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New Horizons for Airlines: Consumers' Adoption of Metaverse

A Qualitative and Quantitative research

Mário Jorge Amaro Guerreiro

Dissertation

presented as the partial requirement for obtaining the Master's degree in Data Driven Marketing

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação

Universidade Nova de Lisboa

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NEW HORIZONS FOR AIRLINES: CONSUMERS' ADOPTION OF METAVERSE

By

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Dissertation presented as the partial requirement for obtaining a Master's degree in Data Driven Marketing, specialization in Digital Marketing and Analytics.

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STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledged the Rules of Conduct and Code of Honor from the NOVA Information Management School.

Mário Guerreiro
Lisboa, 14/07/2023

DEDICATION

I want to dedicate this research to my mother that is fighting the hardest battle of her life. To my sister that is a great support. To my father, that is one of a kind. To my wife that was encouraging me and backing me up during this journey and to António that without knowing is the most important person to me on the entire planet and beyond. Also, a big thank you to my supervisor that guided me with immense wisdom and gave me the extra strength to overcome all obstacles along the way.

This is the way.

ABSTRACT

Metaverse technology is increasing its relevance in this digital and connected world and airlines should decide what is their strategy and purpose to engage with consumers in this new dimension. Because the metaverse it's a new technology, airlines must also understand the factors for its acceptance. Though the technology acceptance is already vastly investigated, the review of acceptance for metaverse technology is still reduced.

This research intention is to provide an empirical study of the technology acceptance on an airline metaverse and contribute to the findings that reveal new opportunities to engage with consumers/ passengers. Following the literature review we based on a Technology Acceptance Model (TAM) framework that proved to be the most suitable for the technology adoption dimension.

This research focused on qualitative and quantitative analysis and our findings reveal the vision from an airline perspective and the factor of adoption of potential users. Qualitative analysis was based on 3 semi-structured interviews targeting airline experts followed by text mining and data analysis via IRAMUTEQ software. Concerning the quantitative analysis was based on a structured questionnaire that uses a convenience sampling technic. A total of 118 replies were collected and analyzed via SmartPLS4 software.

The outcomes of this research are insightful and reveal that Gamification and Perceived Consumer Experience have positive and relevant effects on the intention to use the metaverse of an airline. Management contributions, future studies and academic insights are also present in the final section of the research.

KEYWORDS

Metaverse; Aviation Industry; Technology Acceptance Model; Consumer Adoption

Sustainable Development Goals (SGD):

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LIST OF ABBREVIATIONS AND ACRONYMS

AR	Augmented Reality
AVE	Average Variance Extracted
AWS	Amazon Web Services
CAVE	Computer-Assisted Virtual Environments
DIT	Diffusion of Innovative Theory
ETAM	Extension of TAM
IATA	International Air Transport Association
IS	Information Systems
IT	Information Technology
META	Model of Emerging Technology Adoption
MR	Mixt Reality
NFT	Non-Fungible Tokens
OTA	Online Travel Agency
PLS	Partial Least Squares
PMR	Pure Mixed Reality
SEM	Structural Equation Modelling
SRMR	Standardized Root Mean Square Residual
TAM	Technology Acceptance Model
TPB	Theory of Planned Behavior
TRA	Theory of Reasoned Action
UTAUT	Unified Theory of Acceptance and Use of Technology
VR	Virtual Reality
WOM	Word-of-Mouth
XR	Expanded Realities

1. INTRODUCTION

Aviation suffered the worst downturn ever with an estimated loss of 200 billion dollars from 2020 until 2022 (IATA, 2022) due to the Covid-19 pandemic. Yet, the airline sector is performing positively, with financial performance so far in 2023 overcoming expectations and estimated profitability for the year just revised up to more than double that of 2022 (IATA, 2023) but some situations need special attention like fierce competition, high inflation rates, strikes, technical workforce shortage, climate changes with high temperatures or high precipitation, aircraft delivery shortage (DBRS MorningStar, 2023), and the question is how airlines are preparing to overcome all these questions and overlooking into the future.

High-rated Airlines are investing heavily in new internal roles like Customer Experience Vice Presidents, Customer Experience Managers, and Chief Customer Experience officers with the responsibility to create and manage the experience of their customers. Also, many companies' senior executives have prioritized the management of their businesses to create a significant customer experience during the stages that form the entire purchase decision process, especially in the context of digital business transformation (Accenture, 2015).

Thus, the academic literature has contributed by associating the purchase decision process with the consumer experience at each touch point during this process (Edelman & Singer, 2015). Since the end of the 90s are references to the customer experience by Pine and Gilmore (1998) highlighting the importance of experiences and the benefit of creating strong and long customer experiences and even stating 'that if airlines truly sold experiences more passengers would shop in the seat-pocket catalogues for mementoes of their flight'. In the retail context, Verhoef et al. (2009) explain customer experience as a multidimensional construct involving the cognitive, affective, emotional, social, and physical aspects of the customer to the retailer.

Presently, companies are increasing the use of Blockchain technology to enhance brand recognition and lead to customer loyalty (Ebarefimia, 2017). There are also sectors like food, marketing, and tourism where companies search for solutions to offer consumers a fully functioning immersive metaverse experience (Monaco & Sacchi, 2023). Nevertheless, there are successful use cases of metaverse utilization by airlines where First Airlines a Japanese carrier started to make available virtual flights from Tokyo. The airline stated a 100% Load Factor (Full house) for virtual flights to several locations, including Hawaii, Rome, Paris, and New York (Gursoy et al, 2022).

The metaverse offers consumers the opportunity to experience new Lounges at the airport or a new onboard service from a specific flight virtually from the comfort of their homes. Also, there are already Aircraft Manufacturers like Boeing working in the Industrial segment that is working closely with immersive 3D engineering designers to create airline services on an integrated digital ecosystem in the metaverse (Gursoy et al, 2022).

Metaverse as a concept is available for some years. However, attention to the metaverse surged at the end of 2021 following an acceleration in sales of Non-Fungible Tokens (NFTs) as well as announcements from Big Technological companies like META, owner of Facebook, indicating their interest and investment in the metaverse. The metaverse can be described as a 3D version of the internet (Hollensen et al., 2022) that may boost new business opportunities and will not replace the existing systems of engagement with customers but will emerge as a virtual 3D social media ecosystem consisting of many new and fascinating user experiences (Hollensen et al., 2022) and by 2026, is expected that 25% of people spend at least one hour a day in the metaverse for Leisure and Business, Gartner Inc. (Rimol, 2022). The Metaverse is the central piece bringing all elements into a unified and immersive experience (JPMorgan, 2022). And, according to Citi, the potential market value for the metaverse can stay between $8 trillion and $13 trillion in seven years (2030), with the expected metaverse users around five billion. The metaverse is evolving and can have a huge impact on airlines but only a few carriers are exploring the opportunities of the metaverse to leverage business, create engagement and collect additional revenue. There is research happening for many years in top-tier academic journals and papers about Hospitality, Customer Value, or Experience (So

et al., 2021) and Customer Journey but a short number of publications exploring the adoption of the metaverse in the Aviation sector. The shortage of academic literature exploring this subject represents an opportunity to explore the interconnections of these elements and a research gap, since the aviation sector has many touchpoints and business opportunities to explore (non-air experiences/air experiences) before boarding, at the airport, and onboard, and after the flight, experiences can be maximized to engage with customers.

This research aims to understand which factors influence metaverse adoption in an airline context, defining the range to which gamification, perceived brand engagement and perceived consumer experience influence the intention to use an airline metaverse. This research, therefore, pursues to fill this gap by addressing an adapted conceptual model with 6 hypotheses on how the intention to use is affected.

This research is organized as follows: Chapter 2 explores the literature review by highlighting the key concepts to understand the focus of the research and, refers to the model and the hypothesis under investigation. Chapter 3 presents the empirical study, methodology, and data collection. Chapter 4 reveals the results of the analysis and discussion of the findings. And finally, Chapter 5 reveals the final considerations and conclusions, also the limitations encountered, and further investigation of the subject.

2. LITERATURE REVIEW

2.1. AVIATION AND METAVERSE

Metaverse is a digital space that entitles users to social interactions using avatars to generate value and co-create experiences (Gursoy et al., 2022). Since 1992 when first appeared the designation in Neal Stephenson's novel, Snow Cash was a comprehensive virtual world that exists in parallel to the physical world.

The definition of 'digital twins' describes this symbiosis clearly. When is added an augmentation layer to the physical world and mixing virtual and physical universes into a thoroughly connected one, Metaverse erupts as a lifelike immersive virtual world. 30 years later the concept of the metaverse evolved into a real business consideration for marketing, amid many other applications. But there are 2 other branches of the metaverse: the industrial and enterprise — that are already being used to test potential scenarios in industries like aerospace, logistics, and manufacturing.

According to Nokia's CEO, Pekka Lundmark, the future can be one of the plural metaverses: consumer, enterprise, and industrial (www.nokia.com). The consumer version is where consumers play, the enterprise version is where companies can co-design with the engaged community and the industrial version is where products are ´manufactured´. The aviation business can easily be present on the 3 levels and investigate new opportunities to engage with customers, design new products and services, and create new features. Our focus in this research will be the consumers´ version.

Many big tech companies such as Facebook, Microsoft, Google, Roblox, Shopify, and Nvidia Corp. are investing hugely millions of dollars to take the lead in building a digital universe – metaverse (Curry, 2022; Rees, 2022), but not only the big tech companies are looking closely to this opportunity also retail companies are taking a front seat, Nike for instance registered already a trademark and created already an online corner – Nikeland – in Roblox, also, luxury brands like Gucci started selling several digital goods and also experimenting with NFTs (Cotriss, 2022), and in the entertainment sector, Verizon partnered with Disney, Google, and Snap to create AR lens that allowed enthusiasts to interact with Avengers characters (Yim, 2022) have begun to deeply explore opportunities to engage with consumers in the metaverse. Also, relevant consultancies like PwC and Accenture are present with new client services - the metaverse advisory hubs - with the ambition of facilitating a new generation of professional services, including accounting and taxation in the metaverse (Birch, 2022).

Furthermore, other business areas like official or public entities are also engaging in service-level metaverse initiatives. For example, South Korea's capital city released the first stage of what it calls 'Metaverse Seoul', which is the first city-twin public metaverse platform in the world. The intention is to focus on improving public services through the virtual platform (Park, 2023).

The future for the travel industry with a 'digital twin' looks exciting, the World Economic Forum (2022) stated that new travel experiences will be crafted with increased adoption of the metaverse. People with limitations and that can't travel — due to health, financial, or other reasons—will have a chance to experience their favourite airline, or destination, meet friends, or go to a music show, all through fully immersive and interactive experiences. Also, according to McKinsey & Company (2022), the potential impact of the metaverse is between $2 trillion and $2.6 trillion on e-commerce by 2030.

But the airline business in the metaverse already started for some carriers, in table 1 it's easy to spot the Status-Quo and find that almost all the airlines implementing metaverse strategies are following different approaches.

Table 1 - How Metaverse is Being Used in Aviation

Airline	Metaverse utilization in aviation
Qatar Airways	QVerse, a VR experience, empowers users to virtually explore the aircraft cabin interior and take a virtual tour of the Premium Check-in area at Hamad International Airport. They are the first worldwide airline to present a Metahuman cabin crew who offers an interactive customer experience.
American Airlines	American Airlines would start to offer services within the virtual space Meta (formerly known as Facebook) has created. For a short period, virtual passengers in the Metaverse can experiment AA flight experience, opening new travellers up to destinations the carrier currently serves in the real world.
Emirates Airline	Plans to invest $10 million into building "signature brand experiences" in the metaverse.
First Airlines	Virtual Flights to top destinations.
Etihad	Offering VR to the physical airport, Passengers when using the lounge can interact and entertain themselves with VR headsets before boarding.
Vueling	Plans to offer customers the opportunity to visualize their travels. Passengers can also track carbon offset and settle "carbon-positive" transportation….
British Airways	Introduced VR as part of its in-flight entertainment in first class.
Air Europa	Associated with a blockchain distribution company known as TravelX it offers the world's first NFT air ticket known as NFTickets. The first-ever ticket sold at auction went for $1 million.
Lufthansa	Already looking at the metaverse.
Singapore Airlines	Already looking at the metaverse.

Adapted from World Aviation Festival (2022)

The aviation industry is at an early stage in terms of metaverse adoption, only a few airlines have some strategy in place from the universe of 300 airlines represented by IATA (2023).

2.2. CUSTOMER EXPERIENCE

Customer experience can be defined as a customer's multidimensional—cognitive, emotional, sensorial, behavioural, and relational—responses to a firm's service (Schmitt 1999, Lemon & Verhoef, 2016) during the customer's entire purchase journey. More recent research suggests that every service exchange drives a customer experience (Schmitt et al., 2015). The latest technological breakthroughs are introducing new ways to experience both physical and virtual worlds. The fast pace of smartphones and mobile commerce development shows the true potential to potentiate disruptive breakthroughs in tourism (Wang et al., 2016). Smartphones enable wider context relevancy, empowering the co-creation of value in real-time and contextualized (Buhalis, 2020).

When firms engage customers to join firm-owned mobile apps they are potentiating the increase in purchase and frequency (Jang et al., 2021). The latest development in mobile networks enables the use of more powerful tools like the three-dimensional (3D) simulation and creates the conditions for the functionality of immersive technologies, such as augmented reality (AR), and virtual reality (VR), those two known as mixed reality (MR), augmented virtuality (AV) and pure mixed reality (PMR), also known as XR technologies, as seen on Figure 1 (Rauschnabel et al., 2022). VR offers immersive experiences by transporting consumers in artificially built environments. Almost all sensory perceptions are coordinated via screen-based technologies, haptic gadgets, and exoskeletons (Buhalis et al., 2019). VR can isolate the users completely from the real world and

transports them into a virtually designed world by using VR glasses or computer-assisted virtual environments (CAVE). The users are fully immersed in the digital scenario and can navigate and interact via the gamified 3D environment (Flavián & Barta, 2022). VR plays a vital part when deceiving the human mind to believe it is inside the rebuilt reality. By deceiving the brain, it allows the virtual exploration of sites and experiences via a variety of scenarios and storytelling. This is useful when customers would like to experience a facility or travel compartment before deciding to purchase the product.

Very differently, AR assists users already in situ but showing layered information on visitors' or passengers' portable screen devices, like smartphones, glasses, and wearables (Yovcheva et al., 2014). Extra information and further graphs and pictures are visible in sight to overlap content and increase the sensory experience. Content is exhibited via static, mobile, or wearable gadgets (Flavián et al., 2019). Information concentrates on the user's actual context and geolocation as well as their vision, mixing the real and digital worlds. AR offers great opportunities for bands and destinations to interact with customers on-site in real time and dramatically changes their on-trip experience (Buhalis & Foerste, 2015; Buhalis & Sinarta, 2019). From these concepts, VR is already playing a relevant role in tourism (Griffin et al., 2017).

All this technological development and fast internet connection are creating a potential mix of opportunities for marketers that can engage with customers immersively. But all the new opportunities by themselves are not changing anything, Airline marketers should be proactive in comprehending and adopting new technologies for advertising, branding, customer engagement, and customer service.

Metaverse in tourism and the aviation industry might first take advantage of MR, integrating VR and AR with a range of new tech tools to efficiently merge the physical and virtual worlds. It uses real-world reality combined with MR (AR and VR) to congregate all needs and stakeholders in a shared, 3D virtual space and boosts physical spaces to MR spaces, changing the internet to a parallel virtual universe (Buhalis & Karatay, 2022). Visitors and passengers may be moving between realities back and forth seamlessly. MR introduces an augmented copy of the real world, preferably so close to reality that a user can no longer tell what virtual or physical objects are. Augmented Reality Smart Glasses, such as Google Glass, Microsoft HoloLens, or MagicLeap One, will support the merger of physical and virtual worlds. These wearables incorporate impressive 3D content into the user's physical environment (Rauschnabel, 2021). Extended or Expanded Realities (XR) introduce a continuum ranging from, AR, and VR to MR (Dwivedi et al., 2020). Passengers will no longer be able to differentiate between virtual items and real objects and will use them both in a swapping way. XR is an agglutinating term that includes all interactive media immersive technologies in the Reality-Virtuality continuum (Kailas & Tiwari, 2021). XR stands as a key player in shaping the metaverse ecosystem. It empowers the 3D real-time rendering functionalities to enhance realism by delivering immersive user experiences along the AR to VR continuum (Milgram & Kishino, 1994).

Gamification has been broadly adopted by tourism and hospitality, and airlines can follow the example, for marketing, co-creation of experiences, and training purposes (in the training area the

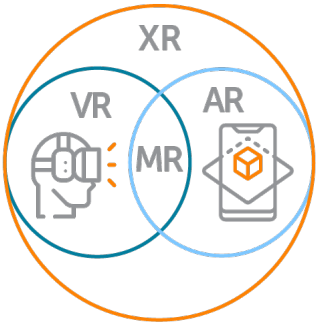

Figure 1 Extended Reality continuum,
Wonza (2022)

aviation industry is already playing a central role in using some of these tools). Gamification is mostly attractive to younger market segments, many of whom are gamers already (Dwivedi et al, 2022). It delivers extraordinary new marketing opportunities and guides visitors or passengers in the experimental co-creation of on-site experiences and compensating interactions with locals and fellow travellers (Dwivedi et al, 2022). In aviation, these interactions can create a gamified onboard new experience where passengers can interact with each other (while seated). Personalized elements can leverage both hedonistic and utilitarian value for visitors (Dwivedi et al, 2022). Adding value potentiates higher brand awareness, engagement, satisfaction, a better share-of-wallet, and repeat visitation (Xu et al., 2017). The gamification design process is valuable when focusing into design metaverse tourist experiences as well as for incorporating the before-during-after experience successfully (Dwivedi et al, 2022).

2.2.1. Before Travelling

Metaverse allows digital twins and other interface facilities so consumers can explore options in an immersive environment (Dwivedi et al, 2022). Therefore, the metaverse presents the possibility to prospective travellers to experience destinations and facilities virtually. Utilizing immersive technologies, customers can experience tourism destinations and products via immersive videos.

Trying and assessing travel alternatives immersively can enable experiential consumption. Using a digital twin, that can replicate a lounge or a flight deck, empowers passengers to select the best option that matches their needs and preferences. By empowering tourists and passengers to obtain an accurate preview and pre-experience multiple options, the metaverse can be a powerful tool that helps tourists and passengers to reduce their travel concerns. Tourists and passengers might ask for immersive information from friends, relatives, and/or other unknown travellers that knows the product or service already (Fan et al., 2022).

2.2.2. During travelling

Metaverse can increase the passenger experience. Passengers benefit from both face-to-face and online social contact when travelling (Fan et al., 2022). Like in museums AR can be used in airplanes to acquire augmented textual and/or audio-visual information. Metaverse successfully empowers passengers to become active or virtual actors in the context they choose to be. Like in the restaurant area, passengers on a flight can see the origins of their meal, the ingredients, the cooking process, and all the processes in the value chain by using a smartphone or other device (Rejeb et al., 2021).

2.2.3. After travelling

Metaverse can be used for evoking experiences and engaging with other passengers on the same flights. Users and passengers can ‘re-live’ past experiences and flights. Passengers can also share information with other passengers that want to take the same flight or sequence of flights with immersive media-rich reviews.

In Table 2 we suggest a series of experiences that can be shared immersively by passengers or by airlines via the usage of AR and/or VR.

Table 2 – Metaverse Airline's Immersive Experience

Before **travelling**	During **travelling**	After **travelling**
Seek inspiration/ Assess options/ Customize package	On-site experience	Assessment of value and satisfaction
Real assessment of the offer/ services to match the needs	Using VR and/or AR to see the landscape/ outside aircraft	Re-experience the Flight
Look and feel the atmosphere through realistic gamification	Using AR to experience the onboard service and meals	Re-engage with other passengers and recommend
Collect information and gather directions at the airport	Create a new immersive experience when flying First, Business, or Economy class	Reconnect with service providers
Experience the lounge offer	Interact with other passengers onboard – gamification	Rebook the same product/service for the next trip

Adapted from Buhalis et al (2023), Buhalis and Foerst (2015)

Immersive technologies like AR, and VR, have huge potential to affect all the dimensions of the experience during the complete customer journey (Flavián et al., 2019).

Along with the survey and interviews some of these moments will be highlighted and will become key points in the fact that the metaverse can influence the customer experience and the journey.

2.3. TAM – TECHNOLOGY ACCEPTANCE MODEL

Over the years many frameworks and models have been developed in studying technology acceptance that evolved and become theories, such as the Theory of Planned Behavior (TPB), Theory of Reasoned Action (TRA), Technology Acceptance Model (TAM), Extension of TAM (ETAM), Diffusion of Innovative Theory (DIT) and Unified Theory of Acceptance and Use of Technology (UTAUT) (Taherdoost, 2019) and many studies that complement these established frameworks, and new models are surging such as Model of Emerging Technology Adoption (META).

From the cited frameworks, the Technology Acceptance Model (TAM) Technology Acceptance Model (TAM), early developed by Davis (1989), still is one of the most significant research models in studies of the determinants of information systems (IS) and information technology (IT) acceptance to predict intention to use and acceptance of referred models by individuals. In the TAM, there are two determinants: perceived ease of use and perceived usefulness. Perceived usefulness represents the level to which a person believes that using a particular IS or IT would increase their job or live performance. Perceived ease of use is the point at which a person thinks that using a specific IS or IT would be effortless. Both perceived usefulness and perceived ease of use positively affect the attitudes toward an IS, and positively affect the individuals' intentions to use and the acceptance of the IS. Furthermore, perceived ease of use positively affects perceived usefulness, and both perceived usefulness and perceived ease of use are influenced by external variables. When compared with other theories like the Theory of Reasoned Action (TRA) and Theory of Planned Behavior (TPB) which can explore the system usage by including subjective norms and perceived behavioural controls with attitudes toward using technology, the TAM is more appropriate to be applied in online contexts for various advantages: a) TAM is specific on information system used for applying the concepts of usefulness and ease of use; b) TAM is stronger in various IS applications; c) well-validated questionnaire from all the prior studies; d) flexibility to include multiple theories and sources to better reproduce the acceptance understanding.

We may find a lot of previous studies on technology acceptance for emerging technologies, but only a few studies focused specifically on the metaverse. Literature also reveals that a lot of research was carried out to investigate technology adoption for metaverse's related technologies and components, such as VR, AR, wearable devices and blockchain.

These previous studies included additional elements that influence an intention to use the related technologies such as perceived trust, privacy, and perceived security (Kumar et al., 2022), social influence and perceived risk (Zhuang et al., 2021) hedonic motivation, perceived risk, and organizational trust (Magni et al., 2021), security, reduced cost, and efficiency (Sciarelli et al., 2021), perceived enjoyment and perceived informativeness (Holdack et al., 2022), convenience, entertainment and perceived informativeness (Hsu et al., 2020).

New moderating factors have also been considered towards the technology acceptance of these related technologies like millennials vs non-millennials generation (Zhuang et al., 2021), and rewards (Magni et al., 2021). However, the factors of gamification, perceived brand engagement and perceived consumer experience have not been much investigated.

2.4. HYPOTHESIS AND THEORETICAL MODEL

For the present research, six hypotheses (perceived consumer experience, perceived brand engagement and Gamification) were settled to further investigate how they influence the consumer's intention to use the metaverse technology of an airline.

2.4.1. Gamification

Gamification can interact on four layers: in-game, intra-organizational, customer and transformative (Wünderlich et al., 2020). For this research let's focus on the customer level where literature has found support for the role of gamification in customer relationship management, namely in loyalty programs, where it has been demonstrated that increases customer loyalty, participation, and intention to download apps (Hwang & Choi, 2020). Also, gamification has proved to augment marketing effectiveness by supporting user commitment, willingness to pay and customer referrals (Wolf et al., 2020), acceptance of product innovations (Müller-Stewens et al., 2017) and insights into brand equity (Xi & Hamari, 2020). At all four layers gamification is connected to engagement (Syrjälä et al., 2020). Upon all the above considerations, the following hypotheses are suggested.

H1. Gamification (G) positively influences the intention to use metaverse (ITU).
H2. Gamification (G) positively influences perceived brand engagement (PBE).

2.4.2. Perceived Brand Engagement

Consumer brand engagement can be defined as consumers' activities in emotional, cognitive, and behavioural aspects towards brand interactions (Cheung et al., 2020), would increase brand loyalty that involves repeated purchases (Dwivedi, 2015), directly or indirectly through consumer satisfaction (Fernandes & Moreira, 2019). Also, brand engagement could increase consumers' plans to co-create brand value instead of repeating the brand's purchase (Cheung et al., 2020). So, perceived brand engagement may become an element that influences consumers to use the metaverse.

Metaverse incorporates a virtual reality characteristic that can leverage social interaction and social presence side by side with services and products offered by the brand, and therefore it can generate affective brand engagement, which then results in the highest level of brand outcomes – brand advocacy (Cheung et al., 2020; de Regt et al., 2021). Saying this we may propose the hypothesis.

H3. Perceived brand engagement (PBE) positively influences the intention to use the airline metaverse (ITU).

2.4.3. Perceived Consumer Experience

Consumer experiences concerning technology can be separated into two branches: Positive experiences that involve social, emotional, and functional values, and negative experiences that involve technological barriers and price risk (Youn and Lee, 2019). Perceived experience is described as the perception of the individual towards a negative or positive experience that is aligned with one's expectations in using technology.

Using VR in a metaverse context fully immerses the human five senses, engages through realistic sounds and visuals, and interacts with objects and avatars by using the handheld device (Nuncio and Felicilda, 2021), which takes to the positive experience, either emotional, social, and functional values, towards the usefulness of new technology and therefore influences the behavioural intention to use (Kari et al., 2020; Youn and Lee, 2019). The following hypotheses are suggested:

H4. Perceived consumer experience (PCE) positively influences Gamification.

H5. Perceived consumer experience (PCE) positively influences the intention to use the airline metaverse (ITU).

H6. Perceived consumer experience (PCE) positively influences Perceived brand engagement (PBE).

There are previous studies, namely from Afkar et al., 2022, looking to find correlations and interactions between constructs and the intention to use the metaverse but the focus of that research was a specific brand. Because the metaverse is a technology recently available among the general population the number of active users is reduced. The shortage of active users encouraged the choice of intention as the dependent variable in this research.

From Figure 2 it's possible to check all variables and the hypothesis that we considered in this research. We additionally included hypotheses H2, H4, and H6, mainly to understand if we can create some dynamics between brand engagement, loyalty, and consumer experiences and get some managerial insights. It can be relevant to test if a specific Gamification action may affect positively airline Brand Engagement. Or, if actions focusing on the Consumer Experience may influence positively Brand Engagement.

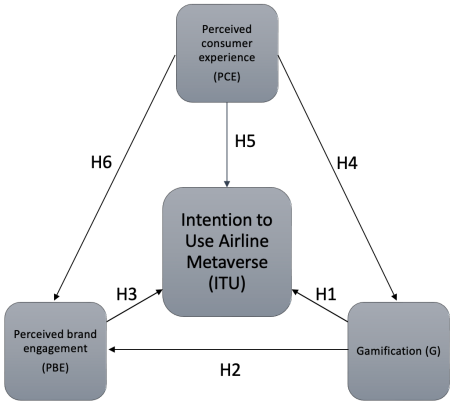

Figure 2 – Theoretical Model (Adapted from Afkar et al., 2022)

3. METHODOLOGY

In terms of methodological approach, the empirical elements of the research are an interview with experts and a questionnaire towards the general population. The use of a qualitative approach gave valuable insights to formulate questions for the online questionnaire and helped to understand and feel the actual status of the theme metaverse in the high management teams. Using a quantitative methodology was also advantageous, as it allows for quantifying a range of data and analyzing different correlations, it can cover large samples at a low cost and quickly and anonymously (Saunders et al., 2012).

3.1. INTERVIEWS DATA COLLECTION

Firstly, it was conducted a research interview with aviation experts as part of an exploratory study to gather preliminary data before designing the survey for the target audience. Regarding the interview there are earlier reflections that we must take into consideration like who to interview, the number of interviews, what type of interview, and how the collected data will be analyzed (Doyle, 2004). Considering the work experience and contacts for more than 20 years of the researcher in the aviation industry the target audience of the interview will be 3 senior managers working in the aviation business in loyalty, marketing & sales, and IT departments. The profile of the experts can be found in Table 3.

Regarding the type of interview was selected a semi-structured interview because is one of the models that generate richer insights and content. The semi-structural interview is flexible, easy, clear, and important, facilitating the appearance of hidden aspects of human and organizational behaviour. Many times, is the most successful and convenient way of collecting information (Kvale et al., 2009). This type of interview empowers interviewees to reply in their terminologies and abbreviations. It can take the most out of it if the researcher is knowledgeable in the industry terminology. It's like a professional conversation (Kvale, 1996, p. 5).

In the semi-structured interview, the interviewer has a clear roadmap of all topics but allows the interview to take other ways and unexpected directions where these open relevant new areas. Part of the success of this type of interview lies in allowing the interview to progress naturally so that the respondent does not 'see' that they are just replying to questions. The roadmap of the semi-structured questionnaire can be found in Appendix A. It used purposive sampling because the researcher's knowledge within the aviation sector is extensive and was relatively easy to find people who can and are willing to deliver the information by knowledge or experience (Bernard, 2017).

The data from the Experts' interviews were collected via a semi-structured interview with 3 aviation experts using online tools like Zoom and Google Meet with recordings of all conversations and using voice-to-text tools for later review of all key points and highlights and further analysis (questionnaire available in Appendix A). The key ideas and concepts from all the conversations are shown later in section 4.

The 3 interviewees have a consolidated background in senior management positions including, Senior Vice President (SVP), Vice President (VP) for Marketing and Sales and Marketing more details can be found in Table 3. In the same table, we present the demographic profile of the experts and can identify that 66% have basic knowledge of the metaverse and 33% (one expert) have advanced knowledge. Concerning professional experience in senior and managerial roles in the aviation industry 100% of them have more than 20 years of consolidated experience.

Table 3 - Experts' demographic

Interviewee	Country	Type of Airline	Work Experience	Actual Job	Experience in years	Experience with Metaverse
Expert #1	Portugal	Legacy	Marketing Manager (Airline), SVP - Marketing and Sales Manager (Airline)	University Associate and Aviation Consultant	>30	Basic Knowledge
Expert #2	Portugal	Legacy	VP Sales Airline (Airline), Commercial Director Airline (Airline), Sales Director Portugal (Airline)	Aviation Consultant	>30	Basic Knowledge
Expert #3	Portugal	Legacy	Chief of Strategy and Partnerships (IT), Executive Board (IT), Executive Board (Digital), Senior Manager (IT), VP Marketing (Airline)	Principal | EMEA Business Development and Innovation | Hospitality	>20	Advanced Knowledge

Source: Authors' elaboration

After compiling the key topics of the conversations in a Word document in English, a file conversion was made to Unicode UTF-8 due to systems requirements.

The software IRAMUTEQ - Interface de R pour les Analyses Multidimensionnelles de Textes et de Questionnaires, created in 2009, that is free open-source software, that uses the statistical environment of the R software used to explore the thematic data analysis to identify key themes and sub-themes (Brochado et al., 2019).

The technic of textual analysis was used to extract key and fundamental elements from the original data from the text originating in the voice recordings from the interviewees (Guerreiro et al., 2020). Textual analysis is a type of data analysis that deals specifically with transcribed verbal material, that is, texts produced in different contexts. It is applied in studies of thoughts, beliefs and opinions produced about a particular phenomenon, or research topic, allowing the quantification of essentially qualitative variables originating from texts, to describe the material produced by a particular subject or subjects (Camargo et al., 2013). This software makes it possible to identify the context in which words occur.

They perform lexical analysis of the text and partition it into hierarchical classes, identified from the segments of texts that share the same vocabulary, thus making it easier to know their content.

The system has several normalization methods like Lemmatization which is the process of deflecting a word to determine its Lemma. In Iramuteq there are its own rules for Lemmatization. Verbs are converted to infinitives, nouns to the singular, and adjectives to the masculine singular. Iramuteq also performs lemmatization from dictionaries, without disambiguation. Some trials were conducted to get a 'clean' report and words like 'a', 'be', 'in', 'can', 'to', 'is', etc. were removed from the analysis as seen in Table 4.

Table 4 - Forms Frequencies

formes	*exp_01	*exp_02	*exp_03
the	12	31	43
a	6	4	16
metaverse	6	25	26
be	6	8	14
in	5	5	20
can	5	1	17
to	5	5	16
is	4	12	11
used	3	0	7
will	3	12	0
an	3	4	3
and	1	13	6
of	1	10	8

Source: IRAMUTEQ software, 2019

The experts contributed with valuable questions like loyalty – extra miles or points, the opportunity to win a free flight in the gamification construct. Also, the brand engagement was enriched by content resulting from the experts.

3.2. QUESTIONNAIRES DATA COLLECTION

After we finalized the interviews and consolidated the data-texts we gathered insights that we considered important to integrate into the questionnaire. The first and major step in designing the questionnaire is to have a clear idea of what we are searching for (Jones et al., 2013). Normally we may be tempted to ask as many questions as possible hoping to get as much information as possible. This random approach does not work as asking many irrelevant and illogical questions decreases the response rate (Edwards et al., 2009). We must consider only the relevant data we need to use in our research and work on a 'need to know' basis rather than a 'would be nice to know' basis (Jones et al., 2006).

The next step is to find a target for our survey – in the research, the target group are individuals over the age of 18 years old with access to smart devices (mobile phones, tablets, etc.), since the metaverse can be used by most of the population (Toraman, 2022). From this broad target group, a sample was analyzed. Convenience sampling methods were incorporated into this research. Convenience sampling can be explained as the inclusion of only those who can be reached among the people within the scope of the research (Stratton, 2021).

Going further, we selected the method of data collection that consists of an electronic basis – an online survey using the Qualtrics tool.

There are many frameworks in searching for technology acceptance for emerging technologies already tested and resulting in solid theories like the Theory of Planned Behavior (TPB), Theory of Reasoned Action (TRA), Technology Acceptance Model (TAM), Extension of TAM (ETAM), Diffusion of Innovative Theory (DIT), Unified Theory of Acceptance and Use of Technology (UTAUT), and many other variations (Taherdoost, 2019). From the available literature limited studies focus on the metaverse and the TAM approach showed to be a popular framework (Park and Kang, 2021; Akour et al., 2022; Almarouqui et al., 2022; Misirlis and Manuawar, 2022; Mostafa, 2022; Fussel and Truong, 2022), and was the framework agreed for this research.

TAM is based on the Reasoned Action Theory, which is commonly used to explain human behaviour. In the actual context of new and disruptive technologies invading our day-to-day life, it's of vital importance to study the factors that affect the attitudes and intentions to use important technologies (Davis, 1989). This model has four simple variables that are perceived usefulness, perceived ease of use, intention, and active use (Venkatesh and Davis, 1996). Taking into consideration that many of the respondents of the questionnaire are not currently using the metaverse we are taking special attention to the intention to use the system. The relationship between perceived usefulness and intention to use is substantial while perceived ease of use may not likely affect the acceptance (Holden and Karsh, 2010).

TAM strengths also include the well-validated questionnaire from all the earlier studies and its plasticity to include multiple theories and sources to better replicate the acceptance understanding. There are also weaknesses that we may point that includes a lack of standardization due to many variants in TAM studies that may lead to a less clear theory (Holden and Karsh, 2010).

Regarding the questionnaire, the questions were made concerning the key concepts identified in the interview with experts and variable operationalization resulting from a literature review and can be detailed as follows, the construct of Perceived Consumer Experience and Perceived Brand Engagement was adapted from (Sheng & Teo, 2012), the Gamification construct resulting from the experts' inputs and adapted from (Baptista & Oliveira, 2017), the Intention to Use construct was adapted from (Venkatesh and Davis, 1996) and can be found in Appendix A.

The questionnaire was open for replies from 9th May until 31st May 29, 2023. There were 118 replies with 72 fully replied to all questions. In the analysis process of research, the Structural Equation Model (SEM) was used. In this model, the relationships among more than one independent

variable and more than one mediator as well as the dependent variable are considered. SEM is very popular in the literature and was used because the correlation between more than one variable was verified in the research (Hair et al., 2010). SmartPLS 4.0 software was used to apply the least squares statistical method via PLS (Partial Least Squares). In the analysis section of the results, the validity and reliability of the data acquired from the variables were checked (Hair et al., 2017).

Table 5 - Technical specification and sample characteristics

	Population	Sample type	Size	Collection	Period
Interview	Aviation/Tech Experts	Purposive sampling	3 interviews	Online	April 2023
Questionnaire	General population over 18 years old	Non-probabilistic (Convenience)	118 total replies with 72 full replies	Online	May 2023

Source: Authors' elaboration

4. RESULTS AND DISCUSSION

4.1. QUALITATIVE ANALYSIS - RESULTS OF THE INTERVIEWS WITH EXPERTS'

For the results were compiled 3 texts with a total of 1431 occurrences and 446 forms resulting in 284 hapaxes (19,85% of occurrences and 63,68% of forms).

Using the Actives form's function, with lemmatization, from the IRAMUTEQ system, it can easily be identified in Table 6 that 'metaverse' is the word with high frequency in the conversations, which makes sense once it's the central theme of this research and was used abundantly. The other top 3 words with high frequency are 'game' and 'sale'. Concerning the word 'game' was also surprising to see opposite points of view among experts.

For Expert #2, the metaverse is purely a game for young people but for Expert #3, you just go to the metaverse with a well-defined focus, a purpose, and a strategy, you don't go to the metaverse just to play games this by itself doesn't create any type of engagement with the audience. The word sale was used in the context of the need for airlines to monetize in the context of the metaverse and was not so obvious how can they do that with the current level of information and examples from the early adopters' airlines of the metaverse.

Table 6 - Most Significant Word Frequency (with lemmatization)

Form	Freq.	Type
metaverse	74	nr
game	14	nom
sale	10	nom
create	10	ver
consumer	9	nom
market	8	nom
funnel	8	nom
virtual	7	nr
experience	7	nom
product	6	nom
brand_awareness	6	nr

Source: IRAMUTEQ software, 2019

Also, an important word for the context analysis is 'create' was the most used verb in all conversations playing a key point focusing on the creation of new metaverse platforms, new avatars, and new digital twins, among others.

But this analysis is not exhaustive and doesn't give us many insights, so we dig deeper into the data and built several visualizations like a word cloud, a graph analysis that according to Gupta et al., and Hashimi et al is often used to uncover unseen patterns in big data.

4.1.1. Word cloud

As part of the analysis of the interviews by IRAMUTEQ software, it was generated a word cloud to better access the word frequency. A word cloud representation can be described as a visual representation of word frequency from a given set of texts. The more often the term appears within the data set under analysis the bigger and more centred the word appears in the image created.

Word clouds are just a raw representation of the words not considering words of the same meaning and they often fail to group words of the same meaning. In the same way, Ramsden et al., identifying single word frequency, fail to identify phrases reducing, this way, context.

Although these constraints we created a word cloud visualization where the main words were spotted (Figure 3). Metaverse is easily identified being a word with more frequency, which is understandable because is one of the main topics of this research and was used often in the conversations. Other terms have some centricity and are bold than others: game, create, consumer, sale, funnel, market, and experience. Apart from 'Sale' and 'brand awareness' all other words have the same weight in the visual representation (as seen in Table 6).

Figure 3 - Word Cloud (IRAMUTEQ software, 2019)

4.1.2. Graph Analysis

Via the IRAMUTEQ Graph Analysis, we were able to create a representation where the linkage strength in terms is explored. We have selected the following graphic configuration: Score = cooccurrence; Presentation = Fruchternam Reingngold; Type of graphic = Statique; Community = fastgreedy.community. In terms of interpretation, we should consider that the closer two sets of terms are located to each other, the stronger they are related (Souza et al., 2018). Figure 4 represents the Graph Analysis of the 3 text data sets, and we can see 6 distinct thematic beings represented by colours: light blue represents the new products available to consumers; pink shows the need for airlines to create new simulated worlds and avatars; purple represents the Gamification process with loyalty being a reference; red presents the Sales Process with some highlights to the sales funnel and the large green represents the metaverse experience process.

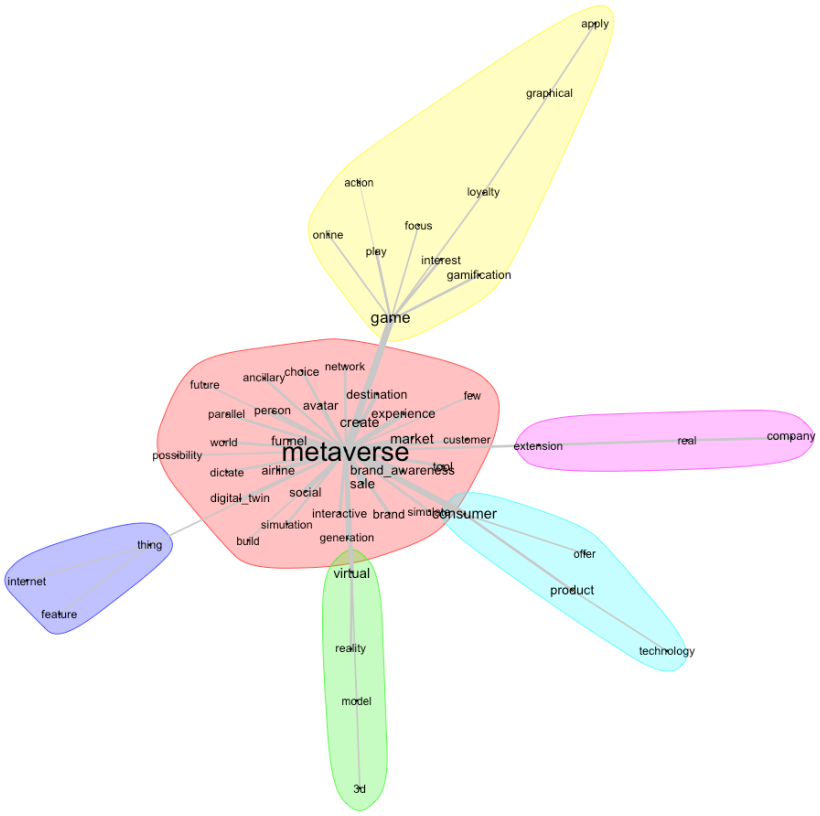

Figure 4 - Graph Analysis (IRAMUTEQ software, 2019)

4.1.3. Themes Analysis

Iramuteq bundled 54 terms into 6 main clusters that are apart from each other yet, Interconnected. The full list of terms is available in Table 7.

Using text mining tools, we went from text files into 6 clusters each of these clusters represents some form of interpretation of how the metaverse can impact the aviation industry. After reading and interpreting the texts we found the codes in each cluster: The light blue Cluster represents how airlines can be present online with new tech products to consumers; Pink Cluster indicates the digital extension of the company. Yellow Cluster indicates how the metaverse can be integrated into loyalty programs using gamification technics. Purple Cluster shows how IoT, and how technology may affect customer experience. Green Cluster indicates the possibilities of the use of VR/AR/XR. Big Red Cluster is a wider and centric cluster integrating most of the concepts of the metaverse in an airline context.

Table 7 - List of Terms

Cluster Light Blue	Cluster Pink	Cluster Yellow	Cluster Purple	Cluster Green	Cluster Red	
consumer	extension	game	thing	virtual	metaverse	future
offer	real	online	Internet	reality	brand_awareness	ancillary
product	company	play	feature	Model	brand	parallel
technology		interest		3D	simulation	funnel
		gamification			tool	world
		action			market	possibility
		focus			customer	dictate
		loyalty			experience	airline
		graphical			few	digital_twin
		apply			create	social
					destination	simulation
					network	build
					avatar	interactive
					choice	generation
					person	sale

Source: Authors' creation

After processing and grouping according to word occurrences we dig deeper into the data to find exhaustive information and obtain key prominent themes and subthemes. In this path, we expanded the data via a creation of a class Dendogram. In addition to presenting the classes, this image shows the connection between them since they are associated with one another. Figure 5 shows the Dendogram with the percentage of text segments in each class and words with greater chi-square (χ2). We have validation with a score of 97,5% - 39 segments classified over 40. Figure 6 shows the validation table.

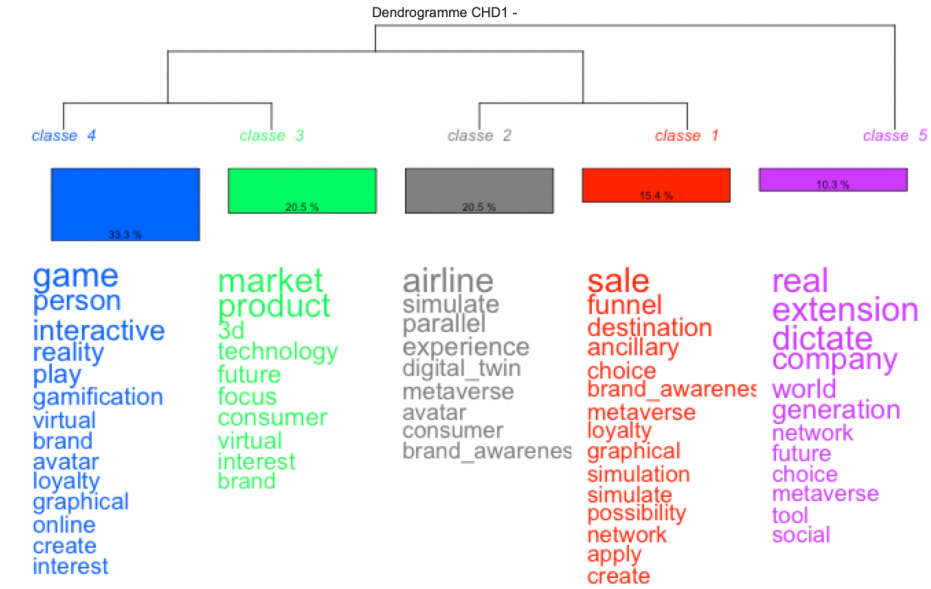

Figure 5 - Dendogram (IRAMUTEQ software, 2019)

It is observed in the most stable structure (Figure 5) (Ratinaud, 2014; Camargo & Justo, 2013) two main branches: The first branch with class 5 isolated and the Second branch is subdivided into two branches resulting in one branch with Classes 1 and 2 and the second branch with Classes 3 and 4. The closer the intermediate categories, the greater the contextual affinity and the future (re)groupings to form the final categories, under the perspective of the Textual Discourse Analysis (Ramos et al., 2019).

From the interpretations based on the precepts of the Textual Discourse Analysis method, (Moraes et al., 2016) supported by the analyses in Iramuteq (Ramos et al., 2019), five final categories were formed as shown in Figure 5.

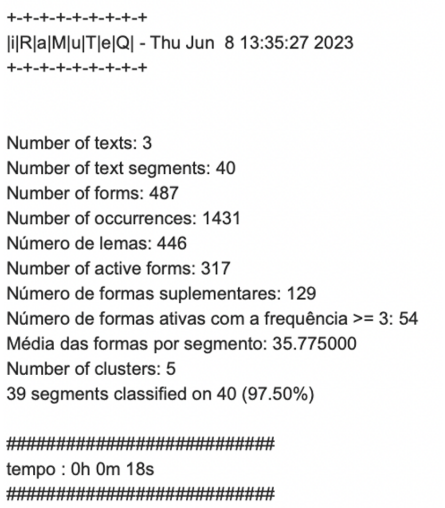

Figure 6 - Validation Table(IRAMUTEQ software, 2019)

Qualitative data are word-based, non-numerical and not structured not giving all the meaning to the hidden 'messages' of the texts. We need a stronger coding analysis to organize and put the data in a manner that we can read between the lines (Basit, 2003). There were identified four major themes and three subthemes in Table 8 that help review how the experts overlook the metaverse in an airline's context.

Table 8 - Codes, Theme and Sub-theme

Codes	Theme	Sub-theme	Class
Game Gamification Loyalty Sale Funnel Simulation Destination	Sales opportunities	Sales & Marketing - Loyalty	1, 2, 3, 4
Brand Awareness Brand Experience Digital Twin Graphical Simulation	Consumer engagement		1, 2, 3, 4
Create 3D Technology Network	Technology Constraints	IT and Technology	1, 2, 3, 4
Real Extension Dictate Company World Generation	Future opportunities	New consumer trends	5

Adapted from IRAMUTEQ software, 2019.

4.1.4. Exploratory Study Discussions

Our findings suggest that there are a new series of opportunities for airlines but only a few are already present in one of the available metaverses. From Table 1 we can check again that just a few airlines in the world are present and investing in some kind of digital platform in the metaverse. Many companies state that they are willing to invest but have no concrete outcomes yet from the big airlines.

4.1.4.1. New Consumer Trends

In terms of new consumer trends, Expert #2 suggests that the young generation will use the metaverse and they will lead the airline technological departments that will use disruptive technologies and the metaverse is one of these technological breakthroughs. This same expert also says that It's not the old generation of managers that will change the world and lead to new disruptive managerial technics. Also, refers that we must see with the eyes of a young person to see the new opportunities for the business.

Expert #3, the most experienced in terms of metaverse usage states that the new business opportunities must be adapted and integrated into the sales funnel to get some extra revenue via ancillaries or extra sales. The word 'sale' has a high frequency and was used in the context of the need for airlines to monetize in the context of the metaverse and was not so obvious how can they do that with the current level of information and examples from the early adopters' airlines of the metaverse.

4.1.4.2. Sales & Marketing

Sales were one of the top frequent words in the data texts, this meaning that there were talks around new sales opportunities, a new sales funnel, and a new channel for sales and marketing.

According to the version of Expert #3 gamification plays a vital role on the road to implementing new strategies to reach the players that are already in the metaverse. Gamification it's not a term with such a high frequency in the data texts but it's a word that has considerable relevance in the revealed codes and reveals a possible shortcut to deep dive into the metaverse. In terms of gamification, we can see that there are new opportunities for airlines to adapt actual concepts and create new ways to interact with customers in the metaverse, the possibility to adapt current loyalty actions to the metaverse format was referred to quite a few times. Also, according to Expert #3, we must join the metaverse with a well-defined purpose and strategy, being there is not enough, and our clients will disengage sooner. Not only be there but instead engage there with a strategic purpose.

Digital twins were also one term referred to as an actual reality in the industrial segment and for the sales & marketing departments, it can be adapted to incorporate a new promo campaign to a new destination, or a new onboard service or product and this way offer new experiences that might surprise consumers/ passengers.

4.1.4.3. Technology Constraints

Technology constraints are one theme that was not so much explored because we had a conversation with professionals from commercial and marketing departments but were debated regarding technology limitations and huge investments involved. If we approached IT managers maybe the findings were different and in other terms and themes. But we consider that there are limitations for airlines to invest in all sectors and mainly in sectors that they might not be familiar with and with many new technological challenges sometimes hard to explain and comprehend.

Only a multi-department team empowered to deep dive into the metaverse by the board members will succeed to implement any entrance into one of the many available metaverses. It's not needed to create a 3D version of the real product from scratch because there are already suppliers in

the market like Amazon Web Services (AWS) offering solutions that might reduce time and investments to an acceptable level.

4.2. Quantitative Analysis – Results from the questionnaire

Regarding the questionnaire, we registered a total of 118 replies with a score of 74 fully replied questions, the socio-demographic of the respondents' profile is shown in Table 9.

Table 9 - Socio-Demographic Data

Demographic	Atribute	Percentage	Count
Age	18-24	24,32%	18
	25-34	13,51%	10
	35-44	18,92%	14
	45-54	32,43%	24
	55-64	9,46%	7
	65+	1,35%	1
Gender	Female	52,70%	39
	Male	45,95%	34
	Non-Binary	1,35%	1
	Others	0,00%	0
Nationality	Portuguese	85,14%	63
	Other	14,86%	11

Source: Adapted from Qualtrics

We started the analysis of the measurement model by the reflective constructs, analyzing the indicators of reliability: Composite Reliability and Cronbach's Alpha, and the indicators showing convergent and discriminant validity. We present in Table 10 Cronbach's alpha, Composite Reliability and Average Variance Extracted (AVE), criteria that range from 0 to 1. The first indicator is a measure of internal consistency reliability that adopts equal indicator loading. This of the items and the correlation between the answers (Ringle, 2014). It is considered a traditional and conservative criterion used in latent variables, with a tendency to underestimate the internal consistency, indicating greater reliability when above 0,7 (Henseler et al., 2009; Ringle, 2014).

In our model, Cronbach's alpha range is between 0,862 and 0,918. According to Hair et al. (2013), we consider this criterion accomplished. Composite reliability also concerns the reliability and internal consistency of the scales and in the context of SEM, is a stronger internal consistency criterion than Cronbach's alpha. In our model, all values are above 0,873. The AVE is a criterion for convergent validity, and literature recommends values above or equal to 0,5 (Henseler et al., 2009) and our model shows an AVE between 0,613 and 0,738.

It can be stated that convergent validity was confirmed for three main reasons: First, as noted earlier, all items were positive and significant in their respective constructs; Second all constructs had Cronbach's alpha values greater than 0,70 and Third, the AVE for all constructs exceeded the minimum value of 0,50 (Bagozzi et al., 1988).

Table 10 - Construct Reliability and Validity

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Gamification	0,918	0,923	0,918	0,738
Intention to Use	0,908	0,914	0,909	0,715
Perceived Brand Engagement	0,862	0,869	0,863	0,613
Perceived Consumer Experience	0,879	0,892	0,880	0,651

Source: Smart PLS 4

The outer loading analysis is run to test the validity of a construct, with a value that must be superior to 0,7 to be considered valid. The results, as described in Table 11, show that all indicators of Intention to Use, Perceived Consumer Experience, Perceived Brand Engagement and Gamification have a loading factor > 0,7 so it means that they meet the requirements of good convergent validity value.

Table 11 - Outer Loadings, List

	Outer loadings
G_1 <- Gamification	0,850
G_2 <- Gamification	0,952
G_3 <- Gamification	0,830
G_4 <- Gamification	0,799
ITU_1 <- Intention to Use	0,822
ITU_2 <- Intention to Use	0,904
ITU_3 <- Intention to Use	0,895
ITU_4 <- Intention to Use	0,753
PBE_1 <- Perceived Brand Engagement	0,703
PBE_2 <- Perceived Brand Engagement	0,843
PBE_3 <- Perceived Brand Engagement	0,722
PBE_4 <- Perceived Brand Engagement	0,852
PCE_1 <- Perceived Consumer Experience	0,724
PCE_2 <- Perceived Consumer Experience	0,737
PCE_3 <- Perceived Consumer Experience	0,800
PCE_4 <- Perceived Consumer Experience	0,946

Source: Smart PLS 4

Discriminant validity is conducted to test if one latent construct is different from other constructs and in this research, the Fornell-Larcker methodology and Cross-loadings are used. The first criterion indicates that the latent variable should share more variance (square root of average variance extracted) with its set of items than with any other latent variable.

The second criterion evaluates the discriminant validity at the indicator level, where the value of the correlation (outer loadings) of its latent variable should be higher compared to the other variables (Henseler et al., 2009). The Fornell-larcker criterion is not fulfilled and shows that the tool has poor discriminant validity because as Table 12 shows, the square root of the average variance extracted on the diagonal is not always higher than the correlations of the remaining off-diagonal constructs except for the PBE > G; PBE > PCE and PCE > ITU, that show poor correlations. We can conclude that there is a positive relationship among the variables of the research except for the above-indicated correlations.

Table 12 - Fornell-Larcker Criterion

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)	G	ITU	PBE	PCE
Gamification	0,918	0,923	0,918	0,738	**0,859**	0,820	0,819	0,771
Intention to Use	0,908	0,914	0,909	0,715	0,826	**0,846**	0,773	0,821
Perceived Brand Engagement	0,862	0,869	0,863	0,613	0,821	0,769	**0,783**	0,858
Perceived Consumer Experience	0,879	0,892	0,880	0,651	0,780	0,819	0,851	**0,807**

Note: CR -Composite Reliability; AVE – Average variance extracted. Numbers in bold represent the

AVE square routes. Below these diagonal numbers are the correlations between constructs, and above the diagonal number are the HTMT values.

Source: Author's elaboration

Table 13 shows the Outer loadings and the Cross loadings criteria. Looking into the Outer Loadings of the items in Table 13, to continue the analysis of convergent validity, this reliability indicator should also assume values greater than 0,7. Thus, higher values indicate that the items that are part of a construct are related to each other (Henseler, et al., 2009).

The Cross Loadings criteria are not fulfilled, for all the constructs. For Intention to Use; Perceived Brand Engagement and Perceived Consumer Experience there are low correlations with other constructs. Only Gamification shows that there is a strong correlation with all other constructs in the model.

Table 13 - Cross Loadings

		Gamification	Intention to Use	Perceived Brand Engagement	Perceived Consumer Experience
Gamification	G_1	0,850	0,732	0,633	0,696
	G_2	0,952	0,809	0,754	0,744
	G_3	0,830	0,654	0,727	0,634
	G_4	0,799	0,632	0,709	0,598
Intention to Use	ITU_1	0,667	0,822	0,618	0,691
	ITU_2	0,783	0,904	0,668	0,704
	ITU_3	0,765	0,895	0,600	0,724
	ITU_4	0,559	0,753	0,731	0,653
eived Brand Engager	PBE_1	0,520	0,528	0,703	0,669
	PBE_2	0,679	0,651	0,843	0,725
	PBE_3	0,629	0,536	0,722	0,610
	PBE_4	0,728	0,678	0,852	0,663
ived Consumer Expe	PCE_1	0,483	0,606	0,684	0,724
	PCE_2	0,566	0,619	0,622	0,737
	PCE_3	0,651	0,621	0,688	0,800
	PCE_4	0,784	0,784	0,752	0,946

Source: Smart PLS 4

The next step in the analysis process is the estimation and validation of the structural model. There is one model developed to test the relationship between the technology acceptance variables in the context of using the metaverse in an airline context. The model aims to evaluate the direct effect of all predictors of intention to use and to understand if the gamification construct affects perceived brand engagement and if the Perceived consumer experience affects gamification and perceived brand engagement.

The evaluation of the structural model parameters went through the following tests: collinearity, path coefficients and coefficient of determination (R-square). Collinearity is checked again by VIF (Variance Inflation Factor) values and their tolerance (Ringle, 2014)

Table 14 - Collinearity Analysis

	VIF
Gamification -> Intention to Use	3,306
Gamification -> Perceived Brand Engagement	2,550
Perceived Brand Engagement -> Intention to Use	4,713
Perceived Consumer Experience -> Gamification	1,000
Perceived Consumer Experience -> Intention to Use	3,921
Perceived Consumer Experience -> Perceived Brand Engagement	2,550

Source: Smart PLS 4

According to the literature, the VIF recommend values below 5 and higher than 0,2. From what we can observe in Table 14, the mentioned criterion is satisfied. Collinearity occurs when two variables are highly correlated.

Table 15 - R-square

	R-square	R-square adjusted
Gamification	0,608	0,605
Intention to Use	0,760	0,754
Perceived Brand Engagement	0,788	0,784

Source: Smart PLS 4

The R-square values of the research are shown in Table 15 above. Since the metaverse technology, which is the focus of the research, is new, the intention to use was the focus of our questionnaire. The R-square adjusted value was found to be 0,754. R-square values above 0,75 indicate that it has a strong explanation percentage. In our case, we can agree that a substantial part of the fundamentals that affect people's acceptance of their motivation to use metaverse is covered by our model (Agustina, 2019).

4.2.1. Structural Model Validation

The hypothesized model was set to bootstrapping with 5.000 samples and the significance level at 0,05. settings can be accessed in Table 16.

Table 16 - SmartPLS Settings

Data setup	
	Setting
Algorithm to handle missing data	Mean replacement
Weighting vector	-
PLS-SEM algorithm	
	Setting
Initial weights	1.0
Max. number of iterations	3000
Stop criterion	10^{-7}
Type of results	Standardized
Use Lohmoeller settings?	No
Weighting scheme	Path
Consistent PLS-SEM algorithm	
Bootstrapping	
	Setting
Complexity	Most important (faster)
Confidence interval method	Percentile bootstrap
Parallel processing	Yes
Samples	5000
Seed	Fixed seed
Significance level	0.05
Test type	Two tailed

Source: SmartPLS 4

The literature refers that Path coefficient outputs must be at least 0,100 and at a significance level of at least 0,05. For all the hypotheses except for H3, the Path Coefficients (ß) are accepted. Also, p-values must be below 0,05 to be accepted in the model.

Supported by the literature we can assume that a p-value less than 0,05 is usually considered to be statistically significant, in which case the null hypothesis should be rejected. Concerning our model results, p-value values of 0,000 indicates that it has a very high t-distribution parameter. In relationships where the t-test has a higher value, the p-value becomes highly significant.

The t-test is not comparing two samples, the value of the t-test compares two effects and high values show that there is a significant effect of one construct on another construct. And consequently, since the p-value is inversely proportional to the t-test result, high values in the t-test represent significant p-values. So, when the value is below 0,05 it proves that the relationship is significant. According to these considerations, we can see that of all the 6 hypotheses one was NOT Supported. Perceived Brand Engagement did not influence Intention to Use (ß = -0,017, p = 0,989).

All other hypotheses are supported by our model. Table 17 shows all six Hypotheses and the relevant data with the testing support results.

Table 17 - Hypotheses Testing Support

		Path coefficients	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
H1	Gamification -> Intention to Use	0,483	0,476	0,456	0,181	2,636	0,008
H2	Gamification -> Perceived Brand Engagement	0,400	0,400	0,373	0,202	1,979	0,048
H3	Perceived Brand Engagement -> Intention to Use	-0,017	-0,017	-0,020	1,265	0,014	0,989
H4	Perceived Consumer Experience -> Gamification	0,780	0,780	0,776	0,079	9,884	0,000
H5	Perceived Consumer Experience -> Intention to Use	0,457	0,819	0,816	0,068	12,047	0,000
H6	Perceived Consumer Experience -> Perceived Brand Engagement	0,539	0,851	0,847	0,068	12,502	0,000

Source: SmartPLS 4

The outcome of the research analysis indicates that the model is reliable and valid. The correlation between the variables was as expected. Continuing the analysis, the existence of hypotheses constructed in the model was tested with path analysis. The SmartPLS 4 output of the research model is provided in Figure 7.

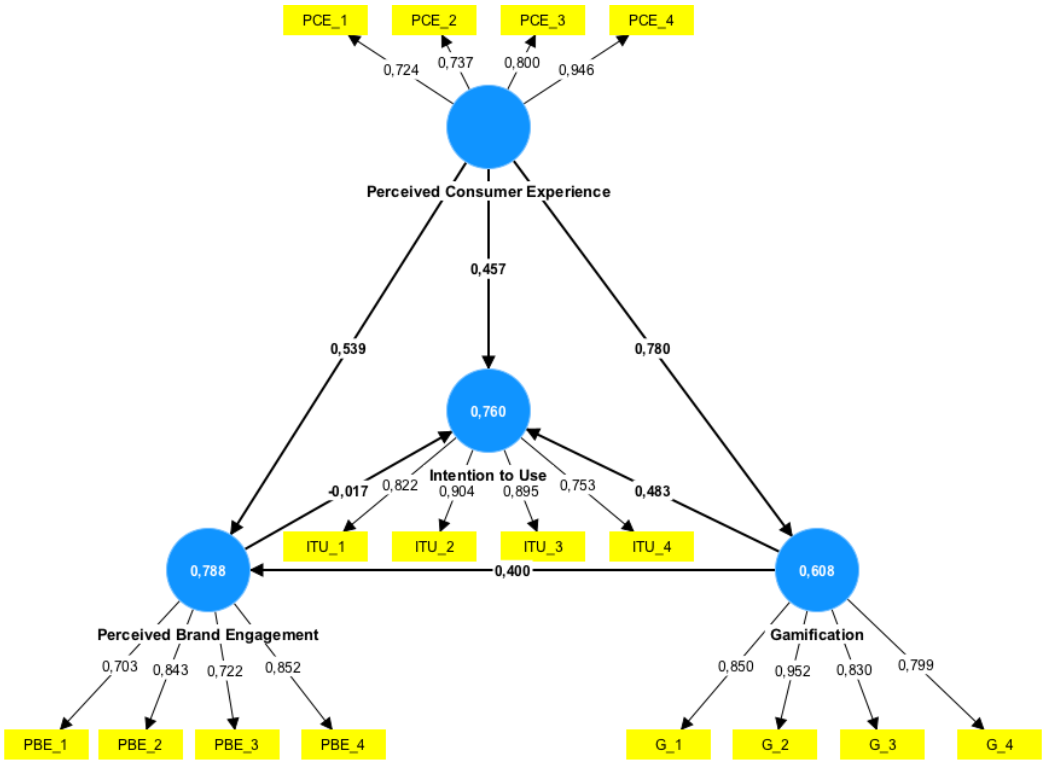

Figure 7 - Path Loadings (SmartPLS 4)

Concerning the fitness of the model it can be confirmed via the Standardized Root Mean Square Residual (SRMR). The result of the SRMR of our model is 0,058, which is in the range of 0.05 – 0.08, indicating that the model is fit. The mean, the median and the standard deviation of the questions are easily seen in Table 18. No indication of issues with the output data.

Table 18 - MV Descriptives

MV descriptives

	Mean	Standard deviation	Excess kurtosis	Skewness
G_1	3,873	0,802	4,326	-1,566
G_2	4,113	0,808	4,647	-1,758
G_3	3,859	0,806	3,403	-1,402
G_4	4,000	0,873	3,216	-1,469
ITU_1	3,597	0,809	2,495	-1,017
ITU_2	3,653	0,815	3,274	-1,245
ITU_3	3,889	0,754	4,873	-1,632
ITU_4	3,306	1,005	0,654	-0,502
PBE_1	3,400	0,752	2,604	-0,779
PBE_2	3,357	0,760	2,319	-0,649
PBE_3	3,343	0,832	1,507	-0,669
PBE_4	3,592	0,787	2,880	-1,064
PCE_1	3,417	0,810	2,606	-0,872
PCE_2	3,750	0,918	2,347	-1,222
PCE_3	3,465	0,852	2,105	-0,882
PCE_4	3,746	0,778	2,880	-0,957

Source: SmartPLS 4

4.2.2. Quantitative Analysis Discussions

In the scope of the quantitative analysis, we used the TAM approach because is a popular tool among experts to study the acceptance of new technologies and was used to explore the acceptance of metaverse in the context of the aviation industry.

Metaverse can be described as a digital space that entitles users to social interactions, using avatars, to generate value and co-create experiences (Gursoy et al., 2022). Due to the novelty of metaverse technology, the number of actual users is restricted. This limitation made it necessary to define the dependent variable of this research as the intention to use. Though according to TAM theory, one of the most significant predecessor indicators of peoples' use of technology use of technological innovation is their intention. The metaverse for the present research has been assessed within the framework of the TAM model.

Concerning this quantitative analysis, it is now important to discuss the results and understand which factors are contributing to the intention to use. After the analysis of the different results obtained, the next step is the verification of the listed hypotheses, to accept or reject them accordingly.

Hypothesis H1 (G > ITU), H2 (G > PBE), H3 (PBE > ITU) and H5 (PCE > ITU) were designed agreeing to the TAM theory. According to the literature, we can accept that a positive and significant effect was found between G and ITU and between PCE and ITU. Hypothesis H3 by the opposition was not confirmed by our research model.

H1 (G > ITU) | H2 (G > PBE)

For this research, we focused on the customer level where literature has found support for the role of gamification in customer relationship management, namely in loyalty programs (Hwang & Choi, 2020). Additionally, we also consider that gamification is connected to engagement (Syrjälä et al., 2020).

Results show that gamification has a positive effect on the intention to use (β = 0,483, p <0,008), concerning H1 from our model we can agree that gamification positively influences the Intention to Use metaverse. This construct registers the highest mean and median from all the questions (questions G2 and G3), namely where we asked the respondents about gaining extra miles or points and winning a trip by participating in a quiz respectively. Respondents can easily understand what we were asking and reply accordingly without major effort because they can remember other actions in real contexts.

We can agree that this is the construct that relates more to real life and in case of companies decides to enter the metaverse this can be the entry door to start to engage and liaise with potential new customers for example via the utilization of loyalty actions (extra points or extra miles) or the

launching of a new destination with several activities in the metaverse over the sales funnel. We can also see a positive effect for gamification over a perceived brand engagement (*ß* = 0,400, *p* <0,048), we consider that H2 of our model is also validated. Again, the mean and de median of the replies show a high ranking among all the replies obtained. We can relate to the fact that people can understand and relate to the questions and reply with less effort to see the hypothetical scenario that we are asking in the questionnaire.

Also, in the literature gamification is one of the constructs that is connected to engagement, and we consider that customers can easily enter a simulation game and win any kind of reward and this way increase the perceived brand engagement with the brand.

H3 (PBE > ITU)

Consumer brand engagement can be defined as consumers' activities in emotional, cognitive, and behavioural aspects towards brand interactions (Cheung et al., 2020), would increase brand loyalty that involves repeated purchases (Dwivedi, 2015), directly or indirectly through consumer satisfaction (Fernandes & Moreira, 2019). Also, brand engagement could increase consumers' plans to co-create brand value instead of repeating the brand's purchase (Cheung et al., 2020).

Perceived brand engagement (PBE) not influences the intention to use the airline metaverse (ITU) and is not validated by our model (ß = 0,-017, p <0,989). This construct requires more emotional engagement, cognitive and behavioural aspects and what the metaverse concerns we are talking about a technology that few people adopted and used already, meaning that people when replying may not make the emotional bond with the researched theme.

This is an important topic because brand engagement could increase consumers' plans and co-create brand value on top of repeating the purchase of the brand (Cheung et al., 2020). Also, the social buzz around the metaverse may be the ideal place to generate affective brand engagement, which results in the highest level of brand outcomes – brand advocacy (Cheung et al., 2020; de Regt et al., 2021).

H4 (PCE > G) | H5 (PCE > ITU) | H6 (PCE > PBE)

We can state that Perceived Consumer Experience (PCE) positively influences Gamification (ß = 0,780, p <0,000) in our model which corresponds to Hypothesis H4. This is an indicator that might be further investigated to see deeper results and understand where companies can increase their presence and introduce new experiences that induce consumers in social, emotional, and functional values also referred to in previous studies from Youn and Lee.

Concerning Perceived Consumer Experience (PCE) also positively influences the intention to use the airline metaverse (ITU), (ß = 0,457, p <0,000) in our model which corresponds to Hypothesis H5. This is also an important result of our research that might lead to further discussions. We can idealize a scenario where airlines can adopt and use AR/VR tools in a metaverse context fully immerses the passenger's five senses, engages through realistic sounds and visuals, and interacts with other users/ avatars by using the handheld device (Nuncio and Felicilda, 2021), which takes to the positive experience, either emotional, social, and functional values, towards the usefulness of new technology and therefore influences the behavioural intention to use (Kari et al., 2020; Youn and Lee, 2019).

Perceived consumer experience (PCE) positively influences Perceived brand engagement (PBE), (ß = 0,539, p <0,000) in our model which corresponds to Hypothesis H6. This is also an important finding since Perceived Consumer Experience can involve social, emotional, and functional values that might lead to higher brand engagement where consumers and passengers will buy more and ultimately will advocate our brand (Cheung et al., 2020; de Regt et al., 2021).

To better acknowledge the results from the 6 hypothesis we consolidated in Table 19 our findings.

Table 19 - Hypothesis Validation Results

Hypothesis	Result
H1. Gamification (G) positively influences the intention to use metaverse (ITU).	Accepted
H2. Gamification (G) positively influences perceived brand engagement (PBE).	Accepted
H3. Perceived brand engagement (PBE) positively influences the intention to use the airline metaverse (ITU).	Rejected
H4. Perceived consumer experience (PCE) positively influences Gamification.	Accepted
H5. Perceived consumer experience (PCE) positively influences the intention to use the airline metaverse (ITU).	Accepted
H6. Perceived consumer experience (PCE) positively influences Perceived brand engagement (PBE).	Accepted

Source: Author's elaboration

5. CONCLUSIONS AND FUTURE WORKS

New Technology is popping up daily. During the last days of this research, Apple just released the Apple Vision Pro – opening a new era of spatial computing. The new device of Extended Reality (XR) offers new navigation possibilities while the user can still see their familiar surroundings. This is just an example of how fast and how often we have access to new technological products. Although new technology is available, we still need adaptation and adoption for widespread use among the general population.

The aviation industry already included the XR in some activities like training programs for staff and cabin crew where is possible to find simulations that include emergency scenarios, 3D virtual hubs, virtual training, simulated experiences and gamified ambient. This will lead to cost reductions and fast sessions of on-ground training. Also, VR can provide users with very high-quality immersive entertainment onboard long-haul flights, and it was tested some years ago by Qatar Airways, Alaska Airlines and British Airways. We have also some examples of AR use from ground handling and airports, but those are out of the scope of this research.

But most of the investments are being made in the enterprise, and industrial versions of the metaverse and in the consumer version just a few airlines are investing at an uninterrupted and increasing pace showing that many airlines are waiting for the competition to decide what to do next. From Table 1 we can spot this reality of a low number of carriers investing and dealing with some kind of digital platform in the metaverse.

According to the experts' feedback, we can expect that the younger generation will enter in leading and managerial roles in airlines and will spark a change in the organization to explore new business opportunities in the metaverse. Also, from the experts' we can learn that going into the metaverse should only occur when a company have a well-defined strategy and a clear purpose and those are key concepts that must be considered by leading teams and managerial staff. In many businesses like the aviation industry, some players are more risk-friendly than others, the fact that companies are holding investments may be seen as a conservative strategy to enter a not-well-known digital platform and wait and follow the leaders. Many companies are part of joint ventures or alliances but not even the collaborative environment that is part of those ecosystems is forcing new metaverse opportunities to rise.

From the consumer side, our research also shows some limitations because the metaverse is not a common and daily used technology with constraints on its adoption. Some respondents clearly didn't understand the questions (direct feedback), and some gave up answering the questionnaire. This indicates that although technology is available for some years average population are not aware of potential usage and application in an aviation ecosystem. When we asked for some well-known activities like free bonus miles and free tickets, respondents recognized and explicitly chose those questions with higher scores. This can be seen as an opportunity to explore new business opportunities adapting activities that people know from the actual sales and marketing actions to the metaverse. Briefly well show a series of areas within the customer journey where airlines can adopt metaverse actions and interact dynamically with customers:

Table 20 - Customer Journey - Metaverse Adoption

Before flight	**During** flight	**After** flight
Launching a new destination via immersive VR campaigns	Use XR to access the surroundings of the flight	NPS assessments using VR
Upsell campaigns – cabin class upgrade offers – using VR	Using XR to experience the onboard service and meals	Create a community of advocates that can share experiences after flight
Ancillaries offers within the sales funnel – using VR	Create onboard social interaction using XR	Members get member campaigns
Lounge acquisition campaigns – via the use of VR	Onboard sales using VR	Special offers of bonus miles when purchase from the metaverse

Source: Author's elaboration

In summary, as technology evolves and is entering our daily lives, it will open new doors to more applications across the industry creating breakthrough leaps in commercial aviation but managers, board members and all related stakeholders must be committed to the company strategy and be engaged in creating a collaborative mindset that will support the implementation of a new metaverse ecosystem.

Furthermore, not all consumers are ready to adopt the metaverse and the way to success seems bumpy and long, but the companies that invest earlier, consistently and with a well-defined strategy and purpose will allure the early adopters and will start to collect the benefits before the competition.

5.1. LIMITATIONS AND SUGGESTIONS FOR FURTHER STUDIES

It is important to consider that the findings presented in this research result from limitations inherent to reduced research in terms of sample size (qualitative and quantitative) and the fact that it reproduces results from a specific context (Airline experts from one Portuguese Airline and respondents mainly from Portugal).

Additional research among several airline managers is recommended considering cross-country interviews to get a wider and broader view of the metaverse readiness and intention to invest. Additional research can also explore if there is a difference between medium-haul and long-haul airlines in terms of metaverse investment intentions.

Also, a broader survey is highly recommended to validate the results with a larger audience. In this sense, in terms of external validity, that is, the possibility of generalizing the results found to other contexts or samples, although this study has covered some of the existing theories concerning the Intention to use the Metaverse in an airline context, it was only an exploratory study that cannot be generalized or representative.

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APPENDIX A

a) Semi-structured interview questions

Type of Questions	Purpose of questions	Questions
Introducing questions	To kick start the conversation and move to the main topic	Can you tell me more about Metaverse?
Probing questions	To draw more complete narratives	Could you be more specific about what extent the Metaverse can be integrated into an airline?
Structuring questions	To close one chapter and move to the next topic	How do you believe the use of the Metaverse will increase the brand engagement of an airline?
Structuring questions	To close one chapter and move to the next topic	Now, let's move to the intention to use the airline Metaverse in a new customer journey.
Interpreting questions	Like some types of probing questions, to clarify and interpret rather than explore new information	Does gamification play an important role in this new customer journey path?

Adapted from Kvale (1996)

b) Variable Operationalization

Items	Questions
I1	I am likely to use Metaverse soon.
I2	I am willing to use Metaverse shortly.
I3	I intend to use Metaverse when the opportunity arises.
I4	I am planning to use Metaverse in my future search for air travel.
PCE1	Using Airline X Metaverse reminds me of the activities I can do.
PCE2	I can relate to other people through the Metaverse of Airline X.
PCE3	Using Airline X Metaverse causes me to think creatively.
PCE4	Airline X Metaverse tries to stimulate my curiosity.
PBE1	Using Airline X Metaverse makes me have the intention to use other services or products.
PBE2	After using Airline X Metaverse I shall be more inclined to buy Airline X brand from now on.
PBE3	Using Airline X Metaverse makes me feel more emotionally bonded with the Airline X brand now.
PBE4	I may recommend Airline X to other people.
G1	If Airline X Metaverse was more fun/enjoyable, I probably use it more often.
G2	If I can get extra points, rewards, and prizes I probably use Airline X Metaverse more often.
G3	If Airline X Metaverse was more fun, I probably advise others to use it.
G4	If I can get a trip to a new destination by playing a game in the Metaverse of Airline X I might use it more often.

Adapted from Sheng & Teo, 2012; Baptista & Oliveira, 2017; Venkatesh and Davis, 1996 and Experts' feedback.