

Article

# Corporate Social Responsibility of Companies Producing PFOA Containing Waxes for Cross-Country Skiing

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**Abstract:** The chemical industry is a particularly sensitive sector that very often works with toxic, harmful and dangerous substances. This paper offers insight into the corporate socially responsible (CSR) behaviour of a specific segment of the chemical industry—the production of fluorinated ski waxes. Perfluorinated compounds, which excel in water and fat stability and repellency, are nowadays considered as harmful to human health and nature. During 2020, the basic compound, perfluorooctanoic acid (PFOA), will be banned, and finding its replacement will be a difficult task. So far, there are no alternatives in terms of environmentally friendly compounds that can maintain the desired properties of extreme ski glide. Based on a questionnaire distributed to twenty wax producers worldwide, we have concluded that, although the attitudes of companies towards CSR certification was rather negative (87.5%), and companies had not developed or documented any CSR policy/strategy with specific goals, they found CSR activities/instruments beneficial and important. The survey highlighted the fact that companies were aware that their products are dangerous for the environment, and that environmental issues are important for all of the responders, despite them being mostly without certified systems. The size of a company had no significant effect on their attitude. Micro and small producers were involved in raising awareness of environmental policies and responsibilities to the same extent (maybe even more) as medium or large companies. We also found varying behaviours between companies involved in environmental programs and those who were not. The companies involved felt a strong attitude towards all three pillars of CSR, which are the environment, as well as social and economic aspects. Those companies not involved had a strong attitude towards their customers, but not towards their employees, suppliers or the wider community. They also had stronger feelings about the quality of their products and economic profit, but without a strong approach to the related environmental issues. The Norwegian approach and the commitment of the company Swix to CSR are two positive examples leading to a fluorine-free future.

**Keywords:** corporate social responsibility; sustainability; perfluorinated compounds; fluorine-containing waxes; PFOA

## 1. Introduction

The chemical industry is a particularly sensitive sector that very often works with toxic, harmful and dangerous substances. For chemical companies, corporate social responsibility is important and should permeate all three pillars of socially responsible behaviour (economic, environmental and social) [1]. Nowadays, modern industry considers environment protection, namely, innovative developments and technologies, which focus on green processes and products and minimise the

burden on the environment, a necessary modern condition for sustainable development [2]. Moreover, companies operating in the chemical industry should not neglect the occupational health and safety of their employees. Again, this is mostly being done in developed countries, except for in production that cannot be simply registered to the relevant working conditions or limits.

Attitudes towards chemical toxicity have changed over time (e.g., fluorine compounds were tolerated until CFCs were identified as ozone-depleting substances and were banned as early as in 2009) [3]. Nowadays, other fluorine compounds are considered as harmful to human health and nature [4]. Perfluorinated compounds, which excel in water and fat stability and repellency, are tolerated, and are, therefore, often used in industrial production [5]. One of their application fields is *inter alia*, the manufacture of paraffin waxes for skis [6]. These paraffin waxes can be categorised into various different types of different chemical compositions, as well as the possible or substantiated negative consequences of their use. Incorrect handling during their application can seriously damage the health of all those working with them [7]. This area is of course regulated—some substances have already been blacklisted by the Stockholm Convention [8]. Although the restrictions and limits are aimed primarily at industrial production, such measures should be applied for the conditioning and waxing of skis as well. Skiing, although traditionally thought of as a recreational activity, has seen a global boom recently, but mainly in Europe and the United States, which has resulted in the expansion of skiing as a popular public competitive winter sport [9]. This boom brings the need for sustainable ski development through sports events, but also in the context of environmental protection and community involvement [10].

In the paper, we focus on social responsibility in this field—the use of fluorine-containing waxes in Nordic skiing, which is considered a more significant environmental problem than downhill ski waxing.

## 2. Theoretical Framework

### 2.1. Corporate Social Responsibility

The idea of corporate social responsibility dates back to the early 1950s, and its foundations were laid in a book entitled “Social Responsibilities of the Businessman” [11]. Today, there is no standard definition of corporate social responsibility (hereafter referred to as “CSR”), but a number of international and national organisations and movements have sought to define this concept, including, for instance, the Business for Social Responsibility, the World Business Council for Sustainable Development, institutions associated with the World Bank, the United Nations, and the International Labour Organisation. In Europe, the development of CSR is supported by the European Union, according to which CSR is defined as, “The responsibility of enterprises for their impacts on society” [12]. The main feature of a socially responsible corporation is that it has adopted the concept voluntarily, beyond its legislative obligations. Along with that, such corporations recognise the three main pillars of corporate responsibility: economic, environmental and social, which are often referred to as the “triple bottom line” on which the overall strategy of a business is developed, thus moving from the basic level of “profit only” [1]. A socially responsible business is based on standards that control the behaviour of a company. Studies show that the most widely used standards are the UN Global Compact, the International Environmental Management System Standard ISO 14001 and the Global Reporting Initiative [13,14].

### 2.2. Responsible Businesses in the Chemical Industry

Besides producing most material valuables on the Earth, the chemical industry is undoubtedly a sector that is associated with several negative impacts (e.g., it accounts for 22% of all industrial greenhouse gas emissions) [15]. Products of the chemical industry are used in all areas of the economy, and they are indicators of a state’s level of development [16–18]. The most developed countries—the European Union, the USA, China and Japan—represent the highest share of the worldwide chemical industry, accounting for 72% of all global turnover [16].

The negative influences of the chemical industry are perceived very sensitively by society and, above all, as a potential danger not only during production, but especially during the disposal of waste and unwanted products. The EU decided to monitor, evaluate and, if necessary, regulate the use of chemicals in the framework of the REACH (Registration, Evaluation and Authorisation of Chemicals) regulation of 18 December 2006 [19]. Adopting this standard implies the obligation to verify the safety of chemicals, to know their usage and to determine that their use is safe. Substances and procedures approved in the database are considered safe, and the opposite, potentially hazardous substances are listed as well. For companies, this standard means that they need to have new substances approved before they are launched and marketed (in quantities exceeding 1 t/y). This also means the avoidance of the use of substances that are not approved or are identified as hazardous.

Another attitude is summarised in the twelve principles of green chemistry, based on minimising waste, maximising raw materials in the desired product, the use of renewable sources and less energy-intensive processes and replacing raw materials with natural, renewable and safe materials [20].

Previous works on a circular economy and the environment have led to an environmental circular economy, which has considerable potential for sustainable industrial production [21]. The interaction between the economy and the environment is an increasingly popular research theme, the main element of which is sustainable development [22]. Important participants involved in comprehensive environmental protection are primarily the International Council of Chemical Associations (ICCA), the European Chemical Industry Council (Cefic), and the European Association of Chemical Distributors (FECC) coordinating the Responsible Care initiative, the European Technology Platform for Sustainable Chemistry and the Together for Sustainability. They mainly aim to meet the objectives of the Lisbon Strategy as part of the European Union's research and innovation activities [23]. Between 2011 and 2030, the world's chemical production is expected to grow by an average of 4.5% annually and generate a turnover of EUR 6.3 trillion. Simultaneously, by 2050, the European Union has set the target of reducing carbon dioxide emissions by 80% compared to 1990 [24].

### 2.3. A Study of Fluorine and its Compounds

Fluorine and hydrogen fluoride are released into the atmosphere mainly in the production of aluminium, phosphate fertilisers, ceramics, and glass [25]. Fluorine poses a threat to both the environment and humans because fluorine-containing substances can penetrate the soil, and fluorine has negative effects on human and animal health [26]. One of the prominent ways fluorinated substances are introduced into the environment is through their use in ski waxes. Annually, in the USA alone, about 13 tonnes of fluorinated compounds are consumed for wax production [27]. Therefore, it should be essential that the companies producing and using ski waxes include CSR in their business and perform innovative research into alternative products and waxing methods.

Fluorine is a biogenic element (e.g., important for developing strong and hard bones and healthy teeth) with an average daily dosage for adults of 3–4 mg; however, the effects of higher doses are relatively severe on human health [28]. Studies also show that fluorides damage vegetation and have an enormous ability to penetrate leaves, accumulating in high concentrations [29–32]. The exposure paths are through the surface of leaves, where fluorine disrupts their protective wax layers and reduces their resistance. Fluorine also penetrates plant tissues in a gaseous form, through pores, or from the soil through the root system [29,32,33]. The US National Institute for Occupational Safety and Health (NIOSH) has set a recommended exposure limit of 0.2 mg/m<sup>3</sup> over an 8 h workday [34].

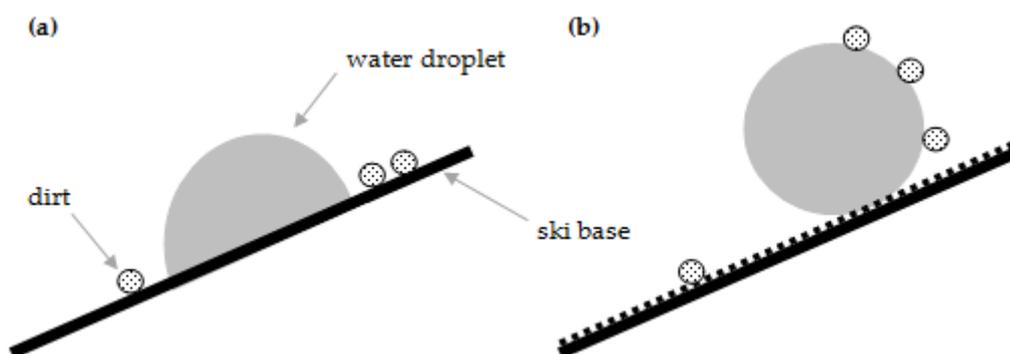
### 2.4. Ski Waxing

Originally, skis were made of wood, and wood, in principle, soaks up water and transports it from the soil to the leaves. Therefore, skis needed protection by applying preservatives to the wood to prevent it from absorbing water. The first waxes, which were based on purely natural products, such as pine tar or animal fats, including spermaceti oil, appeared on the market in the mid-19th century. Pine tar has a hydrophobic effect, which allows water to form in small droplets, and the skis can glide

on these tiny droplets mixed with air, which is significantly less viscous and, therefore, the skis move faster [35].

In 1913, the first klister, containing admixtures of solvents and oil, was patented in Norway [27], and the production of the first paraffin waxes made from crude oil derivatives began as early as the 1940s. TOKO, Swix, HOLMENKOL and Rex were among the first companies in the 1950s to develop a paraffin-based commercial wax [27]. Nowadays, ski bases are made from polyethylene (PE) with an admixture of graphite and PTFE (Teflon), which ensures better gliding properties. The surfaces of ski bases are relatively hard and resistant to the increased temperature generated by friction, and porous, containing pores of different sizes, depths, and spatial orientations. Each ski structure is designed for a different type of snow [36,37]. When a ski is waxed, the paraffin wax is melted (depending on type at between 120–180 °C) and poured into the pores. The excess paraffin is scraped off the ski base, and the ski is finally carefully brushed. Paraffin compounds remain inside the ski base until they gradually come off during skiing. They remain in the snow and then penetrate the melted snow into the soil and groundwater. Unfortunately, original **hydrocarbon paraffin waxes**, composed of ethene molecules (usually with 25–30 carbons), are harmless to the environment and human health, have limited hydrophobicity, and nowadays they are suitable for low air humidity and low snow temperature only (approximately −15 °C), when a significantly smaller microscopic layer of water is formed on the ski base [38].

**Fluorocarbon paraffin waxes** contain fluorine in the carbon chain. They have a higher hydrophobicity than hydrocarbon waxes and their friction coefficients decrease, making them suitable as the basic layer of waxing for cross-country skiing. Once properly applied, these waxes work for about 30 km [38]. The difference between hydrocarbon and fluorocarbon paraffin waxes is shown in Figure 1.



**Figure 1.** The difference between hydrocarbon (a) and fluorocarbon paraffin (b) waxes. Source: redrawn based on [39].

The first fluorine-containing waxes were marketed in 1986 by Hertel Wax [27]. After that, the Norwegian company Swix improved this technology and produced a wide range of waxes with varying fluorine content as well as the first powders increasing the repellency of spring snow impurities (needles, dust, pollen, etc.). Today, molybdenum (an environment-friendly element) was added to improve the repellent effect on snow impurities [38].

Nowadays, paraffin waxes are categorised according to the type of snow, snow temperature, and air humidity, but from the chemical features, they are divided into hydrocarbon paraffin waxes; low (2–3% F) or high (5–7% F) fluorocarbon paraffin waxes, powders and accelerators. Physically, the waxes are sold as solid blocks or in a liquid form (liquid glide wax) (i.e., paraffin waxes in solvents).

**Powders and accelerators** contain perfluorocarbons (PFCs), where all of the hydrogen atoms are replaced by fluorine. They show the highest repellency of water and fats (snow impurities) [40] and are, therefore, used in industry in the production of protective coatings, varnishes, water-repellent materials, and Teflon [41]. They are the most expensive wax (about EUR 100–200 for 30 g). The powder

(approximately 5 g per ski) is ironed into the base at high temperatures, and a mere 20% of the amount remains in the base after brushing. The rest is waste, which cannot be reused due to the thermal decomposition damage made to the chemical structure of the PFCs.

### 2.5. The Health Risk Posed by PFOA

Perfluorooctanoic acid (PFOA), which is the most frequently used perfluorinated compound in the production of accelerators and waxes, is ranked among the potential carcinogens in group 2B by the International Agency for Research on Cancer (IARC) [42,43]. In as early as 2013, PFOA appeared on the candidate list of the Substances of Very High Concern (SVHC), given its possible inclusion in the Annex to Regulation XIV [19]. For the formation of dangerous compounds, the temperature must exceed 250 °C; therefore, wax manufacturers recommend ironing at around 180 °C [44], while the maximum temperature of the waxing irons currently produced does not exceed 210 °C [45]. Paraffin waxes can also contain perfluorooctanesulfonic acid (PFOS), which has similar properties.

The environmental concern of PFOA and other perfluorinated compounds arose from the fact that they are non-natural substances with no natural degradation mechanisms in the environment. Moreover, they have a significant bioaccumulative potential and long half-life in the human body. The bioconcentration factors (BCF) of PFOS and PFOA in fish were determined in the range of 10,000 or above, and 200 and below [46] and the half-lives of 8.67 and 1–3.5 years, respectively [47]. They can enter the human body by inhalation, ingestion or dermal contact. Especially people who consume contaminated tap water, as well as animals, may be subjected to a health risk [46]. The inhalation of air contaminated with other volatile PFCs that are degraded to become PFOS and PFOA is also an important intake pathway.

Tests have shown that service personnel who work with paraffin for more than eight hours a day have high levels of fluorine compounds in their blood. A Norwegian study monitoring 45 service workers during a cross-country race in Norway found the average concentration of PFCs in the air they inhaled was from 3.1 to 6.2 mg.m<sup>-3</sup>, which exceeds the Norwegian limit (2 mg.m<sup>-3</sup>). These compounds can cause respiratory problems and other serious diseases [48]. Another Norwegian–Swedish study showed that PFCs in the blood of service workers was up to 45 times higher than the general population [7].

Therefore, PFCs and their salts have been blacklisted by the Parties to the Stockholm Convention, the REACH standard, and the European Union [3,8,19]. The EU Commission Regulation No 2017/1000 of 13 June 2017 prohibits the production and marketing of PFOA and its salts, beginning 4 July 2020. The concentration limit was set to 25 ppb for PFOA and its salts, and 1000 ppb for PFOA-related substances in other substances or mixtures [49]. Similarly, for PFOS, the EU Directive [19] sets the limit for consumer products to 0.005% by weight, but its production is still permitted in the production of fire extinguishing mixtures and the photographic industry [50].

### 2.6. Negative Effects of Perfluorinated Compounds in Ski Areas

PFOA and PFOS are also among the most monitored pollutants at world-famous ski resorts. Research conducted by the Norwegian Environmental Agency (NILU) has shown that the soil, groundwater and organisms at Holmenkollen (Oslo) are contaminated by PFOA. Earthworms indicated eight times higher PFOA concentrations than other areas [51]. Increased concentrations of PFOA have also been reported in pine needles [52]). With the increase in winter tourism related to ski resorts, operators are becoming increasingly concerned about environmental issues [53]. Swedish Mora, where the Vasaloppet long-distance run with up to 16,000 participants takes place every year, and the Norwegian Birkenbeiner race, have shown similar results. The organisers make great efforts to inform the public about the fluorine pollution of the landscape and encourage them to use fluorine-free waxes that can easily decompose in the environment.

### 3. Methodology

#### *The Corporate Social Responsibility of Companies Producing Paraffin Waxes*

There are about twenty companies worldwide operating in the production of ski waxes. Within these companies, quantitative research was conducted to map their CSR awareness. The research focused on obtaining information on their involvement in CSR, the pillars of CSR (environmental, social and economic) and their mutual relations, differences in approaches to CSR between different sized companies and the specifics of the ski wax industry compared to the chemical industry in general.

To obtain more profound information on CSR in the wax industry sector, three hypotheses were set and answered based on the questionnaire survey. The hypotheses are as follows:

**Hypothesis 1:** *The size of the company plays a significant role in its involvement in CSR activities.*

The hypothesis comes from the general opinion that CSR is useful mostly in cases of large budgets and, therefore, it is dedicated to large enterprises [54].

**Hypothesis 2:** *Since the ski wax industry produces chemicals to be applied in nature, environmental issues are important for these companies.*

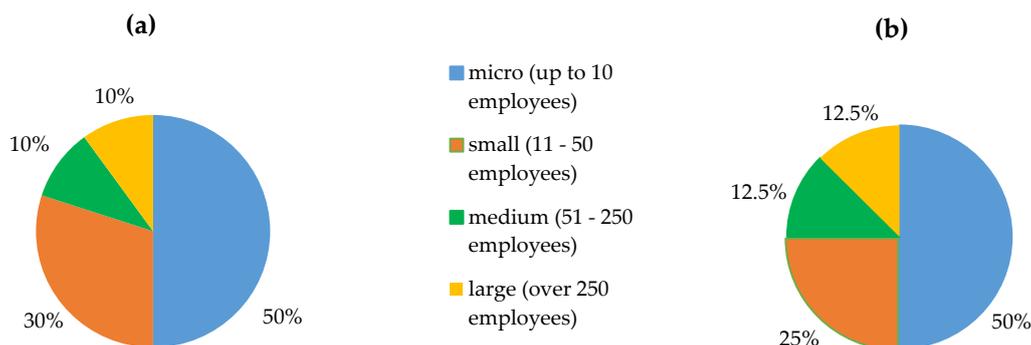
Do the companies feel a responsibility that they produce and apply chemicals potentially or actually dangerous for the environment?

**Hypothesis 3:** *Companies that have not defined or documented their CSR policy/strategy are not involved in all three pillars of CSR (economic, environmental and social).*

Based on the presumption that micro companies and SMEs do not document their CSR policy, we presume that they are not involved in all three pillars of CSR, but an informal and intuitive approach meets some of the goals of CSR.

For data collection, the CAWI (Computer Assisted Web Interviewing) method was employed. The questionnaire survey was conducted from January 2019 to March 2019. The questionnaire was spread using the online Survio form [55], and the data were collected anonymously. There were 25 questions altogether, where the answer to ten of the questions was simply YES or NO, eleven answers were scaled into five categories (where 1 = YES, 2 = mostly YES, 3 = maybe, 4 = mostly NO, 5 = NO) and the last four answers were in the form of comments or numbers. The questionnaire was mainly directed to persons in senior management positions and representatives of the marketing and sales departments. Twenty global leading manufacturers/dealers of ski waxes from all “skiing” continents were contacted: Europe (Norway x1, Germany x1, Sweden x2, Italy x4, Finland x3, Spain x1 and the Czech Republic x4), the USA x3 and Japan x1. The companies varied in size from micro to large. In alphabetical order, the following companies participated: Dominator Wax, Druchema, Gallium Wax, Green Ice Wax, HOLMENKOL, HWK Ski Wax, MAPLUS CZ, Nanox Ski Wax, NZero ECO Ski Wax, OPTIWAX, Red Creek, Rex Ski Wax, RODE Wax, SKIGo, SkiTrab, Startex Oy, Star Ski Wax, Swix, TOKO and Vauhti Wax Technologies. The rate of return of the questionnaire was 40%. The size distribution of the respondents corresponds to the size distribution of those contacted, so the companies from all categories have a similar knowledge of and involvement in CSR, as shown in Figure 2.

Five questions concerned the company’s general awareness and perception of CSR and the significance of international standards. The main part of the questionnaire covered questions about the relationship of the company with CSR, where all three pillars of the CSR were surveyed specifically, including questions focusing on strategy, social pillars, communication, international standards, environmental issues, and the company’s activities related to CSR. The environmental and economic pillars were covered by five questions each and the social pillar by nine. Further questions dealt with company turnover and an estimation of the funds invested in CSR annually.



**Figure 2.** Distribution of the (a) demanded companies and (b) respondents by size. Source: own elaboration.

For the statistical interpretation of the results, two methods were applied:

### Cramer's V coefficient

To determine the answer to Hypothesis 1 (The size of the company plays a significant role in its involvement in CSR activities), the interrelations between the answers of ten questions, scaled to five categories (1–5), and company size (micro, small, medium, large) were evaluated. The degree of association between these two variables was calculated by Cramer's V coefficient [56]:

$$V = \sqrt{\frac{\chi^2}{N(k-1)}} \quad (1)$$

where  $\chi^2$  is Pearson's chi-squared test,  $N$  is the number of observations and  $k$  is the minimum from the number of rows and the number of columns. In our case, the number of rows was equal to 4 (micro, small, medium, large company) and the number of columns was also equal to 4 (YES, mostly YES, maybe, mostly NO), because the answer NO was not given. The number of observations was 80 (10 answers by eight companies).

### Correlation

To determine dependencies between the answers to two single questions ( $X$  and  $Y$ ), Pearson's correlation coefficient  $corr(X, Y)$  was calculated.

$$corr(X, Y) = \frac{cov(X, Y)}{\sigma_X \sigma_Y} \quad (2)$$

where  $cov(X, Y)$  is the covariance and  $\sigma_X$  and  $\sigma_Y$  are standard deviations of the single distributions.

## 4. Results and Discussion

### 4.1. General Awareness of CSR

Before analysing the relationship of the companies with CSR, the general attitudes of the companies were evaluated. The results indicate that only those companies that were aware of CSR (a positive answer to the appropriate question in the survey) responded to the survey. On the other hand, companies aware of CSR may have ignored the questionnaire for other reasons, so the conclusion is that a minimum of 40% of the companies surveyed were aware of CSR.

Another interesting conclusion from the survey is that, although the attitudes of the companies towards certification, as per ISO 26000 (Social Responsibility), was rather negative (87.5%), and the companies had not developed or documented any CSR policy/strategy, including goals or commitments, they found CSR activities and instruments to be beneficial and very important. Although only 12.5% of

the respondents monitored the performance and the efficiency of CSR activities, all of the respondents agreed with the specifications of competences, workshops and maintaining the awareness of the relevance of CSR for all employees. All of the companies also saw the importance of establishing powers and responsibilities in the area of communication (both internal and external). The conclusion from this part of the survey is that the absence of a transparent and measurable CSR strategy is unlikely to affect the success of companies on the market.

The answers to the importance of individual factors of social responsibility are summarised in Table 1. It is not surprising that the most important factor perceived in the context of CSR was environmental protection. Although only 12.5% of the respondents had a certified environmental management system (according to ISO 14001), all of the respondents took into account the predictable impacts of their activities on the environment in their further development and communicated with interested stakeholders on these environmental issues. Moreover, half of them were actively involved in environmental protection programs.

**Table 1.** Percentage of answers to the importance of individual factors for a company to be socially responsible. Source: own elaboration.

3 Pillars (According to Assumptions)	Importance of Individual Factors of CSR	YES	Mostly YES	Maybe	Mostly NO	NO
Environmental pillar	Environmental protection (gentler production, waste sorting, etc.)	100%	0%	0%	0%	0%
Social pillar	Customer service (loyalty programs, after-sales service, website accessibility, barrier-free shops, etc.)	50%	37.5%	12.5%	0%	0%
	Quality of products and services at an appropriate price	12.5%	37.5%	50%	0%	0%
	Clear and accurate product or service information	0%	62.5%	37.5%	0%	0%
	Code of Advertising compliance (true, decent and honest advertising)	50%	37.5%	12.5%	0%	0%
	Cooperation with non-profit organizations in marketing activities	37.5%	50%	12.5%	0%	0%
	Employee development, sophisticated evaluation and remuneration system, work-life balance, etc.	50%	37.5%	12.5%	0%	0%
Economic pillar	Solvency towards suppliers, state and employees	0%	75%	25%	0%	0%
	Corporate foundations or endowment funds	12.5%	50%	37.5%	0%	0%
	Donorship (financial and non-financial donations to interest groups)	0%	62.5%	25%	12.5%	0%

The second group of important factors was the sale of products (Customer service, Code of advertising compliance), where companies felt it was important to advertise their products truly and honestly, and maintain contact with their customers (after-sale service, website, etc.), respectively. The factor of honest advertising may have come from negative experiences with competitors' unfair advertisements. On the other hand, the factor "clear and accurate product or service information" was not significant.

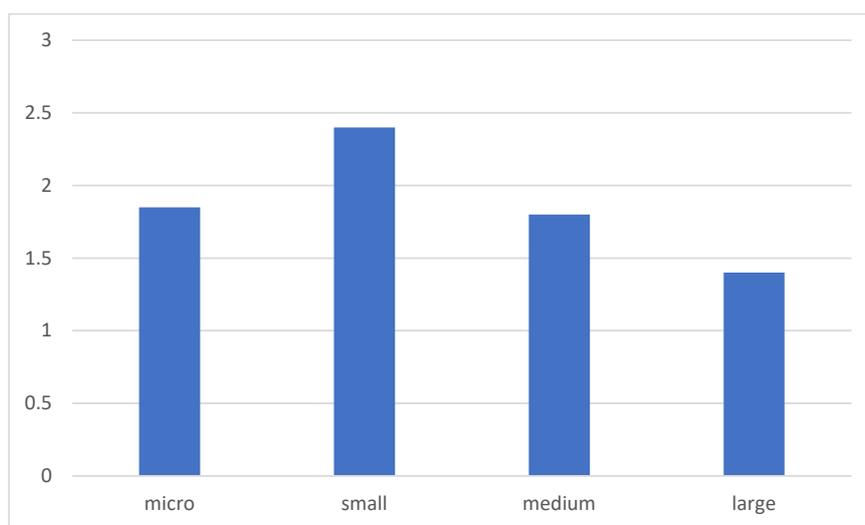
The third important factor was "employee development and sophisticated evaluation and remuneration system", where a substantial role may be played by the fact that managers were surveyed. The least important factor for the surveyed companies was "Donorship" (financial and non-financial donations), where the fact that the companies are rather small and generate limited profits can play a significant role.

#### 4.2. Testing of the Hypotheses

**Hypothesis 1:** *The size of the company plays a significant role in its involvement in CSR activities.*

As mentioned above, although all of the companies knew what CSR means and took competencies, training and awareness of CSR seriously, all but one had no defined or documented CSR policy/strategy and did not monitor the performance and effectiveness of CSR activities. Therefore, Hypothesis 1 should be tested based on the answers to ten questions about the importance of individual factors

for a company in terms of social responsibility, as shown in Table 1. The elaborated contingency table interrelated the company's size (micro, small, medium, large) and the statistics of the answers, and Cramer's V coefficient evaluated the degree of association. From the contingency table, the average mark of the answer as a function of the company's size was plotted, as shown in Figure 3. We may conclude that smaller companies feel less sensitive towards CSR factors since, for the "small" companies, the average answers were between "mostly YES" and "maybe", and for the medium and large companies the answers were "YES" and "mostly YES". However, this relation is weak because the calculated Cramer's V was 0.25, which suggests a negligible association between company size and the distribution of the answers. Therefore, Hypothesis 1 was rejected on the basis that the companies feel CSR similarly, independently of their size.



**Figure 3.** Distribution of the responses to ten individual factors related to the company's size. Source: own elaboration.

**Hypothesis 2:** *Since the ski wax industry produces chemicals to be applied in nature, the environmental issues are important for these companies.*

A previous survey involving large Swiss and German chemical companies found that chemical producers are professionals in reporting social and environmental information that corresponds to the risks that their industry faces [57].

For all of the companies, environmental protection was a significant factor (all answered YES to the question "How important is environmental protection (gentler production, waste sorting, etc.)") and took into account any predictable environmental impacts (all also answered "YES" to the question "Do you take into account any predictable environmental impacts when developing your organisation's activities further?"). With the exception of large companies, none had implemented/certified an environmental management system. This result was expectable because usually micro and small companies have neither the personnel nor financial resources for such activity, and CSR is dedicated mainly to large corporations [54]. On the other hand, all of them communicated with stakeholders about environmental issues. Therefore, Hypothesis 2 was accepted, as environmental issues were important for all, but mostly without certified systems (such as ISO 14001).

**Hypothesis 3:** *Companies that have not defined or documented their CSR policy/strategy are not involved in all three pillars of CSR (economic, environmental and social).*



In the case of companies involved in environmental programs, there was a strong correlation between answers to the questions concerning: clear and accurate product or service information, code of advertising compliance (true, decent, and honest advertising), cooperation with non-profit organisations in marketing, donorship, employee development, sophisticated evaluation and remuneration system, work-life balance, etc., and solvency towards suppliers, state, employees. Therefore, these companies felt a strong attitude towards all social sector members, tangibly towards clients, employees, suppliers and also the wider community. They felt a strong social and economic responsibility.

On the other hand, the companies that were not involved in environmental programs felt an importance in the quality of their products and related customer services. A correlation was found between answers to the questions concerning: customer service (loyalty programs, after-sales service, web site accessibility, barrier-free shops, etc.), quality of products and services at an appropriate price and clear and accurate product or service information. They also felt an importance in corporate foundations or endowment funds (financial support for charitable activities). Hence, these companies had a strong attitude towards their customers, and they were more economically oriented. Therefore, the response to Hypothesis 3 was ambiguous. The companies that were involved in an environmental program were involved in the other two CSR pillars as well, and those that were not involved were mostly product-oriented only. In general, Hypothesis 3 was rejected.

#### 4.3. Conclusion Related to CSR

The results of the analysis show that the number of employees or the company size category had no significant influence on the answers. Micro and small producers were involved in raising awareness of environmental policies and responsibilities to the same extent (maybe even more) as medium or large companies (Hypothesis 1 was rejected). The reason may be the fact that the respondent companies operated in the chemical industry, where awareness of the potential risks posed to the environment is very high [58]. Lock and Seele [57] made a comparison of different sectors and found that, in the chemical industry, environmental issues slightly outweigh (58%) social ones, which is different from the banking and insurance sector, where social impact is more topical (55%).

The wax production sector is rather small and, therefore, perhaps the social responsibility of the surveyed companies was low and did not meet the requirements of any of the three pillars (economic, environmental or social) on which CSR is based. In particular, in the social pillar, working conditions were certainly not at the level set in ordinary chemical companies. In the economic field, companies settle for making a profit and do not engage in development or voluntary investment. Moreover, the business they conduct leads to social and environmental risks, which may cause certain restrictions in these areas. According to Plinke [59], these companies are not sustainable in the long term, because a sustainable company is one that reduces social and environmental risks. On the other hand, they were aware of their production of chemicals dangerous for the environment, and environmental issues were important for all of the responders, despite most being without certified systems (Hypothesis 2 was accepted).

We also found varying behaviour between companies involved in environmental programs and those that were not. Companies involved felt a strong attitude towards all three pillars of CSR—environmental as well as social and economic. Those companies not involved had a strong attitude towards their customers, but not towards their employees, suppliers or the wider community. They also had stronger feelings about the quality of their products and economic profit, but without a strong approach to the related environmental issues. This may be risky to them because, despite their awareness of the dangers of the substances used, there is a great deal of concern that a European Union regulation will be established, instead of allowing companies to enact internal efforts to replace the dangerous substances. As the first of the restrictions on the use of some of these substances, a European Commission Regulation [49] will come into force in 2020, and it is expected that these companies will not be prepared for the changes. For all of the companies, due to their long-term neglect

of development, they will not have sufficient funding to develop substitutes for these substances, and they may be pushed out of the market by prepared companies with funds for the necessary activities.

We should keep in mind that, despite the high selling price, the production of accelerators (the most endangered substances) does not provide sufficient funding, since the market for this type of product attracts only a small segment of consumers. However, there are companies on the market that have chosen a different strategy because they can afford it. These include medium-sized and large enterprises that make a profit by selling mainly the basic types of waxes for the largest segment of customers (i.e., the general public). Therefore, in this segment, they can afford higher prices than production costs and thus invest money in both development and socially responsible behaviour (i.e., invest in safe work conditions and protect society, the landscape, and the environment). For example, the Norwegian company Swix is one of the large companies with sophisticated research, development and marketing that complies with the concepts of socially responsible business.

#### 4.4. The Norwegian Approach

Norway is one of the leading countries that places emphasis on issues of ecologically sustainable development [60]. This attitude makes Norway one of the initiators of corporate social responsibility, emphasising the issue of ecology. Since 2007, CSR has been regulated in the White Paper [61], but even 15 years ago, without the necessary legislation, Norwegian SMEs were at the forefront of CSR rankings in Europe, with around 95% of the companies interested in this topic as a result of a natural tendency to protect the environment and human rights throughout Norway [62,63].

In ski waxing, Norway is also the world leader in promoting the protection of the health of people working with paraffin waxes. The “Tøffest uten fluor” (Toughest without fluorine) movement was established in Norway, which aims to significantly reduce perfluorinated compounds, especially among the young generation of skiers and their ambitious coaches and parents [64]. This campaign started in January 2017 as a result of an unfortunate event when a Norwegian trainer and service worker died of cancer due to a high concentration of fluorine in his body. The voluntary campaign, supported by 300 Norwegian ski clubs, is based on the idea of fluorine-free races. Thanks to the immediate response to the situation, beginning from the winter season 2018/2019, a rule prohibiting the use of fluorine paraffin waxes by youths under 16 years was introduced in Norwegian clubs. Independent of the Norwegian concept, Alaskan ski clubs have also sought a similar solution to the situation, and they have also imposed a ban on the use of fluorine paraffin waxes in cross-country skiing, except for NCAA (National Collegiate Athletic Association) races [65].

#### 4.5. Alternative Resources and Solutions

Activist groups around the world enforce the use of fluorine-free hydrocarbon waxes that do not adversely affect the environment and human health. Some companies (e.g., Dominator, Green Ice Ski Wax and Purl Wax) are thinking in a socially responsible way. They are engaged in the production of fluorine-free hydrocarbon waxes and, therefore, investing in the research and development of alternative chemical compounds that maintain good ski properties while being environmentally friendly.

The current leader in the production of ski wax is the Norwegian company Swix, which controls nearly 75% of the worldwide market share for wax and waxing tools [66]. Because Swix is strongly committed to CSR, it has developed a Code of Conduct in which it presents its social responsibility to the environment, suppliers and business partners [67]. Swix has offered products labelled “Fluorine Free” in all categories of waxes and accelerators since the 2017/2018 season. An example is Future Cera Wax, based on PFC with a shorter C-6 carbon chain instead of C-8 [68]. Secondly, the company declares that 90% of its paraffin waste remains where it was handled. Swix was involved in introducing an environmental tax and responsible waste collection at the appropriate location, so the waste is disposed of properly. Since 2014, Swix has been working with the research organisation SINTEF on the “LowFriMat” project to find suitable lubrication alternatives to dangerous PFOA compounds. Moreover, there is a great potential in the use of new materials, such as hybrid materials and plasma,

as well as in the development of nanomaterials for ski bases and waxes, which seems to be promising for skiing in harmony with the environment [69].

## 5. Conclusions

The paper offers insight into a specific segment of the chemical industry in respect to socially responsible behaviour. It is necessary for companies to make efforts to avoid negative impacts by enacting regulations and restrictions that should encourage them to produce harmless products using environmentally friendly technologies or alternative sources. Furthermore, it is necessary for companies to be actively interested in socially responsible behaviour in all areas—environmental, social and economic.

Fluorine compounds used for the production of waxes have a negative impact on the environment and human health. The most vulnerable are service workers in racing ski teams, who are in daily contact with PFCs. Due to high concentrations of PFCs in their blood, they are exposed to health risks, including cancer. During 2020, based on an EU regulation, PFOA-based substances will be banned in the context of industrial manufacturing [49]. The companies producing waxes will also have to respect this regulation, which will be a difficult task for many of them. So far, there are no other alternatives in terms of environmentally friendly compounds that can maintain the desired properties of extreme ski slip.

Based on the answers to the questionnaire, we have concluded that, although the attitudes of companies towards CSR certification are rather negative (87.5%) and companies have not developed or documented any CSR policy/strategy with specific goals, they find CSR activities/instruments beneficial and important. It is not surprising that the most important factor perceived in the context of CSR was environmental protection. All of the respondents took into account the predictable impacts of their activities on the environment in their further development and communicated with the appropriate stakeholders. The second group of important factors was the sale of products, mainly honest advertisements and contact with their customers. The third important factor was employee conditions, where a substantial role may have been played by the fact that only managers were surveyed.

Hypothesis 1 (The size of the company plays a significant role in its involvement in CSR activities) was rejected based on the contingency table and the calculated Cramer's V coefficient. Company size played no significant role in CSR activities and attitude. Micro and small producers were involved in raising awareness of environmental policies and responsibilities to the same extent (maybe even more) as medium or large companies.

Hypothesis 2 (Since the ski wax industry produces chemicals to be applied in nature, environmental issues are important for these companies) was accepted, as environmental issues were important for all, but mostly for those without an implemented/certified environmental management system (such as ISO 14001).

Hypothesis 3 (Companies that have not defined or documented their CSR policy/strategy, are not involved in all three pillars of CSR) was also rejected, but two types of behaviour were found. The companies that were involved in environmental programs felt a strong attitude towards all of the pillars of CSR, and those that were not had a strong attitude towards their customers, but not towards their employees, suppliers or the wider community. Since the ski wax industry is a part of the chemical industry, such an attitude should be investigated in the other parts of the chemical sector in the future.

In terms of ski waxing, Norway is the world leader in promoting the protection of the health of people working with paraffin waxes. The "toughest without fluorine" movement is an example of such environmentally-related activity. Swix, a leading wax producer, is strongly committed to CSR. It has developed a Code of Conduct in which it presents its social responsibility towards the environment, suppliers and business partners. Swix has been engaged in continuous research, introduced fluorine-free waxes and sees future solutions in nanotechnology, hybrid materials, and plasma surface treatments. However, the question remains whether the research will be finished in

time. It is important that organisations and companies want to reduce the use of fluorinated substances and encourage society to ski in harmony with the environment.

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