost implications of scalability for mass production of sustainable surfboards does not appear to make it a currently tenable proposition. Furthermore, the bespoke nature of eco friendly or sustainable surfboard manufacture may price all but the most ardent recreational surfer out of the market.

Very Good!

For those that wish to embrace the sustainable surfboard movement, there are accreditations such as the ECOBOARD project by Sustainable Surf that provides assurances on the source and manufacture of boards. The ECOBOARD Project helps the board-riding community to build, buy, and ride high-performance sustainable boards. The organisation considers themselves to be much more than just the 'ECOBOARD' label but educators that engage individuals about the environmental impacts of their lifestyle through the lens of their surfboard (The Eco Board Project, 2024). Grading is split between level one and Gold.

According to their website, ECOBOARD Level One makes It easy for any board builder to get started making ECOBOARDS. By using at least one qualified material either core or resin, any produced board will have a significant reduction in environmental footprint without affecting performance, durability, or quality. Informed by sustainable surfs Life Cycle Assessment, ECOBOARD Gold Level rewards the top sustainable surfboards and surfboard producers by identifying those with the greatest environmental impact reduction. It should be noted that under the current ECOBOARD criteria, wooden boards that require little to no resin and/or fibreglass in their manufacture such as a Hawaiian Alaia board made from FSC-certified

Paulownia wood, produced by manufacturers that have been audited and have met the requirements of the gold level designation, also qualify as Gold Level boards.

The ECOboard life cycle study identified that more than 13.6kgs of a board's carbon footprint is a direct result of the energy used when making the board. If focus is applied to reviewing the energy inputs and moving away from fossil fuels to renewable sources such as photovoltaic, manufacturers of both polyurethane and sustainable boards can significantly reduce their carbon emissions (The Eco Board Project, 2024).

It is however noted that some manufacturers are changing their business models in recognition of a desire to manufacture more sustainable products and solutions. In 2023 Finisterre launched a world first in providing a UK based rental service for Yulex wetsuits. This compliments the fact that 91% of their 2023 clothing range was made with organic, recycled or natural materials. They also operate a repair service as well as a marketplace for selling second hand but still usable clothing and equipment, all of which is looking to promote item longevity whilst ultimately reducing its carbon footprint (Finisterre, 2023). In addition to material and manufacturing changes in pursuit of being more sustainable, some companies are reflecting on historical practices and driving a better future by measuring and comparing their environmental performance by signing up to initiatives such as the UK Government's Sustainability Disclosure Standards (UK SDS) (gov.uk, 2023), which are based on the International Sustainability Standards Board (ISSB). This, in turn, improves the transparency of the organisation's Environmental, Social and Governance (ESG) reporting and allows consumers / investors to make informed decisions about the sustainability credentials, inclusive of the whole life supply chain, of the company they are looking to engage with.

Furthermore, Improved ESG reporting opens the way for Science Based Targets Initiatives whereby organisations agree to meet specific energy reduction commitments that are Aligned to the Paris Agreement's 1.5 degree Celsius cap on global heating (UNFCCC, 2024). To do so, companies implement strategies to reduce their scope 1, greenhouse gases a company puts into the atmosphere, and scope 2 emissions, those which come from the electricity the company buys, in accordance with Greenhouse Gas protocol (GHG) (World Resources Institute and WBCSD, 2011)

Finisterre for example have pledged to reduce their scope 1 and scope 2 emissions by 42% by 2030 based on a 2020 baseline Finisterre, 2023).

Individual attitudes to sustainability in surfing will also have a significant bearing in the adoption of change. The hardest thing to change is long-held beliefs and perceptions. A 2013 study conducted by Holland-Smith, Love and Lorimer (2013) suggest that surfers, while motivated to engage in pro-environmental behaviours, are also influenced by a range of factors and appear to be primarily motivated by their identification and a need to maintain their experience of that sport. The paper suggests the interviewed cohort are aware of the trade-offs required in pursuing their sport that may damage the environment (e.g., toxic material involved in sport kit manufacture). When questioned, the surfers stated they would be unwilling to give up their sport even at the cost of the environment in which those activities are experienced.

A more recent study in 2021 reaffirms that surfers see themselves as 'green' (Langseth and Vyff, 2021) environmentally conscious but also cognisant that they buy a lot of surf-related apparel and equipment and travel extensively, and thereby contribute with a lot of CO2-emissions. On the one hand, surf culture highly values its connection to nature and environmental thinking, but on the other hand it also values and gives recognition to surfers that travel to and explore exotic destinations. Therefore, these dominant values within surf culture leads surfers to conflicting actions. This study suggests that surfing culture and ethos is embedded and as such could be hard to reverse.

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FINAL GRADE

42/100

GENERAL COMMENTS

In general terms, the format and style of writing are both excellent. Whilst I am happy for the use of subtitles in principle, you do need to be more careful about the contents under each one and consider whether so many subsections are necessary.

Your **abstract** makes clear what your study purports to address and your key findings. It does not state the methods or methodology employed to do this or for what purpose. .

The first two and half pages of your **introduction** have no apparent relevance to your study. You provide a detailed history of surfing, but there is no attempt to demonstrate how this is linked to the title or the abstract of your study. Personally, I am fascinated by the heritage and cultural dimensions of surfing, but this level of detail is not necessary or relevant to fulfilling the aims of your study.

You pay attention to two different aspects of surfing and it appears at times that you confuse and conflate the characteristics and issues related to the development of surf craft-and surf-wear. E.g., On page 5 you mention surf wear under the subheading "development of surf boards" , whilst on page 6 you include detail of surfboard evolution under the subheading "modern wetsuits". **A key omission is a working definition of "sustainability"** and how you view the term in relation to your study.

Your methodology fails to identify a research paradigm. This section is far too brief and vague. You list key words used in your search, but it is not clear how those words were used in order to retrieve the articles you have reviewed. At no

point do you clearly state what form of research you will be using- you don't state that your study is a literature based study. You do not provide a rationale for your chosen approach and fail to identify any strengths and weaknesses of the method. You have no clear inclusion or exclusion criteria. There is no accounting for potential bias .
Overall your method lacks significant detail .

The section titled results does not contain any results. Its actually a continuation of your method.

The discussion section is well referenced and touches on many interesting and relevant issues and topics. However, there is a lack of cohesion and purpose, with too many short isolated sections. Your writing is mostly descriptive and there is a lack of analysis and critical awareness. The reliance on dated literature is highlighted in the section on fibreglass. Fiberglass is now commonly recycled and used in the insulation of high voltage cables, circuit boards and in filters for gases and liquids. (cf: Tao, Hadigheh, & Wei., 2023)

Disappointingly, there is a whole paragraph on page 15 that has been copied
(https://www.researchgate.net/publication/326458120_Analysis_of_the_technological_impact_on_industry_and_its_effects_on_waste_production_and_disposal_a_case_study_of_the_surfboard_manufacturing_industry).

Your **conclusion** also contains sections of writing that appear to be directly lifted from other sources. I can see that this maybe a consequence of poor referencing technique, but all the same the inclusion of this verbatim content in the section where you should be drawing your own conclusions is far from satisfactory. Having said that, I feel that the conclusion is the strongest chapter and actually has a sense of purpose. Your writing here is more concise and the various points more closely aligned. However, much of the content in this section would be better placed in the main body.

You access a wide range of **literature**, but much of it is very dated and a lot is commercial in nature and more a kin to marketing information rather than good quality academic literature. There s an overreliance on single sources for long sections of writing (e.g., Barcelos and Ieripio, 2017, on pages 15 and 16.) It also seems that you have listed the reference material that these few articles have used without clearly demonstrating that you have actually accessed let alone used the literature cited. There are also a number of articles which are published in Spanish, yet it is unclear how the work was accurately translated for your use. Your referencing in text is good , although some page numbers would be helpful. Your end reference list is very poorly and inconsistently formatted.

Second Marker:

The concept of the dissertation is sound, as is the overall structure and format of your work.

There is initially a long focus on history which maybe sets a scene, however there is little space within a research project of this size to elaborate on background information. I think this space could have been used more concisely and with greater relevance to enhance your work.

As per the first marker I have some concerns over your references and how you may have selected those. There are a large number of old and fairly remote pieces of literature which suggests the trawling of others reference lists rather than a search for more up to date and geographically appropriate material. In addition to this there are a number of sections that are either poorly referenced or not referenced at all.

Your results are not results, they are part of your method. I would have liked to see at least. a table

identifying the papers considered, how they were or weren't selected (inclusion and exclusion criteria) and then perhaps a flow diagram outlining the process of categorising them as you have stated, within the aims of the research study. These could have been added as appendices to stop them using up word count.

I enjoyed the structure of your discussion, it is just a shame there is no rationale or evidence provided for the selection of subheadings. There is a lot of valuable content in here however your closing statement suggest your key finding lies within surf culture and attitudes rather than within a cost/performance mismatch as suggested by your abstract. A clearer and more coherent message would have made this a much stronger conclusion rather than one which undermines the preceding work.

Your reference list is at times inconsistently and poorly formatted, for example references appearing in the wrong order or not stating when websites were accessed.

Agreed Mark: 42%

PAGE 1

PAGE 2

PAGE 3

PAGE 4



Comment 1

are you implying that there should be a centralised (government ?) production of equipment?

PAGE 5



good

Good

PAGE 6

PAGE 7



Comment 2

you are contradicting yourself here- Peru is outside of the Polynesian islands.



Comment 3

no, surfing goes in the opposite direction!



Comment 4

This makes more sense.

PAGE 8



Comment 5

More precisely, the Calvinist missionaries attempted to ban it for two key reasons- locals tended to surf naked and they would bet on the outcomes of surfing competitions.

PAGE 9



Comment 6

so far its very difficult to see how this level of historical detail is directly relevant to the aims/ abstract of your study.



Very Good!

Very good

Additional Comment

This would be much better positioned at the start.



Comment 7

but your study only relates to manufacturing... doesn't it?

PAGE 10



Comment 8

This is a key term in your title and central to your whole thesis. You really need to provide a working definition of the term and how you regard it in relation to your study.



good but needs ref

good but could be improved with reference to some supporting literature

your ideas are sound but without references that show that you are not the only person who has this idea then your point is a basic personal idea.



Comment 9

Again, this would be better placed as part of a general introduction



good

Good

Additional Comment

Again, this rationale would be much better as part of a general introduction rather than under the subheading sustainability.

PAGE 11



Comment 10

This should be in the next section



Comment 11

I appreciate the need to establish a starting point for the technical development of surfing equipment, but there is far too much detail on history of surfing that is not directly necessary. You should try to be more concise and focussed on the key purposes of your study.

PAGE 12



good but needs ref

good but could be improved with reference to some supporting literature

your ideas are sound but without references that show that you are not the only person who has this idea then your point is a basic personal idea.



Comment 12

This is contestable, other authors declare surfing as originating in multiple locations and with a range of surf devices from planks, bladders and even dolphins!



Comment 13

surely this is under the wrong subheading?



Comment 14

at some point you should make it absolutely clear what you mean by sustainability in this context.



Explain further

This a key issue that needs further explanation



Dated literature

This literature is quite dated now. Ideally you should be looking to use literature that is less than five years old.

Obviously, if there is an important theory or principle which was written a long time ago, then that should be included, for example Kolb (1984) or Dewey (1932)

If your writing is seeking to apply older theories and principles to current circumstances, you need to use more recent evidence to support your application of that established principle.

You should be able to find a more recent publication to support this point!



poor source | 1. Engagement with Literature

This is a poor source of information.

For academic writing you need to refer to better quality academic literature.

If you are discussing technical issues then you need to use a recognised authoritative source. This may come from experts who are highly qualified in the field or from recognised official organisations.

There are plenty of more appropriate resources available to support your point, many have been included on the moodle page or in the module reading lists.



Comment 15

The latter of which? i don't see what this statement pertains to



Dated literature

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Comment 16

I am not sure what this subtitle refers to, the contents below don't seem to mention athletes or any athletic specific development



good
Good



Comment 17

This is inaccurate- most surfers in the UK would wear a 2-3mm wetsuit in the spring or autumn, with water temps around 18C. Only once water temps drop below 10C would a 5mm wetsuit be needed.

PAGE 15



Comment 18

so far you have been very reliant on this one source for this section of writing.

PAGE 16



Comment 19

how were these words input to a search- e.g., did you just search "cork" or "petroleum"?



Very Good!

Very good



Explain further

This a key issue that needs further explanation



Comment 20

but you have not mentioned any research criteria!

PAGE 17



Comment 21

these are not results, this is an extension of your method

PAGE 18



Comment 22

I am not at all comfortable with the use of a brand name as a section heading, particularly as you have not established how or why it might appear here in your introduction or abstract. .

QM

good

Good



Comment 23

This is purely descriptive, there is no analysis or attempt to link the "literature2 to anything else.

QM

Very Good!

Very good

PAGE 19



Comment 24

which R&D team?



Comment 25

so if its not stitched or glued, how are seams formed? is it heat bonding?



Comment 26

this requires further substantiation. A commercial entity claiming to meet government and UN standards cannot be accepted uncritically.

PAGE 20

QM

Dated literature

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You should be able to find a more recent publication to support this point!

Additional Comment

there have been significant advances in recycling in the last decade, this literature is far too dated for the point that you are addressing.



Very Good!

Very good



Comment 27

this research does not specifically relate to surfboard manufacture.

PAGE 21



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Comment 28 | 1. Engagement with Literature

My suspicion was aroused by the number of publications from foreign sources within a relatively narrow time span... this section is entirely copied from a single source. If this was any longer, this would have to be considered as plagiarism.

PAGE 22

PAGE 23

PAGE 24

PAGE 25

PAGE 26



Comment 29

your writing has not addressed the outdoor sector.



Comment 30

reference needed

PAGE 27



Very Good!

Very good

PAGE 28

PAGE 29

Dated literature

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If your writing is seeking to apply older theories and principles to current circumstances, you need to use more recent evidence to support your application of that established principle.

You should be able to find a more recent publication to support this point!

good

Good

Dated literature

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If your writing is seeking to apply older theories and principles to current circumstances, you need to use more recent evidence to support your application of that established principle.

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poor source

This is a poor source of information.

For academic writing you need to refer to better quality academic literature.

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PAGE 33

PAGE 34



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PAGE 35

PAGE 36

PAGE 37

PAGE 38

GRADING FORM: BMSS6007 INDEPENDENTPROJECT 24

1. ENGAGEMENT WITH LITERATURE

A clear rationale for the project should be presented, with evidence of the literature having been critically reviewed and appropriate literature selected for inclusion. The literature should also be critically reviewed to identify the most suitable and valid methods and data analysis approach. (25 marks available)



Engagement with an appropriate range of research-informed literature, including sources retrieved independently. Some over-reliance on texts. Referencing may show minor inaccuracies or inconsistencies

12**2. KNOWLEDGE AND UNDERSTANDING**

The project should display evidence that the chosen research topic is understood at an advanced level, including the suitability of the research design chosen and the methods and data analysis used. (25 marks available)



Limited knowledge and systematic understanding of the relevant concepts and principles within the subject area which to some limited extent, is informed by current research and scholarship

11**3. COGNITIVE AND INTELLECTUAL**

The project should display evidence of higher level thinking and an ability to evaluate research resources to present and conduct a well thought out piece of research. The selection of a research design, methods, data analysis and selection of results for presentation should be appropriate for this level of study. (30 marks available)



Largely descriptive work, with superficial use of critical evaluation. Weak development of arguments and judgements. Information accepted uncritically, uses generalised statements made with scant evidence and unsubstantiated opinions. Ideas sometimes illogical and contradictory

9

4. PRACTICAL SKILLS

The project should be informed by any relevant guidelines and standards of best practice. The practical implications of the project should be clearly identified. (10 marks available)



An adequate awareness and mostly appropriate application of well-established methods, materials, tools and/or techniques.
Basic appreciation of the context of the application. Theoretical knowledge and understanding applied in practice, but not always making logical links between the two.
Can identify problems and propose basic solutions in complex and unpredictable contexts without fully appreciating the complexity.

4

5. TRANSFERABLE SKILLS

You should demonstrate of the ability to communicate clearly through written work which is correctly referenced. The project should be

structured and organised appropriately for the discipline selected. (10 marks available)



Can communicate well, confidently and consistently in a suitable format.

Work is coherent, fluent, well-structured and organised. Can work very well autonomously and/or as part of a team, with very good contribution to group activities.

Demonstrates very good graduate employment skills, with just occasional minor weakness

6