UNIVERSIDAD DEL ROSARIO

How Companies in the Aerospace Industry are Creating Value concerning the UN Sustainable Development Goals? The case of Airbus.

Trabajo de Grado

Mario Esteban Hernández Guzmán

Rennes, Francia

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Mario Esteban Hernández Guzmán

Yann Duzert

Administración de Negocios Internacionales

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Resumen

El compromiso por una sociedad más sostenible para las próximas generaciones es tarea de todos, por lo que entidades gubernamentales y grandes actores privados han unido sus fuerzas para que la industria aeroespacial, una de las mayores productoras de emisiones de gases, se convierta en una industria más limpia y verde para el año 2050. Los participantes se dividieron en cinco grandes grupos formados por proveedores, fabricantes, clientes, consumidores y un panel de expertos para analizar los motivos, intereses y acciones que cada uno está llevando a cabo en esta larga cadena de producción, con énfasis en el caso de Airbus, el gran fabricante europeo. Acciones que van desde la instalación de paneles solares en sus instalaciones para promover el uso de energías alternativas hasta la creación de combustibles para aviones a partir de fuentes distintas de los combustibles fósiles, son sólo una muestra de lo que está logrando esta industria. Sin embargo, estas acciones deben medirse para verificar su eficacia, por lo que los indicadores clave de rendimiento proporcionados por los participantes se utilizan como prueba de su progreso. Para validar que su comportamiento hacia una industria más sostenible es efectivamente percibido por sus grupos de interés, que hoy en día exigen una mayor responsabilidad social y medioambiental a las empresas. Debido a un mundo globalizado y en constante cambio, si un grupo de interés no es capaz de percibir la propuesta de valor que ofrece una empresa, elegirá otra que sí satisfaga esa necesidad. El estudio valida que las acciones emprendidas por las partes interesadas siguen creando valor dentro de esta industria a través del aumento del número de pasajeros para las aerolíneas y de los pedidos para los fabricantes. Pero como los Objetivos de Desarrollo Sostenible también se centran en el impacto social global que tienen las empresas en la sociedad, este estudio nos permite ver cómo lo están haciendo en cuestiones de igualdad y equidad.

Palabras clave: Objetivos de Desarrollo Sostenible, transformación, responsabilidad, alternativa, indicadores clave de rendimiento, relación, propuesta de valor, inversión, productividad, medio ambiente.

Abstract

The commitment to a more sustainable society for the next generations is everyone's task, which is why governmental entities and large private actors have joined forces so that the aerospace industry, one of the largest producers of emissions, can become a cleaner and greener industry by 2050. The participants were divided into five main groups consisting of suppliers, manufacturers, customers, consumers, and a panel of experts to analyze the motives, interests, and actions that each is taking in this long production chain, with emphasis on the case of Airbus, the large European manufacturer. Actions ranging from the installation of solar panels on its facilities to promote the use of alternative energies to the creation of jet fuels from sources other than fossil fuels are just a sample of what this industry is achieving. However, these actions must be measured to verify their effectiveness, which is why Key Performance Indicators provided by the participants are used as evidence of their progress. To validate that their behavior towards a more sustainable industry is indeed perceived by their stakeholders, who today demand greater social and environmental responsibility from companies. Due to a globalized and constantly changing world, if a stakeholder is unable to perceive the value proposition offered by a company, it will choose another that does satisfy that need. The study validates that the actions taken by stakeholders continue to create value within this industry through increased passenger numbers for airlines and order numbers for manufacturers. But as the SDGs also focus on the overall social impact that companies have on society, this study allows us to see how they are doing on issues of equality and equity.

Keywords: Sustainable Development Goals, transformation, responsibility, alternative, Key Performance Indicators, relationship, value proposition, investment, productivity, environment.

1. Introduction and Research Question

The Sustainable Development Goals (hereinafter, SDGs) were born in 2015, during a summit of the United Nations where they sought to address the prosperity of the planet for the year 2030. The agreement consists of 17 different goals that were adopted by the member countries of this organization, all seeking to improve living conditions for the future in the long term (United Nations, 2022). However, governments realized they could not implement their actions alone without the cooperation of private entities, since they are an important pillar of a state's economy. For this reason, and to highlight the actions undertaken by companies in the aerospace sector, this research will focus only on the impact they represent in the fight against climate change and its effects, and on the promotion of an inclusive and sustainable industry.

The SDGs have gained importance as the relevance they represent to stakeholders has grown. Keeping your suppliers, employees, consumers, and other stakeholders in a company happy is a complicated task that requires a lot of effort and dedication. However, organizations must identify the relevance that represents the creation of value against the product or service offered in the market. Due to a globalized and constantly changing world, if a stakeholder is unable to see the value offer it receives for a product, it will choose to look for one that satisfies a certain need.

Now, taking into consideration that the scope of the aerospace industry is quite broad, ranging from private and commercial aviation to cargo and freight, to military and defense presence, this sector has been a thriving growth sector, sporadically affected by international events such as economic crises, however, it has never stopped to such an extent as it did in March 2020. When the current health crisis broke out with Covid-19, the number of flights in the

air was drastically reduced due to the border closures and the fear of catching the virus on an airplane.

Still, not everything was negative, according to (NASA, 2021) 2020 had a drop in carbon dioxide emissions of 5.4% compared to 2019, showing how closely climate warming and air pollution are linked. Although this was caused to a greater extent by other industries such as livestock or oil, the aerospace sector also contributes to its pollution. But, thanks to (Alonso, 2019) it can be observed that in 2018 there were on average more than 120,000 flights moving more than twelve million daily in the world and contributing 2.7 trillion to the world economy, reflecting the magnitude and importance that this industry represents.

Hence, we are seeing how the world is moving towards something greener and more efficient, which is why understanding the importance of value creation at the enterprise level represents one of the fundamental pillars for any company in the industry. Starting from the point at which it can ensure the survival of the organization in the long term, due to the establishment of lasting relationships with current customers and potential consumers, and additionally, establishing the standards of differentiation that represent a company concerning its brand and its product against its competition. These are concepts that can make an organization a total success in its industry.

Consequently, the purpose of this study is to demonstrate how companies have adapted their supply and sales policies to continue to be chosen by their customers. To identify if the perceived value has changed over time and to analyze if the impact these actors have had is indeed positive and therefore perceived by the final consumer. Focusing on the larger factors to the smaller details allows showing how the industry has been performing and to identify a possible trend where it will be heading in the coming years in line with the SDGs.

Therefore, to take all the above mentioned to a real-life scenario, it was decided to choose the aeronautical industry at the manufacturing level because it is one of the most important contributors to environmental pollution. Because the industry is too broad, Airbus was chosen as a source of information due to the great contributions that have been proposed for the future under the Sustainable Development Goals. However, the aim is to compare not only the actions taken by this company but also those of other companies.

2. Literature Review

The Concept of Sustainability and Its Relevance

As global perceptions change, sustainability is turning into a must for businesses. It is more important than ever for businesses to adopt sustainable business strategies to close the knowledge-action gap. To meet the requirements of the present without jeopardizing those of future generations, something is said to be sustainable (Rafi, 2022). A study found that just 100 companies are responsible for 71% of global emissions, herein lies the importance of a sustainable business. An environmentally aware business considers more than just profits, it considers its impact on society and the environment. A business is sustainable because it contributes to the health of the structure within which it operates, thereby helping construct an environment in which the business can thrive (Maryville University, 2021).

According to (Breuer et al., 2018) four guiding principles provide the means to increase the possibility of designing a sustainable business model, but without predefining a distinct outcome. Principle 1: *sustainability orientation*, which is a key requirement for its development. Principle 2: *extended value creation*, for the market and non-market actors in monetary and non-monetary terms. Principle 3: *systemic thinking,* since business models are systems of interdependent activities, a task is directly required of managers. Principle 4: *stakeholder integration*, due to the important role they represent in an organization's sustainability orientation and its pursuit of social and ecological goals.

An issue lies in the fact that the concept of sustainability has taken on greater importance since the beginning of the 21st century, and for those companies that were previously established

it was a matter of creating a series of policies that would help reduce the impact of their activities on the environment. However, today the situation has changed for the two main players, large companies, and small and medium-sized enterprises, as it has become an obligation due to policies imposed by governments or due to increased customer demands for a sustainable business model.

The problem is that “green” or “sustainable” business practices can sometimes entail profit sacrifices, particularly in the short term. A conflict thus arises with the commonly held view that corporate directors and officers must strive to maximize shareholder wealth and affirmatively neglect other corporate constituencies like labor, creditors, suppliers, customers, the public, and the environment. This perceived duty to maximize shareholder profits lies at the heart of the conventional law-and-economics-laced view of corporate governance, thus imposing a formidable obstacle to corporations wishing to become more sustainable (Sneirson, 2009).

McKinsey and Company did a study where the results show that almost half of those interviewed mentioned business and growth opportunities as a reason to get started on sustainability. Sustainability also offers an interesting way to scope out product innovations that use fewer resources or that meet specific social needs. Redesigning products and services around sustainability can drastically increase profits or reduce costs. But it also found that paradoxically, taking such actions may be easier to do in companies that have been slow to embrace sustainability. There are almost certainly “quick wins” ripe for the picking that can bring tangible results and create momentum to do more (Bonini & Swartz, 2014).

In 2010, when the Boston Consulting Group joined forces with the World Economic Forum their researchers uncovered many visionary enterprises that defied previously mentioned stereotypes. The results showed they have achieved it by following one or more of three general

approaches: (1) taking a long view and investing in initially more-expensive sustainable operating methods that eventually lead to dramatically lower costs and higher yields; (2) bootstrapping-making small adjustments that generate big savings, which then fund purchases of advanced technologies; and (3) extending their sustainability efforts to the operations of their customers and suppliers (and in the process, devising new business models) (Haanaes et al., 2014).

Current Panorama in the Aerospace Industry

Some leaders in the aerospace industry, like Airbus, ATR, Boeing, Bombardier, Embraer, Honeywell Aerospace, GE Aviation, Pratt & Whitney, and Rolls-Royce, to name a few, signed a United Nations Declaration in 2008 committing themselves to act on climate change and sustainable aviation. Their long-term commitment is to demonstrate environmental leadership by delivering a 50% reduction in net carbon emissions by 2050 compared to 2005 levels (United Nations, 2021). The industry has decided to innovate its manufacturing and maintenance processes to meet this goal, something that may sound very ambitious and yet very realistic because since then, companies have proposed different alternatives on how this industry can accomplish this Declaration.

According to (Schmidt et al., 2021) aircraft manufacturers estimate that more than 40% of the global fleet will reach the end of life in the next two decades. Therefore, dismantling products to maximize reuse and recycling is vital to ensuring sustainable end-of-life aircraft management. However, these have not been the only actions taken by some, both aircraft manufacturers and airlines have opted to produce and choose, *respectively*, more modern aircraft that are efficient and faster and at the same time reduce fuel burn consumption and produce less

noise. Although they are all competitors, they are all striving for the same goal: to offer a cost-effective and sustainable solution.

Making air travel more sustainable is not simple. It takes a lot of energy to lift people and cargo into the air and carry them long distances. Airlines are trying to reduce their emissions in several ways. Probably the most common is switching from traditional fossil-derived jet fuels to ones that are made from renewable sources and have lower emissions during production. Airlines are also looking for new materials and coating technologies to make planes lighter, more aerodynamic, and more resistant to wear and tear. Meanwhile, a few airlines, such as United, think they can get to carbon neutrality while reintroducing supersonic flight (Boerner, 2021).

"*Achieving sustainable global connectivity cannot be accomplished on the backs of airlines alone*. *All parts of the aviation industry must work together within a supportive government policy framework to deliver the massive changes that are needed, including an energy transition*" said Willie Walsh, Director General of the International Air Transport Administrator (IATA, 2021). Although some governments, such as Joe Biden's in the United States, have taken action to achieve net-zero emissions by 2050, no strategy directly involves the aerospace industry, unlike others such as rail or motor vehicles. Without concrete support for aerospace, it is difficult for the actors here to achieve this intended plan.

Government Representation on the Subject

On the European side, we can find how CO2 emissions from aviation have been included in the EU emissions trading system since 2012. Under this European policy, all airlines operating in Europe, European and non-European alike, are required to monitor, report, and verify their emissions, and to surrender allowances against those emissions. For example, in the EU in 2017,

direct emissions from aviation accounted for 3.8% of total CO2 emissions. The aviation sector creates 13.9% of the emissions from transport, making it the second-biggest source of transport GHG emissions after road transport. If global aviation were a country, it would rank in the top 10 emitters (European Commission, 2021).

There is a variation of existing Government policy in the United Kingdom that supports the aerospace industry's quest to reduce its impact on the environment. Actions like Sustainable Aviation Fuels (hereinafter, SAF), airspace modernization, carbon offsetting, and the British emission trading schemes are some examples pursued by this country. There are also areas in which policy does not yet exist, or needs to go further, to accelerate progress in aviation and aerospace (ADS Group, 2021).

SAF stands for sustainable aviation fuel. It's produced from sustainable feedstocks and is very similar in its chemistry to traditional fossil jet fuel. Using SAF results in a reduction in carbon emissions compared to the traditional jet fuel it replaces over the lifecycle of the fuel. Some typical feedstocks used are cooking oil and solid waste from homes and businesses. SAF gives an impressive reduction of up to 80% in carbon emissions over the lifecycle of the fuel compared to the traditional jet fuel it replaces, depending on the sustainable feedstock used, production method, and the supply chain to the airport (Moyes, 2021).

Suzanne Benoit, president of Aero Montreal said that: if the aerospace sector is to deliver on the high expectations of carbon-neutral flight, electric aircraft (manned and unmanned), digitized workplaces and processes, autonomy, and advanced manufacturing, it must be recognized as a strategic asset. "*We need a long-term strategy for aerospace. If we don't have one, it will be piece by piece to go to a jurisdiction where there is a commitment from the government to support innovation*." (Thatcher, 2021).

Back in November 2021, the United States released the U.S. Aviation Climate Action Plan that sets out to achieve net-zero greenhouse gas emissions from the U.S. aviation sector by 2050. Because transportation produces the most emissions, the United States, the Department of Transportation, and the Federal Aviation Administration need to be a large part of the solution. This ambitious, but achievable action plan, will create a sustainable aviation system that the United States is committed to. The U.S. also will work with international partners to maintain and strengthen the Carbon Offsetting and Reduction Scheme for International Aviation (Federal Aviation Administration, 2021). Although some governments have reiterated their support for the issue, only a few have taken action to combat the problem.

The Airlines' Point of View

Numerous airlines around the world have already taken measures to mitigate their environmental impact. They apply various techniques to improve fuel efficiency, reduce waste on board, cut duty-free sales to reduce weight, use more sustainable materials, serve more environmentally friendly meals, invest in sustainable aviation fuels, and offset emissions. The International Air Transport Administration has set sustainability targets for airlines, these goals put further pressure on airlines to implement more sustainable initiatives not only to remain competitive in the market but also to contribute to the overall sustainability of the industry (Honeywell Aerospace, 2022).

In October 2016, the 193 member states of the International Civil Aviation Organization (ICAO) made the historic decision to adopt a global market-based measure for aviation emissions. This scheme is the Carbon Offsetting and Reduction Scheme for International Aviation – more commonly known as CORSIA. Here, airlines and other aircraft operators will

offset any growth in CO2 emissions above 2020 levels. This means that aviation's net CO2 emissions will be stabilized, while other emissions reduction measures, such as technology, sustainable aviation fuel, operations, and infrastructure options, are pursued (Aviation: Benefits Beyond Borders Organization, 2021).

An investigation done by (McInnis, 2022) shows how United Arab Emirates-based Etihad Airways operated its most sustainable flight ever as part of its Etihad *Greenliner* sustainability program. The flight saw a 72% reduction in calculated emissions, thanks to several key initiatives the airline also plans to implement in future flights, including sustainable in-flight products, better coordination with airspace management for optimized flight routing, and utilizing Sustainable Aviation Fuel (SAF). While Hong Kong-based Cathay Pacific is another industry leader in terms of actionable sustainability efforts. The airline has committed to using SAF for at least 10% of its total fuel consumption by 2030.

In America, multiple airlines have announced programs to try to become more sustainable in the coming years. Delta Air Lines recently committed $1 billion to become carbon neutral by 2030. JetBlue pledged to get there by 2040, and United Airlines by 2050 Many other global airlines around the world have made similar promises like EasyJet and British Airways in Europe or VivaAerobus in Mexico. But the author insists that making air travel more sustainable is not simple. It takes a lot of energy to lift people and cargo into the air and carry them long distances (Boerner, 2021).

Actions Taken by Manufacturers

Sustainability at Airbus means uniting and safeguarding the world in a safe, ethical, socially, and environmentally responsible way. We have a comprehensive sustainability strategy built on four core commitments, which guide our approach to the way we do business and how we design our products and services. Decarbonization of the aerospace sector, a lifecycle approach to environmental impact, a sustainable supply chain, and cleaner technology are the areas currently working in the company (Airbus, 2021). Likewise, this company has a broader approach in its commitment to the SDGs such as respecting human rights and fostering inclusion, building businesses on the foundation of safety and quality, and finally exemplifying business integrity.

According to Boeing's Sustainability Report 2021, "*our company and our industry recognize that decreasing carbon emissions is an urgent challenge of our time*". Achieving this objective requires a portfolio of solutions and partnerships that allows this industry sector to decarbonize. We are focused on four key areas: fleet renewal, network operational efficiency, renewable energy transition, and advanced technology. Boeing Chief Sustainability Officer Chris Raymond said "*renewable energy plays a critical role and can include sustainable aviation fuels, electric-powered battery propulsion, and green hydrogen*. *Boeing is working to advance the development of all three of them*" (Boeing, 2022).

Other manufacturers like Embraer in Brazil have opted for the following initiatives: (1) Energy management, how to reduce weight, power consumption, and ultimately carbon footprint; (2) Electrification, developing an electric aircraft; (3) Silent Aircraft, creating the quietest single-aisle aircraft (4) Aircraft Lifecycle, where materials are recycled to create new aircraft and the overall supply chain has a far lower environmental impact. and (5) Sustainable fuels, an initiative multiple actors have mentioned above (Embraer Aviation, 2021).

While Canadian manufacturer Bombardier establishes its policy in three related pillars. First is environmental excellence, trying to reduce the impact of air travel on climate change while investing in technology for aircraft efficiency and a decarbonization transition plan. Second is Environmental Management, improving the use of resources (energy, water, waste) to improve cost efficiencies. The third is environmental performance, creating multiple indicators that can be measured against competitors and entities within the aerospace industry (Bombardier, 2021).

Creating Value in The Business Environment

The value-creating process has been always considered the key to firms' long-term survival and success of businesses and the source of competitive advantage for firms and remains at the center of business marketing practice and theory. Adopting the relational perspective has set in motion considerable efforts to re-think the value-creating processes acknowledging that, rather than being embodied in products or services transacted between buyers and sellers, value originates in relationships (Haas et al., 2012).

Today’s critique includes a call on companies to include a broader set of stakeholders in their decision-making, beyond just their shareholders. It’s a view that has long been influential and is frequently embedded in corporate governance structures. The approach is gaining traction with the emergence of public-benefit corporations, which explicitly empower directors to consider the interests of constituencies other than shareholders. For example, Value-creating companies create more jobs. When examining employment, we found that the US and European companies that made the most shareholder value in the past 15 years have shown more substantial employment growth (Goedhart & Koller, 2021).

To understand the shift occurring in the air travel category, think of the change we're seeing around value and quality. The value used to be simple. $30 return flights to a popular European city, a stripped-back inflight experience on a cramped plane. It's a little more complicated now. The stereotypical 18-30 traveler looking for a cheap getaway is now naming environmental impact as their number one challenge facing society, according to Deloitte's 2019 Global Millennial Survey. Global Web Index found that over half of 18-55s would pay more for eco-friendly products. Value is not just the lowest cost to the consumer, it's also the lowest cost to the environment (Flowerdew-Clarke, 2022).

Research examining the relationship between the creation of value and corporate social responsibility made by (Green & Peloza, 2011) demonstrates how corporate social responsibility manifests itself and determines consumer support. It can provide three forms of value to consumers: emotional, social, and functional. Each of these enhances or diminishes the overall value proposition for consumers. Further, the value created by one form of it can either enhance or diminish other product attributes like affordability or accessibility.

Airlines must consider maintenance as one of many interconnected factors that contribute to operational excellence to achieve value. They must also prioritize resources and expenditures to develop an efficient predictive maintenance capability. Airlines will need to invest heavily to secure, standardize, and incorporate that data in systems that connect with the airline operation, where the potential advantages of predictive maintenance lie, once this availability barrier can be overcome (Hirshman et al., 2021).

3. Methodology

Research Methodology

To help investigate in-depth the thesis proposed in this research work, it was decided to implement qualitative research, research that will be conducted between March 2022 and August 2022. Conducting a qualitative study will allow in this way to discover whether indeed companies belonging to the aerospace industry are creating value for their customers Concerning the Sustainable Development Goals, in particular the resilience pillar. The literature review can show how some major players in the industry, such as manufacturers, governments, and airlines, have tended in recent years to opt for greener options through the value propositions offered by these entities.

Using this research method serves as a reliable source of information since, according to (Kalra et al., 2013) a qualitative method is used to understand people's beliefs, experiences, attitudes, behavior, and interactions. Thus, it allows the information shared by the study participants to help determine if there is a gap between what was previously stated in the literature review and what companies in the aerospace sector are putting into practice, mainly about the value creation offered by the manufacturers and that perceived by the customers. In addition, allows future research to be carried out based on the results generated by this research.

Selecting Sample

To proceed with the qualitative research, it was decided to use non-probability sampling (or non-random sampling) for the selection of people to interview, since it provides a range of

alternative techniques to select samples based on a subjective judgment (Saunders et al., 2016). However, one of the problems with using this type of sampling is that you do not know how well you are representing the population. For this reason, *purposive sampling* is used because it enables the investigator to use his judgment to select cases that will best enable him to answer his research thesis.

Because the individuals to be interviewed belong to a particular subgroup of members of the aerospace industry, then *homogeneous sampling* technology will be used to be more conclusive. This technique allows that with the study group used in this research the results collected will be of great value to the researcher once they are analyzed.

Regarding the size of the sample, it has been decided to interview ten people members of the industry, distributed as follows: two representatives of the companies Rolls Royce and Pratt & Whitney, who will act as suppliers of different components in the sector. Three representatives of the companies Airbus, Boeing, and Bombardier, which in turn act as aircraft manufacturers. Two representatives from different commercial and cargo airlines act as customers in this industry. One representative of the space industry to view a different panorama within the sector. And finally, two independent experts representing the consumers, who are the ones who make use of the service investigated in this research.

Data Collection

To process the best information from the interviewees, data will be collected through semi-structured interviews. Additionally, because the companies that will be used as references in this study are geographically distributed around the world, the use of digital platforms for videoconferencing and phone calls will also be used. Using this type of format allows the

interviewer to omit certain questions that may not be relevant due to the business context of the company, and to focus on other issues that are significant when analyzing each of the stakeholders present in this case. It should be noted that the interviews will be conducted in Spanish and English depending on the preference of the interviewee, to have a written transcript (in cases whether the person allows it due to confidentiality reasons), with an average duration of 30 minutes.

The content of each interview is distributed in three parts that are fundamental to later analyzing the interviewees. The first part refers to the opening, in this phase the focus is on getting to know the other person on a personal and professional level, intending to appreciate the importance that he/she represents for this research. The second part refers to those open and probing questions, being this the most extensive part of the interview, since here the actions that a company has taken in the current context are known in greater detail and at the same time, it is possible to inquire into topics that will help to prove the thesis because of the information shared. The third part refers to the closing, here there will only be questions with less complexity but that is significant for the research, followed by thanking the interviewee for being part of this study.

Questionnaire

Opening Questions

- Could you please tell me your name?
- What is your current position?
- Which company are you representing today?
- How long have you been in the industry?

Open and probing Questions

- When did your company realize the concept of sustainability was a must in the current business environment?
- Did the company do it by choice or by following a trend set by another company? What was the motivation to do it? What was the interest?
- What actions have your company taken to be more sustainable? What is the differentiation factor between your company compared to a competitor?
- How do you measure the results of the actions taken by your company? Could you show me an example?
- What strategies has the company used to mitigate the risk associated with the journey to SDG compliance?
- Has the offer value proposed by the company changed over time? Please explain.
- Do you think the company is providing an added value to its stakeholders? Please explain.
- Proposing a more sustainable offer value would not be more expensive? How do you think it will impact your customer buying decision?
- How has the company been able to keep your clients and attract new ones concerning the previous questions?

4. Analysis

To conduct this qualitative research, a total of 10 interviews were carried out. The higher the level of the company, the more difficult it was to request a recording of the conversation due to confidentiality standards, for this reason, and to ensure the greatest veracity in the analysis of this research, it was decided to present the investigation grouped by essential topics that will allow answering how companies in the aerospace industry are creating value concerning the UN SDGs?

Because gender did not influence the sample participants, 80% of the participants were male and 20% female showing a primarily male-dominated industry. Respondents with experience between 10 and 30 years in the aerospace industry in different job positions, ranging from commercial pilots, and aeronautical engineers to Environmental, Social, and Governance (hereinafter, ESG) experts, and senior executives. All located in different parts of the world, from Colombia, through North America to Europe, one of the most advanced regions in terms of sustainable development at the corporate level.

Motivation and Interests

Businesses that practice environmental responsibility may be able to cut costs by reducing waste and improving efficiency. Although some environmentally friendly practices can be expensive to implement initially, businesses can compensate for this by avoiding fines and legal action related to unfavorable environmental effects. Additionally, by enhancing the company's image, businesses are better able to establish themselves within their industry and boost market share (Currin, 2012).

The common denominator here is to be leaders and to be able to differentiate themselves from their competition, 80% of the participants consider themselves as such, and 10% are policy followers, and the remaining 10% is a special case given that the trend in cargo airlines is different.

For Carlos Aparicio, quality control manager in *Lineas Aereas Suramericanas* (hereinafter, LAS) being a leader in this area has not been of major importance, especially in developing countries since the equipment that this airline uses, is mostly relatively very old aircraft the last ones built in the late 80s, purchased for their lower price and not for the environmental impact they generate.

Some of them rely on the implications of following the law, a concrete example is the companies that only follow the directives established by a higher entity like local governments or the Federal Aviation Administration (FAA), said Eddie Barrera, general manager of *Infraestructuras de Colombia*. This shows that there is no natural motivation to change, but rather an obligation to do so to remain in the market.

Being a leader or pioneer in the industry is a complicated and tedious task. Boeing states that its responsibility for this world comes from its inception in the 1900s when it focused on safety councils in designing its first aircraft and evolved as time went on, by the 2000s it was the first to qualify to fly with sustainable aviation fuel, said Chris Raymond, Chief Sustainability Officer (Opris & Hernandez). These actions demonstrate the interest that companies have in both researching new greener techniques and implementing them, being first to market can make a difference.

At the satellite level, for *Société Européenne des Satellites* (hereinafter, SES) none of its competitors had an ESG strategy pushing the company to create a whole new way of thinking.

Although ESG technically is a department in the company, it is now becoming a culture, a new way of thinking for the business, hence every decision that they make needs to incorporate ESG values (Aman & Hernandez). At the same time, with no other entity with which to compare what the company is doing, SES is leading the race and others must try to keep pace, so they do not fall off the sustainability path the company is establishing in the industry.

For Airbus the journey began in the early 1990s when the path to zero emissions was suggested in aviation. Thirty years ago, the emissions emitted by the company's aircraft and helicopters were twice as high as they are today. Together with new-generation engines, more advanced production materials, and optimized aerodynamics, this will conceivably allow the company to see zero emissions in 2050, although there are still another 30 years to go before then and new measures should be taken.

Engine manufacturers saw it as a business opportunity to embark on the development of more environmentally friendly aero engines. They saw that regulators wanted these components to produce less noise and reduce their emissions and that airlines wanted to reduce their fuel costs and improve their route range. When the engines officially hit the market and realized how well received, they were, the engine manufacturers considered their research a success. However, the race does not end here because now the airlines have new demands on their services and expect them to react in the same way.

Economic interest is the common factor among the participants in this research, since by investing money now, it is because they expect their operating costs to decrease in the future. There is also a social interest, that of promoting a more gender-heterogeneous company at the organizational level, as well as the promotion of a healthy environment for employees. But without exception, the environmental interest is the one that everyone is fighting for, since it

seeks to meet the goals proposed by the SDGs for 2030 and to have no emissions by the year 2050 of the United Nations.

Steps to a Sustainability Transformation

Each company is different, some began to address the issue since the creation of the SDGs in 2015, others think that the pandemic made them reflect on their impact on society, and fewer companies have been dealing with the issue for a long time. Regardless of the moment in which the companies began to deal with the issue, it is important to highlight the actions that each of them is implementing to promote a better world for the new generations.

There is no due process for how companies should go about it, but the study shows that change should happen first and foremost within the company (only if necessary). If things are not working properly, others will be the first to notice, putting the company's permanence in the market at risk. Once things are going well, we move on to the second scope at the external level, where all the stakeholders of the company get involved for a common goal: to have a sustainable transformation at an economic and social level.

It is important to remember the four main groups used to divide this research: suppliers, manufacturers, customers, and consumers. Since the actions that each group of companies has taken are similar, it was decided to group them to be more concrete. It is worth mentioning that although some actions have the same name, the approach is different depending on the group.

Suppliers

Pratt & Whitney

The 1925-founded Canadian supplier, which is currently ranked as one of the top three aero-engine producers, claims that its efforts to support environmentally friendly aircraft date

back to the dawn of time. Three words sum up Pratt & Whitney's current environmental approach: Smarter, Cleaner, and Greener (Bourdages & Hernandez).

The process is explained as follows: (1) Smarter technology, from the development of today's GTF engines which are currently powering the airbus A320NEO family, the Airbus A220, and the Embraer E190/195-E2 to the creation of hybrid-electric systems. (2) Cleaner fuel, which works with the previously mentioned technology pillar focused on hydrogen-fueled propulsion systems and of course the SAF. (3) Greener business, through the implementation and use of solar energy in its factories and supply chain with a common objective of reducing emissions (Pratt & Whitney, 2021) (Bourdages & Hernandez).

Generally, the measures taken by companies are carried out independently, however, there are cases of partnership and in the world of sustainability, this is no exception. An example is an agreement that exists between the Canadian engine company and Embraer in Brazil, which in June 2022 successfully tested for the first time a 100% SAF-powered flight. The aircraft made by Embraer and the engines developed by Pratt & Whitney is currently certified to operate with SAF blended up to 50%, thus marking a new milestone towards the reduction of emissions (Pratt & Whitney, 2022).

Rolls Royce

It is important to highlight what Warren East, CEO of Boeing said regarding the company's chosen path to sustainability *"when we joined the UN Race to Zero coalition, we committed to play a leadership role in bringing the sectors in which we operate to zero by 2050"* (Rolls Royce, 2021). With this objective in time Rolls Royce has also opted for business-level strategies aligned with that goal.

The British engine manufacturer's goal is to become a company that generates zero net operational impact by 2030. In other words, in less than a decade, the company expects to make this amazing project a reality. To make it a reality, the company has taken the following actions: to make its engines 100% SAF, by 2022 there are only 10% SAF compatible. To produce new production systems ready for this type of fuel as well as those propelled only with electricity or hydrogen, even Sismey (2022) mentions a project for the use of nuclear energy as a support mechanism during this transition, but due to the criticism that exists around the subject, it was not deepened in it (Sismey & Hernandez).

In addition, the company seeks to generate a change in its chain of systems, thanks to the reuse of previous materials used for the construction of other elements. As well as the investment of time and money in research and development (hereinafter, R&D) that allows identifying those stages with the highest emissions and being able to act immediately and efficiently. An example of this is the money invested in R&D, in 2020 of the total budgets allocated to this area, 75% was allocated to the activity (Rolls Royce, 2021).

Both suppliers highlight the importance of stopping the use of fossil fuels as the sole source of energy for their engines, so they are working on testing new sources of technology that will allow an aircraft to fly. Methods with SAF, hydrogen and electricity are already in the design or implementation phases due to their high complexity, but once this first transition to a less environmentally impactful one is achieved, the perceived value for the company will increase and become a milestone for the aerospace industry.

Manufacturers

Boeing

Although the information shared by Opris can be corroborated in the company's annual sustainability report, it is relevant to mention the problems brought about by the Boeing 737-MAX scandal and the Covid-19 pandemic. When two of the aircraft crashed, killing more than 300 people on board, and governments were forced to intervene to ground them, the company was severely affected as it had to take the blame for the accidents. This was accelerated by the pandemic which drastically reduced air travel levels, leading the company to lay off staff and borrow money from banks to survive. Basically, the company was losing money bloodily, due to multiple lawsuits and non-payment of customers due to non-compliance and non-conformity of the situation.

The concept of aerospace sustainability began to be mentioned more often as interviews were conducted. For Opris (2022) something important to note about Boeing is that it was not until 2020 that Chris Raymond was chosen for the first time in the company's history as Chief Sustainability Officer. A relatively new position for the industry because it is no secret that everyone knows the terms CEO, COO, or CFO since they have historically been present in the organizational structure of every company. This position is created with the objective of making a team responsible for the design and implementation of the company's sustainability strategy.

New action is mentioned at the level of the manufacturers, it is the fleet renewal. Airlines have invested more than $1 trillion to purchase these new airplanes, in many cases to replace older, less-efficient models. Many airlines have accelerated retiring older airplanes during the pandemic, and expect this trend will continue (Boeing, 2022). This means an increase in the number of aircraft orders for the company, which translates into higher revenues which in turn translates into profits.

Nonetheless, the money received by the company is reinvested in technology, for the development of sustainable alternative fuels such as SAF, battery-electric energy storage, and green hydrogen, and in actions that allow the company to further reduce its waste, water, energy, and greenhouse gas emissions.

Bombardier

Commercial aviation is dominated by Boeing and Airbus, and that is a fact that all entities in this industry recognize. But it is also important to know the actions of your competitors, even if they are small. Companies like Bombardier, Embraer, or Gulfstream are competitors at the level of private/business jets, medical transport, and single-aisle 100-passenger aircraft.

The Canadian manufacturer has focused in recent years on two main areas. The first is the environmental footprint, directly related to the reduction of greenhouse gasses in both production and after-sales service, in pursuit of a more environmentally responsible supply chain, as well as the reduction of water and energy consumption and the management of hazardous waste (Lucas & Hernandez).

The second is sustainable aviation, here the term Environmental Product Declaration (EPD) comes into play. In short, it is a report where the environmental performance from a lifecycle perspective is published for those aircraft manufactured by the company, this is a differentiating factor against the other two major manufacturers since none of them mention it in their current or future actions. In addition, the company has R&D programs for greener aircraft as well as maximizing the use of SAF during flight (Bombardier Inc, 2021) (Lucas & Hernandez).

Airbus

Thanks to Van Werch, it can be seen how the company is taking action to deal with this situation in the short term, one of which is to improve fuel burning in the existing fleet. To give context to the situation, take the case of the Airbus A220 and A350, the first is a single-aisle aircraft and the second is a double-aisle aircraft, each designed to meet the demand in very different markets. Thanks to the company's team of engineers, and through a new aerodynamic design both in the curvature of the wings and in the winglets as well as a reduction in the weight of the aircraft due to the use of advanced lightweight materials (Van Werch & Hernandez).

Airbus also proposes an ambitious project in commercial aviation with a target date of 2035, called ZEROe, referring to the development of the world's first zero-emission commercial aircraft. The concept proposes three different aircraft models that can potentially be sold to airlines and with a maximum capacity of up to 200 people, the model uses liquid hydrogen as fuel for combustion with oxygen (Van Werch & Hernandez). Currently, the project is only in the design phase, but they hope at least by 2025 the technology they want to use will have been approved (Airbus, 2021). These two actions undertaken by the company also reflect a factor of differentiation from its biggest competitor Boeing, they are projects both for the present and for the future that its counterpart may have contemplated but has not yet executed.

Other actions such as managing the entire life cycle of the aircraft explain the leadership that the company has shown in the industry. From investing capital in the design phase to developing improved tactics and techniques to committing to better supervision in the supply chain to get to the manufacturing phase, here focus its resources on reducing the consumption of energy, water, and carbon dioxide. The cycle continues with the operational phase where the

aircraft complete their flight cycles and as well as early maintenance checks, to reach its last phase, which is the aircraft dismantling for recycling and/or reuse of parts.

Airbus is European, and although Boeing and Bombardier are North American, culturally there are big differences between Canada and the United States. Of the actions that were shared in this study, the following stand out, from the creation of greener aircraft endorsed by the environmental product declaration to the creation of the position of chief sustainability officer at the organizational level, to the creation of programs that design zero-emission aircraft. All the actions described are good ideas that need to be evaluated to review their effectiveness, but we will see that later in this study.

Customers

Avianca

After analyzing this new group, it is evident that some of the strategies previously exposed are similar and complementary, but it is worth noting that some of them change due to the industry sector in which they are located as well as their geographic location. Clearly, the airlines in Colombia are committed to reducing their carbon footprint on the planet, however, the case of Avianca is unique and must be explained for the purposes of the study. Due to the pandemic, the airline almost went bankrupt, forcing an internal organizational restructuring, moving to a low-cost airline business model like the one used by Ryanair.

At the time of this change, the airline's Airbus A320 aircraft increased its passenger capacity from 150 to 180 seats with the elimination of business class. Today the company has more than 60 aircraft flying on different routes mainly in Latin America, this increase in seating

capacity allowed a reduction in the carbon footprint produced by each passenger and offered an economically sustainable service (Bazzani et al.).

In 2010, with the goal of reducing high maintenance costs and man-hours, the company began modernizing its fleet. The company switched from the Boeing 757/767 to the highly efficient and environmentally friendly Airbus A320 family, reducing fuel consumption and noise emissions (noise will become more relevant when talking about cargo airlines). Here we no longer talk about the SAF, but about improving fuel use through optimization of route distances and flight speeds (Avianca, 2022) (Bazzani et al.).

Lineas Aereas Suramericanas

In Colombia, all airlines operating in its territory must abide by the locally imposed regulations. The RAC 121 regulation, last amended in 2019, establishes the minimum standards to be met by both commercial and cargo carriers. One of the limits imposed is the take-off time for certain aircraft models. For example, for the Boeing 727, the company cannot take off between 10:00 pm thru 02:00 am, while the Boeing 737 does not have any restrictions, due to the high noise produced by its engines because of its age (Aeronautica Civil, 2019).

This is the case of an airline that has been forced to undertake its actions in sustainability by a regulation imposed by its country. For Aparicio 2022, this is nothing out of the ordinary, as he explains how the air cargo sector in Latin America and Africa is one of the most backward on the subject. The companies that start operations in these places tend to buy very old aircraft, on average with a longevity of more than twenty years for its "affordable" price compared to a brand-new aircraft (Aparicio & Hernandez).

In accordance with the previously exposed above, the biggest action that this airline has undertaken is the modernization of the fleet, however, due to its limited capital, it is now going from a fleet with an average age of 25 years to one of 15 years. Doing this implies complying with the Colombian standard and being able to fly its planes without any restrictions as well as for fuel consumption level since it reduces the cost of fuel, a relatively new plane consumes less fuel, thereby reducing its environmental impact and joining the path to meeting the SDGs.

The airlines are also showing a slight trend towards the need to renew their fleet, as new aircraft, although their financial impact is very high, bring major benefits for both the airlines, including passengers, and the environment. For entities that do not currently have the necessary financing to make this transition, it is necessary to review the business model being used, i.e., if it is not currently possible to reduce the emissions generated by the aircraft, it is necessary to look at how to reduce emissions per passenger. There are also actions that can be taken at the organizational level, such as the design of menus with less environmental impact, but this will be developed later in this research.

Consumers

Thanks to the invited experts (Becker & Barrera), two groups of consumers were represented in this study. On the one hand, we find the user whose interest in the environment is greater, is concerned about the future for new generations, and makes decisions based on their social responsibility. On the other hand, there are those who have no interest in caring for the environment; their decisions are based on factors other than sustainability and show a greater interest in their personal wellbeing.

Both agree that in the aerospace industry it is difficult to judge any of its players by the high levels of pollution they generate. An average passenger generates only one-millionth of the greenhouse gasses produced by flying an airplane from one city to another. A passenger does not check before boarding what type of fuel is being put into the aircraft before takeoff, many will not know if the model they are flying is part of the new generation produced by its manufacturers or what brand their engines are (Barrera & Hernandez).

The average passenger looks at other factors that affect their purchase decision: price, duration, or the number of stopovers, to name a few. These factors are more important to the consumer than the airlines' responsibility for sustainability. Becker points to an action he recently saw on an airline's website, when he got to the checkout page there was a new option that allowed him to voluntarily pay two dollars to completely offset the CO2 emissions that he as a passenger would produce on that flight (Becker & Hernandez). This demonstrates the contribution that passengers can make related to sustainability matters; however, the number of people willing to make this voluntary contribution will not be discussed in this research because it is beyond the limits of this research.

The only way for a consumer, who in this case are passengers using an airline as a method of transportation to act is to demand more benefits for the service they are paying for. This does not refer to having more legroom or free checked baggage, it refers to demanding a service that reduces their environmental footprint. That is to say that the consumer is the one who has the bargaining power in this case, since if the customer is not happy, he will turn to another airline and if he is not satisfied either then he will use another method of transportation to move from one point to another. So, to keep customers happy, airlines must turn to their suppliers and so on to provide a more complete, cleaner, and greener service.

Therefore, consumers play such a fundamental role in this business cycle; if passengers do not demand improvements in the service offered by airlines, they will not be forced to do so. It all comes down to value for money, to meet these environmental demands airlines must resort to buying new aircraft or other strategies already mentioned. If the consumer does not sue for these improvements, the companies will use that capital for other purposes or even claim it back from shareholders as it is money not invested. The consumer becomes an important axis to renew the old and revolutionize the new in the aerospace industry.

Experts

The aerospace industry is quite large and for this reason, the satellite sector could not be left out of this study. Its goals are the same in relation to the reduction of its footprint but according to the cycle of this product, i.e., from its launching to its decommissioning, ranging from 15 to 25 years depending on its orbit. Also, in the reduction of its emissions both in its daily operations and in its supply chain, the company has also committed to zero emissions by 2050 (Aman & Hernandez).

By 2024, the company wants to become certified by the upcoming Space Sustainability Rating of the World Economic Forum (Société Européenne des Satellites, 2022). This goal is striking because although it is only aimed at companies working in space, there is no equivalent for the aeronautical industry beyond the safety certifications, which, although important, are not comparable. Obtaining this type of certification also motivates companies to take the path of sustainability with greater ambition because they see it as a reward for their hard work to achieve it.

Additionally, among all the companies and participants in this study, there are proposals to increase the use of renewable energies such as the installation of solar panels, the use of wind

energy and some even mention nuclear energy as cleaner energy sources. Also, they talk about the processes of collection and reuse of material to reduce the amount of waste generated in the development of the final product. The correct use of water is mentioned throughout this research through training of personnel on the ground and the adaptation of spaces so that this can be done. Finally, the use of electric vehicles is promoted to mobilize within the facilities whenever necessary, all of these are measures taken to eliminate greenhouse emissions in the future.

All the actions undertaken by the different companies participating in this study demonstrate the common goal of striving for a better environment for future generations. Although the actions are similar among peers, each company has decided to have a different approach, both at the micro and macro levels. No one actor has a greater weight than another, except for consumers, without whom none of the actors in this long chain could survive, since they are the ones who bring in the profits. This reflects the importance that sustainability has taken on over time as fundamental to the functioning and success of a company.

Measurements of Success

Once the goal is defined, a series of objectives are proposed to guide the path that the company must follow to make it a reality. But these objectives must be tracked and measured to evaluate how effective they are being, which is why the term Key Performance Indicators is used. This type of indicator allows to evaluate the strategy at an individual or global level, as well as to schedule review meetings to evaluate the progress towards the fulfillment of the objective. In cases where it is not being met, the company must immediately re-evaluate whether to change the time boundary applied or to use another type of measure. These indicators act as a traffic light since they show how prepared the company is to meet its goal.

To look at the progress companies are making toward meeting their sustainability goals, they should be measured to identify how far or how close they are to achieving them. Below is a series of Key Performance Indicators provided by the study participants.

To measure these results, companies must set environmental goals in a time frame (short, medium, or long term), these are reviewed when the date has been met and it is analyzed whether it was successful or needs to be reevaluated. Becker exemplifies the following cycle: First, an environmental objective is set: to reduce the generation of hazardous waste. Second, a target is chosen: to distill 4,000 gallons of solvent for reuse for cleaning paint equipment and landing gear. Third, the actions to achieve it are determined: to maintain the volume of solvent processed through the distiller for reuse. Fourth, a date is chosen: December 2022. Fifth, the fulfillment of the goal is determined: in 2022, we reached (or not) the goal by distilling 4,000 gallons of solvent for reuse.

EPNdB is a measure of human annoyance with aircraft noise which has special spectral characteristics and noise which has special spectral characteristics and persistence of sounds (Depitre, 2006). The minimum established by ICAO is having a cumulative margin of less than 10 EPNdB, currently, the Airbus A350 has widened that gap and stands at 21.4 in its sound margin. It is important to highlight how this company is the only one to use this measurement compared to Boeing and Bombardier, the other two participants in this study. Although this measurement does not have a direct impact on the environment, it can be used by airlines when purchasing new aircraft, given that a quieter aircraft is a standard that benefits the community.

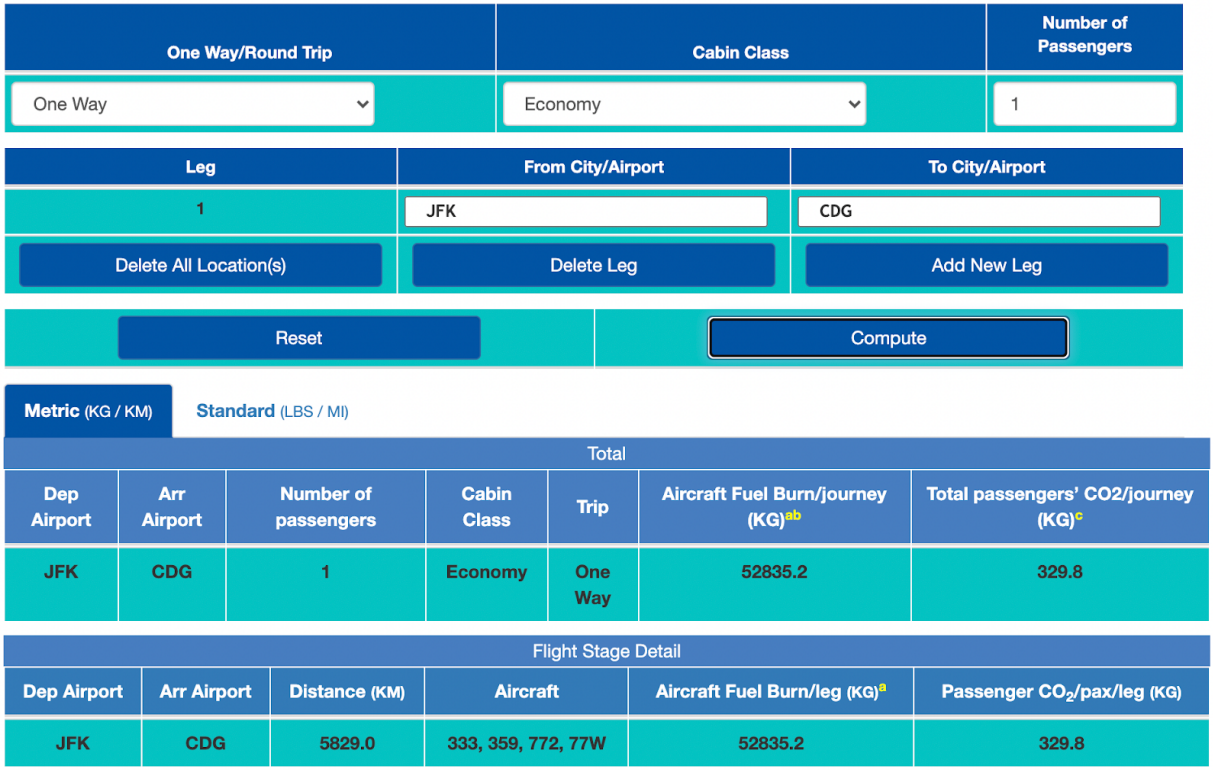
Due to increasing emissions of nitrogen oxides (NOX), the control of these emissions the ICAO regulatory limits for engine NOX emissions have been gradually tightened over time (European Union Aviation Safety Agency, 2021). According to the standards set by this

organization in 2007, by 2016 engines were expected to emit a maximum of 50kN (kilonewton) per flight and the target for 2026 is to be less than 35kN. Currently, Airbus with its most modern aircraft in the fleet emits at least 23% less nitrogen oxide. This measure could not be calculated without the help of the engine manufacturers, for the Airbus A350 it is Rolls Royce, demonstrating how companies can work together towards the same goal, seeking to be compliant, innovative, and sustainable.

That an aircraft can fly from one point to another loaded only with SAF is the goal of all the manufacturers in this study, however, only Boeing has put a time frame on that goal. By 2030, the company expects to have certified its first commercial aircraft powered 100% by SAF. Since 2008, the company has been testing this new type of fuel mixed 50% with traditional jet fuel, a goal that is ambitious but achievable. Other milestones have been set by companies such as Airbus, which has already tested SAF in three different types of aircraft, or Embraer, which in alliance with Pratt & Whitney made its first test flight, however, by carrying out these test flights they have only done so with SAF in one engine and traditional in the other, demonstrating Boeing's leadership in the field.

Rolls Royce, Airbus' main commercial partner, is also measuring its progress towards zero emissions by 2050. As an engine manufacturer, their main interest is to achieve 100% SAF operation but as they have not achieved this technology at the commercial level, they are committed to using at least 10% SAF for their new civil aircraft by 2023, and at the same time, expect to make all their commercial aero engines in current and future production compatible with sustainable fuels by the same year. A target for 2025 is to increase the recycling and recovery rate to 68%, the progress to date is almost 61% which means Rolls Royce is currently recycling over 40% of its products.

Figure 1: Carbon emissions produced in a flight from New York City to Paris



One Way/Round Trip	Cabin Class	Number of Passengers
One Way	Economy	1

Leg	From City/Airport	To City/Airport
1	JFK	CDG

Delete All Location(s) | Delete Leg | Add New Leg

Reset | Compute

Metric (KG / KM) | **Standard** (LBS / MI)

Total

Dep Airport	Arr Airport	Number of passengers	Cabin Class	Trip	Aircraft Fuel Burn/journey (KG)[ab]	Total passengers' CO2/journey (KG)[c]
JFK	CDG	1	Economy	One Way	52835.2	329.8

Flight Stage Detail

Dep Airport	Arr Airport	Distance (KM)	Aircraft	Aircraft Fuel Burn/leg (KG)[a]	Passenger CO_2/pax/leg (KG)
JFK	CDG	5829.0	333, 359, 772, 77W	52835.2	329.8

Source: https://www.icao.int/environmental-protection/Carbonoffset/Pages/default.aspx

Thanks to the ICAO Carbon Emissions Calculator it can be seen how a one-way flight between New York and Paris, with over 5800 km and an approximate duration of 7 hours, emits a total of 329 kg of carbon per passenger during the duration of the flight. This translates into 47Kg per flight hour or 0.05Kg per kilometer flown, demonstrating the high pollution produced by aircraft daily. Despite this, Airbus aims to reduce these emissions per passenger in 2025 by 20%, which it expects to achieve with the introduction of new versions of existing aircraft that can accommodate more passengers depending on the customer's configuration. Increasing the number of seats offered on the same route decreases the Kg of emissions produced per

passenger. It should be noted that these results depend on the type of aircraft used, since, as previously explained, an older aircraft emits more carbon due to its higher fuel consumption.

A unit of measurement used by this industry but specifically by airlines is the Cost Per Available Seat Mile (hereinafter, CASM) is obtained by dividing the operating costs of an airline by available seats (Hayes, 2022). On the cost side, we can find fuel, payroll, maintenance, airport charges, leasing payments, and other costs; and the number of seats depends entirely on the aircraft used. Choosing the type of aircraft also involves considering the following factors: duration of the flight, distance, potential demand for the route, and frequency of the flight, among others. The lower the cost, the higher the profit, which is why Airbus aims to offer an aircraft with 25% less fuel burn and maintenance costs than Boeing thanks to the offer of more capabilities such as its payload and range for the same cost as its competitor offering a lower total operational cost and per passenger.

To reduce its environmental footprint, Bombardier set out to reduce its gas emissions by 25%, energy consumption by 20%, water consumption by 5%, and hazardous waste materials by 20% by 2025. These targets were proposed in 2019, and today, according to Lucas (2022), they are well on track to reduce their emissions, energy, and hazardous waste by 15%, 10%, and 12% respectively. The reduction in water consumption has been a more complicated task due to its essential role in the business, despite the actions taken, they have only managed to reduce it by 1%. All the objectives are achievable over time, and it is expected that they can be reduced even more than initially proposed. In addition, another measure used by the company is that by 2025 at least 50% of the money used for R&D will be earmarked solely for greener and more efficient aircraft.

Both Airbus and Boeing aim for an environmentally responsible end-to-end supply chain. For this reason, both companies have been looking to their suppliers to determine what responsible practices should be implemented to achieve this goal. In addition, the big four commercial manufacturers Embraer, Bombardier, Airbus, and Boeing have decided to create supplier codes of conduct aligned with their ESG strategy, allowing the companies to review whether they meet the standards they expect. Making use of such codes will allow companies to measure in the future whether their supply chain is green and sustainable. However, no company shared the desired date they are planning to materialize it.

In the satellite sector: SES, Boeing, and Airbus are the only players in the study that have products or services. Although the latter two do not have a large market share and therefore more interest, it is important to emphasize how actions are measured on this side. In 2022 they want to look at how we can best support clients in achieving their climate goals and offer climate action solutions as a new objective they intend to measure by seeing how many of their clients they were able to help. Previously they had talked about waste management, but not in space, so by 2040 the company aims to reduce these levels by 30% (Aman), a rather complicated task due to the nature of the waste produced by the satellites but which has dedicated groups of people researching today to make it happen, it is relevant to say that it will not be missions to go to clean space but the design and production of equipment that after its useful life can be disintegrated there, thus reducing the amount of debriefs in space.

At the environmental level, there is evidence of a group commitment among the research participants, because it is a joint effort, i.e., the airlines would not be able to reduce the number of emissions generated in a flight if it were not for the new engines designed by the suppliers and installed by the manufacturer. The industry's commitment to the SDGs is evidenced by the

actions taken by these companies and is also expected to be perceived by their stakeholders. This is also evidence of progress as an industry at a global level compared to others such as the oil industry, however, commitments are not only to the environment.

The SDGs go beyond just representing climate change and sustainability, they also speak to the representation of minorities and the human rights of people. As in the satellite sector, the same three companies and Bombardier are the ones who shared information on the subject. The common denominator among the parties is the issue of gender equality, all wanting to increase gender diversification in executive and board positions. Currently, 75% of the Airbus Board of Directors are men, and in the Executive Committee they represent more than 80%, for this reason, the company wants to act in this regard. One example to follow is SES, which has set itself the goal of increasing gender diversification by 50% in the next five years, Bombardier has set its target to 30% in management positions.

Increasing the number of women in high-level positions is a work in progress for many years, thanks to the United Nations, what is expected is a diversification of the type of people in these high-level positions. It is sought that people equally qualified and with the necessary experience can access these positions regardless of their gender, race, or sexual orientation. In the United States, for the first time in its history, a black woman was recently elected to the U.S. Supreme Court; of the thirteen members of the court, only five are women and two are African American (Horowitch, 2022). Although this is a very specific case, it shows the progress that is being made towards a more equitable world for all.

At the social level, we also talk about having decent working conditions, which translates into a healthy and safe place to work. A measure used by the participants in the study is the lost-time severity rate as it shows the total number of incidents presented by the company represented

in lost workdays. No company shares an exact value, but it is understood that the desired point is zero, however, everyone is prone to an accident in the workplace and that is why their goal is only to reduce it. Companies also offer mental health programs as well as access to training and education and safety training. All of this with the objective of having a business that cares for the quality of its human capital.

Ensuring internal customer satisfaction is just as important as external customer satisfaction. At the organizational level, employees behave like customers and demand a return equivalent to the service they provide to the company. The return is not only economic, nowadays we are talking about the term emotional salary (Ortiz, 2018) since we are looking for a balance between private and working life. Unlike the economic one, there is no standard since each person perceives it differently, and it is only granted when the employee has done a good job. The reward is chosen by the employee, whether it is days off or invitations to dinner or any other activity that makes the employee feel valuable. Investing in employees is just as important as investing in mechanisms to attract new customers.

The indicators presented above are a sample of the decisions that companies in the aerospace industry have made to support the SDGs by 2030 as well as individual and environmental commitments for future generations. In the short and medium-term it is difficult to see the results, but that does not detract from the method that some companies have taken to analyze their results, using these time ranges implies that if they are not met, they should be re-evaluated to a more objective time frame. Many have ambitious but achievable goals, however, only time will be the deciding factor that will show if they were indeed a success or if more work must be done to reach the desired goal. Finally, the only actor for which no explicit unit of

measurement was found is the consumer, however, it will not be discussed because it is beyond the limits of the research.

Actions and measures taken by the research participants have been presented previously, however, these investments of time and money must be reflected in front of their stakeholders. What is also analyzed is whether the value proposition presented by the organizations has changed and whether it is attracting new customers. On the one hand, we seek to analyze whether the offer has changed over time and how they have adapted it to have a more sustainable one, in addition, it is expected to see if customers see these changes and if there is an increase of the same, being this reflected in the economic return received by the companies.

Sustainable Value Proposition

Having a clear value proposition strategy means being able to differentiate yourself from your competitors in that specific aspect, thus translating into the possibility of increasing sales, and no one minds increasing their sales because it can result in potential profits. Although the value proposition has been embedded in the DNA of the companies in the study, despite being a relatively new term, it is important to highlight that due to external factors companies have been forced either to adapt or even to change their offer due to the change in mentality that customers have had regarding sustainability issues, and we cannot forget that without customers there is no income.

Having clear the importance of having a value proposition and if possible one that is sustainable, this section will explain the changes that have been made over time (if any). Additionally, the costs associated with taking these steps towards a greener product offering and the strategies that companies have taken to mitigate the risks of doing so will be mentioned.

Finally, it will show whether all the above has worked and whether new customers have been attracted to the companies.

Changes in Time

Looking at the suppliers, we can see a trend that has not changed in the decades that the big three aero engine manufacturers have been in the industry. Rolls Royce, Pratt & Whitney and General Electric have offered a safe and reliable product for all their customers, given its essentiality to be able to fly, its control and quality standards are impressive, this is seen in the small number of accidents caused by engine failure. Today, to follow the trend of the industry towards a greener, they have implemented actions previously explained in this investigation, but as such, their value offer has not changed. To emphasize, Rolls Royce at the automotive level has a completely different value offer since it offers a different and exclusive product there.

When Airbus started the A320 family aircraft project, it wanted to tailor its offering to airlines, the added value that the company offered back in the 1980s and still delivers today is that there is a commonality across all its single-aisle aircraft. Basically, what it allows is that pilots trained to fly one of these four aircraft that make up the family can fly them all. Even for the newer twin aisle aircraft the goal is to have a process like the one presented above. Offering this allows airlines to reduce their cost in training hours since the transition is mostly smooth. Now with the offer of its new NEO line, there is also a change because they offer more efficient aircraft and with less environmental impact, this because of the commitments made by the manufacturers to reach zero emissions by 2050.

To SES is not the value proposition which has changed but people's minds, on one hand because people can visually see the effects of not caring and their impact. And on the other, because businesspeople saw the role, they can play in an impact being Covid a huge accelerator.

When the Covid pandemic started SES had to increase its connectivity services for kids in remote areas who could not go to school anymore, showing the social impact this company has. Today the younger generation do not accept non-sustainable practices anymore. There's a huge shift in mentality whether companies want to be around in the long term, they must really start thinking otherwise people will not come to them because they know there will be alternatives.

Avianca is a sample of those companies that have had to change their offerings due to external factors. Although the economic crisis, from which it has not yet emerged, has caused major problems for all its stakeholders, the airline decided to move from a luxurious and complete model to a more basic one. That is to say that it became a low-cost airline like the model used by Ryanair in Europe, so today the company offers much cheaper tickets in the past, but now it is the customer's decision whether to pay for other services such as choice of seat, cabin baggage, luggage in the hold, among others. In Colombia, local airlines have decided to use this new business model given the success of VivaAir.

For the cargo airline sector, there has been no change in supply over time. According to Aparicio, freighters promise to get a package from one point to another in a certain amount of time and continue to do so today. Additionally, he clarifies that they have used mechanisms to improve the current offer such as adding new capabilities and certifications to the company. However, at the international level there are players that have changed this offer, such as FedEx, which offers next day delivery service, the problem lies in the fact that to fulfill their time promise, in most cases they must use airplanes, which pollute the environment, but this has been a strategy that has worked for them.

It does not matter if it was by choice or by obligation, if a company expects to stay in the market and succeed in it, it will always be forced to adapt. Avianca is a case of making the right

decision at the right time, even though changing the business model may bring negative effects in the present, it is always necessary to think about the long-term benefit. The opposite case was Pan American World Airways, an airline that despite the downturn in the airline market did not make the right decisions at the right time, condemning itself to bankruptcy. This shows that as time goes by, companies must reevaluate their strategy to measure their level of effectiveness and market acceptance.

As a matter of fact, companies have indeed had to adapt their strategies as time has passed due to current market demands, today we are living in a society that demands more from companies. These demands are reflected in the annual reports where there are specific sections dedicated to ESG issues where their actions to achieve it are explained, but these actions carry an associated cost, which is often high due to its implementation process.

Costs Associated

Within the area of R&D, many companies have decided to allocate a certain amount or percentage to the development of greener practices. Airbus and Boeing are the players who allocate the most money to this area of the company with an average of $3 Billion each. The uncertainty arises when it is not known how much money is being invested solely for the fulfillment of the SDGs. Given that the large sum of money mentioned above also includes the money allocated to the engineering areas, this area represents a strategic role which seeks to create new aircraft to be sold, improve the efficiency of those that are flying in the market, as well as the design of commercial aircraft that can use different fuel sources such as electricity or hydrogen.

Next on the list is Rolls Royce which has allocated more than $1 Billion to R&D but here the same problem as Airbus arises and that is that no exact figure was shared as to what percentage

is allocated to the SDGs. This situation is even more conflictive because this company has presence in two industries, automotive and aeronautics, two industries that although they can complement each other because they both sell engines, they are very different products, with very different demands and prices.

Followed by the Canadian engine manufacturer Pratt & Whitney with a total amount of approximately more than $400 million. Thanks to the data shared by Bourdages, it shows the reality of the industry in terms of sustainability, since it is in line with the activities they have implemented at the organizational level. Composed by the development of engines that are one hundred percent compatible with alternative fuels, and the reduction in fuel burn of its current engines are some of the activities that the company is doing with that money.

Another great practical example is Bombardier, which plans to spend approximately $150 million in R&D and expects to spend 50% of that amount on greener aircraft by 2025. However, some of this money has also been used for the installation of solar panels for alternative energy production, the installation of water optimization systems throughout their offices as well as waste management systems in their factories. It is likely that all participants in this study have also opted for the actions described above but there are no figures to support this.

Airlines are an atypical case of a company, since it is expected that most of them have money allocated to R&D, the problem is that said information was not shared, therefore it cannot be assumed in what the airlines are investing their money. Turkish Airlines, on the other hand, is a company that has its projects in development public, it is worth emphasizing a very large one which is the design of an on-board menu with less environmental impact, that is, the inclusion of more friendly menus but that satisfy the needs of the passengers.

Making an investment of this size always requires that the situation be evaluated by many people, and it also depends on the capital that the company has available to proceed with the project. Here companies must determine the opportunity cost of not making the investment, that is, if they do not allocate that money to the fulfillment of these actions, in the future their results will be harmed because their competitors will most likely use the money in the way they should. The crucial point in this part of the study is to know which actions deserve the money immediately and which ones later, given that all participants theoretically have limited capital.

Ultimately, implementing such measures is costly since sustainable product manufacturers frequently follow their own eco-friendly corporate policies. From the installation of solar panels for alternative energy production in their facilities to the allocation of a percentage of R&D to the production of greener airplanes. However, the benefit of implementing these measures is greater in the medium to long term as the costs associated with this investment will be lower in the future than they are today because of the investment in better environmental practices.

Attracting New Customers

The objective of any company is to have revenues but to achieve this it is necessary to have a source of income, this source comes mainly from the sales made by the company during a certain period. Here lies the importance of increasing the number of customers that the entities have, but a fundamental factor comes into play in this war for customers, and that is social and environmental responsibility. According to this study we have two groups of consumers, those with a greater interest in sustainability and those who do not, but there is a common factor between the two and it is the increase in the interest of the new generations for a better society. For this reason, the results of these measures on this variable are presented below.

For *Lineas Aereas Suramericanas* the result of the actions it has taken has been positive. Starting with the renovation of the fleet, has allowed it to comply with the planned flight itinerary, thus reducing the number of delays. Fewer delays means that the product the customer has transported with the company arrives safely at its destination. But to do that it is necessary to have the staff competencies (on board and at the airport) with a good training program in the new fleet and have the necessary tools to comply with the operation. By measuring the results of the company's operations over the last six months, it can be seen how its actions have taken the right path towards compliance with the law and environmental standards.

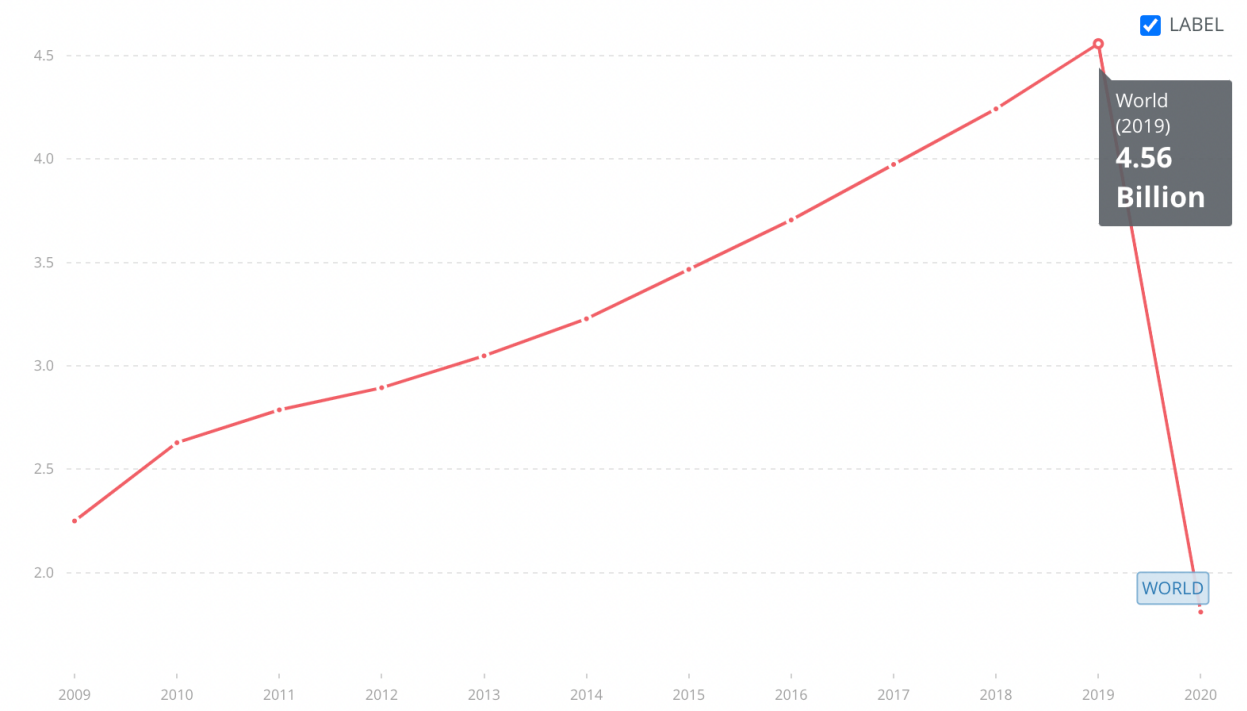
Commercial airlines such as Avianca see that demand for airline tickets has not decreased despite the commitments made by companies to the SDGs. According to (Bazzani et al.) the company has seen an increase in the number of people associated with its loyalty program called Lifemiles, meaning that the business model changes the company was forced to make has brought good results. Additionally, a market study is mentioned in which the income level of people who buy tickets is analyzed and here there is evidence of an increase in low-income customers given the more economical service offered today.

Boeing, as previously mentioned, had many problems with its Boeing 737 MAX but this, although it decreased sales of the other aircraft, did not hurt them in the way it was intended according to Opris thanks to the lifting of the restrictions imposed and the return of the aircraft to the air. For Airbus and Bombardier, the number of orders remained constant even though aircraft deliveries were severely delayed due to the lockdowns imposed by different countries. To this must be added the new customers that have come to the company in search of more efficient and sustainable aircraft, For Var Werch, there is a growing trend at Airbus that is now seen in its NEO line which meets current market demands and will be its flagship product in the future.

In the satellite sector, as in the aircraft manufacturing sector, the business model is similar as sales occur from business to business and from there to the consumer. For both Aman and Van Werch, there is a greater interest in the satellite sector. From a banking perspective, when looking to get investors or when looking to finance some projects, there are lots of different questions being asked about what the company is doing and if they do not meet their expectation, the answer is basically a no. From a return perspective, there is no return yet purely because it is not measuring it now since it is too short-term. From a customer perspective. When establishing new businesses with a customer, the company must fill out a request for proposal, which is a document you need to answer some specific questions, like what is your impact on society or the environment. In cases where a company does not meet their terms and conditions, they will choose somebody else.

For engine suppliers the situation is a little different since their engine sales increase only if airlines and private players order new aircraft from the manufacturers. The problem for companies like General Electric, Rolls Royce or Pratt & Whitney is that the manufacturer offers the same aircraft model with different engine options, since some will emit less sound, some will burn less fuel, and some will have a lower environmental impact. It is solely up to the customer to make that selection for their future aircraft. However, there are agreements between companies whereby a specific model will use only one type of engine. According to Bourdages, this is the case with Pratt & Whitney and Airbus with the production of their NEO family aircraft, as well as with Embraer for their E-Jets E2 family aircraft, the most modern and efficient in their fleet.

Figure 2: Number of air passengers between 2010 and 2020



Source: https://data.worldbank.org/indicator/IS.AIR.PSGR?end=2020&start=2009&view=chart

From a consumer perspective, and thanks to World Bank figures, we can see that since 2010 there has been a gradual increase in the number of passengers transported by air. Ten years ago, only 2.2 billion people were transported by air and by 2019 the figure exceeded 4.5 billion, i.e., the number of people using this method of transportation doubled, however, the figures fell completely in 2020 because of the pandemic and today, two years later, the industry has not been able to recover fully. This increase is due to the entry into the market of multiple airlines with low-cost models around the world, which make transportation more accessible and faster than other means such as train or car. It is not possible to determine if there is a direct relationship between the use of sustainable practices and the increase in passengers.

Attracting new customers is a very challenging task, but without new customers or orders from current ones the business could not grow. It is the responsibility of the sales and strategy team to attract new prospects and maintain an excellent relationship with current ones, just as it is the responsibility of the engineers and scientists to design a more innovative and safer product. But the chain does not end here, it also depends on making strategic alliances with suppliers of parts needed to build an aircraft, Airbus as discussed throughout the work is a success story that works under this model.

Strategies to Reduce Risks

Making any project a reality will always bring with it an associated risk, from the possibility that it may not be fully realized to the loss of the investment. This motivates companies to create strategies that can minimize the negative results of the same, from smaller returns on capital to contingency contracts are actions that participants can use as a measure of retaliation to any unforeseen event. Although the goals proposed by the United Nations and the SDGs are difficult to achieve, the companies here are well on their way to meeting them. Below are different types of strategies used to mitigate risks and have a better outcome when the time comes.

To determine how to mitigate something, we must know what risks companies face today. To begin with, not meeting the goal of zero emissions by 2050 is a common goal for all stakeholders in this study and one that has required everyone's collaboration. From using SAF as a new fuel source, to designing more aerodynamic aircraft that can fly longer ranges and use less fuel, to implementing greener practices in their ground operations, are just some of the strategies that companies have used to mitigate the risk of meeting that goal.

Reaching the 2050 target for the aerospace industry may be a reality in the nearly thirty years that remain before that date. The real problem lies in the fact that this industry was not the only

one to sign such an agreement with the United Nations, but it is a commitment of all heavy industries to reach that goal. From a global aspect the goal is achievable according to a study made by the International Energy Agency where it is stated that these industries must make drastic reductions in the use of coal, oil, and gas for the manufacturing industry as well as the implementation of renewable energies as the only source of energy (Elliott, 2021).

Despite the efforts that multiple industries are making to comply with this UN proposal, the UN has not commented on what will happen to those companies or sectors that do not comply with the zero emissions target. This is because all participants in this proposal know that it is very ambitious and that there is no way to measure whether industries will meet it, however, the joint efforts that companies have taken to achieve it cannot be denied and it is expected that they will be able to meet it.

The impact on productivity is also present in this study, given that for almost a century this sector has used fossil fuels as a source of propulsion for its aircraft. Transitioning to other renewable energy sources may involve high costs and delays in the delivery of such a product. It is for this reason that the players in this industry have designed a plan for the next thirty years, plans that gradually introduce the changes that are expected to become a reality.

An example of this is the flights that are currently being made with SAF fuel in the airplanes since so far, they have all been tested, the problem is that, if any plane has an incident because of this fuel, it will delay immensely all the research that has been done for years, meaning that it would affect the fulfillment of the goal. For this reason, researchers also do not want to put pressure on the progress of the project because they do not want to make a serious mistake.

Making an energy transition requires both human and financial capital, for this reason companies have projects that reduce the consumption of fossil fuels and the use of new energy

sources. The current situation between Russia and Ukraine is a fact that has the industry in suspense, since now that the purchase of gas and oil from Russia stops, countries and companies are forced to go to other entities for their supply. The risk is that in the absence of this desired good, the production of many industries will be severely affected, exacerbated by the international political crisis. However, this has not been an accelerator for companies to carry out this transition, given that for years it has been said that oil will run out and that is why industries have resorted to new alternative energy sources.

The risk of not being sustainable plays a crucial factor because of the possibility of not being partially or totally converted. This situation emphasizes that as time goes by, new generations are the ones that have more influence over the purchase decision. In agreement with Alam, the tendency is that new generations have a much greater interest in social responsibility and the environmental impact that companies generate in society. For this reason, and as this industry has so many competitors, the consumer has a choice if his first option does not meet his expectations, meaning that companies must look at the behavior of their customers in the future or else they will be doomed to fail.

5. Conclusions & Practical Recommendations

Given the trend towards increasing passenger numbers, and ignoring the decline caused by the Covid-19 pandemic, it is expected that the number of flights offered will also increase, i.e., there is a direct relationship between the two. This proportional relationship works in the context of a market with favorable conditions, it is worth mentioning that this can change at any time if affected by external factors such as an economic crisis. Therefore, more aircraft being used translates into higher levels of pollution.

The environmental impact produced by the aerospace industry, aggravated by the demands of a more demanding user community in terms of corporate social and environmental responsibility, has made it necessary for the participants in this industry to act on the matter. However, the commitments acquired for the fulfillment of the SDGs and the non-production of emissions before the United Nations are also an additional accelerator for the implementation of actions to achieve this goal.

To embark on this path towards a greener and cleaner industry, companies are faced with two different motivational scenarios. On one side, we have the participants who have voluntarily taken action to achieve this goal, some of them have been working on the issue for decades because they seek two objectives: to be leaders in their sector and to have the differentiating factor of their competitors. Airbus and Rolls Royce are an example of this group of entities; these participants are the ones who have made the most progress at a social and environmental level and are therefore an example to follow.

On the other side we find those who have done it out of obligation or by copying what another participant is doing. Here we find those companies that have undertaken this path only to comply with the norms established by local governments or those who do not want to be left behind in the path of a more sustainable industry. Avianca and Lineas Aereas Suramericanas are a case of this group, one impacted by its economic crisis and the other by the restrictions imposed in Colombia on the type of aircraft they use, these are the participants that are lagging since their efforts have been devoted to other areas.

The participants were divided into five groups according to their role in the industry: suppliers, manufacturers, customers, consumers, and experts to study the actions they have taken. Aeroengine suppliers have focused on designing a more efficient product in terms of performance and lower impact on the environment, in addition to their research on the use of SAF as a new fuel source. Manufacturers are working on designing more aerodynamic aircraft that are lighter in weight and can consume less fuel, as well as implementing recycling and reuse programs once the aircraft has completed its useful life.

Airlines are focusing on fleet renewal and the implementation of early maintenance programs to reduce costs. Consumers are the most difficult group to analyze since there are no actions that can be verified, but there is an indication that future generations will demand more social and less environmental impact from companies. And the experts refer to the common actions they are all taking to achieve these goals in their plant operations, using renewable energy, reduction of water waste or the production of toxic waste are just a sample of this study.

However, investing money in such measures also means that there is a return on investment in the long term. For this to happen, both the industry and its participants must be attractive to all stakeholders, from governments to investors as well as shareholders and customers. For this

reason, it was studied the value proposition that companies offer to analyze the changes they have undergone over time, the high costs of doing so and the new customers they have gained.

This proposal changes depending on the demands made by each customer to their respective vendor. It all starts with the consumers who have access to the information shared by the airlines regarding responsible practices, as they can make an informed decision and demand that those who do not have it do so because they may lose a potential customer. Airlines will react internally as they look for a way to meet these demands but much of it comes externally as their suppliers are a key part of this process, without them the process would be incomplete. Then the process is scaled up to the suppliers who are pressured to produce a cleaner, more efficient, and greener product that meets the standards expected by the end consumer.

To conclude, this study confirms that companies in the aerospace industry continue to create value for their respective customers in the various ways explained above. Likewise, there is evidence of an increase in both the number of passengers and new aircraft orders, demonstrating the effectiveness and attractiveness of the actions undertaken by the participants. The use of socially and environmentally responsible practices and the establishment of strategic agreements has become a must for any company that wants to stay in the industry in the long term, with Airbus being a success story to date.

6. Limitations & Future Directions

The results obtained with this research need to be developed in more detail in each of the categories used previously. Having complementary information will allow to show the full picture of how the aerospace industry is creating value in relation to the SDGs. While Airbus was the case that was chosen to demonstrate and prove the use of these practices, it is only one of thousands of actors present in the industry, so future research will be needed.

The number of participants was only 10 people, a significantly small sample but with large participants in the industry. In the area of suppliers, it was limited only to aero engines, which although they are an essential element for the final product, other suppliers in the areas of tires, technology and others were not considered. The same happens with the customers referring to the airlines, here a commercial and a cargo airline were used to show the differences between them, but the number of participants should be larger because regulations and trends may change according to their region.

For future studies, it is recommended to continue using qualitative research since the type of questions used in the questionnaire allowed to understand the context in which this industry is located. As one of the objectives of the participants is to have a greener and cleaner supply chain, the number of participants should be significantly increased to obtain more reliable information and more accurate results. It is recommended not to collect the information in a quantitative way since it will show more standardized results and although the companies have similar proposals on the road to sustainability, the actions are individual in different time frames and with different results.

Finally, nowadays more companies have departments dedicated to developing strategies for compliance with the SDGs or new ESG standards. For this reason, it is recommended that future interviewees should come mostly from this area. Although the other areas function as a source of information, they are biased depending on their motive. By collecting the information and focusing from the beginning on these two areas, it will allow for a more meaningful result.

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