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MODERN TECHNOLOGIES IN SHAPING STRATEGY IN THE CLOTHING INDUSTRY – A CASE STUDY OF THE 4F BRAND

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Purpose: The purpose of the paper is to review modern technologies present in building the strategy of contemporary clothing companies and to conduct a case study of the 4F brand (one of the leaders in the use of modern technologies in shaping the product offer in the clothing industry in the Polish market), to present the application of the use of these technologies in the Polish market.
Design/methodology/approach: The paper conducts a case study of the 4F brand from the point of view of the use of innovative technologies in improving strategies for meeting the needs of buyers of clothing products. It was preceded by a literature review on the occurrence of these technologies in the surrounding market reality and their development prospects.
Findings: Innovative technologies are a constant element in building the strategy of the 4F clothing brand. With them, the brand develops such parameters of its offerings as antibacterial, hypoallergenic or adequate moisture wicking. It also uses technologies to present new product lines: 3D and augmented reality (AR). It allows it to optimise the entire sales process and reduce the number of returns. It is part of the company's strategy to shift to circular sales models in line with sustainable development.
Research limitations: The diversity of possible solutions from modern technologies, resulting from their nature and unique specificity, makes it difficult to generalise the results obtained. Each successive example of the use of modern technologies is outstanding in its way, does not lend itself to standardisation and requires individual analysis.
Practical implications: The results of the study indicate that the business operations of apparel companies are becoming more technologically advanced, which will require increasing investment on their part in IT infrastructure and the implementation of new technological solutions.
Social implications: Modern technology is being used in the fashion industry to build relationships with stakeholders through increasingly modern marketing communication tools, forcing expenditures in this area as well. The tools for building these relationships are derived from the instruments used by stakeholders in their personal lives (e.g., social media), and the two areas will intersect and complement each other.
Originality/value: The originality of our study is to comprehensively present the current use of modern technologies in the apparel industry, to isolate the most popular tools used by entities in this industry on the Polish market and to diagnose the attitude of the audience towards them, as well as to determine the development directions of this trend.

Keywords: modern technologies, clothing industry, sustainable development, 3D and augmented reality (AR), 4F brand.

Category of the paper: case study.

1. Introduction

Technological improvements are giving modern providers of goods more and more opportunities to improve their offerings, serving to more fully satisfy buyers' needs. For years, innovations could be seen primarily in the technological process of producing a new product (Kartajaya et al., 2019). Modern technology is used at every stage of the customer's purchase path (Wojciechowska, 2020; Stasiuk, Maison, 2021). Advanced technology helps in marketing research, learning about consumers' expectations and assessing their reactions to the company's actions (Morin, 2011). Thanks to innovations, goods providers can streamline the production process and dynamically improve their products, flexibly responding to further changes in market expectations (Kamboj, Rahman, 2017). Modern marketing also makes heavy use of technological advances (Davies et al., 2020). The idea of Marketing 5.0 cites (Kotler et al., 2021) date marketing, predictive marketing, contextual marketing, augmented marketing and agile marketing as critical components. Through their use, it is possible to build an ecosystem of data, anticipate demand for better targeting, and further create a personalised sensory experience using human interactions supported by technology(Patora-Wysocka, 2014). And all this at scale and a rapid pace. Incorporating these aspects into the strategy of the modern enterprise is becoming a necessary condition for competitiveness. It can be observed in an increasing number of industries that operate in the market.

The clothing industry is also implementing these elements in its operating strategies. The clothing industry is worth about $2.4 trillion in US dollars, employs about 75 million people worldwide, and is multiplying constantly (KPMG, 2018). Its operation is linked to the use of many new technologies. An example of an entity in this sector that relies on technology in all areas of its operations is the 4F brand.

The purpose of this paper is to review modern technologies present in building the strategy of contemporary clothing companies and conduct a case study of the 4F brand (one of the leaders in the use of modern technologies in shaping the product offering in the clothing industry in the Polish market), to demonstrate the application of the use of these technologies.

The text uses available literature on the subject and empirical materials from the company.

2. Literature review

Modern technologies in the clothing industry are present at every stage of the company's operation strategy (Valaei, Nikhashemi, 2017). To systematise the presentation of the place of use of modern technologies, they can be divided into the following areas:

- manufacturing technologies,
- marketing communication techniques,
- sales techniques.

The materials used in the production of garments and their manufacturing techniques are the first areas where technological innovations began to be applied on a mass scale (Rinallo, Golfetto, 2006; Patora-Wysocka, 2014). As a result, the functionality of products was systematically improved, design and manufacturing times were reduced, the costs of these processes were lowered, and environmental performance was improved (KPMG, 2018). Among the most valuable solutions are 3D design and sampling (Hugo Boss, Tommy Hilfiger) - there are no physical prototypes of products, no wasted materials and no shipping costs. At the same time, it is possible to respond more quickly to market trends and consumer expectations. Printed models make it possible to assess the feasibility of designs. There is no need to take photos of the collection, as its design is already digital (Pflaum, Golzer, 2018). The whole process is less harmful to the environment.

Optimisation of the sales process itself is also achieved through the use of:

- Blockchain - makes it possible to track the movement of clothes throughout the production and supply chain.
- Predictive analytics - algorithms that make it possible to predict what demand will be and, thus, reduce product transportation.

In today's marketing communications, technologies are primarily tools for personalising contact, quickly presenting offers, facilitating the selection of the best option, and promptly completing the purchase transaction (Taranko, 2015; Wiktor, 2013). Hyper-personalisation is becoming more and more popular (Jain et al., 2021), which, thanks to Machine Learning and Deep Learning, makes it possible to create advanced predictions about the consumer's future behaviour (Bagherian et al., 2021), both in terms of the products purchased and the shopping experience, customer service methods, offers used, discounts, e-mail marketing, etc (Mortimer, 2017).

The improvement of the sales process with new technologies can be observed in both traditional stores and online stores (there is also a virtual clothing marketplace). The basis for satisfaction with the purchase transaction is the product's fit to the customer, which requires trying them on in the case of clothing products. While this hasn't been a problem in traditional commerce for a long time, it has been a difficulty in online sales until recently. At the moment, artificial reality offers the opportunity to try on products that are often not yet physically made

- all that is needed is a digital visualisation of them. Studies show that the virtual fitting room contributes to a 27% reduction in the rate of returns, resulting mainly from a mismatch in size or the wrong cut of a product.

In the sales process, companies are also using electronic tags, which enable a more seamless management of distribution, warehousing and sales processes, as well as observing the fate of a product after purchase (e.g. using RFID, as in the case of the Spanish brand Inditex, or the Polish LPP) (https://www.newsweek.pl/..., 20.09.2023). Stores are being equipped with progressive lighting and air-conditioning systems that respond to customer movement in the store and adjust the facility's climate conditions accordingly.

The logistics of the sales processes are carried out using automation of the process. Algorithms are responsible for collection planning, the number and type of garments in stores, or discounts. It makes it possible to dispense with a person supervising individual stores. But at the same time, it requires the expansion of IT departments in clothing companies (for example, LPP employs 400 people in its IT department) (https://filarybiznesu.pl/..., 20.09.2023).

Wholesalers increasingly use virtual showrooms to help evaluate the products on offer and make more accurate purchasing decisions without making additional trips and shipping prototypes.

Not long ago, it seemed pure fiction to buy virtual products, and today, there is already talk of digital fashion in social media, which appears to be an ideal solution for influencer marketing, primarily from the point of view of ecology.

The presented list of technologies in the clothing industry is not complete. There are undoubtedly many more tools that individual companies use in their sales processes. However, this selective list of technologies shows that the fashion market is changing radically and gives hope that shopping in this sector will become easier and greener.

3. Characteristics of the studied entity – the 4F brand

4F is a Polish brand owned by OTCF. It also holds 4F Junior, Outhorn, Under Armour, SportStyleStory.com and 4F Fuel (https://www.otcf.pl/marki, 20.09.2023). The initiator of the company and founder of the 4F brand is Igor Klaja (Klaja, 2016). Its prototype was the 4Fun brand established in 2003 (the next version of the name was 4F Sport Performance and since 2010 - 4F) (https://mambiznes.pl/..., 20.09.2023). Over the years, the brand has systematically expanded its commercial offer and adapted its activities to the requirements of the environment. Currently, the company is thriving in the country, with more than 240 stationary stores in various locations, and is developing its activities in the foreign market through a wholesale network (https://www.otcf.pl/marki, 20.09.2023). The brand's products can be found in as

many as 42 European and Asian countries (Sieńko, 2020). OTCF's turnover is about 400 million euros, and half comes from the 4F brand.

The 4F brand, in its extensive commercial offer, has an assortment for children, women and men designed for both amateur and competitive physical activities, such as running, skiing, snowboarding, swimming, cycling, yoga, trekking or fitness. The range also includes casual clothing characterised by versatility and functionality. The assortment comprises T-shirts, sweatshirts, jackets, fleeces, pants, leggings, dresses, skirts, swimwear and underwear. In addition, there are also accessories such as backpacks, bags, goggles, helmets, scarves, hats, goggles, gloves, socks, bidons and specialised training equipment. The 4F brand also produces footwear, including winter boots, shoes designed for running, flip-flops, sandals and versatile sports footwear models.

"The brand's mission is to inspire customers to find a passion for action - not only in sports, and to persevere and go one step further every day" (https://4f.com.pl/fundacja-4f-pomaga, 20.09.2023). In pursuit of this mission, the brand specialises in producing representative and starting outfits for people participating in sports competitions (Klaja, 2016). Foreign Olympic committees appreciate it. In a ranking conducted by "300Gospodarka", 4F ranked second in the list of clothing manufacturers for athletes participating in the 2020 Games (Siedlaczej et al., 2020), where as many as eight national committees performed in clothing created by 4F (https://terazpolska.pl/..., 20.09.2023).

The brand cares a lot about its image. It intensively develops its marketing communication, which includes not only direct activities accompanying the sale of products and the development of business but also, among other things, social and environmental activities. An example of activity undertaken by the brand in this area is participation in World Clean Up Day (https://4f.com.pl/blog/..., 20.09.2023). The brand also partners in activities organised by Aktywni dla Autyzmu or the DKMS Foundation. Meanwhile, an independent initiative undertaken by 4F is the 4F Helps Foundation, whose initiative was born in 2019 as a reaction to the emergence of the COVID-19 pandemic (https://4fpomaga.org/about-us/, 20.09.2023). As a provider of products dedicated to sports, the brand is keen to sponsor sports teams and events of this nature (e.g., an agreement with the Polish Volleyball League). The brand's marketing communication is supported by a group of its ambassadors (the common slogan of this group: "We make a team"), which include Robert Lewandowski, Anna Lewandowska, Wilfredo Leon, Paulina Fialkowa, Łukasz Kubot, Martyna Kotwiła, Kamila Żuk, Adriana Sułek, Sebastian Kłosiński, Milda Valciukaite, Saulius Ritter (https://4f.com.pl/ambasadorzy, 20.09.2023). The 4F brand also uses mass communication tools such as TV, radio and print ads. Communication activities are complemented by mailing and extensive loyalty programs.

4F constantly expands its commercial offerings to adapt to changing market expectations. Its negative impact on the environment and the deteriorating state of the planet has contributed to the brand's innovative efforts to protect the environment (https://4fchange.com, 20.09.2023). Since 2022, 4F Charge has been operating a "Wear_Fair" program to reduce the adverse effects

of overproduction of clothing and unused purchases. A ski outfit rental business has been launched. Interested customers can rent unique 4F winter clothes for a fee and return the products after use. In addition, special zones have been opened in some stores, where customers can return used and unwanted 4F brand clothes to the so-called second circulation. They are thoroughly cleaned and refurbished. Then, marked with a unique "Wear Fair" tag, they go on sale again.

The next step in developing the 4F Charge program is a joint project between the 4F brand and Viamoda University called Circular Design 4F x Viamoda (https://media.otcf.pl/..., 20.09.2023). In this project, students will strive to turn substandard products into exceptional products, using second-circuit clothing, repair, recycling and upcycling. Precious in this initiative is the involvement of an external entity, such as a university and its students. It ensures greater promotional resonance and pro-environmental education for the brand's potential customers, the school's students.

4. Modern technologies in the activities of the 4F brand

One of the most critical elements of the 4F brand's operating strategy is concern for the development of the products offered. The company constantly invests in designing successive collections of products to align with the latest fashion trends. This process involves the company's employees and ambassadors, who create their collections that are later sold under the 4F brand (e.g. RL9, Anna Lewandowska "DOPAMINE BOST").

The brand has also been investing for years in innovative materials for the brand's products. Thanks to this, the comfort of use of these products is increasing - new technologies used in the process of manufacturing materials make the garments sewn from them have increasingly better breathability and moisture-wicking properties (underwear, T-shirts and leggings are made from materials containing quick-drying fibres in 4FDry technology), protection from wind and moisture (outerwear, especially for winter sports). Such measures also increase the durability of products, which, together with a higher level of satisfaction with the innovations contained in the company's products, results in customers using the products they buy for longer. The leading technologies and materials used in 4F products are (https://www.asport.pl/technologie/..., 20.09.2023):

– AQUATECH PRO+ - a high-quality technical material with PU impregnation protects the wearer from environmental moisture. It can have different varieties and technical parameters, and thanks to the millions of micro-holes in the Aquatech Pro+ material, it has a triple property: it blocks wind and water coming from the environment and expels sweat and moisture resulting from the increased physical exertion of the user.

- THERMODRY - a high-quality knit fabric created specifically for customers who demand more practicality from sportswear for their active lifestyles. THERMODRY knitted fabric wicks sweat to the outside of the fabric, where moisture can evaporate quickly. The intricate construction of these fibres ensures that the underwear dries quickly. This thermoregulation effect allows the wearer to stay dry and provides greater freedom.
- MICROTHERM - a high-quality knitted fabric that maintains the body's natural temperature with a low material weight. It has an anti-pilling finish, so it retains its properties and appearance much longer than conventional fabrics.
- INNER-TECH - a high-quality product that protects from wind and moisture while expelling sweat and moisture generated by increased physical exertion.
- MERYL SKINLIFE - bacteriostatic polyamide fibre, which, thanks to the content of silver ions, maintains the bacterial balance regardless of the intensity of physical activity. The fibre's active silver ions have bacteriostatic, anti-fungal, anti-odour and anti-allergenic properties. These properties make Meryl Skinlife ideal for garments that come into contact with the human body. The material has passed tests in contact with the mouth, skin or eyes. By reducing the growth of bacteria and quickly absorbing moisture from the skin's surface, the BODY 4F collection performs thermoregulatory functions in all weather conditions, protects against the formation of dangerous odours and reduces the risk of allergies.
- POLARTEC CLASSIC® - is known for its lightweight, breathability and ability to keep you warm. Polartec® is air permeable, keeping the body warm, thanks to the velour construction used in the material. In addition, the material maintains its insulating ability and proper appearance without pilling, even after repeated washing.
- WINDPILE - a new generation climate-responsive fabric that provides maximum protection against wind and cold. It is a breathable fabric, giving a feeling of comfort while being outdoors.

Individual clothing components can come in very different versions; for example, a membrane that provides waterproofing, windproofing, breathability and sweat-wicking comes in versions 3000, 5000, 10000, 15000 and 20000 (https://4f.com.pl/blog/post/jakie-zalety..., 20.09.2023). As a result, its advantages can be appreciated by amateur athletes and professionals training in very harsh weather conditions. The brand sometimes looks for sources of inspiration for its products in very unusual places; for example, Primaloft insulation (synthetic down) was invented in the 1980s for US Army soldiers (https://4f.com.pl/blog/post/jakie-cechy..., 20.09.2023).

Before the final product is created, a testing phase and presentation of newly developed models is necessary. It is also the space where the brand uses modern technologies. An example is the collection created by the brand in cooperation with Robert Lewandowski. Technologies

were used to present the collection: 3D and augmented reality (AR). 4F's cooperation with this footballer is based on creating joint, innovative collections designed to combine the latest trends and functionality. The products in this collection use materials that have properties known from professional sportswear, such as antibacterial, hypoallergenic and adequate moisture wicking. In addition, they are characterised by extended durability. The 4F x RL9 collection comprises 38 items, including sweatshirts, pants, shorts, long sleeves, t-shirts and baseball caps. The entire collection is available in muted colours that can be combined. (https://mycompanypolska.pl/..., 20.09.2023).

In designing the products of this collection, care was taken to ensure their aesthetics, quality and uniqueness at the same time, e.g. the special edition of sports shoes is only 200 pairs of shoes (in black and white; numbered and signed with Robert Lewandowski's signature) (https://www.vogue.pl/..., 20.09.2023)

The 4F x RL9 collection has been digitised, so the products can be seen in the 4F app using augmented reality (AR). You can also use the 4F app and view each product in a 3D scan of Robert Lewandowski's silhouette. With the help of modern technology, the 4F brand allows its customers to visit the e-fitting room, where Robert Lewandowski's avatar enables them to choose the right clothes size without leaving home. With the help of 3D technology and augmented reality, it is possible to see each garment from the collection on the silhouette of the ball champion. In addition, the brand's customers can visualise the products on their own silhouette in the e-fitting room. An individual avatar can be created using basic silhouette information, i.e. by providing measurements such as height, chest, waist and buttock circumference. All thanks to the use of technology developed by the Polish startup WEARFITS, supported by the Lodz-based gas pedal S5. Using these technologies is also possible because customers of the 4F brand can also shop through a particular app dedicated to it.

The technologies used are designed to bring customers of the 4F app closer to the shopping experience they know from stationery stores. The ability to display Robert Lewandowski's silhouette is a bonus provided by 3D technologies. Augmented reality is one of the technologies the 4F brand is testing to optimise the business's environmental impact. One of the main problems that WEARFITS technology addresses is optimising sales and reducing returns, which can be reduced by more than 20% thanks to AR Digitization at every stage of the production and supply chain, allowing for greater experimentation with marketing and product forms.

Confirmation of the right direction for the 4F brand's business strategy in the Polish market is that the company is growing very well and recording higher sales results yearly. 708,000 (https://4f.com.pl/, 20.09.2023) Internet users have liked its profile on FB, while its profile on Instagram has 153,000 followers, and there are 11,500 followers on TikTok (https://www.tiktok.com/@4f_global, 20.09.2023). The brand and its managers also enjoy industry recognition in Poland and worldwide, as exemplified by the awards they receive. Here are some examples (https://4f.com.pl/, 20.09.2023):

- 2016 - "Retailer of the Year" ("Retailer of the Year"), as part of an international competition, won in as many as three categories - Retailer of the Year, Fashion Retailer of the Year and Debutant of the Year.
- 2020 - Igor Klaja - Entrepreneur of the Year 2020 - for not giving up when the pandemic closed most stores.
- 2022 - Top Brand 2022 - awarding 4F brand as a leader in the clothing industry in 2022.
- 2023 - CEE Retail Award 2022 in the Fashion Retailer category (stores under 600 sqm).
- 2023 - Mobile Trends Awards 2022 - nominations in three categories for two apps: Outhorn and 4F, with the Outhorn app nominated in m-commerce and business mobile-based solution categories.

5. Conclusions

In summary, the multitude of modern technologies used in the clothing industry is truly impressive. As specialists note, the technologies have often been known before, and only how they are used is new. The direction of their development is set by the desire to make fashion more sustainable and help more fully satisfy human needs in the long term. It is crucial because, according to the European Economic Commission, the clothing industry accounts for 20% of the world's water waste and 10% of global carbon dioxide emissions. 85% of manufactured textiles end up in landfills (https://biznes.newseria.pl/, 20.09.2023). Fashion Industry Charter for Climate Action, in which they pledged to reduce greenhouse gas emissions by 30% by 2030 and to achieve climate neutrality by 2050 (https://nowymarketing.pl/..., 20.09.2023). Modern technologies will be of great help in achieving these results. One can even argue that the future of the fashion market is digital (fash-tech).

Fortunately for the climate, the desire of customers in the clothing sector to save money, simplify the buying process and have a more satisfying product is entirely in line with the market's need to reduce waste, pollution and water consumption in this sector.

The 4F brand also fits in well with the observed trends. The brand's managers are fully aware that the clothing industry impacts the ongoing climate change and that the transition to circular models is one of the critical directions for corrective action. The brand's initiatives address this need while making the company's operations more profitable. Skillful use of established brand ambassadors (e.g. Robert Lewandowski) helps convince a broad group of customers of these activities. The brand is recognised by customers and professionals, as evidenced by its high interest in it on social media and periodically awarded.

The main threat to using technology in purchasing processes that help match a product (e.g., e-fitness), make sales processes more flexible, or optimise proper product allocation is the security of the data that flows during these activities. For example, to use an e-fitness room,

a customer must share all of its dimensions (Pflaum, Golzer, 2018). And optimising store supply uses information and the movement of customers and their purchases. The discomfort of realising that one is being tracked may not be outweighed by the shopping convenience accompanying it.

An equally important factor is the high cost of these innovations, which makes purchasing offers prepared with them more expensive. It may happen that an uneducated customer will not appreciate these innovations and will abandon the purchase in favour of another cheaper offer (Tezel, Giritli, 2019; Nguyen, Nguyen, 2021). The times ahead will not be easy for customers. For their purchasing decisions (as well as other market decisions) to qualify as relatively pro-environmental, they will require knowledge of the technology used to produce the good in question and the implementation of different processes in the company of its offerer, etc.

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