FORESIGHT FACTORY

BRITISH AIRWAYS

BA 2119: FLIGHT OF THE FUTURE

A ground-breaking study by British Airways

C O N T E N T S

FOREWORD

This year sees British Airways reach its centenary – a milestone in global aviation and a moment for us to reflect on the past 100 years and to look forward to the next 100 years.

British Airways is here today because of the people – our customers and colleagues – who've chosen to fly and work with us. They've made us who we are today. They drive us to improve, to innovate and move forward.

The pace of technological change is faster than ever before. In a few short years, technology has automated processes that, even 20 years ago, we wouldn't have believed possible, from machines that scan our retinas to board aeroplanes faster, to remote controlled robots that can effortlessly manoeuvre 75 tonne aircraft.

To mark our centenary, we wanted to look to the future of aviation. We conducted this in-depth global research to explore what travellers can expect from aviation in 20, 40, 60, even 100 years from now.

Our BA 2119: Flight of the Future Report brings together the results of one of the largest global consumer travel surveys of its kind, exploring new technological, scientific and socioeconomic drivers of change and culminating with a vision of the flight of the future. And the findings are fascinating – from the possibility of 3D printing of food, to super slow air cruises to organisms that collect water from the air outside the aircraft.

I hope you enjoy the BA 2119: Flight of the Future Report and that it sparks your curiosity. I'd like to thank the experts at Foresight Factory for their expertise and to thank the industry experts and futurologists who gave their time and insights to make this such an interesting and in-depth report.

Finally, thank you to the people who choose to fly and work with us every day.
You make us British Airways.

Alex Cruz,
Chairman & Chief Executive, British Airways

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EXECUTIVE SUMMARY

The world is changing and travellers' expectations are changing too. What will air travel look like for humankind in 10, 20, 50 or even 100 years' time? Our BA 2119: Flight of the Future Report brings together the results of one of the largest global consumer travel surveys of its kind, exploring new technological, scientific and socioeconomic drivers of change and culminating with a vision of the flight of the future.

In Part One of our report we present exclusive new quantitative research to explore the aspirations travellers have towards their flying experience today, in 2019. Our global survey of 13,000 travellers around the world found that they are expecting and seeking ever more convenience and efficiency alongside new, personalised experiences.

Those surveyed believe that new technologies including virtual reality and artificial intelligence will offer them an enhanced flying experience. More than half of global consumers, and in China and India a huge 80% of respondents, say they are excited about the possibility of immersing themselves in new, virtual worlds of their choosing while they fly.

Two-thirds say they would be keen to try out an AI personal assistant during their flight, but that despite technological advancements customer service delivered by airline cabin crew, remains a critical requirement with 75% percent of travellers saying that they appreciate speaking to a real person for more detailed requests.

The research found that consumers are increasingly asking for a more personal and social travel experience. Almost two-thirds of respondents say that they would welcome the chance to pick and choose the elements of their journey that they would like to upgrade and enhance such as food options and entertainment. There was also a strong trend towards a more adaptable space that can be configured to individual's needs. The idea of a communal space for socialising was particularly prevalent in emerging markets such as India, but that falls to a low of 20% to 30% in advanced markets such as Japan, Germany and the UK where a more private experience is preferred.

Reflecting environmental concerns 43% of consumers surveyed say that, given the choice, they would be prepared to pay more to take a flight that produced fewer emissions and 45% say they would fly for longer and opt for the slowest available flight if it was the most environmentally friendly.

All of which suggests that there are opportunities for the airline industry to develop a growing range of service and experiential offers that will provide the airline industry with huge potential to define the flying experience of the future.

In Part Two of the research, following extensive consultation with industry experts and futurologists, we explore the long-term technological, scientific and socioeconomic drivers of change that will shape the future of flying. These drivers provide a framework for understanding the emerging capabilities and opportunities that the airline industry will adopt to respond to the evolving nature of traveller aspirations apparent in 2019.

Advances in jet propulsion technology, spurred on by new waves of investment and innovation, are making the resurgence of supersonic travel a real possibility with the likelihood that a new generation of quieter, faster aircraft will make the world a much smaller place.

Electrification, and other emerging sustainable energy sources such as waste to jet fuel, will soon offer new possibilities for powering flights. Our research highlights the possibility of slower than traditional air travel, setting up a dichotomy between the convenience of supersonic flights and the sustainability of new energy travel.

By 2050 it is expected that 68% of the world's population will live in megacities and that this will drive the emergence of new, dynamic flights, which will transport people between large metropolitan areas. A host of new craft, including mono-passenger VTOLs (vertical take-off and landing craft) will become common-place and they will integrate with other new transport modes such as hyperloop trains to offer a more comprehensive and personal travel experience.

Catering to a wide diversity of travel styles will be possible thanks to rising global affluence, especially in markets such as China and India, which will see average annual consumer spending on transport grow more than 5% year on year over the next ten years.

That growth in consumer spending will drive the rise of hyper-personalisation. Trackers and sensors will allow for more bespoke products and services to be offered to those flying giving travellers an experience that is tailored to their own bodies. For example, advising travellers when and what they should be consuming or advising them when and how to move. Personalised health services, which are already arriving in the market and gaining in popularity with travellers keen to manage every aspect of their well-being, will take dynamic biological data and advise consumers how to improve their experiences and optimise their health with the help of personal devices.

Technology is set to change the entire flying experience – augmented reality will allow for the integration of windowless aeroplanes, offering travellers personalised virtual worlds within the cabin. And automation will continue to progress with the likelihood that robots will undertake basic functions on board, allowing more time for cabin crew to offer more attentive and personalised services to travellers.

In Part Three, we examine five possible scenarios in detail for how flying will change for travellers of the future. By using the range of new opportunities presented by the drivers of change, aviation will be able to take on a range of new forms; from the ability to travel faster and more efficiently across the globe to increasingly experiential and environmentally conscious forms of flying.

The first two scenarios explore how new methods of jet propulsion will enable much shorter flight times for passengers.

Supersonic Transport Ecosystem explores how demands for faster travel will bring together all parts of a consumer's journey, creating a seamless experience through modular transport systems, from leaving the office or home to arriving at an individual's destination. An integrated hyperloop-style transit system sees passengers finding their assigned seat on a train, which is smoothly loaded and integrated onto an aeroplane, with seamless security processes.

My Flight, My Way focuses on how personalisation will impact the in-flight experience on aircraft. AI-powered personalisation will enable passengers to bring cloud-based work and entertainment profiles to their seats, while holographic flight attendants will field basic questions and requests, freeing up cabin crew to offer more value-added interactions.

While the first two scenarios focus on the changes that reduced flight times will bring, the next two focus on slower aircraft. As we become increasingly aware of our impact on the environment, in addition to more efficient aircraft with sustainable fuel sources such as biodiesels, we predict the desire to limit carbon emissions will create a transition towards slower vessels that are carbon neutral or even carbon negative.

Sustainable Skies sees solar panels attached to aircraft to provide a constant source of energy while flying, as well as aerial recharging stations that provide energy through linear induction without requiring the aircraft to land. In the near term, electricity and alternative fuels will take over from fossil fuels and carbon capture facilities on board will enable the aircraft to pull CO2 from the atmosphere.

We suggest that longer flights become an opportunity to offer experiential, learning or health opportunities. **Air-time Reimagined** imagines larger craft with on-board zones available for different activities. These could include immersive entertainment, language lessons and destination information, or health-driven facilities allowing passengers to feel better at the end of the journey than at the beginning.

The final scenario focuses on the way fluid formats will enable different kinds of travel, especially in the context of short-distance journeys.

The ability via autonomous VTOL (vertical take-off and landing) modular drones to transport people from their homes, via aerial highways, to a wide number of destinations, all much more quickly than ground transport, will revolutionise passenger travel. The **Skytrain** scenario sees these drones grouping together to travel in parallel for some of the journey, making it safer and more energy efficient, before splitting off again to land at different destinations.

The scenarios presented in this report provide a window to the long-term future of flying, suggesting how the industry will be able to respond to evolving customer aspirations and thrive in the coming century.

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PART

01

FLYING IN 2019

Global attitudes towards the flying experience today

In this opening chapter, we explore the current views of global consumers towards flying. Here we present exclusive new research conducted across 10 global markets during the first half of 2019, exploring all aspects of air travel. Taken together, the findings present a holistic view on customer expectations and aspirations to flying today, drawing a line in the sand for the state of the market in 2019 and providing the foundations to explore the future of flying in subsequent chapters.

Convenience vs. Experience:

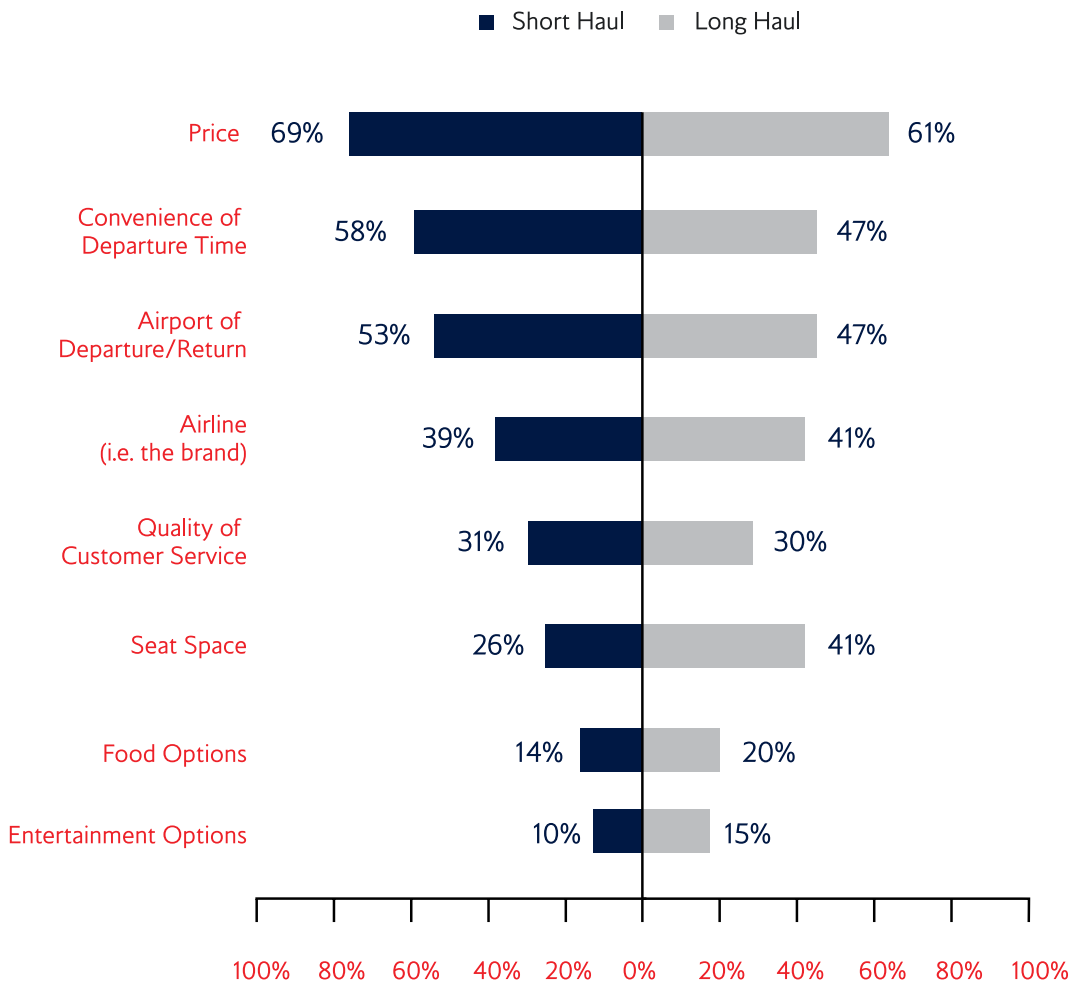
The paradigm shaping consumer attitudes to flying in 2019*

With more options available at their fingertips than ever before, it is fascinating to explore what matters most to global consumers when choosing their flights, and whether functional or experiential factors tend to be stronger motivators.

It quickly transpires that functional attributes are key. Looking specifically at what is considered most important when choosing short-haul flights, price firmly comes out top, followed by convenience of flight departure time and airport of flight departure/return. More experiential attributes such as airline brand, quality of customer service and seat space rank significantly lower, demonstrating how consumers care most about getting the best value for money and making the travel journey as seamless as possible.

* Unless otherwise stated, all data presented in this chapter is taken from the global research conducted by Foresight Factory in the first half of 2019.
For more information on this research, please see the methodology on page 47.

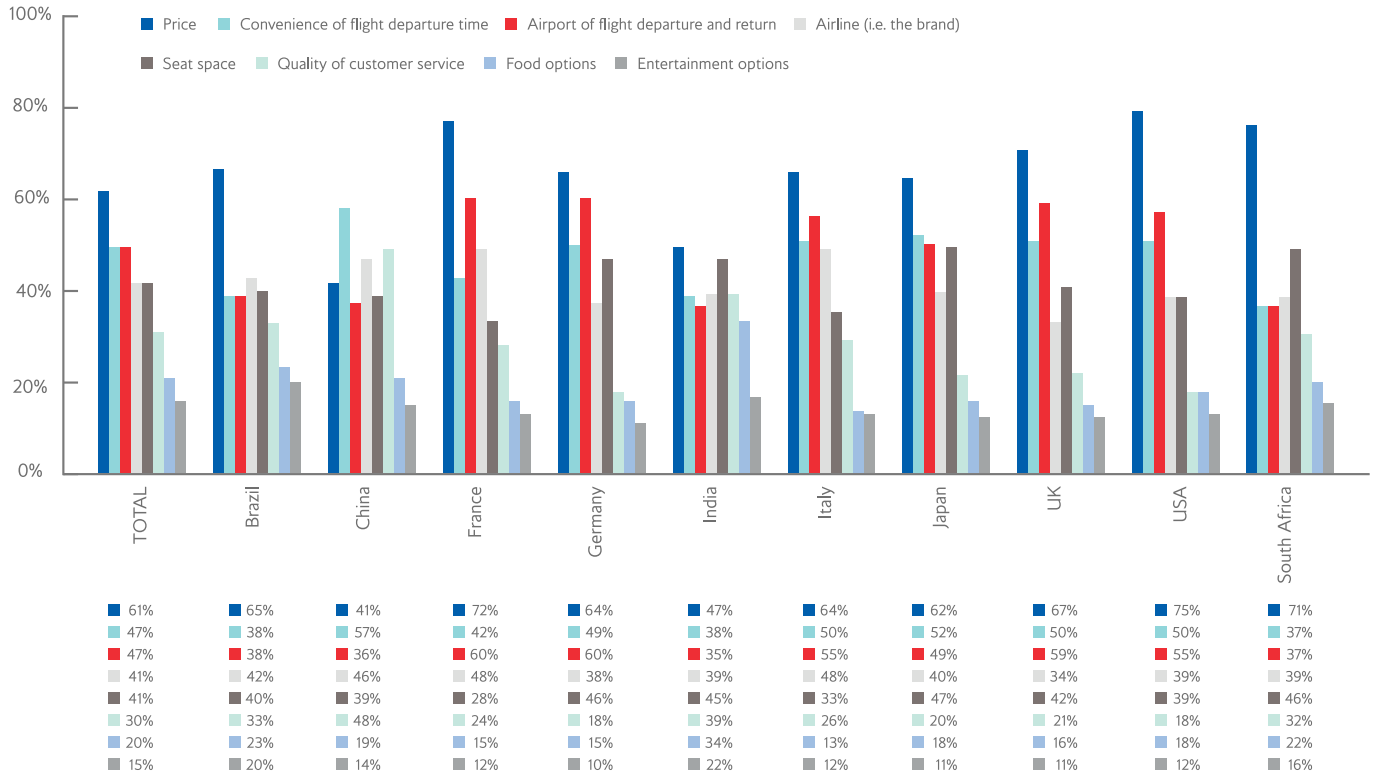
Please rank the following in terms of their importance to you when choosing
SHORT vs. LONG HAUL flights | % ranking within top three



While these functional features remain dominant when consumers are choosing how to travel long haul, it is notable that experiential elements are considered to a greater extent in this context and that they have an opportunity here to serve as differentiators when passengers book their journey.

The priorities of global consumers when flying also reveal interesting nuances based on where they are from. Price, for example, ranks as most important in the decision-making process in all markets for both short- and long-haul travel, with the exception of China, where consumers prioritise the convenience of the flight departure time. Reflecting this, just over one in two Chinese travellers also claim they would go for a flight option that gets them to their destination twice as fast, even if it would mean they need to stretch to the very top of their budget. Only Indian and Brazilian consumers are more likely to agree. Furthermore, Chinese travellers over-index in terms of the extent to which they value customer service, while the airport of departure/arrival tends to be more important for Europeans.

Please rank the following in terms of their importance to you when choosing
LONG HAUL flights | % ranking within top three



76%

OF GLOBAL CONSUMERS
ENJOY TRAVELLING BY AEROPLANE

OVER
60%

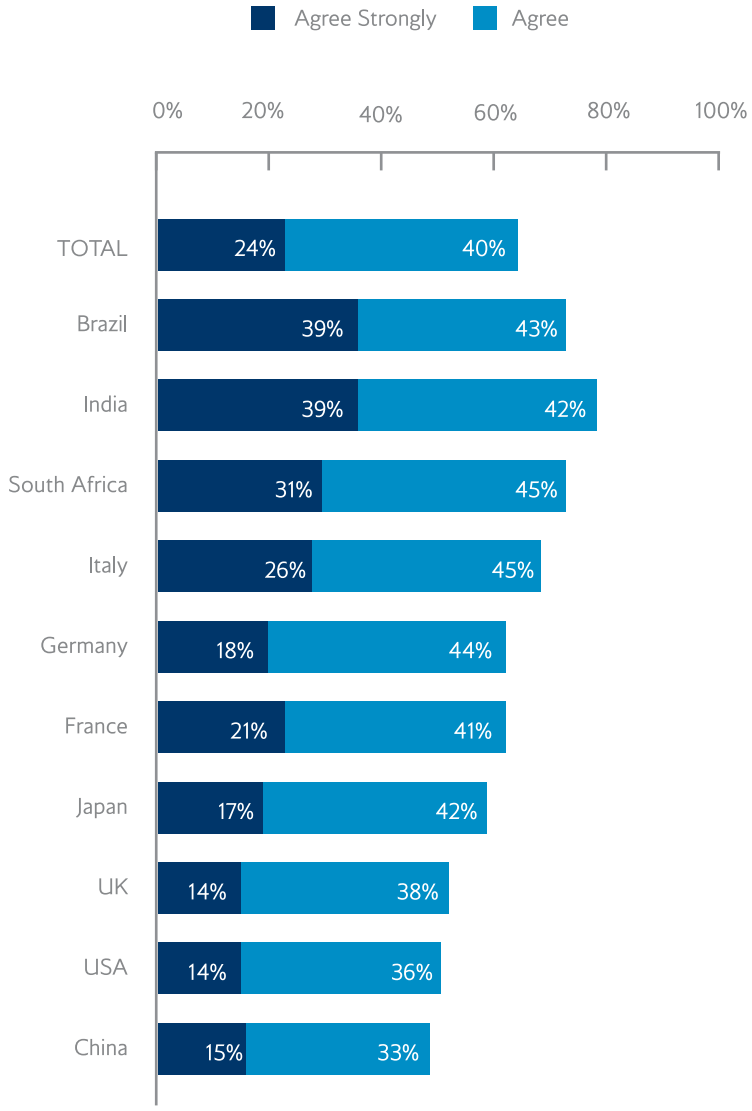
FIND TRAVEL BY AEROPLANE
EXCITING

Despite the rational behaviour that consumers demonstrate when choosing their flights, travel by aeroplane is still very much seen as an experience in its own right. 76% of global consumers say they enjoy travelling by aeroplane and while agreement levels are especially high in developing markets, majorities across all the markets in our survey concur. The joy of flying extends beyond mere gratification: over 6 in 10 would go as far as saying they find travel by aeroplane exciting.

As consumer expectations continue to evolve, a diverse array of demands will need to be met. While functional needs are a core requirement for those booking travel, and will go on to lead the decision-making process, experiences do have the potential to help consumers differentiate between different offers, as they promise to elevate the journey by tapping into people's enjoyment of air travel.

Below we explore the core attitudes that indicate customer preferences and aspirations across both the functional and experiential aspects of flying.

"I find flying onboard an aircraft exciting"
% who agree or agree strongly



A Second Home:

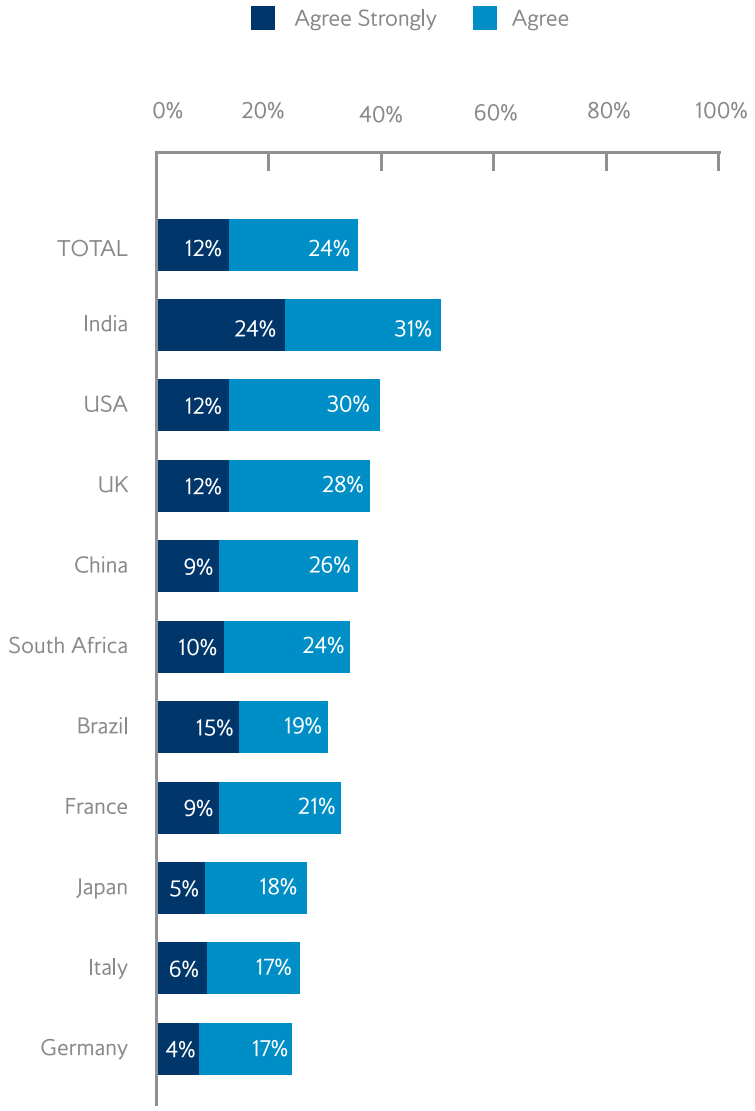
Growing expectations of onboard services

Despite it being a minority attitude, it is notable that 36% of global respondents admit to rarely being comfortable when travelling by aeroplane. Consumers in India, the US and the UK in particular are likely to experience frequent discomfort during flights. This highlights how the ever-evolving consumer demands we see in other areas of life are translating directly to the travel experience, leading to disappointment when they are not addressed. People are keen to replicate the comfort they are used to at home when travelling, without having to compromise on their usual habits, preferences and luxuries.

36%

OF GLOBAL CONSUMERS ARE
RARELY COMFORTABLE
TRAVELLING BY AEROPLANE

"I am rarely comfortable when travelling by aeroplane"
% who agree or agree strongly



64%

OF GLOBAL CONSUMERS THINK
VARIETY AND FRESHNESS
OF IN-FLIGHT FOOD IS IMPORTANT

40%

STRESS THE IMPORTANCE OF
NUTRITIONAL VALUE

Specifically looking at the entertainment options consumers value on aeroplanes, there is demand for recent (the latest films, TV shows, music, books and games) and quality content (surround-sound headphones and HD). Seamless access to this content is also imperative. Inflight Wi-Fi access and the ability to use your own devices have both made it into the top three most important entertainment features.

As their relationship with food has become a key identifier for modern consumers, this is another area in which passengers are reluctant to make sacrifices during flights. More so than the range of menu options available or the time at which food gets served during the journey, consumers rate the freshness of the food being served to as being important, with no less than 64% of all respondents highlighting this as a vital aspect of the inflight food offering. 4 in 10 also stress the importance of the food's nutritional value, and significant proportions of consumers list even more specific preferences, such as the availability of vegan/vegetarian options, the seasonality of food or waste handling practices.

Beyond the introduction of more extensive entertainment and food options, modular seating options would go a long way in truly creating a sense of "being at home" for passengers, as the space they are in would then be able to more seamlessly adjust to their needs and preferred experience at any given time. Gone would be the days of aeroplane journeys restricting passengers to a limited range of activities.

Perhaps not surprisingly, no less than 84% of consumers would be keen on a aeroplane seat that can transform into a sleeping area, but a range of other options appeal as well. For example, 65% would like to see their seat being able to morph into an entertainment space, while 54% are interested in seeing it turn into a working area. The desire for a seat that can transform into a social or exercising area is less widespread yet still significant, with its appeal varying strongly depending on where the consumer is from.

84%

OF CONSUMERS WOULD LIKE TO SEE THEIR SEAT TURN INTO A **SLEEPING AREA**

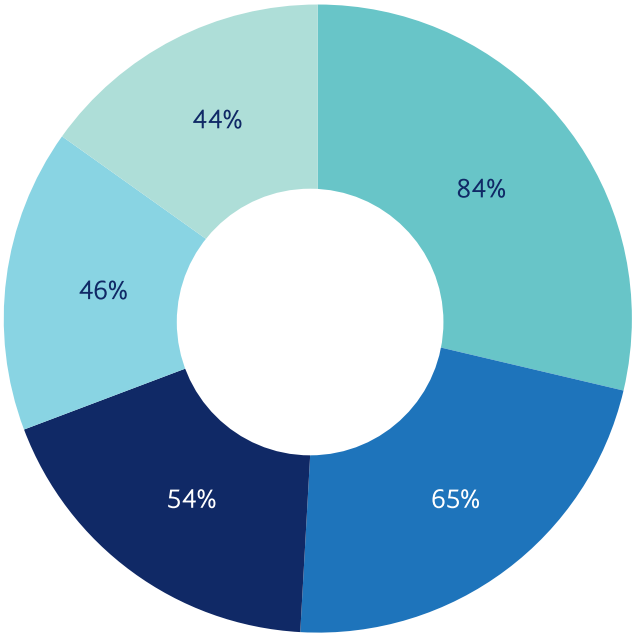
65%

OF CONSUMERS WOULD LIKE TO SEE THEIR SEAT TURN INTO AN **ENTERTAINMENT SPACE**

54%

OF CONSUMERS WOULD LIKE TO SEE THEIR SEAT TURN INTO A **WORKING AREA**

How interested would you be in your aeroplane seat transforming into each of the following?
% who are very or quite interested (Global Average)



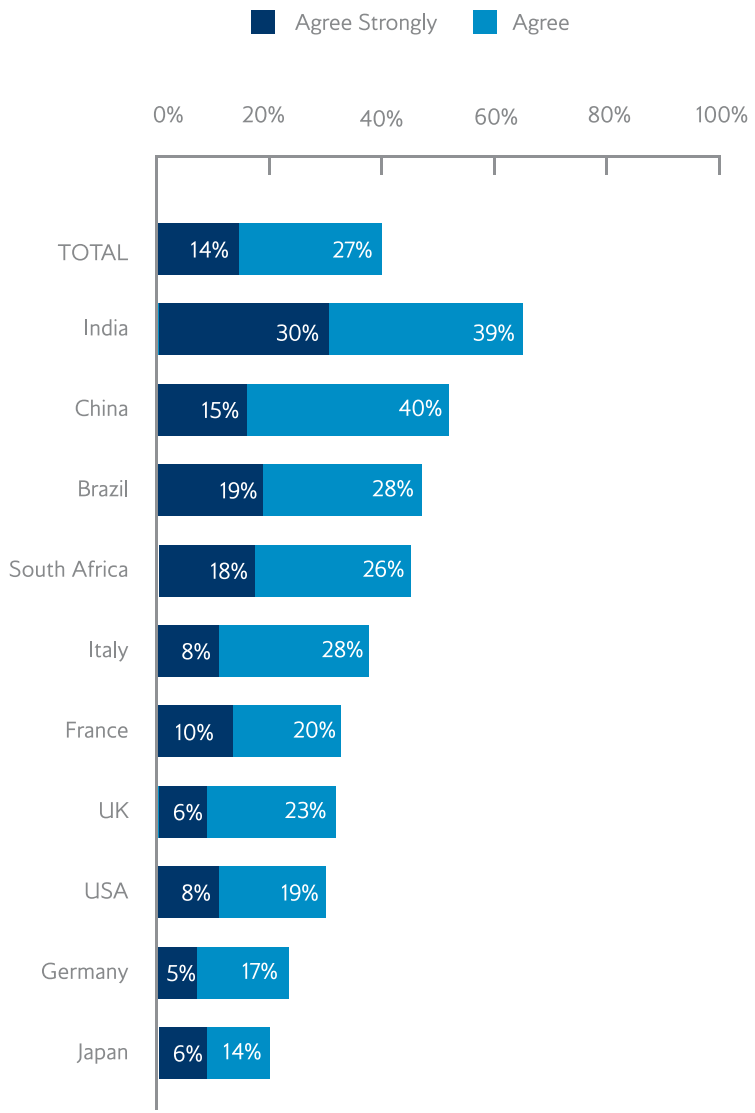
An exercising area | A socialising area | A working area | An entertainment area | A sleeping area

The aeroplane as a social space is an interesting theme to consider, as it challenges the perception of the flight as a mostly individual experience. Around 4 in 10 consumers say they enjoy socialising on aeroplanes, so it is worth exploring what this could look like in practice. We mentioned the option of having a seat that transforms into a social area, which appeals to 46% of consumers. A similar proportion also demonstrate interest in aeroplanes with a dedicated communal space for socialising, which could involve educational or social learning experiences. However, stark cultural differences are at play, with consumers from emerging markets and Italy showing more appetite for these options, while German and Japanese consumers seemingly prefer a more private experience.

For consumers, feeling at home on a flight is all about having the possibility to do the things that are important to them in their daily lives. Leveraging this through more advanced food and entertainment options, as well as a more flexible aeroplane layout, can raise the flight experience to new heights.

A SEAT THAT TRANSFORMS INTO
A SOCIAL AREA
APPEALS TO
46%
OF GLOBAL CONSUMERS

"I would like aeroplanes to have communal spaces for socialising"
% who agree or agree strongly



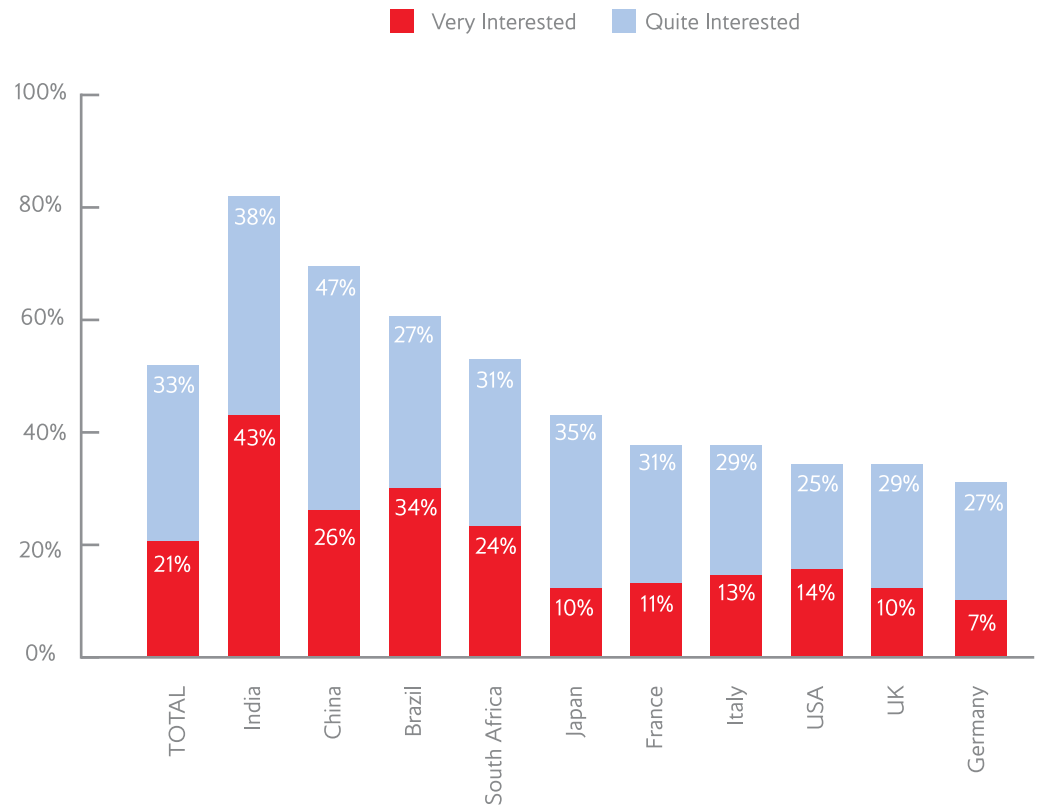
New Worlds:

Interest in new immersion technology to transport passengers to new realities

Building on the idea of flexibility discussed previously, new technologies are increasingly making it possible for passengers to be transported into alternate, customisable realities which can be dialled up or down depending on the extent to which someone wants to be immersed in the "other" world. While this is no doubt a great asset for travellers who are potentially anxious about getting on a aeroplane, it can also improve the experience for those who do enjoy flying and rather than wanting to escape, seek to take their journey to the next level.

There are different ways in which this can be made possible. On one hand, there is the possibility of turning all surfaces of the aeroplane into digital screens, which can display anything from entertainment or information to aesthetic or sensory visual features which can tailor the surroundings to the individual traveller's own preferences. As screens become more intuitive, interactive and tactile, technology assumes a more embedded role in the passenger experience, appearing only when needed and serving specific needs that arise at any given point.

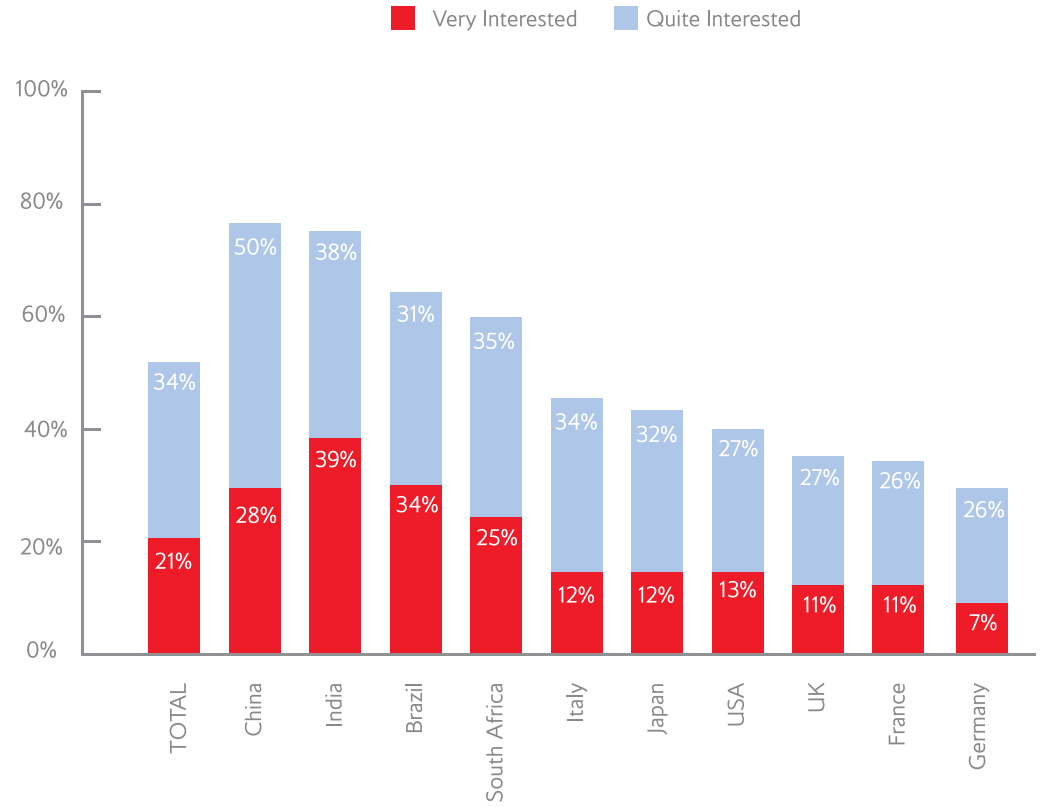
How interested are you in the following futuristic flying/aeroplane services?
"An aeroplane whose interior featured digital screens on all surfaces of the aeroplane"



An alternative application of immersive technology would the introduction of a virtual reality service that allows travellers to immerse themselves in a world of their own choosing, for some or even all of the journey time. This truly transforms the possibilities of the inflight experience, as consumers are no longer restricted to the entertainment options available and can build an experience just for them to enjoy, optimising the time they spend on the aeroplane.

The introduction of immersive technologies is an exciting development for the flight experience, as consumers show great interest in the option of transcending the boundaries of the physical aeroplane by entering a world beyond its walls. This type of innovation allows for the adventure to truly start on board the flight, even before reaching the destination.

How interested are you in the following futuristic flying/aeroplane services?
"A virtual reality inflight service that allowed me to spend all or some of the flight immersed in a virtual world of my choosing"



“

VR technology is incredible; you put on goggles and suddenly you’re in a conference room or a living room and talking with friends who could be on the ground, in another aeroplane, in the same aeroplane. We have the potential to fundamentally change how we think about space.

”

Blake Emery
Director, Differentiation Strategy,
Boeing Commercial Airplanes

The Me Me World:

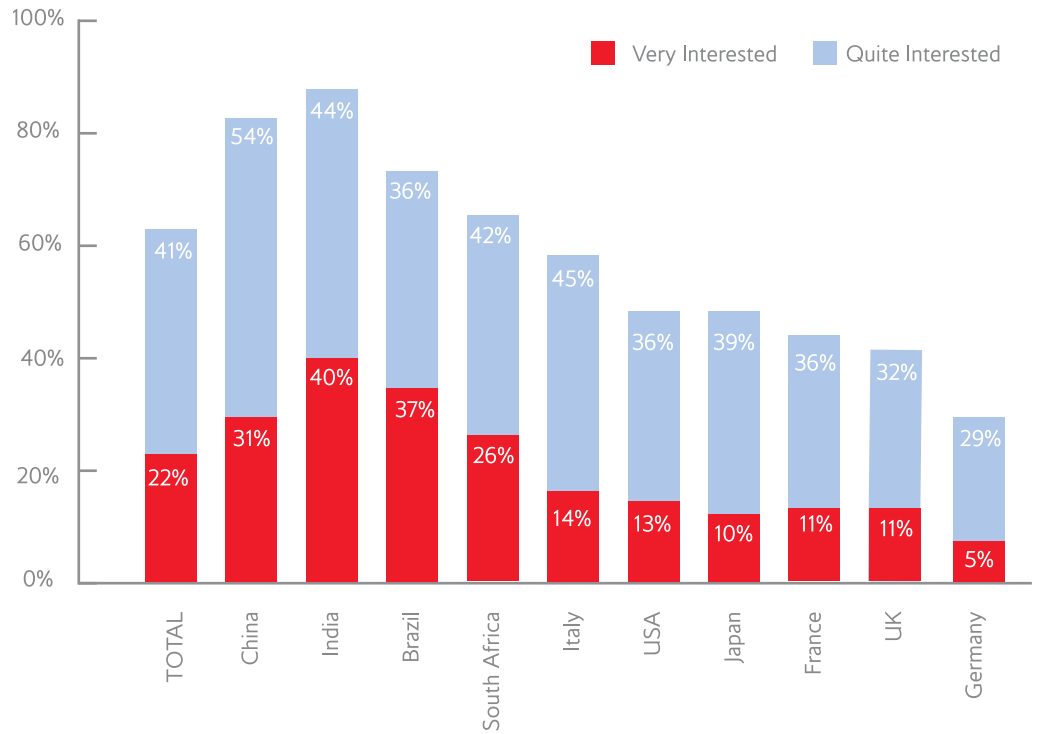
Consumers demand ever greater personalisation across all parts of their journey

As consumers grow more used to the sharing of personal data and the benefits they can receive through doing so, the potential for enhanced, more tailored flight experiences is extensive.

One way in which this can be achieved is through the personalisation of the existing inflight experience, for example through a food service that caters to individual nutritional needs; which also ties in with the more specific demands passengers have from the inflight menu, as discussed in a previous section.

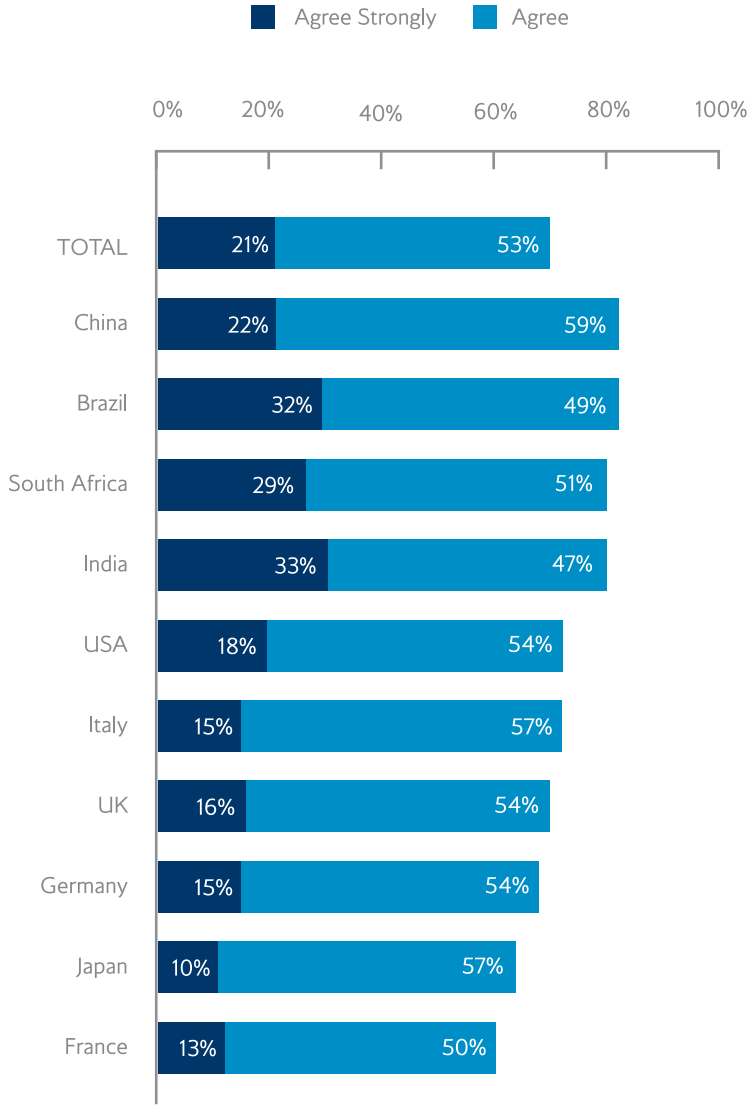
Another example would be an artificial intelligence (AI) customer service assistant with the ability to mine passenger data in order to provide more accurate and bespoke solutions.

How interested are you in the following futuristic flying/aeroplane services?
“An inflight AI personal assistant that could answer my questions about the flight”



Personalisation can also promote a more comfortable aeroplane environment with the help of innovations that manage to address individual preferences in the context of the flight's communal space. Vast majorities of consumers agree that they would like to tailor the lighting within their seating area, further opening exciting possibilities that the same could also be possible for temperature, aroma and other sensorial elements.

"I want to be able to tailor the lighting within my inflight seating area"
% who agree or agree strongly

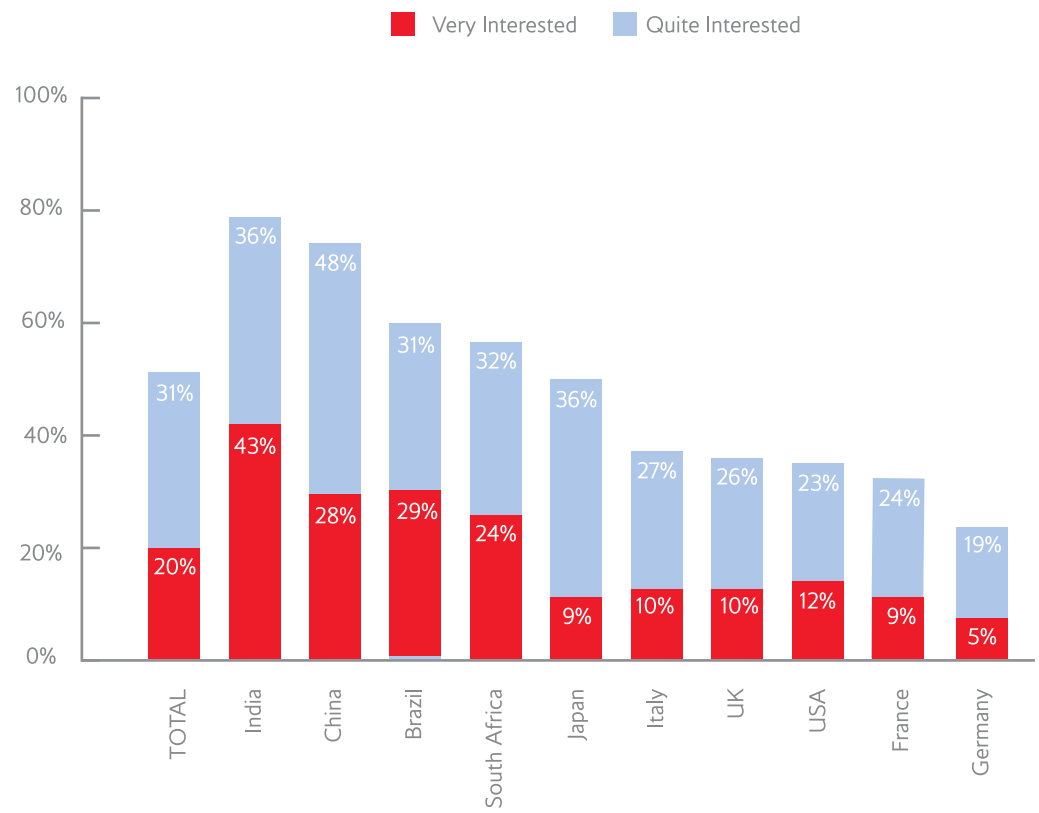


The quality of personalisation depends on the data that feeds into it. Most current personalisation initiatives are based on topline information such as consumer demographics or previous purchasing habits. However, that type of data lacks nuance and fails to address essential real-time insights, such as someone's exact location or how they are feeling at a given time. The future of personalisation will be defined precisely by that type of data collection, i.e., location-based/contextual data, but also sensory data such as information about one's vital signs or mood, for example.

Looking at the research, it appears that many consumers are in fact ready to start sharing more complex insights about themselves in exchange for an improved inflight experience. However, transparency is key, not just because of existing regulation around data sharing practices, but also because consumers tend to open up when they feel as if they are in control of how their data is being collected and used. To illustrate, while an already significant 51% of consumers claim to be interested in an airline service which tracks their mood/sensory data, a very solid 70% show interest in the more specific offer of an inflight entertainment service that tailors content to their mood and preferences.

There are major differences between markets to be aware of. Consumers in emerging markets are most keen on sharing their personal data in return for receiving personalised benefits, while still only a minority of German consumers, for example, are comfortable doing so.

How interested are you in the following futuristic flying/aeroplane services?
"An airline service that monitored your mood/sensory data (e.g. via a sensor you wear)"



Consumers are no longer satisfied with one-size-fits-all solutions, and that needs to be acknowledged in the flight experiences they receive. Whether through the personalisation of the current inflight offer or a more customisable aeroplane environment, the traveller of today is craving a more bespoke approach to flying which manages to fulfil both their functional and emotional demands.

Holistic yet transparent data collection is key, as personalisation will increasingly be expected to stretch beyond mass customisation, allowing for tailoring to each individual based on granular information such as their current mood at any given point.

“

Using technology to understand more about the customer and the customer’s preferences and delivering those customisations onboard in a much more seamless fashion is something that I see changing quite dramatically over the next 10 years.

”

Dupsy Abiola
Head of Global Innovation, IAG

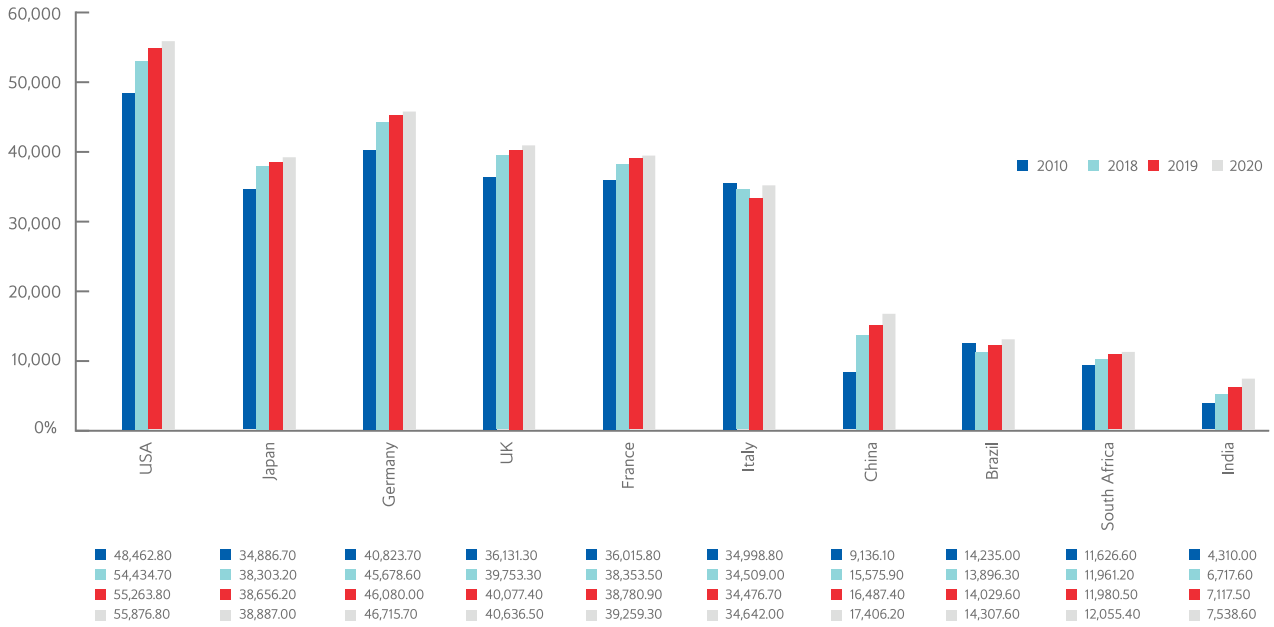
Democratised Luxury:

Flexible premium options expected on-demand

At a global level, prosperity has been growing steadily since the post-war era and has seen a remarkable upward trajectory for the last 50 years, despite more recent economic setbacks that have masked the level of progress to some extent. In the years ahead, affluence is expected to continue its growth in most countries, even if the pace at which this happens varies from market to market.

As Oxford Economics’ historical and forecast data shows us, advanced markets such as the US, Western Europe and Japan remain ahead in terms of GDP per capita, but emerging markets are due to catch up. Even if China’s growth has slowed down, its performance is nonetheless impressive in a global context. Meanwhile, India’s economy is going from strength to strength.

Average real GDP for each person living in the country, in US$ PPP
January 2019 forecast (Oxford Economics, 2019)

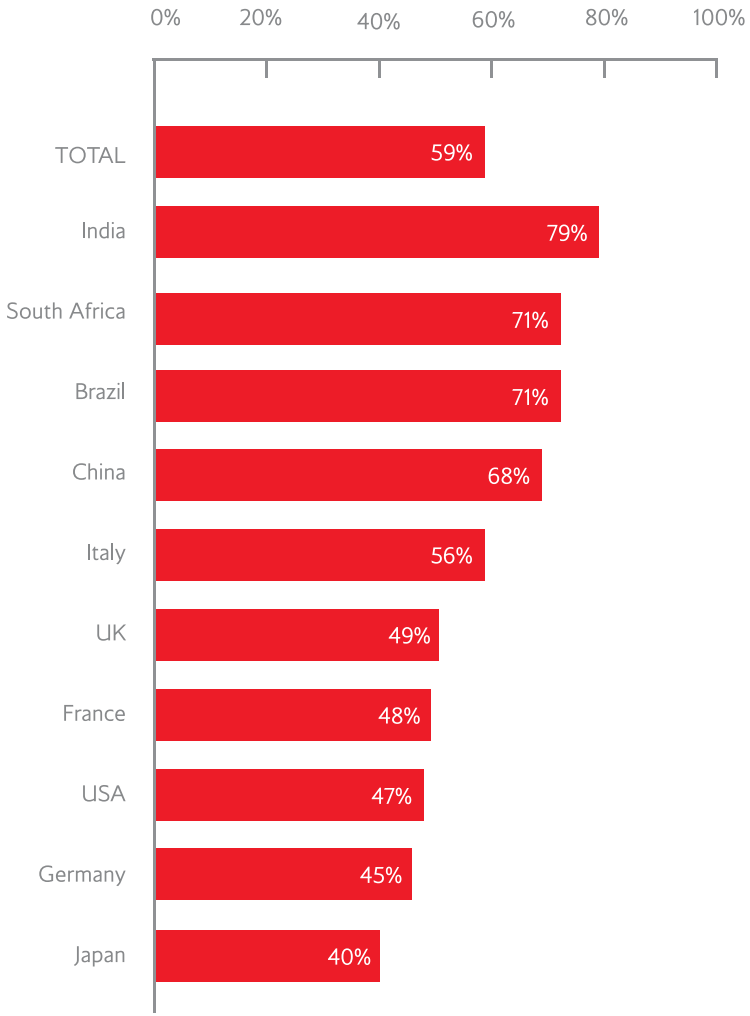


The economic changes we are observing in these emerging markets is driving the growth of the global middle class, which in turn is creating a more affluent audience of consumers who are keen to travel the world and spend their money on new products, services and experiences.

More affluent consumers are typically also more demanding consumers, expecting to be able to access some forms of luxury on their own terms. While they might not have the budget or intention to travel in a premium airline class on all their journeys, the data shows that a majority of consumers would be keen on a system that allows them to customise their travel package and pay for specific aspects of the experience they desire to upgrade. This is especially relevant to consumers in emerging markets such as India and South Africa.

As affluence continues to grow, the airline sector will need to cater not only to the growing middle class with elements of luxury and exclusivity for them to opt in and out of as they wish, but also to the top-end layer of ultra-rich consumers. The latter group's expectations will continue to expand over time, demanding premium services and solutions which stretch significantly beyond what the mainstream audience can access in terms of luxury. Making sure that this audience continues to feel spoken to in a more "mass exclusive" context will be imperative to also maintain their attention over time.

How interested would you be in a new concept of airline 'classes' that, instead of having fixed and separate levels of service allowed you to customise and then pay for specific aspects of the experience you wanted to upgrade?
% who rate interest 7-10 on a 10-point scale



“

The tiered layout that we have at the moment is starting to break down. Going forward, passengers may increasingly be able to tailor their experience to more specific needs; instead of buying a first or business class ticket it might be about buying more space, more significant entertainment or service, similar to hotel rooms; you will be able to package your experience up differently than you do today.

”

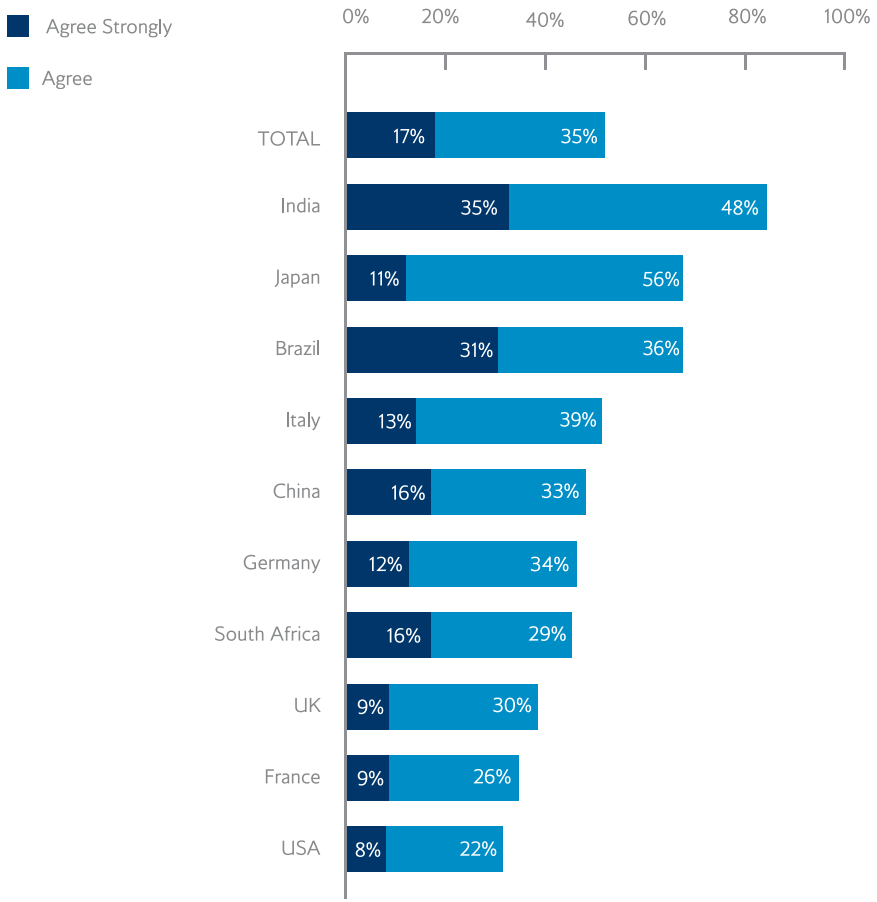
Peter Cooke
Design Lead, British Airways

Seamless Travel:

Putting consumers in control of their entire flying experience

The consumer demand for ultra-convenience, a theme we explored when looking at the key motivations for consumers when booking flights, translates directly to all touchpoints of flying, both during and beyond the flight itself. Currently, just over one in two consumers say they feel in control when travelling by aeroplane but, as large proportions of respondents show strong interest in a range of control-boosting, future inflight services, this number can no doubt grow rapidly if additional efforts are made in this space.

“I feel in control when travelling by aeroplane”
% who agree or agree strongly



Consumers are especially keen on services that would allow them to take care of various aspects of the travel experience while they are still on the aeroplane, to ensure their inflight time is maximised and the journey is as seamless as possible once they disembark. 73% of respondents say they are interested in an inflight digital technology that allows them to self-complete immigration and visa control while they are still in the air. Meanwhile, 63% are keen on an inflight concierge service that organises a hotel for them when they land, and 56% show interest in a similar service that arranges a taxi for them to pick them up at the airport.

In our on-demand culture, there is substantial consumer appetite for a greater level of control at different touchpoints of the travel journey, allowing for a more seamless flight experience from start to finish. Consumers are used to efficient, ultra-convenient solutions in their daily lives and will expect the same level of seamlessness when travelling by aeroplane.

73%

OF CONSUMERS ARE INTERESTED IN AN IN-FLIGHT TECHNOLOGY TO
SELF-COMPLETE IMMIGRATION & VISA CONTROL

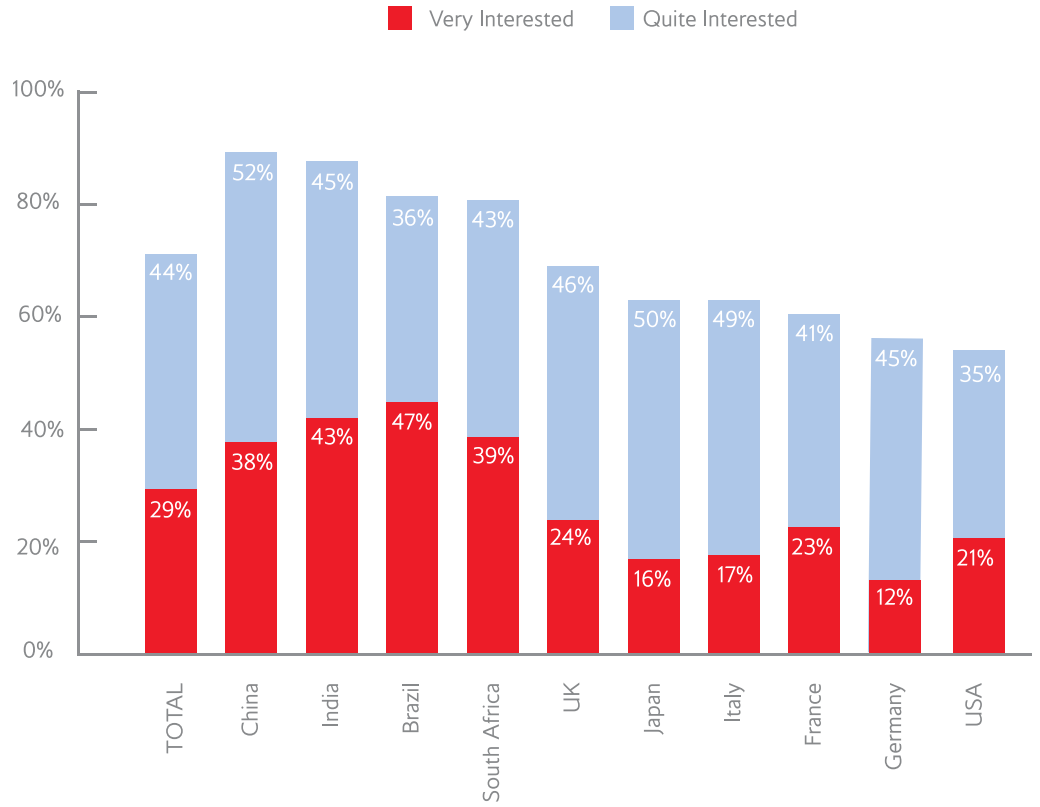
63%

OF CONSUMERS ARE INTERESTED IN AN IN-FLIGHT CONCIERGE SERVICE TO
ORGANISE A HOTEL

56%

OF CONSUMERS ARE INTERESTED IN AN IN-FLIGHT CONCIERGE SERVICE TO
ARRANGE A TAXI TO PICK THEM UP AT THE AIRPORT

How interested are you in the following futuristic flying/aeroplane services?
"An inflight digital technology that allowed me to self-complete immigration and visa control before landing/while flying"



A Human Experience:

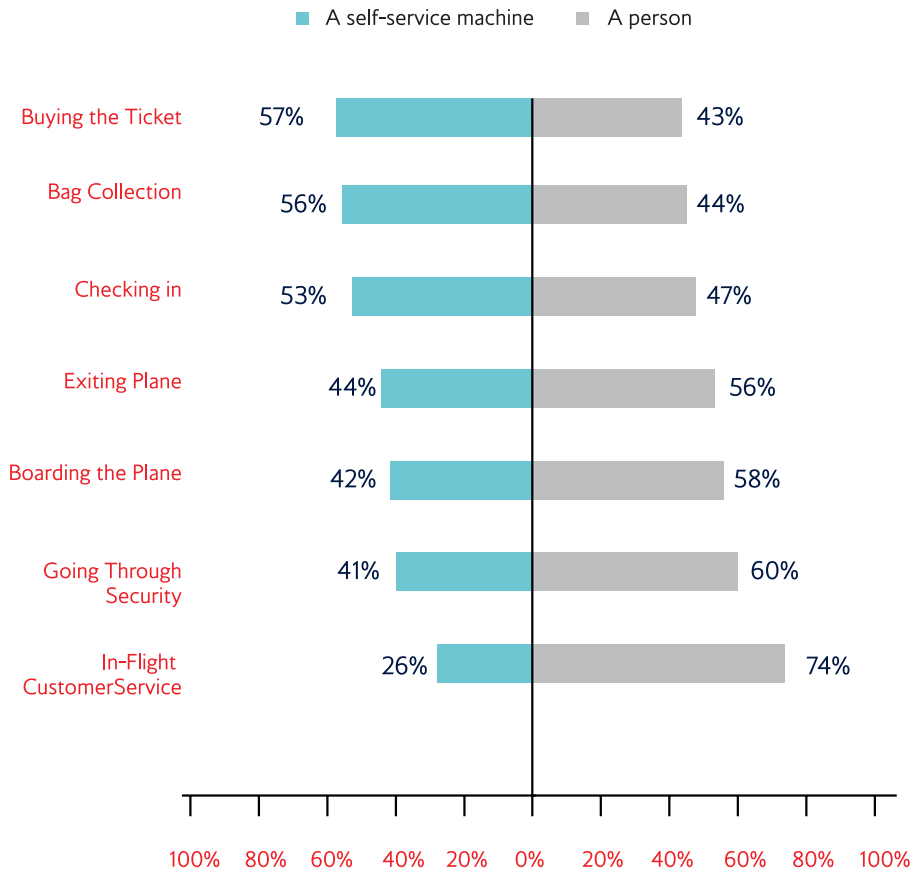
Upgraded and targeted human service is key

In many areas of life, consumers are welcoming the benefits of automated services and machine-based interactions. This makes sense in light of the previous section, in which we discuss the desire for a more seamless travel journey, a goal which AI can help achieve through the removal of traditional pain points.

But are consumers entirely comfortable with the idea of automation, or do they still long for the support of human staff when travelling by aeroplane? This turns out to vary quite decidedly depending on the touchpoint of the journey. For example, more consumers prefer a self-service system when buying an aeroplane ticket, collecting their bags or even checking in. However, more consumers prefer to speak to a person when boarding or exiting the aeroplane, going through security or – most of all – when it comes to inflight service.

This highlights how, while automation holds huge potential for the improvement and streamlining of the travel journey (alongside the delivery of increased personalisation, as discussed in a previous section), consumers still wish to be engaged by people-led services at several stages of their trip. Rather than artificial intelligence replacing human staff, it will play a key role in facilitating the improvement of traditionally complicated aspects of the travel experience, while freeing up human employees to focus on, and truly shine, in those aspects of the journey where consumers most value their presence.

When flying, would you prefer to speak to a person or use a self-service machine during the below points in your journey?
% who select each option, per touchpoint



Health Highlighted:

Air journeys need to cater to a broadening definition of health

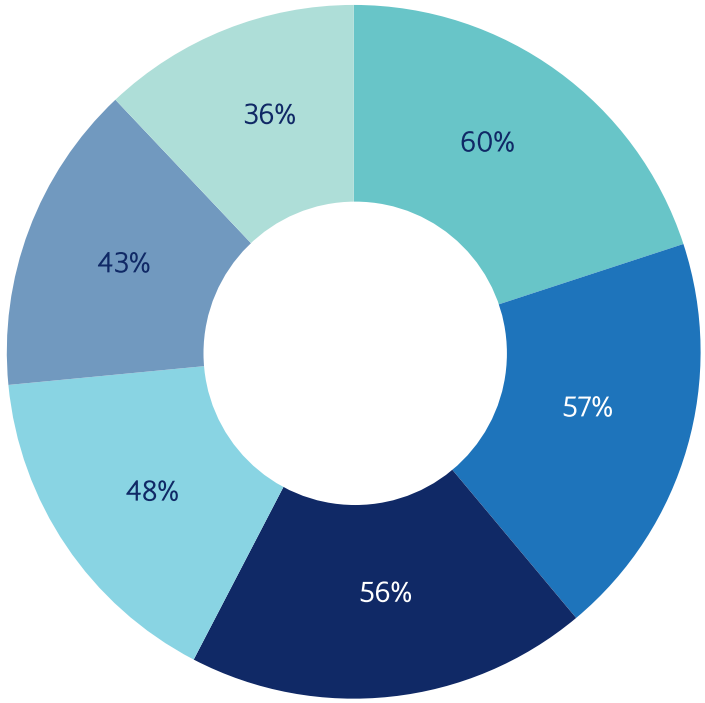
The consumer definition of health has markedly changed in recent years, shifting towards a more holistic perception which considers the importance of many individual factors (e.g., nutrition, quality of sleep, mental wellbeing, physical fitness) in contributing to our overall health.

However, consumers also increasingly understand how our health is not just influenced by the factors we manage ourselves but also those beyond our control, such as the quality of the spaces we spend time in. This can be affected by a range of negative influences, including air and noise pollution, as well as blue light exposure.

This variety of health considerations also comes through in the data, with respondents highlighting a range of factors as being important to them while flying. More so than the ability to walk around on a long-haul flight, consumers rate healthy inflight food options, the ability to sleep, the cleanliness of the seating area, the ability to relax in flight and – in first place – the inflight air quality.

While there are notable differences between markets in terms of which inflight health considerations are most pronounced, consumers everywhere want airlines to address health from a more rounded perspective.

Thinking about health considerations while flying, please rank the following in terms of their importance to you, with 1 being most important
% ranking option in their top three



Environmental Concerns:

A growing factor shaping consumer choice and expectation

In the face of mounting worldwide environmental challenges, 6 in 10 global consumers say they are concerned about what they personally can do to help protect the environment, with countries including Italy, India and Brazil over-indexing on this sentiment.[1]

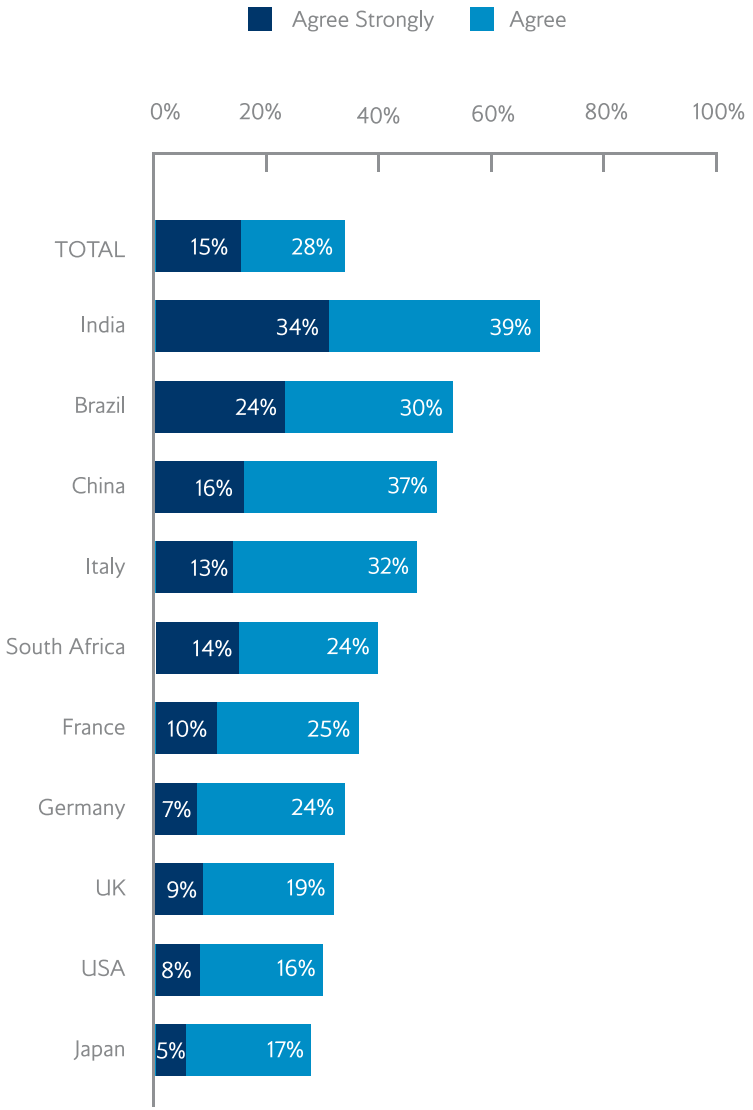
However, especially in the context of ongoing economic uncertainty and busy consumer agendas, environmental intentions are often sidelined for cheaper or more practical offerings. There is a latent expectation that companies act in a more hands-on way and make it easier and more affordable for consumers to contribute to a more sustainable world. This also applies to the airline industry, and while a majority of consumers disagree with the statement, 4 in 10 global consumers believe that airlines care little about their environmental impact.

While results to some extent may be impacted by social desirability, no less than 43% of respondents say they would purchase the eco-friendliest flight even if it would be the most expensive option they could afford. Meanwhile, 45% of consumers would be happy to opt for a flight that got them to their destination slower than other options, if it were the most environmentally friendly.

45%

OF RESPONDENTS WOULD PREFER AN
ENVIRONMENTALLY FRIENDLY
FLIGHT EVEN IF IT MEANT GOING SLOWER

"I would purchase a flight that was the eco-friendliest (e.g., lowest carbon emissions) even if it were the most expensive option I could afford"
% who agree or agree strongly

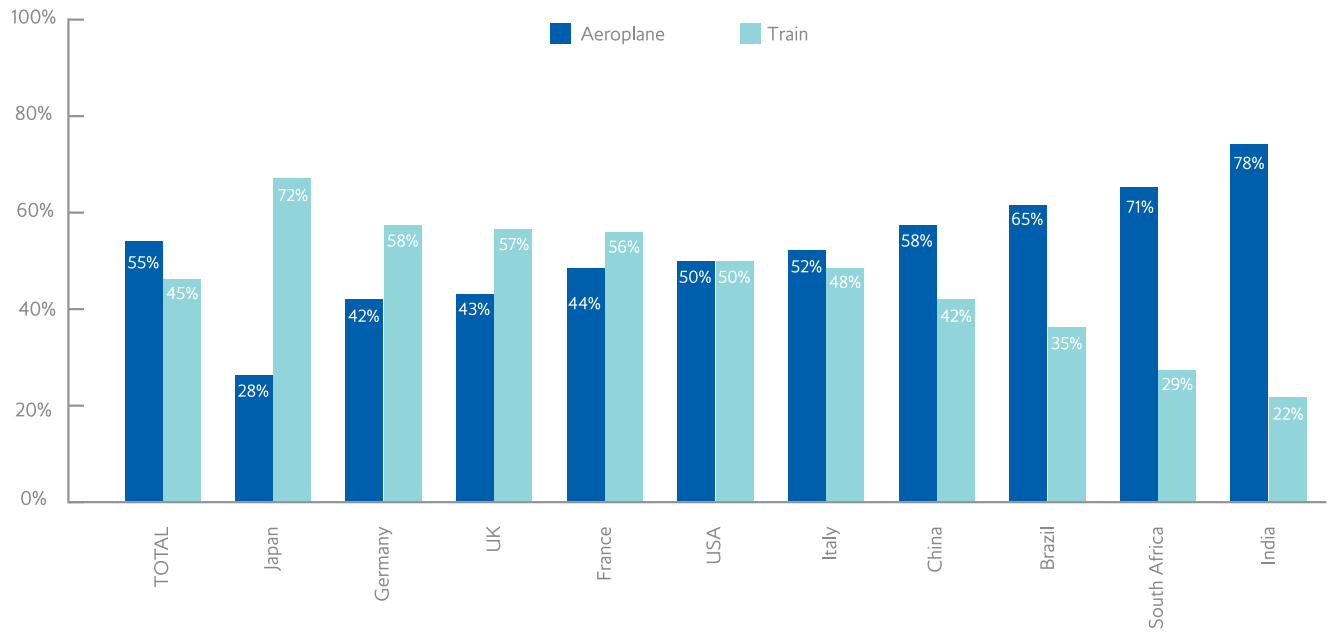


[1] Source: Foresight Factory I Base: 611-3225 online respondents per country aged 16-64 (24 global markets), 2018.

This does not only tell us an interesting story about how intentions regarding more eco-friendly flights are rising to prominence. The latter statistic also highlights that, with consumers considering slower flight times in exchange for more sustainable travel options, they could increasingly look at alternate travel methods altogether. In Japan, Germany, the UK and France, consumers already admit they would rather travel by train than aeroplane if it would take them the same amount of time to reach their destination. With the promise of ultra-fast train travel (e.g., see Hyperloop, page 37), the possibility of train travel as a viable alternative is more real than ever.

As the impact of environmental challenges is becoming more visible in day-to-day life, consumers' intentions to live more sustainably are growing. As the consumer desire to travel the world is at the same time unlikely to diminish, more conscious travel solutions will be welcomed more than ever in the years ahead.

If both options took the same amount of time to reach their destination, would you rather travel by aeroplane or train?
% who select each option



CONCLUSION

In 2019, there is clearly a growing myriad of factors shaping consumer demands, expectations and aspirations towards the flying experience. By responding to these changing needs, airlines can ensure that they capture the dual requirements of providing a functional and experiential service fit for the future. From this starting point, we will now move to consider what forces will drive the longer-term future of flying.

FORESIGHT FACTORY

BRITISH AIRWAYS

PART

02

GETTING TO THE FUTURE

The forces that will shape the future of flying

In this chapter, we explore the forces and drivers that will shape how the experience of flying will evolve over future decades. Such forces include the most fundamental changes in global socioeconomic trends, evolving consumer demand and technological advancements. Together, these long-term drivers provide a timeline to the future and a framework to uncover what the future of flying will look like.

Driver One:

Jet Propulsion Advancement

Throughout the history of modern aviation, supersonic air travel has always managed to capture public interest and imagination. Looking ahead, there is a range of factors that suggests in the next 20 to 40 years, supersonic civilian transportation will re-emerge, heralding a new paradigm for commercial air travel.

A key driver of such advancements is the rapid increase in public and private investment in new supersonic technologies, spurred on by the growth in the space propulsion market, which is projected to reach US$10 billion by 2023. Such investment will unlock new propulsion capabilities and create a possible future where flying at supersonic speeds becomes the norm.

Already there are clear signals of how this future may evolve. For example, through the development of hybrid air-breathing rocket engines which can travel over five times the speed of sound within the atmosphere. Or the exploration by NASA in Low Boom Supersonic Jets that can fly at high altitudes to diminish the effects of a sonic boom.

Such developments will have a dramatic impact on future flying journeys, as flight times become shorter and the experience more constricted. Indeed, the emergence of supersonic jet propulsion will result in a significant decline in the average duration of flights. The average flight time from New York to London will fall from seven hours to just three, and the flight time for Tokyo to San Francisco from 11 hours to under six.

[2] Source: BIS Research, Global Space Propulsion System Market: Analysis and Forecast 2018-2023, 2019

“

NASA is working on how to design spacecraft with a reduced sonic boom, which would make it easier for the wider return of supersonic flight, especially over populated areas.

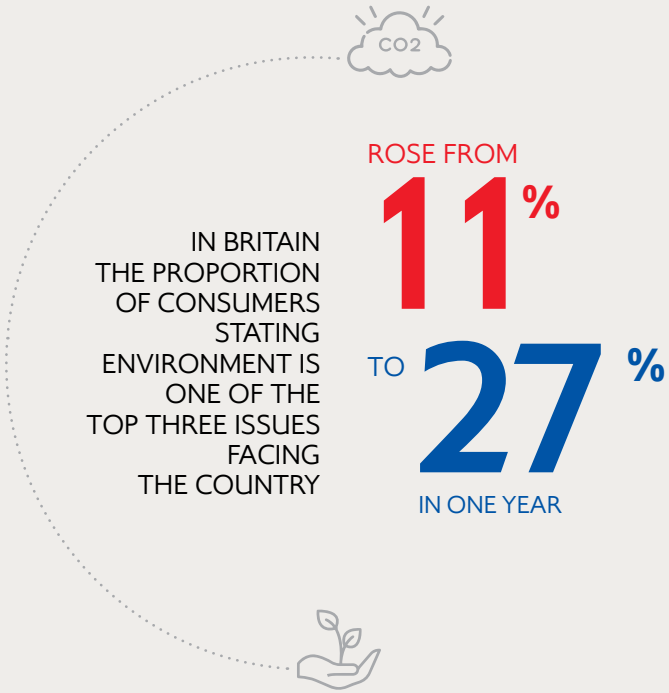
”

Dr. Tibor Balint, PhD
Principal Human Centered Designer,
Jet Propulsion Laboratory,
California Institute of Technology

The NASA ‘Low Boom Flight Demonstration’ got US Government funding in 2019

Photo credit: NASA

Boom Supersonic jets, which are expected to be ready to fly by the mid 2020s, will be able to travel from London to New York in 3 hours and 15 minutes



Driver Two:

Mounting Environmental Concern

In recent years, growing public awareness of environmental issues and their consequences has led consumers across the world to ask themselves what they can do to reduce their impact. As the effects of climate change become increasingly visible, consumer concern will only grow. In Britain, the proportion of consumers stating that the environment is one of the top three issues currently facing their country rose from 11% in June 2018 to 27% in June 2019.[3] In countries on the front lines of the impact of environmental change, this sense of concern will grow even stronger.

In Part One of this report, we learned that consumers are willing to take measures to reduce their environmental impact, such as choosing the more environmentally friendly travel option even if it costs them more. However, these initiatives need to be offered by industry in the first instance. Indeed, consumers are relying on industry to make their desired, eco-friendly choices available and easy.

[3] Source: YouGov, Top Issues Tracker: Great Britain, 2019

“I think over the next 10 to 20 years, there will be a real focus on the world coming together to address emissions and climate change. It’s not just about emissions either, it’s about noise and it’s about air quality as well. I think aviation is going to play its part, and we’re going to take a leading position on sustainability, how we design our infrastructure, and how we operate.”

Robert Sinclair
CEO, London City Airport

There are already companies in the aviation sector taking the lead as trusted partners, helping consumers achieve their goals of living more sustainably. Carbon offsetting, biofuel substitution and the development of carbon-capture technology all point towards a cleaner future for the airline industry. Further out, as environmental considerations become a key design criterion, we will begin to see products and services in the aviation sector that not only minimise environmental impact but also make a positive contribution.

Driver Three:

New Energy Aircraft

Growing awareness of the aviation industry's environmental responsibilities has driven new waves of innovation in sustainable propulsion systems.

Current indications point towards two diverging paradigms of air travel that together aim to address the central issue of carbon emissions. On the one hand, as outlined above, we will see the growth of much faster supersonic flights that get passengers to their destination quickly while still being as efficient as possible. On the other, we expect to see the emergence of new aircraft designs that enable ultra-energy-efficient air travel, harnessing biofuel, electric and solar energy, as well as new engine design.

In the more immediate future, such changes are likely to be driven by the electrification of aircraft for short haul. Not only are we witnessing the development of fully electric aircraft (see below), but also new innovations that will allow existing aircraft to be converted to electric power. For example, Magni X is an Australian company developing an electric propulsion system that can be added to existing aircraft to make them electric-compatible.

Looking further ahead, the role of solar power also presents exciting possibilities. In 2016, the experimental aircraft Solar Impulse 2 circumnavigated the globe on solar power alone. However, this journey took 23 days as the aircraft was restricted to an average speed of 45 miles per hour. It is likely that the more environmentally friendly aircraft of the future will result in longer flight times; possibly even longer than the average flight time today. Consequently, the dual demands for increased convenience and eco-friendly options will be a core tension in understanding future customer choice and demand for air travel.

Ampaire is attempting to create electric aircraft that can reduce both operating costs as well as environmental impact


Solar Impulse 2 was the first aircraft to circumnavigate the globe on solar power alone

Photo credit: © Solar Impulse/ Jean Revillard / Rezo.ch

Driver Four:

Megacity Urbanisation

The structure and organisation of the aviation industry are inextricably linked to the distribution of our populations and cities. By 2050, it is expected that 68% of the world's population will live in cities; potentially adding another 2.5 billion people to urban areas.[4] What's more, this period will also see a rapid growth in the number of global megacities (with a population of over 10 million people). Indeed, by 2030 the United Nations predicts that there will be 43 such megacities, with most of these located in Asia.[5]

The rise of megacities will raise fundamental issues for the transportation and airline industries, namely how to adequately service the burgeoning and increasingly dynamic mobility needs of these growing populations. For instance, rapid urbanisation will not only alter global air traffic patterns, but will also result in increased demand for intercity travel across key regions of the world.

Critically, rising demand for intercity travel options will encourage development of new aircraft formats that can provide alternative travel solutions for the urban dwellers of the future.

[4] Source: UN World Urbanisation Prospects (2018)

[5] Source: UN World Urbanisation Prospects (2018)

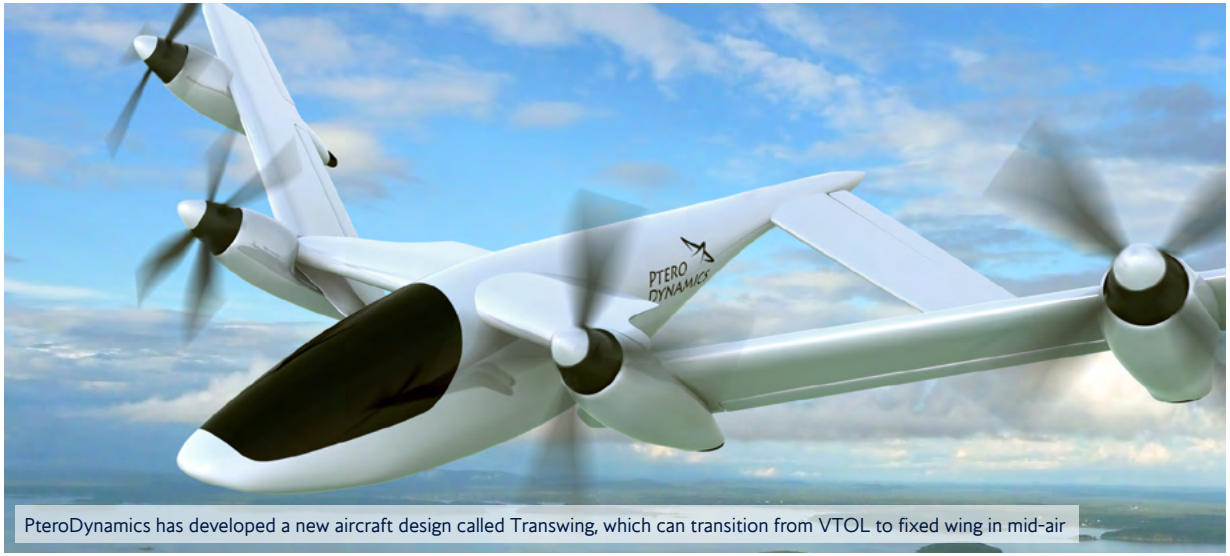
Driver Five:

Fluid Format Aircraft

In response to changing demographics and inter-urban transport needs, a rapidly expanding range of vehicle innovations is seeking to fill the gap that current aircraft and airlines are unable to address.

Indeed, there is a growing range of new aircraft formats and designs that are seeking to meet changing consumer demand, such as mono-passenger VTOLs (vertical take-off and landing craft) that can take off and land more efficiently within dense urban environments.

Alongside this, there is increased investment in non-airborne modes of transport, such as Hyperloop trains that can service traditional rail routes in times closer to aircraft speeds. In the summer of 2018, WARR Hyperloop, a group of engineering students at the Technical University of Munich, set a top speed record of 284mph in SpaceX's Hyperloop competition. Theoretical top speeds for future Hyperloop systems could approach Mach 1 (760mph).[6]



PteroDynamics has developed a new aircraft design called Transwing, which can transition from VTOL to fixed wing in mid-air

[6] Source: Space X, 2013

“

I definitely see VTOLs as a major influencing factor on the future of aircraft cabins, or even how people consider travel. We’re dipping our toe in it now. It’s very exciting.

”

Ian Scoley
VP,
Safran Cabin Innovation & Design Studio, California

Blackfly is a new innovation from Opener; an electric-powered, single-passenger aircraft with a joystick to navigate the controls

Photo credit: Opener, Inc.

The emerging nature of these vehicles also means that they will be able to incorporate environmental concerns into their propulsion design. New single-passenger, all-electric VTOLs like the Blackfly can travel 40 miles on a single charge.

As urbanisation and population pressures increasingly stretch existing transport infrastructure, new forms of aircraft innovation will provide a significant opportunity to create a more varied and flexible range of transport options for global consumers.

Driver Six:

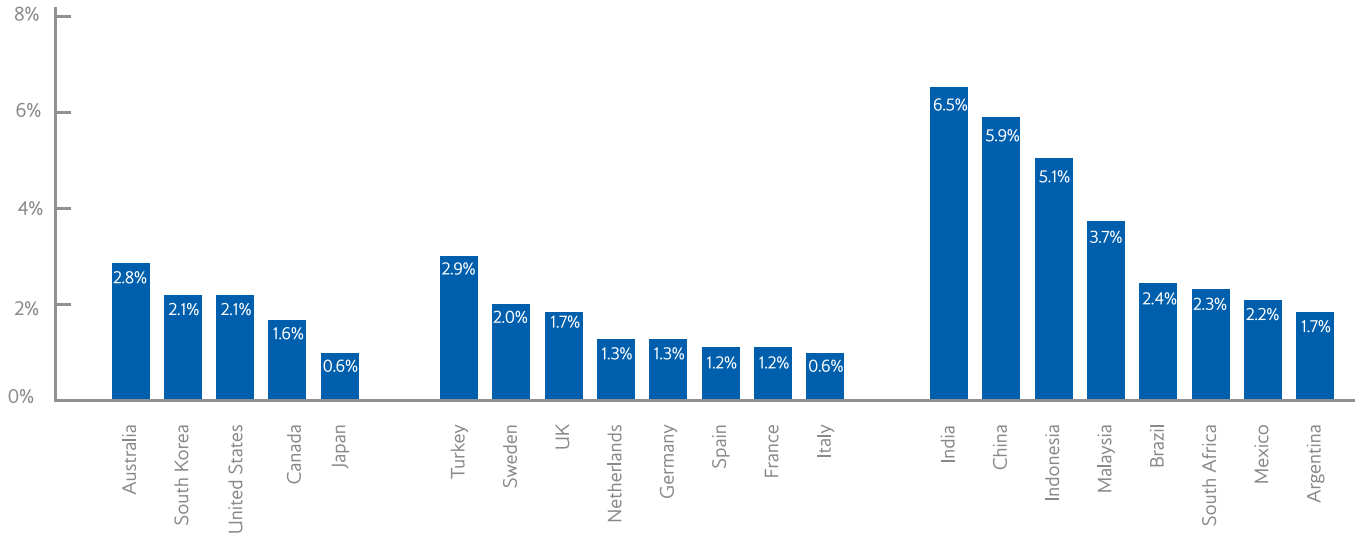
Rising Global Affluence

The key changes impacting the aviation sector explored above, especially in the context of expanding populations and the aggregation of urban centres, are both driven and perpetuated by the trend towards rising global affluence. Indeed, the sheer number of consumers able to afford and partake in air travel in the coming decades is set to expand significantly, radically altering the demands and expectations that consumers will have of air travel.

Such trends will have particular significance in emerging markets. In China, Oxford Economics forecasts an average annual growth of 6.2% in consumer spending on transport services over the next 10 years. India is set to see a 5.1% growth for the same metric. In comparison, just 2.8% is forecast for the USA and 2.2% for the UK.

A growing customer base for extensive air travel will place increased pressure on global transport systems and increase the level of demands on future airline services and experiences.

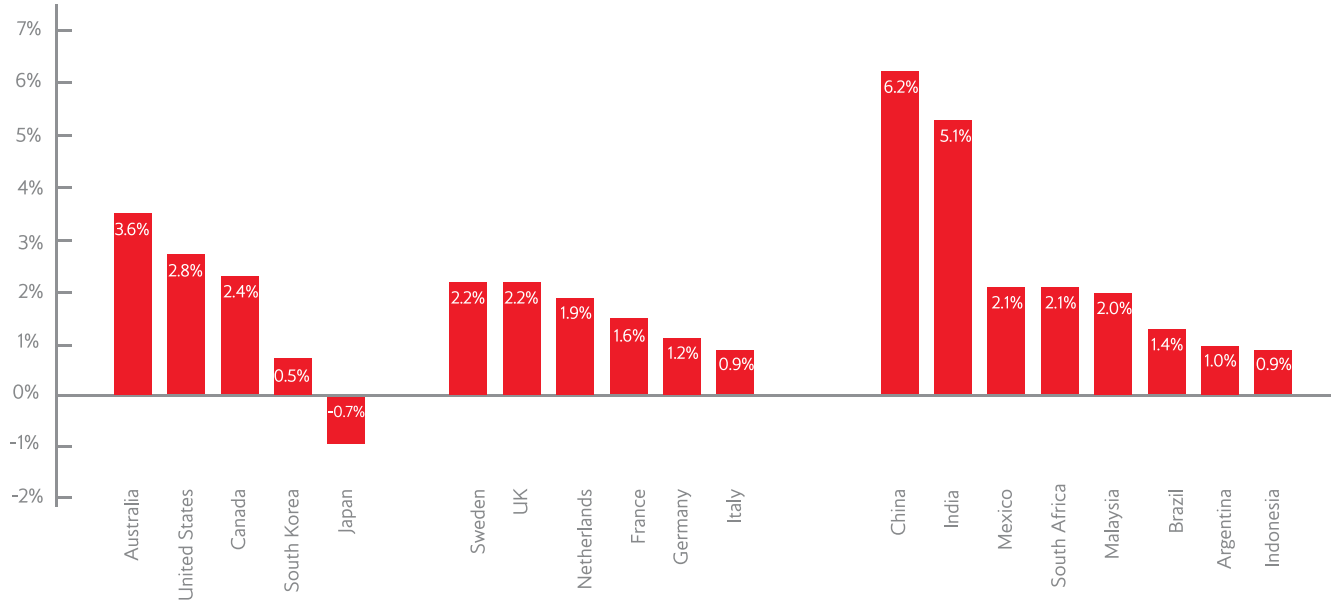
Annual average growth in consumer spending, from 2019 – 2029
(Oxford Economic Forecast)



“Technology and automation are unlocking increased leisure time for consumers, and as the number of people participating in air travel is set to double in the next decade, the balance of changes we will see in the aviation sector will really be very significant.”

Dupsy Abiola
Head Of Global Innovation, IAG

Annual average growth in consumer spending on transport services, from 2019 – 2029
(Oxford Economic Forecast)



Driver Seven:

Rise of Hyper-personalisation

Future customers will inevitably expect their flying experience to be highly personalised. In the last 10 years, we have gone from "mass personalisation" to a more nuanced, contextual version, building on the massive amounts of consumer data unlocked by the digital revolution. Over the coming decades, airlines' ability to understand their passengers at a much more granular level will grow exponentially, especially due to advances in biometric technology. This, in turn, will help delivery of ever more powerful services built to each passenger's unique, even biological, specifications.

One exciting possibility is DNA-tailored services on board. Indeed, by 2025, we forecast that 75% of people will use, or will be interested in using, a service that provides personalised health advice based on their DNA.[7] Such advances will open up a range of new data that airlines can use to provide a hyper-personalised service to each individual customer.

A second angle to future personalisation will be the delivery of bespoke, relevant, human service at scale. Emerging technology, such as augmented reality, will increasingly allow human staff to access and view customer data in new and more actionable ways; empowering the provision of an ever more tailored, empathetic experience for everyone.

[7] Source: Foresight Factory | Base: 696-4043 online respondents per country aged 16-64 (Indonesia, South Africa 16-54), 2017 February

“Smart cabin components with embedded sensors will certainly change how passengers interact with their environment. A responsive cabin adapts to the passengers’ ergonomic needs, proactively change ambience or increases comfort such as intelligent seats or activity areas.”

Tobias Mayer
Expert Cabin Branding
& Functional Design, Airbus

Panasonic Avionics and Tascent on-board biometric scanner concept

Driver Eight:

Invisible Connectivity

As the products and services available to passengers pre-flight, during, and post-flight grow in number and sophistication, the digital infrastructures needed to deliver them at scale will become a critical aspect of aeroplane design. The trend is towards greater integration of these systems, including everything from internet connectivity to biometric tracking, into the fabric of the aeroplanes themselves.

Innovations such as Li-Fi, which can deliver download/upload speeds of up to 8Gbps via light waves, are an example of how in-cabin connectivity will be unleashed to fundamentally transform inflight experiences.[8] This will allow for content streaming, enhanced capabilities to work, and even remote customs and immigration verification leveraging integrated digital passport controls.

Indeed, such connectivity and processing speeds will enable the possibility of streamlined services from the comfort of the passenger’s seat. For example, Panasonic and Tascent have partnered to explore biometric identity devices that will be able to deliver instant passenger recognition for payments and personalisation, more responsive entertainment experiences, and inflight immigration services.

[8] Source: Haas, LiFi: paradigm-shifting 5G technology (2018)

“Astronauts already have suits that monitor their stress levels and other biological indicators, and it’s possible that this idea or something similar could be adapted for commercial use, giving passengers more tailored experiences based on how they’re feeling.”

Doug Millard
Deputy Keeper of Technologies and Engineering,
London Science Museum

44%

OF GLOBAL CONSUMERS STATE THEY SHOULD BE ALLOWED TO USE **REMEDIES AND TECHNOLOGY TO IMPROVE THEMSELVES** EVEN WHEN THEY ARE HEALTHY

Driver Nine:

Beyond Human

Today, regardless of how well it is embedded into our surroundings, technology remains an external entity that we interact with. But the coming decades will see greater scope for technology to become more ingrained into our very biology. Though this may seem more the fantasy of sci-fi theorists than customer experience designers, consumers are already warming to the idea that embedded technology could help enhance their everyday lives.

Indeed, 44% of global consumers state that people should be allowed to use remedies and technology to improve themselves even when they are healthy.[9] This will fundamentally change how we interact with our surroundings, unlocking a new world of potential services and experiences.

For airlines, this will result in future connected aircraft not just communicating with a customer’s mobile phone or wearable device, but potentially also with technology embedded in their bodies. Again, such developments would unlock vast amounts of new biometric data that can power hyper-personalisation.

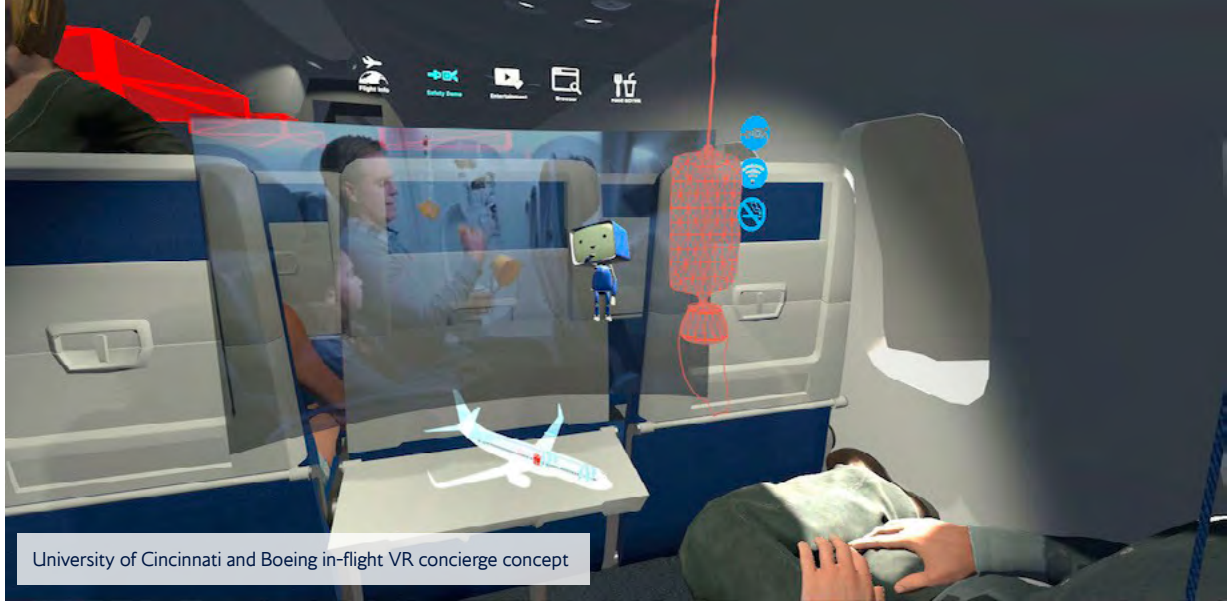
[9] Source: Foresight Factory | Base: 587-3108 online respondents per country aged 16-64, [Indonesia 16-54], 2018 July

“

The engineers tasked with designing the next generation of immersive interiors will be more like artists, as they’ll have to consider the more experiential and human aspects of our interactions with our environment.

”

Daniela Sousa
Senior Software Engineer,
Manufacturing Industry Futures,
Autodesk Research



University of Cincinnati and Boeing in-flight VR concierge concept

Driver Ten:

Immersive Realities

Today, incredibly powerful immersive worlds are already becoming a reality. By 2022, 75% of global consumers will have already used or be interested in using virtual reality tools.[10]

But this story is not just about big headsets; it is also about augmenting existing environments with rich layers of digital information and engagement, finely tuned to the immediate needs and contexts of consumers. Immersive platforms and interfaces will also assist the interaction between consumers and staff, helping deliver improved customer satisfaction at scale.

In the context of aviation, immersive worlds can come in all shapes and sizes. For example, the University of Cincinnati has partnered with Boeing to develop a patent for an inflight VR concierge concept that would be able to execute traditional cabin crew functions, as well as deliver entertainment personalised to each passenger from the luxury of their seat.

As well as transporting passengers to their own unique realities, immersive technology can also transform the cabin environment. For example, engineering firm CPI is developing a system of windowless aeroplanes, in which ultra-light and flexible screens can cover key areas of the cabin to transform the environment into a dynamic experience with content that can be updated and contextualised throughout the flight.

Dynamic surface technology infused with immersive capabilities will provide new opportunities to transform onboard entertainment and the sensory landscape of the cabin.

[10] Source: Foresight Factory | Base: 373-3287 online respondents per country aged 16-64, (Indonesia 16-54), 2017 August (2018)

“Passenger experience is not just about the seat that you sit in, or the restaurant you go to in the airport, it’s about a more holistic view of what constitutes wellbeing while you’re in certain spaces.”

Pat Askew, AIA, NCARB, LEED AP
Principal and SVP,
Global Aviation Practice Director,
HKS Architects

54%

OF GLOBAL CONSUMERS SAY
THEY WORRY ABOUT THEIR LONG TERM HEALTH

Driver Eleven:

Healthy Habitats

As consumers start to think more about the environments that they interact with – how they are created, modified, and maintained – they are also starting to think more about the relationship that exists between their health and their external environments. Indeed, 54% of global consumers say that they worry about their long-term health.

Brands are stepping in to help consumers address more and more aspects of their health, especially as the definition of wellbeing expands and becomes more holistic. Alongside enhanced nutrition and wider health services on board, it is expected that more sophisticated health services will be built into the very design of the aircraft.

Panasonic’s Nanoe prototype, currently under development, provides a glimpse of how future health services might be interwoven with the fabric of the aircraft. The system uses low-voltage moisture that bursts into electrostatic, atomised particles in order to continually deodorise the air around a passenger’s seating area throughout the flight. The system also rids the air and surfaces of viruses, allergens and bacteria.

Driver Twelve:

Aircraft Automation

LG's robot trialled at South Korea's Incheon Airport

Advances in automation are already delivering innovations that can provide more efficient and seamless services across many aspects of the customer journey.

However, the impact of future automation technology on the role of human staff on board remains much debated. In a survey conducted by the World Economic Forum in 2018, 50% of companies in the aviation and travel sector stated that they expect automation will contribute to the shrinking of their workforce, while the other 50% of companies expected it will lead to an expansion of their workforce.[11]

There are certainly tasks for which automation is better suited, but equally there are those that can only be performed by humans. Going forward, businesses that are able to find the most valuable roles for each will have the most success creating a comprehensive, emotionally resonant customer experience. The most likely scenario will see automation replacing some of the more functional tasks on board, providing more time and scope for human staff to provide more expert-led, concierge service; not reducing the number of human staff, but elevating and enhancing their role.

Indeed, one channel via which automated technology could provide support for the more functional tasks on board is new robotic technology. For example, the LG robot being trialled at South Korea's Incheon Airport.

The robot can interact with passengers in multiple languages, provide detailed contextual information and even guide those who need directions to their gate, freeing up the time of human staff to help passengers with more complex requests and requirements.

[11] Source: World Economic Forum, The Future of Jobs (2018)

CONCLUSION

The drivers presented here will collectively shape the future flying experience, both in terms of changing consumer demand, the design of the aircraft and the provision of services onboard. In the next chapter we combine the future trajectories of these drivers and use them to develop a series of possible scenarios for the future of flying as we approach 2069.

FORESIGHT FACTORY

BRITISH AIRWAYS

PART

03

FIFTY YEARS AND BEYOND:

Welcome to the flight of the future

In the previous chapter we outlined the main forces shaping the future of flying. By integrating the drivers into a single framework and pushing their consequences out 50 years and beyond, we have created a series of scenarios exploring different possible flying experiences. In this chapter, we present a window into the long-term future of flying.

SCENARIO

01 Hypersonic Transport Eco-System

Fifty years from now, in 2069, demands for faster air travel will have transformed all parts of a passenger's journey; even leaving the office to go to the airport will have become streamlined, with time delays from security or queuing a thing of the past. Through innovative use of the Hyperloop transit system, which will be present in most major cities, commuters will avoid any roadblocks and delays on their journey, enabling them to cover intercontinental journeys in half of current time scales or less.

In this scenario, we present a future where:

• Most aeroplanes designed for rapid intercontinental travel will be equipped with engines similar to SABRE's hypersonic prototype, a hybrid air-breathing design.

• These engines will enable aircraft to travel at Mach 5. SABRE engines have been initially designed for rocket propulsion, but can be adapted for passenger aircraft.

• As futurist Ian Pearson says, "hypersonic is really making big inroads now in this technology [SABRE engines] and in our hypersonic missiles, and we will see resurgence of Concorde-style aeroplanes coming back".

• In order to maximise efficiency and minimise travel times, transport to and from the aircraft will have to be significantly adjusted.

• A typical passenger journey will involve an individual travelling by elevator from their office to a Hyperloop terminal and finding their assigned seat.

• Luggage will be picked up from an individual's home and delivered autonomously to the Hyperloop, avoiding the passenger needing to bring their bags to work. This will operate similarly to how Amazon's Ring enables personnel to deliver packages to inside a customer's home.

• The passenger will be able to quickly travel from their office to the airfield, without having to exit the transit service.

• During this short journey, passengers will be able to use extensive VR shopping facilities; headsets provided on the service will enable access to duty-free displays and limited-edition products.

• Upon reaching the airfield, various sections of the transit service will split off, with different compartments diverting to different destinations.

• The passenger's compartment will enter a lift system, travelling through a tunnel with sensors that determine the safety and security status of the passenger, as well as any and all personalisation requirements. In order to save space and weight on board, personalisation settings will be applied at this stage.

• The seating system from the Hyperloop will then neatly slot into an assigned space on board, completing a rapid and seamless journey from office to aeroplane.

DRIVEN BY:

FLUID FORMATS

GLOBAL AFFLUENCE

HYPER-PERSONALISATION

JET PROPULSION

The key driver for this type of technology and transit service will be the ever-increasing need for more time. Consumers across the world are echoing the sentiment that they not only need more time in their lives, but also fewer pain points and delays. Consumers will have to pay more for this premium service, but the time saving alone will be considerable – not to mention the ability to exit the office in comfort, as well as the avoidance of long queues at boarding and delays at security.

The key benefits to consumers are clear: the option to travel in comfort and speed across urban spaces while avoiding delays and queues. The result is a more stress-free and streamlined journey which allows customers to continue their work or entertainment while travelling to their destination. Furthermore, inbuilt personalisation options will deliver bespoke amenities; passengers will never have to settle for retail or consumption options that do not match their preferences.

A key challenge to this proposition is the infrastructure requirement; while Hyperloop prototypes have been constructed and proposed worldwide, there is not yet a viable system that can transport at the speed and volume required. However, given the level of innovation and variety of different organisations working on the technology, a version of the Hyperloop system will likely emerge and be developed by 2069.

SCENARIO

02 My Flight, My Way

By 2069, the truncation of flight times due to new jet propulsion technology will result in new necessities for onboard entertainment and amenities. With flight times potentially cut in half, aircraft will need to supply luxuries and facilities in a much shorter timeframe, while ensuring maximal efficiency. Personalisation will be key; providing onboard services that create an easy and fluid environment for passengers, while also eliminating any pain points. AI and 3D printing will enable on-the-go accessories, but human staff will be key to providing concierge services and luxury.

In this scenario, we present a future where:

• After entering the aircraft, a passenger will find themselves in an already personalised environment.

• Their seat, which uses biological scanners, will be able to pick up physiological and nutritional needs, suggesting different foods and beverages to complement any activity.

• Furthermore, retina scanners will analyse the identities of individuals on the aeroplane, enabling immigration and customs information to be transferred immediately, without the need for a passenger to fill in forms or stand in long passport queues.

• Fully functional tablet computers will be built into the seats, which can be extended with micro-LEDs and hologram technology to the specifications the passenger requires, enabling the seamless continuation of work or entertainment.

• This entertainment will be determined by the passenger; individuals will have little desire to choose from a pre-selected catalogue of media titles.

• These tablets will be internet connected, and the passenger's own cloud profile pre-loaded before they even board the aircraft, so they can continue playing the same game or working on the same document.

• 3D printers on board the aircraft will meticulously construct food and beverages for passengers. Passengers can order any meal without the onboard weight allowance of the aeroplane being affected.

• Jet lag will also be a thing of the past. 3D printers will be able to print pills with melatonin and other health supplements to ensure that passengers not only have a pleasant and stress-free flight, but are fully refreshed upon reaching their destination.

• Chip implants will be commonplace in 2069, able to interface with various muscle groups within the individual to combat stiffness and strain.

• These meals and pills will be delivered by holographic staff that emanate from small robots, freeing up human staff for other activities such as answering questions and delivering high-end concierge services.

• These human staff will have a vital role in maintaining the human touch on board, and differentiating the level of service from other fully automated aircraft.

DRIVEN BY:

HYPER-PERSONALISATION

INVISIBLE CONNECTIVITY

BEYOND HUMAN

IMMERSIVE WORLDS

The two key drivers of this proposition will be the desire for convenience and luxury, but it will be the expectation of these two drivers that propel this type of service. Consumers will have access to these types of fluid services in many other areas of their lives, and this will drive expectations of these services on board as well. 3D-printed food, for example, will be common in 2069.

A key benefit to consumers is the availability of choice and flexibility while in a traditionally inflexible environment. Through offering onboard 3D printing and personalisation options, as well as connections to the cloud for consistent access to personal profiles, consumers will have the luxury of having all they need, tailored to their preferences, wherever they are.

Most of this technology is already available, making the challenges here much less about technological development than the logistics of making sure weight on board will not impact the ability of the aircraft to cover large distances in a short time with few environmental impacts. This may require the development of more lightweight 3D printers, different materials for the construction of the aeroplane itself, and ways to maintain affordable connectivity on board.

SCENARIO

03 Sustainable Skies

As we approach 2069, humanity will have experienced an increasingly intense period of climate change, and as a result, concerns about an individual's personal environmental impact will be front of mind always. This will in turn lead to increased consumer pressure for much more environmentally sustainable forms of flying, in particular alternative fuels. Innovation and technological advancement will be targeted towards developing carbon neutral ways of powering flight, so that consumers can still satisfy their need and desire for long-distance travel without incurring "green guilt". Here we present a scenario where technologies such as solar power, carbon capture and aerial recharging stations have been developed to make this concept a reality.

In this scenario, we present a future where:

• By using solar power, as well as rechargeable batteries, aircraft can travel long distances without recharging.

• These aeroplanes could be hybrid-electric or all-electric, and will naturally be slower than hypersonic examples, claims expert Herve Morvan, in charge of Group Technology Strategy for Rolls Royce. He states: "In the next 30 years, there is the possibility of sustainable hypersonic flight. However in the shorter term, from an environmental perspective there are definitely proven benefits to flying differently and a little bit slower, to limit emissions, but also to aid the introduction of electric passenger flight."

• However, through the use of an aerial recharging station, aeroplanes can travel much longer distances, with the ability to recharge in the air. Fully-automated mechanical arms will assist with controlling the trajectory and speed of the aircraft.

• This recharging station will be constructed using graphene and helium balloons. This is corroborated by research from the American Institute of Physics.[12]

• The initial battery will be recharged from renewable sources, enabling the aeroplane to fly up to an aerial recharging station to get enough power to reach the eventual destination.

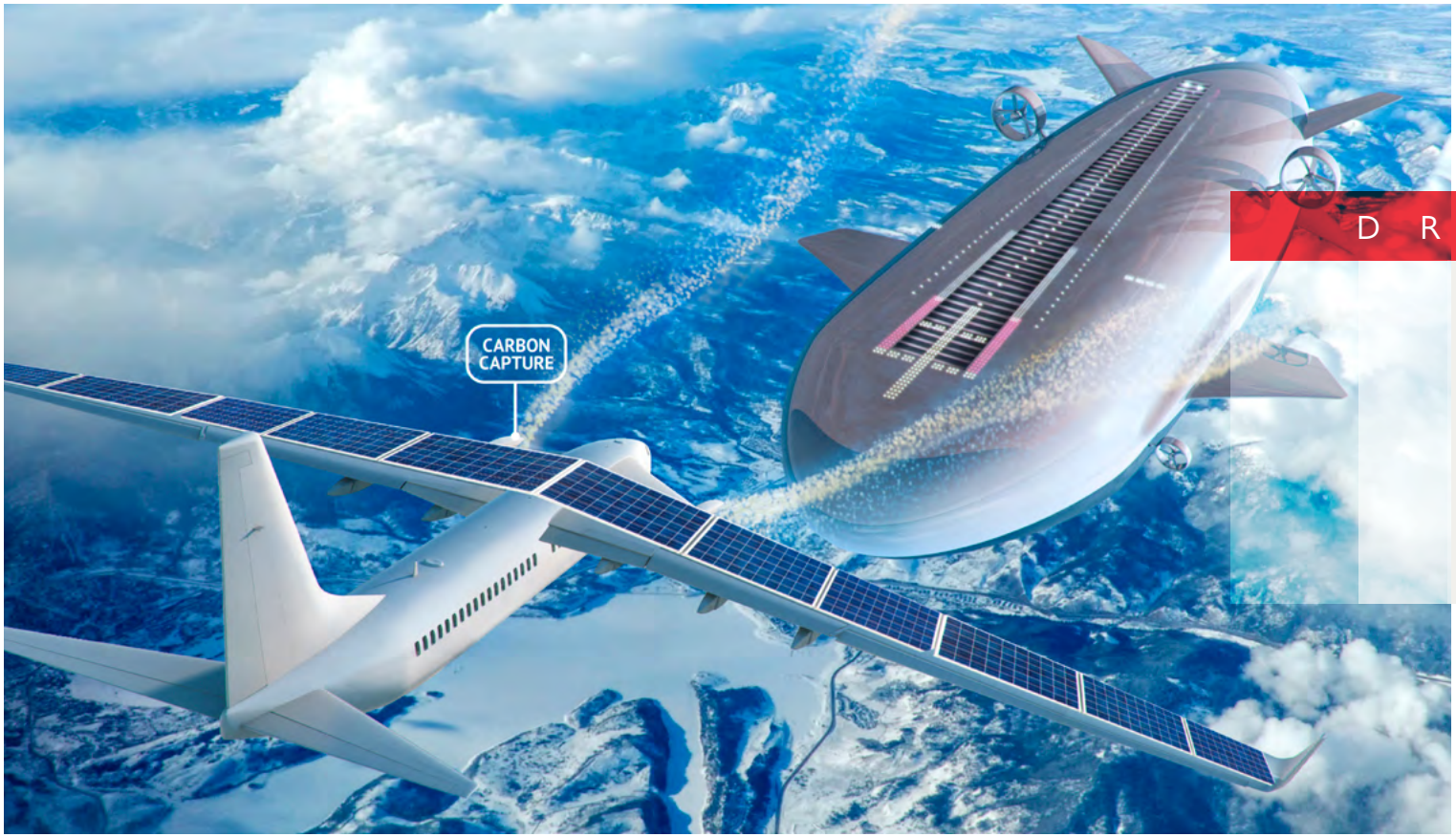
• Linear induction, a technology that can allow short-range energy transfer facility, could be the key to recharging the aeroplane while it is slowly moving across the floating terminal.

• Carbon capture facilities within the aircraft will enable passengers to achieve a net reduction in CO2, transforming the gas into a solid that can be more efficiently disposed of on the ground.

• Pat Askew mentions the viability of 3D printing in the context of constructing lighter materials: "computer 3D printing is going to have a huge effect and that is just going to make construction easier and more dependable."

• Through 3D-printing titanium and other materials to exact specifications, aircraft can be made significantly lighter and therefore much more environmentally efficient.

[12] Source: American Institute Of Physics, 2008



DRIVEN BY:

ENVIRONMENTAL CONCERN

NEW ENERGY AIRCRAFT

AIRCRAFT AUTOMATION

The key driver of this type of proposition will be environmental concern. While aircraft are not the highest volume polluters, they are a highly visible source of CO2. Consumers concerned about their level of emissions and how they personally can reduce or eliminate them will be the key customers for this service, allowing them to travel guilt-free.

The key benefit of this type of service will be the creation of a net-negative carbon production facility from a technology that previously was considered to be a polluter. This could radically reform the image of aviation in general while providing ways of helping consumers protect the environment.

The creation and launch of the intermediate charging stations will be a significant challenge to this type of service. While these charging stations will be self-sufficient in the air, they will require significant initial investment and development to create. However, most of the technology for the aircraft themselves is readily available.

SCENARIO

04 Air Time Re-imagined

As an alternative to the super-fast flights of the future, some consumers in 2069 will seek to select slower aircraft if they see an appropriate trade-off for the lack of speed. While some will seek a sustainability-driven trade-off, some will look to those brands providing advanced entertainment and onboard health services to deliver a unique and engaging airborne experience. Principally, this scenario explores the creation of different zones on board the aircraft, where passengers can experience different entertainment, health and educational activities.

In this scenario, we present a future where:

• Slower, experiential flights will require new forms of entertainment or activity to maintain interest. While contemporary entertainment options are enough to sate many appetites today, we predict that these will likely become less engaging as consumer expectations grow.

• Prof. Hervé Morvan, Chief of Future Platforms at Rolls Royce, expands on this: "we've seen some airship developments. Indeed, they can stay in the air for several days and not even need anything more than a mooring. So if you're in a moored area, why not have some air cruises? There are beautiful parts of the world where I would love to have an air cruise like this for a few days. I could imagine this being an opportunity."

• After boarding the aircraft and taking off, advanced stabilisation technology will enable passengers to effectively remain out of their seats for the entire flight, without fear of turbulence.

• Passengers will be able to leave their seats to go to a central part of the aircraft, where they will encounter different zones, each bordering a central bar. Each of these zones will have a different focus, and each will be developed with screens replacing the walls of the zone.

• One zone, for example, will focus on experiential learning about the destination of the aircraft. Passengers will don VR headsets and interact with a holographic local celebrity tour guide, who will show them some of the key sites and advise them on where to go according to their preferences. This will be key for visiting the more tourist-heavy areas in advance, to determine whether they are still worth going to.

• Another zone will focus on entertainment. Passengers will interact with hologram and extended reality experiences in a more engaging and immersive form of Hollywood-style film or video game entertainment.

• Finally, a health zone will incorporate both technological and natural facilities to encourage passengers to land healthier than when they took off. Passengers will have the opportunity to explore different exercise options, such as yoga, VR-enhanced treadmills and other training machines to build towards personal goals while on board.

• Live plants will be chosen specifically for their atmospheric and environmental properties, such as snake plants for improving air quality and jasmine for anti-anxiety and other holistic benefits. Specific lighting cycles will match with passengers' own circadian rhythms to minimise jet lag and ensure sleep cycles are not affected after landing. Humidity modifiers will ensure that passengers' skin doesn't become dry or cracked due to the high altitude.

DRIVEN BY:

ENVIRONMENTAL CONCERN

IMMERSIVE WORLDS

BEYOND HUMAN

HYPER-PERSONALISAITON

The key driver of this proposition for consumers is the desire to utilise time effectively and to have unique and engaging experiences. Consumers will seek slower journeys in order to use the journey time more effectively, having a more leisurely journey as a precursor to a holiday or longer excursion.

The fundamental benefit to passengers of the zone-based aircraft approach will be a greater familiarity with the destination, as well as potential health benefits on board. Personalised approaches to entertainment and health will enable passengers to disembark the aircraft in better health than when they boarded, allowing them to best utilise the first day of their holiday without having to recover from the flight.

However, a significant challenge to this proposition will be the creation of an aircraft that can be large enough to fit different zones on board, while still remaining energy-efficient. The zones will require technology that is nascent now, but will become more advanced in the future, and will provide connectivity options that will smooth out any latency and frame rate issues that cause problems for current hardware.

SCENARIO 05 Skytrain

While passenger aeroplanes between countries may need to retain their size and speed to operate efficiently, by 2069 intercity flights could change significantly to address a consumer desire for more convenient short-haul solutions. Modular, smaller vessels would allow consumers to begin their flights much closer to their point of departure and end them closer to their destination. These will be able to join up to form larger vehicles that operate along predetermined routes for safety and efficiency.

In this scenario, we present a future where:

• Global working conditions will still likely necessitate intercity flights, but these will often more easily be covered by drones than current transportation options such as cars or trains.

• Travelling by drone will be expensive for many consumers, and private drones will be out of reach for the vast majority of consumers.

• However, drones that transport groups of between 15 and 50 passengers may be more popular. These will be much cheaper than personal drones, and as a regular transport system could be a feasible alternative to trains.

• The time-saving aspects of this technology will be significant, as will the ability to reach specific areas. Instead of entering a central train station, passengers will be able to direct the drone to fly to a more specific location.

• Flotillas of drones, however, will likely need some sort of organising principle in order to prevent chaos in the air. We see this manifesting in the form of "skytrains", in which disparate drones will join up to form a larger entity.

• This larger entity will be more fuel-efficient and will only form during the journey; at the beginning and end, the cars will separate.

• At the beginning of a journey from, for example, Beijing to Shenzhen, an individual will board the drone at their house, which will then connect to other drones in the sky heading in the same direction. At the end of the journey, the passenger's skytrain will split up, with their own car going to Shenzhen and other cars going to Hong Kong or Macau.

• Current multi-passenger airborne concepts of this type, such as the Zunum Aero, can reach a top speed of 340mph. The ability to collect individuals from their place of work or near their home, combined with high-speed transport, would enable passenger flight times to be often cut in half, if not much further.

D R I V E N B Y :

FLUID FORMATS

UBRANISATION

ENVIRONMENTAL CONCERN

Driving the adoption of this type of technology will be the desire for increased efficiency in travel, as well as the desire for convenience. These multiple-occupant passenger drones will be able to collect individuals from their workplaces or homes and deposit them much closer to their eventual destination, avoiding the use of airports or train terminals. However, this type of proposition will still be more expensive than the transport options that are currently available. We assume that increased global affluence and technology advancement will make this proposition as affordable as intercity travel currently is for most passengers.

A key benefit to passengers of this technology will be the ability to travel quickly and fluidly at much lower cost than hiring a private, single-person drone. The increased fuel efficiency that will be achieved when the skytrain is linked together will bring prices and environmental emissions down.

A key challenge to this technology will be passenger efficiency. Higher numbers of passengers will increase weight and therefore the fuel necessary to maintain a good speed. However lower passenger numbers will mean the number of tickets purchased will not be enough to justify the cost of the trip.

CONCLUSION

The scenarios presented here provide glimpses into what the future of flying will look like by 2069. Whether we see these scenarios emerging in full or in part, it is clear that flying in 50 years will present incredible and exciting possibilities for future societies, industries and governments alike. In the final chapter of this report, we look even further out to the distant future, and imagine what could be possible as we approach the year 2119.

FORESIGHT FACTORY

BRITISH AIRWAYS

PART

04

THE NEXT CENTURY OF FLYING:

A look to 2119

In this final chapter of the report, we push the timeline of flying even further out to the long-distance future; concluding the report by considering what could be possible as we approach the year 2119.

Flying has evolved steadily over the last century, gradually developing into the service we know in 2019. For a reasonably accessible price, a large proportion of global citizens can travel to most places in roughly one or two days. We project that this evolution will accelerate over the next 100 years, integrating other adjacent technologies and capabilities to improve both the technical infrastructure and the passenger experience of flying.

From an infrastructure perspective, we envision flights of the future to be radically different; longer distance flights will be more vertical than horizontal, using space elevators and the benefits of low-Earth orbit to achieve much faster speeds than on the ground. Intercity and short-haul travel will be almost entirely drone-based, with swarms of passenger drones shifting between different modes depending on context.

By far the biggest shift in flying will be the accessibility of space and low-Earth orbit. Blue Origin, SpaceX and Virgin Galactic are already developing private launches. The stated intentions of business[13] and political[14] leaders to begin lunar development and establish permanent colonies will herald a new era of efficiency in Earth-to-Moon transportation. However, while lunar tourism and new efficiencies could deliver regular private passenger trips to the moon in 2100, the key technologies that will emerge in the process of working towards such possibilities will be more important.

One of the most exciting and potentially transformative of these technologies is the "space elevator", a carbon nanotube construct that would enable individuals to quickly reach low-Earth orbit, from which they can then easily travel to other destinations. A number of companies have been established over the last two decades to facilitate space elevator production, including LiftPort Group, Obayashi Corporation and even Google's own R&D department. One of the key enablers of space elevator development will be the creation of massive, but still perfectly formed, carbon nanotubes. When these become more viable, space elevator technology will be eminently accessible to consumers. Upon reaching "geostationary orbit" or another point along the elevator, passengers would be able to disembark, taking much quicker routes across the world with pinpoint accuracy, using Earth's own gravity and momentum to propel them to their destination.

Another core difference in passenger transport infrastructure will be the availability and ubiquity of drones. Drones controlled by centralised AI will become a publicly owned transit tool that will no longer require driving licences and will put an end to delays. This ease of use will be a huge step-change for consumers, eventually changing the ways in which they live their lives. Super-fast, efficient and cheap passenger drones will allow individuals to live in rural areas, diluting the necessity for centralised human populations (and all the problems that these cause). Metropolitan borders will become more porous, as consumers will be able to live in more remote areas and source different needs from ubiquitously available cargo drones. Transitional approaches to transportation will also be much more common, with drones being able to use different structural options as necessary; ground-based approaches could be more relevant in certain contexts, as could rail- or even sea-based forms. The ability to quickly and smoothly transform from one mode to another will be a key feature of the next century.

[13] Source: https://futurism.com/elon-musk-moon-base-spacex

[14] Source: https://www.washingtonpost.com/technology/2019/05/13/trump-wants-an-additional-billion-nasas-audacious-moon-mission/?utm_term=.686553c3020f

While infrastructure changes and challenges will reframe transportation in terms of speed, efficiency and energy use, experiential changes to flying will also radically adjust what passengers can expect on their journeys. The biggest change in the future flying experience will be the ubiquity of virtual and mixed reality. We expect the majority of individuals to spend large proportions of their day in VR in the next century, with certain work, entertainment and social activities conducted entirely virtually. Concurrently, many physical objects will likely decline in value as 3D printing and digitalisation become more efficient; digital experiences will inevitably replace all but the most necessary physical experiences.

Virtual reality has progressed significantly since its creation in the mid-20th century, but it has much further to go before it becomes a universal access point for the digital universe. Recent announcements from Apple[15], as well as open-source augmented reality developer kits[16], point to the potential of an augmented reality revolution over the next few decades. As a result, travelling may be much rarer in the far future, with individuals residing in virtual reality during the entirety of their journey. Work or academic study conducted in virtual settings can be continued during transit and on board, while entertainment will likely use inflight features to contextualise narratives and storylines.

The availability of 3D printing and rapid construction will further disrupt our relationship with objects. The increase in value of digital objects, with the ability to simply print new physical items when needed, will further change how individuals approach ownership. Luggage and larger objects can limit the efficiency and ease of flying for many passengers, and being able to 3D-print items at the destination can save time and fuel costs. While currently only plastic can be 3D-printed easily, natural fibres and other materials will likely become availableenabling clothing or shoes to be printed on-site without the need for heavy baggage.

Flying will undergo a transformative change over the next century, with new modes of transport challenging traditional methods – just as aeroplanes were the previous century's challenger. From the use of low-Earth orbits and drone networks to virtual reality environments and 3D printing, the ways travellers transport themselves will operate under vastly different conditions and challenges. Ultimately, across all future travel methods, experience, efficiency and speed will be the key factors of enjoyment and success, just as they are today.

[15] Source: https://techcrunch.com/2019/03/08/apple-could-launch-augmented-reality-headset-in-2020/

[16] Source: ARKit and ARCore

METHODOLOGY

The insights and findings presented in this report are derived from a range of research conducted by Foresight Factory, on behalf of British Airways, in 2019. The key parts of this research and the methodology are outlined below.

Global Quantitative Research

Foresight Factory conducted new and original quantitative research across 10 global markets in May and June 2019. The 10 markets surveyed were Brazil, China, France, Germany, India, Italy, Japan, South Africa, UK and USA.

In each market, an online sample of aeroplane travellers (people who have ever taken a flight) completed a 20-minute survey.

The sample size in each market was 1,000 respondents, except in the USA, India and China, where the sample size was 2,000.

National quotas were set on age, gender and region, and the data was weighted to be nationally representative of the age and gender of the 18+ population in each country (18-64 in China, South Africa and India).

The fieldwork was conducted by Dynata on behalf of Foresight Factory.

Expert Panel

Foresight Factory conducted interviews with a range of experts on all aspects of the current and future aviation landscape. These were conducted between February and June 2019. The experts who were interviewed for this reportare outlined on page 4.

Proprietary Foresight Factory Research and Bespoke Data Forecasts

Foresight Factory conducts global research across 24 global markets on an annual basis. Throughout the report, this data has been used to supplement the findings. In addition, the in-house data team at Foresight Factory has developed forecasts on changing consumer behaviour and demand, which have also been inputted throughout the report.

Scenario Generation Workshop

Foresight Factory conducted a one-day workshop in May 2019 in partnership with students from the Royal College of Art and experts from British Airways. The outputs of this workshop were tested, refined and developed by Foresight Factory based on all parts of the research conducted to date. The final outputs and visualisations of the scenario generation process are presented in Part Three of this report.

FORESIGHT FACTORY

About Foresight Factory

Foresight Factory is a consumer analytics company specialising in trends and long-term socioeconomic change. We blend data to predict and size future commercial opportunity, and have partnered with our clients for over 20 years to help them be truly customer-centric and future-focused in their decision-making.

Our expertise is understanding what consumers worldwide want now and in the future, and translating this into insights and recommendations for brand strategy, product development, loyalty, customer service delivery and other key touchpoints on the consumer journey.

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