Exploring Sustainability Challenges in the UK Aerospace Industry: Insights from A Qualitative Research

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Abstract

This study explores the Enablers and barriers that shape sustainable practices adoption and their development in the UK aerospace industry, a crucial sector generating £645 billion yet is responsible for 2.5% of global carbon emissions, the industry faces real challenges that must be overcome. Through Qualitative research, involving 12 diverse participants with varying levels of seniority, the study uncovered government funding, public awareness, and industry competition as prime motivators. Conversely, deficient regulations, and heightened flight demands, unsustainable workplace culture, limited junior employee involvement, and creative restrictions impeding SD adoption.

Introduction

Sustainability in engineering involves the development and operation of systems that utilise sustainable resources throughout the product life cycle. Air travel alone accounts for 2.5% of global CO2 emissions, and the industry affects the concentration of various gases such as O3 & CH4 and pollutants including soot; sulphur & aerosols (Gaillot et al., 2023). Moreover, there is a lack of research addressing adoption of sustainable practices in the aerospace industry Karagiannis et al., 2019, highlighting the need to explore factors that enable and impede its shift to more sustainable practices (Rice et al., 2020). This research addresses the gap by creating a framework which companies and policy makers can use. To explore this, the following research questions were framed:

1. What are the main factors that influence the aerospace industry efforts in their transition towards sustainability?
2. How do the identified factors influence the motivation of the aerospace industry in their efforts for sustainable development?
3. What type of model should be formed to assist Aerospace industries in their efforts to shift to more sustainable means?

Methodology

The research utilises qualitative methodology to answer the questions proposed, its effectiveness in exploring research questions and providing insights aligns with the aims and objectives of this work (Bakthavatchaalam et al., 2021). The study doesn’t explore technical aspects but rather focuses exclusively on the qualitative aspects of the factors influencing the aerospace industry in the southwest of the UK regarding sustainable practices. The interviewees worked exclusively within the civil aviation sector with no engagement in military technology development. Semi-structured interviews were used, which is widely used and was deemed the most effective qualitative method (Holloway, 2005; Mak et al., 2007; Larsson et al., 2019). The interviews involved twelve engineers of various levels of seniority interviewed over a one-hour session as seen in figure 1.

Figure 1. Detailed participant sample and seniority levels

Source: Authors

Thematic and content analysis were used to identify the recurring themes and categorise the findings into their relevant sections. The interview questions explored mainly sustainable technologies and did not discuss wider SDGs such as human rights. The questions focussed on the incorporation of renewable technologies and how to motivate engineers within the sector to shift towards utilizing said technologies. Aspects such as regulations, technology safety and readiness and infrastructure were explored. Moreover, Human factors such as monetary rewards and education were discussed where their impact on the industry was noted through questioning the participants. Wider SDG covering health, human rights, equality were deemed outside of the scope of this research.
Results and Discussion

The interviews have identified various motivators and hindrances affecting the aerospace industry's shift toward sustainability.

Motivation Factors

Corporate culture emerged as a pivotal motivator. The participants noted working in a culture that encouraged achieving sustainability goals showcased heightened personal motivation and were more interested in achieving said goals. This aligns with (Govindaraju & Daily's 2004, Kanter's 2014) research which emphasises the link between employee motivation and sustainable organisational culture where constant communication of Company SDG, feedback, and collaboration of the workforce in achieving SDGs was found to motivate the employees in ensuring the attainment of SDGs. Conversely, those lacking the former expressed demotivation. This aligns with a study by Fernández et al. (2003) where a lack of sustainable focus in projects has been demotivating for the employees looking to fulfil SDGs in their work.

Involvement in company goals emerged as another critical motivator (See appendix, Quote 1). Maseko's (2020) research indicates that engaging and involving all employees is critical in achieving SDGs. This aligns with the study's results, where participants involved in designing, implementing, and checking sustainability goals expressed motivation, irrespective of seniority.

Creative freedom to incorporate sustainability

From the participants’ perspective, the study revealed that having creative freedom to incorporate sustainability aspects on the management and technical side was a motivating factor. However, strict guidelines involved in the product lifecycle hindered the integration of sustainability. Interestingly, the nature of the project, rather than how complex the project was, is seen to influence the level of creative freedom. This emphasises the importance of providing autonomy and flexibility in sustainability initiatives within aerospace companies (Yeh-Yun Lin et al., 2012).

The United Nations recognises innovation as a catalyst for pursuing sustainability goals, making the lack of autonomy and creative freedom a hindrance as seen in Appendix, Quote 2.0

Challenging goals

The participants noted that the technological complexity of alternative propulsion methods, particularly hydrogen, proved demoralising. The participants noted that due to a lack of definitions in terms of project goals and a lack of clear regulations in renewable propulsion hindered the shift to sustainability. Appendix, Quote 3.0 showcases said findings.

The study uncovered that project complexity didn’t affect the participants motivation but rather how well-defined the project goals or plan was, played a crucial role in employee motivation. In fact, challenging projects were seen as motivating. A proper management plan as well as clear realistic goals within said plan boosted motivation.

Additionally, participants cited the lack of clear tasks in achieving the technology and the ever-changing renewable propulsion regulations as the main reasons causing demotivating. Research by Hoelzen et al. (2022), and Höchli et al. (2018), emphasise the positive impact of well-defined goals in complex tasks on employee productivity, corroborating findings by this study.

Demotivating Factors

The second category explores factors hindering the aerospace industry's shift to sustainability. Respondents emphasised the need for improved governmental regulations to facilitate industry transitions highlighting as impeding the shift as seen in Appendix, Quote 4.0

Studies by Okine et al. (2018) and Mak et al. (2006) had similar findings highlighting a gap in safety regulations in terms of renewable propulsion in the airline industry, suggesting the need for better defined safety mandates. Moreover, Gösslng et al. (2022) argue that current regulations, such as CORSIA, are ineffective in curbing aviation emissions, a sentiment echoed by Dolšak & Prakash (2022) and Larsson et al. (2019), calling for policy reforms.

The interviewees have highlighted hydrogen propulsion airworthiness certification process as a barrier to progress, with a senior male engineer stressing this in Appendix, Quote 5.0. Spencer (2023) highlight the lengthy timelines involved in certifying aircrafts with sustainable technologies as major impediment to the shift.

The study’s findings indicate that the increasing demand for air travel poses challenges for sustainability efforts. According to IATA (2018), air travel demand is expected to rise by 33% over the next 20 years, leading to an increase in aircraft orders and subsequent growth in air traffic. Multiple participants identified the growth
in air travel demand as a significant theme as featured in Appendix, Quote 6.0.

The study’s findings also reflect the difficulties and limitations associated with sustainable propulsion technologies, particularly hydrogen propulsion. As a senior female engineer noted in Quote 7.0, Rivard et al (2019) discusses the drawbacks and technological challenges related to hydrogen propulsion, including low efficiency and stability issues.

Infrastructure issues and the high implementation costs of hydrogen infrastructure are also recognized as impediments to sustainable aviation by Airbus (2021) and Gray et al (2021).

The results found no notable differences between the themes identified by male and female engineers. Both cited similar themes and addressed the issues in systematic fashion. However, interestingly, the study highlighted two discrepancies where some junior engineers have noted that the industry requires younger engineers as they have felt that younger engineers. They indicated that the upcoming generation of engineers have more of a sustainability centred mindset due to higher education providers putting more of an emphasis on the former in their curriculum incorporating the SDGs into their technical university work. Meanwhile monetary and recognition factors were exclusively discussed by engineers in a senior capacity which will be discussed in detail below.

**Improvements**

The participants cited the following improvement/mitigation methods to help propel the industry into more sustainable means in the face of the discussed impediments. These can be seen in table 1.

**Table 1. Themes identified from the results**

<table>
<thead>
<tr>
<th>Identified themes</th>
<th>No. of respondents citing</th>
<th>Frequency of mentions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education for SD</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Monetary incentives / recognition</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Governmental regulations and subsidies</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

Source: Authors

The participants in the study emphasised the significance of educating engineers in the aerospace industry about their environmental impact and the need for more rewards and recognition for employees endeavouring to fulfil said goals, with a senior male engineer reiterating this in Appendix, Quote 8.0. These findings align with the works of Quilty 2003, Shafii et al 2006 who underline the importance of education and training in achieving a sustainable mindset. Moreover, Oto et al (2012) comment that a sustainability centred aerospace industry can be achieved through the education and training for employees, stakeholders, and the general public.

Their work has also identified Government monetary incentives as a major factor that would accelerate the transition. A senior male participant reiterated these sentiments in appendix quote 9.0.

Madu et al (2017) conducted a study in the transportation industry which found that monetary incentives and recognition have enhanced workforce performance. Similarly, Participants in this study have lauded Airbus’s patent systems for motivating innovation through rewards citing it as a compelling reason to help the industry shift to more sustainable means due to the monetary rewards and recognition it provides.

Secondly, they emphasised the necessity of increased governmental pressure and financial incentives for sustainable advancements in aerospace companies. This aligns with the works of Gray et al (2021) and Mousavi & Bossink (2017) which noted that the lack of regulatory pressure and financial obstacles hindered the adoption of alternative fuel adoption such as Sustainable Aviation Fuels.

Gössling et al (2017) and Larsson et al (2019) similarly identified obstacles like government tax exemptions on jet fuel and lack of subsidies as factors that are delaying a sustainable shift. These findings align with participants’ views, emphasising government intervention’s vital role in sustainable transformations. A model (fig.2) visually represents the identified factors.

**Figure 2: Model on the aerospace sector’s motivation to sustainable transition:**
Conclusion and future work

In conclusion, the research aids policymakers and companies transitioning to more sustainable means, providing a modifiable framework. Motivators and industry barriers, like legislation and economic issues, were identified, resulting in a transition framework. Qualitative study limitations include limited responses and generalisability, considering the regional focus.

Future research should test the model using quantitative and mixed methods approaches for a comprehensive understanding. Expanding the scope beyond commercial aviation to include all aerospace sectors is recommended for a holistic view of sustainability challenges and opportunities.

References


Bakthavatchaalam, V. 2018. Motivation to conduct research in a rapidly evolving academic environment: Study of Coimbatore's engineering institutions. PhD, University of Plymouth, Plymouth, UK.


Appendix

Quotes 1.0 - Two Senior male engineers

"Aerospace manufacturers are developing more of a sustainable outlook, not just in terms of materials and the manufacturing process but in terms of life and work life balance and how you do your job which is motivating”

"I think my job does require me to think in a way where sustainability is, something that needs to be considered and an aim to fulfill throughout our work. I'm asked for my input”

Quote 2.0 - Senior female engineer

"Yeah, lots of freedom. The sustainable Development Goals are so broad that it's almost hard to know well how to get specific action in place towards applying this mindset and having this creative freedom is very motivating”.

Quote 3.0- senior male engineer

"Legislation is problematic now as aircraft legislation isn’t bound by a universal system rather the country it’s travelling to which creates confusion consequently increasing conformity complexities on the industry due to the vagueness limiting innovation due to a lack of collaboration”.

Quote 4.0- Junior male engineer

"For our company, the projects, like the hydrogen ones, they have plenty of complex and challenging aspects but lack defined problems and have broad goals. We find this demotivating even though the complexity is enjoyable”.

Quote 5.0- senior male engineer

"Technologies such as hydrogen propulsion systems are not ready yet and they are a lot of safety regulation aspects that we must go through before they are certified which slows the transition”

Quote 6.0- junior female engineer

"There is a massive growing demand in terms of consumers, everyone wants to fly and it’s as cheap as it ever has been, even though we are creating more efficient aircrafts we end up putting more aircrafts back in the air to essentially produce the same amount of carbon emissions”.

Quote 7.0- senior female engineer

"We lack the proper infrastructure necessary to run with these new technologies, we need to put in the infrastructure into place to say as soon as we can and as soon as we have the money if we’re ever going to use for example hydrogen or electricity with aviation”

Quote 8.0- two senior male engineers

"We need to try and instill a sustainability mindset in all engineers working in the aerospace industry to see a shift”.

"We can encourage change also by rewarding employees, so instead of using the stick, use the carrot whether they’re through money or appreciation”.

Quote 9.0- senior male engineer

"The government can help further motivate the industry by trying to incentivize things and it needs to put some money into the industry to motivate more sustainability related projects”.