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# **Game of (Delivery) Drones: A Game-Based Approach for Supporting Deliberation on the Use of Drones in Logistics**

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# **Game Of (Delivery) Drones: A Game-Based Approach for Supporting Deliberation on The Use of Drones in Logistics**

Taalia Nadeem

## **Abstract**

This study investigates stakeholder perceptions of delivery drones, focusing on their societal implications and potential to inform policy development. While drones are anticipated to transform last-mile logistics, public understanding of their operational and regulatory challenges remains limited. Current research often adopts a deficit model, emphasising gaining acceptance over meaningful explorations of public concerns. This study addresses this gap by employing Social Representations Theory and Knowledge Co-creation to examine how individuals construct shared understandings of delivery drones through dialogue, media narratives, and social interactions.

A qualitative approach was adopted, and a serious board game, The Game of (Delivery) Drones, was developed to engage participants in discussions about drone logistics. The game simulated realistic scenarios, incorporating parameters such as ground risk, energy consumption, and operational challenges. Participants explored these aspects while responding to embedded questions that elicited their views on delivery drones. A total of 11 game-based focus groups were conducted, with 58 participants. In parallel, a media representation study analysed drone-related headlines from three major online UK news sources to contextualise how delivery drones are framed in public discourse. These representations informed the design of game scenarios and served as reference points during participant discussions, particularly when reflecting on dominant narratives around drones.

Participants actively explored complex scenarios, collaboratively reflecting on the implications of delivery drones. Gameplay facilitated knowledge co-creation, enabling participants to articulate and negotiate diverse perspectives. Participants expressed concerns about safety, privacy, noise, and socio-economic inequities, contrasting these with media portrayals that often emphasise technological progress while downplaying risks. Essential versus non-essential drone use emerged as a key area of debate, with participants calling for place-specific regulations and clearer policy frameworks.

The board game effectively engaged stakeholders and captured nuanced insights into public perceptions of delivery drones. This adaptable tool offers a replicable method for public engagement and policymaking. The findings highlight the importance of participatory approaches in developing equitable, context-sensitive regulations and encourage informed decision-making for emerging transport technologies.

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# 1.0 Introduction

## 1.1 Rationale

The UK government is progressing with plans for Urban Air Mobility (UAM), which includes the use of Uncrewed Aerial Vehicles (UAVs) for last-mile delivery (CAA 2024c). This thesis focuses on using UAVs, referred to as drones in this study, for logistics applications. The UK's Future Flight Vision aims to incorporate drones for retail deliveries by 2030, prioritising these innovations in government agendas due to the potential economic benefits (see, for example, PwC, 2022). However, these claims are debated, with experts suggesting they remain speculative and unproven (Oakey and Smith 2023; Oakey et al. 2022). Oakey et al. (2022) argue that drones' comparative advantage over traditional delivery methods, such as ground transportation, is still unclear. Recognising last-mile delivery as one of the most challenging stages in logistics (Lim et al. 2018), drones are seen as a transformative technology that could help streamline the process (Jazairy et al. 2024) and reshape the supply chain (Merkert and Bushell 2020). Anticipated benefits of drone deliveries include reduced road congestion, shorter delivery times (Liu et al. 2022) and lower emissions from road transport (Figliozzi 2020). However, these outcomes depend on numerous factors (International Transport Forum 2021).

While drones have been adopted in several countries, such as Rwanda, for medical deliveries, their advantages are particularly evident in regions with less developed road infrastructure and challenging terrain, where they can provide faster and more reliable access to remote areas (see for example, Nisingizwe et al. 2022). In contrast, uptake in developed countries like the UK has faced delays due to strict regulatory requirements. Major retail giants such as 'Amazon Prime Air' (Amazon 2016) and DHL's 'Parcelcopter' (Hern 2014) attempted to implement drone deliveries but ultimately ceased operations due to regulatory challenges, lack of infrastructure and public backlash (Metz 2021; Drapkin 2021; Rathore et al. 2022). Notably, Amazon Air has announced plans to relaunch its Prime Air drone delivery services in the UK, seeking planning permission and authorisation from the CAA to proceed (Amazon 2025). Currently, trials are underway in the UK and Ireland with drones delivering retail items in Dublin suburbs (Manna 2024) and transporting medical supplies for the NHS in England (NHS 2023; NHS 2024). However, widespread adoption will necessitate addressing



governance challenges involving stakeholders, including the public. With policies still being developed, now is an ideal time to shape the future of this emerging transport technology in society.

The rise of drones in commercial and consumer markets introduces complex implications for traditional aviation systems and societal dynamics (Boucher 2016; Rao et al. 2016; Luppiciini and So 2016; Pliotsias et al. 2018; Bloise et al. 2019). Both academic and public perspectives, especially in the US and UK, often view drones with suspicion, citing ethical and legal concerns (Roma 2017; Enemark 2013). Although drones are not new, the public remains primarily familiar with hobby drones for leisure use, although awareness of logistics drones is increasing (Marshall et al. 2022). For many in the UK, direct exposure to delivery drones is limited to news of trials focused on services with social value (Smith et al. 2022b), making it challenging for the public to understand their potential impact and practical applications.

Uncertainties around future drone operations, such as specific scenarios, operational parameters, and locations, further complicate public understanding (Smith et al. 2022a). If delivery drones become commonplace, they will directly affect daily life, highlighting the need for inclusive deliberation. However, engaging stakeholders is challenging as delivery drones are not highly visible on the political agenda or at local levels (Smith et al. 2022b). Current research on public opinion often follows a deficit model, focusing narrowly on gaining acceptance, assuming the inevitability of implementation (International Transport Forum 2021; ESRG 2013; Smith et al. 2022b; Stilgoe and Cohen 2021).

In the UK, drone trials often occur in discrete locations with limited visibility, further challenging public understanding. Media coverage of these trials tends to emphasise potential public benefits while downplaying uncertainties, creating an optimistic yet incomplete picture of drones' advantages (Grote et al. 2024; Oakey et al. 2022). Since drones are not a significant part of everyday life, people may find it challenging to contextualise their uses and implications (Stilgoe and Cohen 2021). Engaging stakeholders meaningfully is particularly challenging when the topic holds limited immediate relevance to their lives (Smith et al. 2022a). Research shows that engaging the public on new technologies is more effective when information is relevant to local settings or personal contexts (Kopsel et al. 2017). Encouraging public participation requires innovative engagement tools to explore practical details such as flight paths, frequency, and purpose of drone use (Smith et al. 2022a). Effective participation often requires gaining new insights into complex, unfamiliar issues, such as the operational scope

of drones, their possible locations, payload capacities, and associated risks. These challenges call for a move beyond traditional engagement methods toward strategies involving the public in envisioning future transport systems. Such approaches would allow the public to contribute meaningfully to discussions on future policies, including drone flight locations and regulations.

To address these challenges, this research responds to gaps in current public engagement approaches with delivery drones, particularly the absence of methods that help people explore unfamiliar technologies in a meaningful, context-driven way. Existing studies often assess acceptance or attitudes without grounding them in a real-world context, overlooking how people construct shared understandings through interaction and situated reflection. This thesis contributes to knowledge by combining media analysis with a participatory, place-based approach; specifically, a serious board game designed to support public deliberations about the use of delivery drones. The game aims to facilitate reflective engagement with drone-related scenarios by helping participants navigate complex trade-offs and imagine the implications of drone use in their communities. The game enables participants to engage with realistic operational scenarios, consider trade-offs, and articulate priorities in a structured but creative setting. This approach enables both theoretical insight into the formation of social representations of drones and practical tools for engaging stakeholders in policy-relevant dialogue. The findings are of value to local authorities, organisations such as the NHS, and transport planners exploring drone-based logistics and seeking more inclusive ways to involve communities.

Serious games offer a promising option by encouraging deeper engagement and involvement in decision-making processes (Mayer 2009). These games immerse participants in specific issues, facilitating learning and effective responses that enhance their involvement (Krath et al. 2021). Their interactive nature allows for the inclusion of diverse stakeholders through their engaging format and novelty (Khoury et al. 2018), promoting immersion in complex issues (Aubert et al. 2019). These games can elicit emotions (Marini et al., 2018) and stimulate debate (Rodela et al. 2018), making them particularly suited for participatory exploration of topics like delivery drones. A serious game has been developed for this study to involve stakeholders in an informed debate about delivery drones in their local area. The game introduces key concepts, contextualises potential drone applications, and facilitates discussion by allowing participants to explore implications such as flight paths, operational constraints, and societal impacts.

This study uses Social Representations Theory (Moscovici 1981) to analyse participant discussions on delivery drones. It examines how shared perceptions and collective understanding help individuals make sense of new technologies like drones within their social context. These representations shape how participants perceive and discuss the associated risks, benefits and implications of drone use in daily life. Additionally, the knowledge co-creation cycle (Nonaka 1994) is applied to understand how participants collaboratively generate insights and ideas during board game interactions, encouraging a more inclusive and participatory approach to exploring the societal impacts of delivery drones.

This research has been conducted as part of the 'E-Drone: Transforming the Energy Demand of Supply Chains through Integrated UAV-to-land Logistics for 2030' project, funded by the Engineering and Physical Sciences Research Council (EPSRC). As part of the E-Drone project, this research benefits from data from other project strands. The University of Leeds contributed by implementing a Q-sort methodology, which informed questions embedded in the game design for specific stakeholder groups. The University of Southampton played a key role in identifying and mapping ground risk on the board game. Additionally, the project team played and tested various iterations and prototypes of the board game, allowing for further refinement and improvement. This research also contributed to the Future Flight in Place project, funded by the Economic and Social Research Council (ESRC), which envisions the role of drones and electric vertical take-off and landing (eVTOL) in future transport systems, leading to the design of three additional board games.

Given the collaborative nature of the project, Table 1 clarifies the specific elements of the research that were designed, conducted or led by the author.

Table 1: Author's contributions to the research

| <b>Research Component</b>                        | <b>Author's contribution</b>                                                                                                                                                                                                  |
|--------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Literature Review and Theoretical Framing</b> | Conducted independent literature review and selected theoretical frameworks to guide the study                                                                                                                                |
| <b>Game Design</b>                               | Led the design and development of the Game of (Delivery) Drones board game, including scenario planning, visual layout, game rules and mechanics. Iteratively refined the game, based on playtesting and participant feedback |
| <b>Data Collection</b>                           | Facilitated focus groups alongside team members and independently                                                                                                                                                             |

|                                       |                                                                                                                                                 |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Media Headlines Analysis</b>       | Designed and carried out full analysis of media headlines, including sourcing data, coding and interpreting results                             |
| <b>Focus Group Data Analysis</b>      | Solely conducted thematic analysis of participant discussions using NVivo, developed coding framework and identified key social representations |
| <b>Writing and Thesis Development</b> | Sole author of all thesis chapters. Integrated project level contributions into the thesis where appropriate and acknowledged team input        |

The table above outlines the author's responsibilities within the wider project team. Collaborative contributions from other institutions and researchers are acknowledged throughout the thesis where relevant, but the design, analysis and interpretation presented here represent the author's original work.

## 1.2 Aim and Objectives

### 1.2.1 Overall Aim

To investigate how participatory, place-based methods can support stakeholders in exploring and expressing their views on delivery drones, contributing to more inclusive and locally grounded policy discussions.

### 1.2.2 Objectives

1. To understand the attributes of drones in logistics to build realistic scenarios for the public to respond to.
2. To analyse online news media headlines to understand how the public forms media representations around delivery drones.
3. To develop and test a tool to help people understand a future involving delivery drones that can be deployed in different settings.
4. To use the tool to investigate people's views of delivery drones in specific settings to inform future policy.

## 1.3 Research Questions

This study investigates how public understandings of delivery drones are formed, shaped and negotiated across contexts, from media discourse to situated, interactive deliberation. Guided by Social Representations Theory and a participatory approach, this research examines how delivery drones are socially represented and explores how participatory tools can support stakeholder engagement and inform policy development.

The overarching research question guiding this thesis is:

How are public understandings of delivery drones shaped through media and social interactions, and how can participatory tools facilitate stakeholder engagement?

To address this, the following sub-questions were explored, each corresponding to a core component of this project:

- 1- How are delivery drones framed in UK online news media, and what representations are communicated through headlines? (Corresponds with Objective 2)

This question examines how public understandings of drones are initially shaped by media narratives and framing, providing a baseline for understanding dominant representations.

- 2- How do participants negotiate meanings around delivery drones when responding to realistic, place-based scenarios? (Corresponds with Objectives 1 & 4)

This question explores how stakeholders construct and share interpretations of drone use through situated engagement, contributing insight into the social processes of meaning-making.

- 3- How can a serious game be used to support public understanding, deliberation and feedback on future drone scenarios? (Corresponds with Objectives 3 & 4).

This question investigates how a participatory tool can facilitate stakeholder engagement by enabling structured reflection, discussion, and expression of priorities in a locally meaningful context.

Together, these questions allow the thesis to examine how representations of drones circulate through public discourse and how participatory, context-specific tools can be used to inform public debate and policy development.

## 1.4 Overview of Thesis

Chapter 2 overviews drone technology in the logistics and public safety sectors. It reviews the literature on drone applications and public concerns and sets the foundation for designing a game-based tool that reflects drones' real-world attributes and challenges in logistics.

Chapter 3 outlines the study's theoretical framework and introduces Social Representations Theory and Knowledge Co-creation.

Chapter 4 investigates the literature on how the media shapes public perceptions of emerging technologies, focusing on media theories such as framing. It also examines the media's role in amplifying risks associated with emerging technologies and the effects of media credibility on public opinion formation.

Chapter 5 reviews the literature on serious games as tools for public engagement and collaborative learning. This chapter focuses on board games, exploring their design, mechanics and player dynamics as elements that foster engagement and reflection on complex societal issues. It provides a framework for using serious games to gather public insights.

Chapter 6 details the research philosophy and approach underpinning the study. It explains the interpretivist orientation, qualitative methods used and how different parts of the study, such as game-based focus groups and media analysis, are conceptually linked.

Chapter 7 describes the methodology used for the news media analysis and presents its findings. It examines how delivery drones are represented in the UK online news headlines, highlighting dominant themes and emotional anchoring.

Chapter 8 documents the development of The Game of (Delivery) Drones. It describes the design rationale, mechanics, iterations and playtesting process, as well as how expert and stakeholder feedback shaped the final version.

Chapter 9 outlines the game-based focus group methodology. It details the data collection process, sampling strategy and ethical considerations.

Chapter 10 presents findings from the game-based focus groups. It explores stakeholder perspectives on drone delivery scenarios across themes including views on drone

operations, preferences, regulation and the social representations emerging from these dialogues.

Chapter 11 explores the effectiveness of the board game in facilitating discussions about delivery drones. It examines participant interactions, prior knowledge and knowledge co-creation stages that encourage reflection and debate.

Chapter 12 concludes the study with a discussion on key findings, offering policy suggestions and reflections on the contributions of a board game methodology. It also outlines the study's limitations and suggests areas for future research.

## 2.0 Drones in Logistics

### 2.1 Introduction

Drones are an emerging technology claimed to have extensive potential for growth and are being used in numerous sectors such as commercial, public safety and research (Del-Real and Díaz-Fernández 2021; Aydin 2019). Organisations like Google, UPS, DHL, FedEx, and Alibaba are exploring using drones for last-mile logistics, as this delivery stage is costly and labour-intensive (Patro et al. 2024). Other than their use in logistics, they are also used for aerial inspection of gas and oil pipes and power lines (Rathlev et al. 2012), collecting spatial data (Coeckelbergh 2013), civil and construction applications (Bogue 2018), healthcare (Kim et al. 2017), agriculture (Malveaux et al. 2014), community safety and protection (Vattapparamban et al. 2016), and science and research (Marris 2013).

There is an increasing interest in how the public perceives drones and their related concerns that could potentially restrict their implementation (Eißfeldt et al. 2020). Literature has identified that drone use in public places has raised issues about privacy and public safety (see, for example, Sakiyama et al. 2017; Finn and Wright 2012; Clarke and Moses 2014). As people are just beginning to understand and become aware of this technology, it is crucial to involve them in recognising and addressing the questions arising from its use (Aydin 2019). Drones are perceived as mass surveillance equipment, and their use in commercial settings has been criticised by both public and activist organisations (Rao et al. 2016). Drones are transforming our perception of the physical world through their ability to gather data and deliver goods (Rao et al. 2016). Several studies have examined drone-related concerns, including how knowledge, risk perception, and demographic variables shape acceptance (see for example, Melo et al. 2023; Clothier et al. 2015; Aydin 2019).

Drones hold transformative potential across various sectors but face significant societal challenges, including privacy, safety, and ethics concerns. Public perceptions, often shaped by fears of surveillance, highlight the need for transparent engagement and inclusive dialogue.



## 2.2 Public Understanding of Drones

While drones are being explored for their potential in logistics, research on public attitudes towards drones remains limited (Yoo et al. 2018). Understanding public perceptions, knowledge, and expectations is essential as it is crucial to their successful integration (Herron et al. 2014). Studies consistently demonstrate that public perception of drones varies greatly depending on their intended use. For example, drones used for emergency aid, medical deliveries, and rescue operations are generally favoured over those used for retail logistics or recreational purposes (Smith et al. 2022a; Hameed et al. 2023). Smith et al. (2022a) provide valuable insight into how perceptions are shaped by the specific context of use, highlighting the role of perceived value and legitimacy. During the COVID-19 pandemic, drones were perceived positively when deployed to address public health needs, reflecting a situational increase in support for applications that serve a social good (Martins et al. 2021). Conversely, Zailani et al. (2020) found that while safety and scientific applications were well-received, medical deliveries faced limited support due to concerns about privacy and potential security risks. These situational and contextual factors significantly influence the public perception of drones (Boucher 2016; Reddy & DeLaurentis 2016). Boucher's (2016) sociological account is notable in demonstrating how trust, control and perceived legitimacy underpin drone acceptance.

The identity of the drone operator also impacts public trust. Boucher (2016) found that individuals were more concerned about who controls the drones rather than the drones themselves, with higher support for drones operated by government or emergency services over private companies. This distinction is important for studies that examine how trust in technology is socially mediated. Similarly, Klauser and Pedrozo (2017) observed that 72% of survey respondents in Geneva supported drones used by law enforcement, while support decreased for commercial and recreational uses. Marshall et al. (2022) corroborated this trend, reporting that public approval for domestic drone use varied significantly by purpose and operator. For instance, 92% of respondents supported drones for emergency response and 76% for policing. Trust in the operator thus emerges as a critical factor in shaping public support, particularly when drones are perceived as invasive.

Privacy and safety issues consistently emerge as major concerns across studies. Public apprehensions about drones' surveillance capabilities remain high (Boucher 2016; Lidynia et al. 2016). Similarly, Zhang (2023) found that while residents acknowledge the logistical benefits of drones, safety concerns persist, particularly in densely populated urban settings.

Other common apprehensions include risks of misuse, noise pollution, potential physical injuries and privacy violations with varying degrees of tolerance depending on the application (Eißfeldt et al. 2020). Notably, Eißfeldt et al. (2020) found that noise was the least troubling among public concerns, while Aalmoes et al. (2023) argue that noise annoyance negatively influences perceptions in urban areas. However, Smith et al. (2024, p.17) note that people are fine with disturbance from drone noise for a ‘perceived social benefit.’ This trade-off, as discussed by Smith et al. (2024), is particularly relevant to research that investigates how contextual framing influences public tolerance of technological intrusions. Perception of drones as potential threats to safety and privacy, whether through malicious use or accidents, creates a complex backdrop for public trust and support (Zwickle et al. 2019; Klauser & Pedrozo 2017).

In summary, public attitudes towards drones are shaped by their intended applications, the identity of their operators and concerns about privacy and safety. Situational and contextual factors, such as the perceived social benefits of drone use, play a significant role in moderating these perceptions.

## 2.3 Where the Public Gets Their Knowledge of Drones

Public perception of drones is influenced by indirect sources of information, particularly media coverage that often emphasises drones’ military applications (Richards 2018). This reliance on third-party information contributes to a limited understanding of drones’ broader capabilities (Renn & Benighaus 2013; Clothier et al. 2015). As a key study in this area, Clothier et al. (2015) is central to understanding the gap between public perception and technical reality, which this research seeks to address. Reddy and DeLaurentis (2016) found that while most people learn about drones from media outlets or entertainment, experts and stakeholders rely on trade literature and personal experiences, highlighting a disparity in information sources that affects public awareness and views. This study is particularly relevant as it highlights how knowledge asymmetries can impact opinion formation, an issue this thesis aims to explore through deliberative methods. Smith et al. (2022a) further highlight that the extent of knowledge and familiarity with drones plays a key role in shaping attitudes.

Studies show that individuals with limited knowledge about drones express greater concern about privacy and safety risks, and limited informative media coverage contributes to public criticism of drones (Eißfeldt et al. 2020; Lidynia et al. 2016). This contributes to a public

generally more familiar with current drone uses than potential civilian applications, indicating a gap in public awareness of drones' broader capabilities (Aydin 2019; Clothier et al. 2015). On the other hand, Smith et al.'s (2024b) research demonstrates that providing respondents with informative materials about drones contributed to a shift in perceptions about their concerns but reinforced some of their misconceptions. This is especially valuable to this research for its exploration of how information provision can both clarify and entrench public views, highlighting the importance of dialogic, rather than didactic engagement. However, as the drone industry continues to evolve, media coverage in the past five years has increasingly highlighted civilian applications, which may be gradually bridging this gap.

Lidynia et al. (2016) found that more informed individuals tend to prioritise practical risks, such as accidents, over privacy concerns. In contrast, those with minimal drone exposure focus primarily on privacy issues. However, perceived knowledge does not always align with actual understanding, as individuals often overestimate their knowledge of drones, leading to misconceptions (Radecki & Jaccard 1995). Reddy and DeLaurentis (2016) developed objective knowledge assessments to address these gaps, revealing low awareness of drones' technological limitations and history. However, their study did not evaluate public understanding of specific applications, highlighting the need for comprehensive public knowledge measures that include technical aspects and application awareness. This recognition of the limits of current survey approaches informs the use of interactive methods explored in this research. Additionally, Aydin's (2019) study found that men tended to have more positive attitudes and greater knowledge about drones than women, though no significant differences were observed between individuals with and without STEM backgrounds.

Media and third-party sources significantly influence public perceptions of drones. Focusing on military applications and risks contributes to a limited understanding of the technology's broader uses. This reliance on indirect information sources results in a disparity between perceived and actual knowledge, often leading to heightened concerns about privacy and safety, especially among those who feel less informed.

## 2.4 Risk Perception and Public Concerns

People's understanding and assessment of technological risks are complex and shaped by knowledge, values, and emotions (Renn & Benighaus 2013). While risks are not directly

experienced through sensory input like visual stimuli, the term “risk perception” has become standard to describe how individuals interpret potential hazards associated with new technologies (Slovic 1992). This perception process involves analysing sensory cues and received information to judge risks' seriousness, likelihood, and acceptability (Renn 2004). Individuals rely on mental models and cognitive heuristics shaped through social and cultural learning to evaluate these risks, and their assessments are influenced by media, peer interactions, and other forms of social communication (Morgan et al. 2002).

Scholars argue that technical or quantitative risk assessments fall short of capturing the psychological and social dimensions that shape public attitudes toward technology (e.g., Breakwell 2007; Fischhoff et al. 1984). The public's aversion to risk plays a major role in the potential support for a technology perceived as high-risk, such as drones (Clothier et al. 2015; Fischhoff et al. 1978). These insights into risk perception are crucial for understanding public attitudes toward drones, a technology often associated with diverse risks. Concerns about privacy, environmental impact, regulations and safety and security are integral to how individuals assess the desirability of drone use. These concerns reflect the complex interplay of psychological, social and contextual factors that shape public risk perceptions.

### 2.4.1 Privacy Concerns

Privacy concerns have become a dominant theme in discussions surrounding drone integration into civilian airspace, with numerous studies highlighting the public's unease regarding drones' surveillance capabilities. On the one hand, drones offer benefits in high-risk settings, such as search and rescue, where their ability to provide aerial support enhances security (Culver 2014; West & Bowman 2016). However, their military roots and association with surveillance raise significant privacy concerns (Braun et al. 2015; Klauser & Pedrozo 2017). Civilian resistance to drones often stems from their potential to intrude into personal spaces, regardless of whether they are used for security or logistical purposes (Jensen 2016; Pedrozo & Klauser 2022; Taborda 2017). Research by Pedrozo & Klauser (2017) is particularly relevant for illustrating how the symbolic association between drones and surveillance continues to shape public apprehension across contexts.

Unlike other emerging technologies, drones present a visible and audible presence that heightens public anxiety about privacy (Bajde et al. 2017). Concerns focus on the drones' ability to enter private spaces and the ambiguity surrounding who is operating them and for what purpose. This physical and sensory presence has led some scholars to argue that drones

represent a unique shift in public perceptions of privacy (Calo 2011). For example, Bracken-Roche et al. (2016) note that even drones used for logistical purposes are perceived as potential mass surveillance tools. Anbaroğlu (2017) argues that data collection and usage transparency may alleviate some concerns. The public is more likely to tolerate drones if they understand the data collection process and its sharing.

Studies have shown that cameras on drones, necessary for navigation, raise specific privacy concerns. The public is particularly apprehensive about how footage captured by delivery drones might be stored or utilised, with fears that the footage could be repurposed for surveillance or commercial spying (Pillai et al., 2024; Farber, 2014). Molina and Campos (2018) argue that while much of the drone-related literature has focused on safety, privacy and data security require equally urgent attention. Walther et al. (2019) echo this sentiment, revealing that privacy concerns dominate public discourse on delivery drones, with individuals particularly sensitive to data collected without clear consent (Chang et al. 2017; Nassi et al. 2019). The concept of privacy appears to be evolving, with public attitudes toward privacy protections fluctuating based on context (Jansen 2015).

Privacy concerns associated with drones are shaped by both the context in which drones operate and the demographics of those affected. Bajde et al. (2017) found that people generally feel more comfortable with drones in public spaces but are far less accepting when drones enter private spaces, such as over gardens or homes. Their nuanced analysis of spatial contexts to drones is especially relevant to this study. Interestingly, the study also noted a gendered aspect to these concerns, with women reporting heightened anxiety regarding drones' "gaze," especially when drones operate in residential areas (Bajde et al. 2017, p. 18). This highlights a sociocultural dimension that may influence regulatory responses, as public acceptance varies by perceived intrusiveness and personal safety. The Surveillance, Privacy, and Security (SurPRISE) study carried out across nine EU countries, including the United Kingdom, found a strong public preference for privacy over security, with most participants unwilling to sacrifice privacy even for enhanced security measures (Pavone et al. 2015). Khan et al. (2019) emphasise that such privacy concerns significantly impact consumer support of delivery drones in urban areas. This is echoed by Zwickle et al. (2019), who suggest that public attitudes toward drones are heavily influenced by fears that drones could be used to gather sensitive data, especially as drones equipped with cameras become increasingly common for purposes such as photography.

To address privacy concerns, several studies highlight the need for increased transparency and strict safeguards before drones are fully integrated into civilian airspace (Bravo et al. 2019; Merkert & Bushell 2020). However, the existing literature suggests that as drones become more embedded in everyday life, public expectations of privacy and data protection may continue to evolve. This may require adaptive regulatory approaches that address both the technological capabilities of drones and the shifting societal norms surrounding privacy and consent (Resnik & Elliot 2019).

Privacy remains one of the main issues of contention and an area requiring greater deliberation for the widespread use of drones in civilian airspace. While some studies suggest that transparency and clearer data policies could mitigate concerns, others highlight the complexity of privacy perceptions shaped by cultural, contextual, and demographic factors.

#### 2.4.2 Concerns about the Environment

The potential for delivery drones to contribute to more sustainable logistics systems has been a key area of investigation, but the environmental and energy implications remain complex and context-dependent (Kellerman & Fischer 2020). While last-mile logistics drones are powered by electricity, making them less reliant on fossil fuels, their energy efficiency compared to electric vans or traditional delivery vans can vary based on range, payload, and operational environment. Drones' energy consumption is generally lower for individual flights than conventional delivery vehicles, but the overall environmental benefit may diminish when considering operational scale. Cokyasar (2021) highlights that the current battery technology restricts drones' ability to cover long distances, which poses significant challenges for wider deployment. As drones are primarily suited for short-range deliveries, developing more efficient battery technologies will be critical to improving their feasibility for longer delivery routes (Hur and Won 2024). While Merkert and Bushell (2020) argue that drones could replace delivery trucks, especially in urban areas, they acknowledge that battery constraints must be addressed for drones to become a scalable alternative to trucks. Their study is key for this research, offering early arguments on drone substitution in urban logistics, which informs the broader questions of acceptability and operational trade-offs.

Nentwich and Horváth (2018) argue that although each drone flight consumes little energy, electric vans, which can deliver multiple parcels per trip, may be more energy-efficient when transporting goods over similar distances. This is supported by research by Stolaroff et al. (2018), who highlight that drones' energy use and environmental impact depend heavily on

their range and implementation context. Oakey et al. (2022a) noted that introducing drones reduced greenhouse gas emissions, air pollution, and distance travelled. Similarly, Glick et al. (2022) note that drones are more carbon-efficient when transporting small payloads, particularly in rural areas, where their ability to fly direct routes between delivery points reduces the distance travelled. However, their efficiency in urban environments diminishes as drones can only deliver one parcel at a time compared to vans that consolidate deliveries, making drones less suitable for environments where multi-stop deliveries are more common (Glick et al. 2022). Glick et al. (2022) contribute important context to this research by highlighting how drone sustainability benefits are highly dependent on delivery density, an insight relevant to assessing public perception of feasibility in both urban and rural areas.

One key factor influencing the environmental performance of drones is their reliance on lithium-ion batteries. The manufacturing, extraction of raw materials, and eventual disposal of these batteries contribute to the environmental footprint of drones, raising concerns about their life cycle impact. Rodrigues et al. (2022) emphasise that the extraction of lithium and other materials for battery production is a major contributor to human toxicity and environmental degradation, including freshwater and marine aquatic ecotoxicity. Similarly, Stolaroff et al. (2018) argue that the sustainability of drone deliveries is contingent upon the durability and recyclability of these batteries, noting that the impacts of battery chemistry and manufacturing processes should not be overlooked when assessing drones' overall environmental footprint.

The effectiveness of drone deliveries varies significantly between rural and urban contexts. In rural areas, where delivery routes are typically longer and less dense, drones offer clear advantages by reducing CO<sub>2</sub> emissions through direct point-to-point delivery (Glick et al. 2022), assuming the battery life allows the range. However, in urban areas, the opposite may be true. Rodrigues et al. (2022) suggest that regulatory restrictions, such as airspace limitations preventing drones from flying over populated areas, could lead to longer routes and increased energy consumption. This would negate much of the environmental benefit that drones might otherwise offer in these settings. Moreover, comparing CO<sub>2</sub> emissions between drones and trucks reveals a nuanced picture. Goodchild and Toy (2018) argue that CO<sub>2</sub> emissions depend heavily on drone energy requirements, travel distances, and delivery volume. Lohn (2017) reinforces this point, recommending that additional drone hubs be established to minimise energy consumption, although the feasibility of such infrastructure remains uncertain.

While there is growing interest in the environmental benefits of drone deliveries, research on the actual CO<sub>2</sub> emissions of drones in densely populated urban areas remains limited. Most studies focus on theoretical models or small-scale experiments, leaving a significant gap in real-world data. Hur and Won (2024) suggest that further empirical research is needed to assess the energy efficiency and carbon emissions of drones operating within city environments, where variables like traffic patterns, regulatory barriers, and energy grid composition could influence outcomes. Additionally, more attention should be given to battery recycling processes and battery production's long-term sustainability to understand better the full environmental cost of drone deployment (Rodrigues et al. 2022)

Though delivery drones may potentially reduce carbon emissions, their environmental impact is context-dependent. In rural areas, drones may offer a significant advantage by reducing CO<sub>2</sub> emissions for small deliveries. Still, in urban environments, the limitations of current technology, such as battery life and regulatory constraints, could offset these benefits. Moreover, the environmental footprint of lithium-ion batteries remains a critical issue that needs further exploration.

### 2.4.3 Concerns about Regulation

The rapid development and commercialisation of drone technologies have sparked significant debates about regulation, safety, and privacy. As drones increasingly occupy public airspace, regulators face challenges to balance innovation with public safety and privacy concerns. Chang et al. (2017, p.6770) emphasise the growing need for public consent, as drones would occupy "secondary space," often flying over homes and public areas. This distinction between public and private space is central to this project's exploration of risk perception and flight paths. It is especially relevant for delivery drones, which, unlike traditional methods, might pass directly over private property.

Fear of drone surveillance demands stricter regulations to protect individual privacy rights, particularly in urban settings where drone usage may become more prevalent (Al-Wathinani et al. 2023). Finn and Wright (2016) argue that drone users, especially recreational operators, often lack awareness of privacy requirements, which exacerbates public apprehension. This highlights the need for clearer and more comprehensive regulatory frameworks that inform drone operators about privacy standards, as discussed by Merkert and Bushell (2020), whose work is particularly relevant to this study. Globally, some countries have begun to respond to these concerns. For instance, Australia's drone delivery trials by



Alphabet Wing led to citizen pushback, resulting in a parliamentary report calling for stronger privacy oversight (Cherney 2019). Similarly, past privacy violations, such as those involving Google Street View, have prompted lawsuits and stricter regulations (Duffy 2019; Pillai et al. 2024), suggesting that the drone industry may face similar challenges unless proactive privacy regulations are enacted.

The rise in commercial and recreational drone usage has introduced new safety concerns, particularly around the qualifications of drone operators. Aydin (2019) notes that the Federal Aviation Administration (FAA) in the United States administers a remote pilot certificate that requires only a knowledge-based exam. This study is a useful touchpoint in identifying gaps in practical training, an issue with implications for public perceptions of drone safety, especially in residential areas. While this qualification covers theoretical aspects of drone flight, it does not involve hands-on flying tests, which Aydin (2019) argues is a critical gap. The lack of practical training increases the likelihood of accidents, as inexperienced operators are prone to collisions and other mishaps. In the UK, drones do not require registration if the drone or model aircraft weighs below 250g and is a toy or is not equipped with a camera (CAA 2024a). Furthermore, a theory test is required to get a flyer ID, and the pilot must register for an operator ID to fly a drone (CAA 2024b).

As drone technology evolves rapidly, regulators struggle to keep pace, leading to what Choi and Hwang (2022) term a "regulatory void." This gap is particularly evident in the commercial applications of drones, where existing laws are often insufficient to address new challenges such as data collection, public safety, and airspace management. Tran and Nguyen (2022) argue that urban planning and the development of smart cities will require more comprehensive drone regulations, especially as drones are increasingly integrated into logistics and delivery systems. In many countries, regulations regarding drone operations vary significantly, and the protocols range from permissive (regulatory gaps) to restrictive (total bans) (Bernauw 2016). This regulatory variability is important for this research as it helps understand the boundaries of drone operations that can be explored in depth with stakeholders. For instance, the UK allows drone operations under specific conditions, such as staying below 400ft and within the operator's visual line of sight (Oakey et al., 2022).

However, these restrictions make it difficult for logistic drones to operate effectively, particularly in densely populated areas. In contrast, establishing Temporary Danger Areas (TDA) for drones offers a way to bypass these limitations, though it adds further complexity to regulatory compliance (Oakey et al. 2022). Oakey et al.'s (2022) study is key as it provides

regulatory detail that has the potential to inform the hypothetical drone operation scenarios for public discussion. In the US, Chen (2016) calls for a reform of the regulatory framework to better facilitate the commercial use of drones. A key policy objective is incorporating drones into regulated airspace, especially within urban settings. The European regulatory approach, which focuses on the flight's operation rather than the drone's design, may serve as a useful model. Hirling and Holzapfel (2017) suggest that this operational approach could foster a culture of safety within the drone industry, similar to that of other transport industries such as road and rail.

Regulatory frameworks ensure safety and privacy and shape public perceptions of drones. Boucher (2014) argues that clear, well-communicated regulations, akin to car licensing and registration processes, can enhance public trust in drones. By providing transparency around how drones are operated, what they are used for, and the rules governing their flight, regulatory bodies can help alleviate public fears. Eißfeldt and Biella (2022) suggest that advancing clear drone regulations is especially important in urban environments, where dense populations are likelier to feel the impact of drone operations. Grote et al. (2022) warn that a lack of clear regulations could hinder the public's willingness to accept drones as a legitimate delivery form, potentially stalling the industry's growth. Menda et al. (2011) recommend establishing strict training and education programmes for large drone operators, ensuring they understand and comply with the latest laws. They argue this would reduce accidents and legal disputes, further enhancing public confidence in drone deliveries.

Looking ahead, scholars and policymakers agree that regulatory frameworks for drones will need to evolve in tandem with the technology itself. Merkert and Bushell (2020) highlight the importance of creating laws that can adapt to future innovations, predicting that drones will increasingly share airspace with manned aircraft. The authors note that a unified regulatory environment will ensure safety and supply chain efficiency as drones are integrated into broader logistics networks. Druehl et al. (2018) and Foina et al. (2015) suggest that consistent global regulations will be needed to manage cross-border drone operations, particularly as the industry grows. While current regulations are focused on weight, altitude, and operational parameters, future frameworks will likely address more complex issues, such as managing drone fleets across different regions and optimising their flight paths for efficiency (Jeong et al. 2019; Liu et al. 2019). Oakey et al. (2022) note that without uniform global standards, drone operators may face significant challenges in complying with varied national regulations, leading to inefficiencies and delays in deployment.

The literature on drone regulation highlights several key issues, from privacy concerns to safety and certification challenges, as well as the current broader regulatory gaps. As drone technology continues to develop, so must the regulatory frameworks governing its use. Integrating drones into public airspace and logistics networks will require clear, consistent regulations addressing privacy, safety, and operational efficiency.

#### 2.4.4 Safety and Security Concerns

Significant public concerns regarding their safety and security include risks of malfunction, collisions, misuse, and vulnerability to hacking. Brar et al. (2015) note that mechanical or system failures increase the likelihood of accidents, particularly in cities with high-rise buildings that obstruct navigation (Ramadan et al., 2017). Schlinkheider et al. (2014) emphasise that drone crashes, due to factors like GPS errors, battery depletion, or environmental interference, negatively impact public perception of drones. Research suggests that unpredictable urban wind turbulence caused by tall buildings further complicates safe navigation, requiring flight paths to be designed to avoid proximity to structures and people as much as possible (Gianfelice et al. 2022; McLeod et al. 2024). Several studies identify factors contributing to drone crashes, including poor weather, autopilot errors, or human mistakes, and underline the importance of continuous monitoring to reduce potential hazards (Kumar et al., 2023; Yoo et al., 2018). The consequences of crashes, particularly with larger drones carrying heavy payloads, can be severe, potentially resulting in property damage or physical injuries (Nentwich & Horváth 2018). McLeod et al. (2024) elaborate that risks associated with drone impacts depend on the size, weight, and velocity of the drone, noting that analyses of both ground and air risks reveal the complexity of quantifying potential crash impacts (Koh et al. 2018; Svatý et al. 2022; Lu et al. 2020). Recent models, such as by Pilko et al. (2023), estimate fatality risks in densely populated areas, though they currently omit additional risks from drones carrying dangerous goods, highlighting a gap in safety research (McLeod et al. 2024).

Research has proposed several mitigation strategies to address these safety risks, including technological interventions. For example, Ansari et al. (2023) suggest using parachutes or airbags to cushion drones during falls. Singh (2017) proposes onboard diagnostic systems to detect imminent failures and redirect drones to safe landing zones. However, while these safety mechanisms show promise, they require further testing and development for practical deployment in civilian airspaces. Another safety concern involves drones carrying hazardous materials, which could have severe environmental impacts in the

event of a crash. For example, Nentwich and Horváth (2018) argue that while a drone's weight already poses a risk to the population on the ground, dangerous goods can have far-reaching consequences if the drone crashes. Regarding regulations on the delivery of hazardous materials, Grote et al. (2022) report that there is limited literature on this topic concern. This study builds on Nentwich and Horváth (2018) and Grote et al. (2022), whose work collectively identifies key safety and regulatory blind spots, which this project aims to probe through stakeholder engagement. Mcleod et al. (2024) highlight that European delivery drone regulations mandate using crash-proof containers for carrying dangerous goods. While studies have examined the effects of vibrations on cargo quality (Poljack & Šterbenc, 2020; Johannessen et al., 2021), little research has focused on the consequences of hazardous material spills from drones in populated areas (McLeod et al., 2024). Such gaps highlight the need for comprehensive safety protocols that consider drones' operational and environmental impacts in urban settings.

The possibility of drones being exploited for unlawful activities, such as contraband transport, espionage, or even as weapons, is a critical public safety concern. Nentwich and Horváth (2018) caution that drones, particularly those branded with recognisable company logos, could be repurposed for illicit activities like carrying weapons or acting as "kamikaze" devices. This work is relevant to this study's exploration of perceived misuse and risk escalation, especially in high-visibility delivery contexts. Furthermore, Khan et al. (2019) highlight public concerns about the safety of drones and the security of parcel delivery, as drones carrying high-value items may attract theft or tampering. Cybersecurity vulnerabilities also pose significant risks. Beauchamp (2015) and Khan et al. (2019) describe scenarios where hackers could intercept drone GPS signals, alter flight paths or steal shipments mid-delivery. Software vulnerabilities could allow attackers to control drones remotely, potentially endangering public safety and security. Chowdhury et al. (2017) and Boselli et al. (2017) suggest defensive technologies such as geofencing and signal jamming to restrict drone access to sensitive areas like airports and power plants. However, these solutions require that drones be equipped with advanced navigation systems, which many retail drones currently lack (Merkert & Bushell 2020).

There is an ongoing debate about whether drones should be managed within existing air traffic control systems to ensure safety. Zhang et al. (2018) propose integrating drones into the broader air transport management system, facilitating the use of standard aviation technologies such as collision-avoidance systems and identification (Lin 2019). In response to these challenges, the drone industry has begun developing navigation systems that allow

communication between drones operated by different companies, enabling safer routes and collision avoidance protocols (Merkert & Bushell 2020). Their contribution is particularly useful in informing how future infrastructural adaptations might be represented or discussed with the public in engagement-focused research such as this study. These technologies could facilitate more secure and coordinated operations, though broader regulatory support is required to integrate them. Internationally, National Aviation Authorities (NAAs) have established strict guidelines for drone operations in urban areas. In developed countries, safety regulations limit drone operations above populated areas to mitigate risks (CAA 2021). However, the acceptable level of risk for drones remains debated, with the aviation industry often promoting itself as the safest mode of transport (IATA 2018). Merkert and Bushell (2020) note that ongoing small-scale trials aim to demonstrate that the drone industry can self-regulate. Still, broader regulatory reforms are likely needed to manage the complexities of urban drone operations effectively.

Studies on drone safety and security emphasise the complexity of integrating drones into shared airspace, especially in urban environments. While technological innovations and regulatory measures are being developed to mitigate safety and security risks, challenges remain in addressing these vulnerabilities.

## 2.5 Conclusion

In conclusion, this review has highlighted the complex factors shaping public perceptions of drones. A key influence is the limited public knowledge about drones' broader applications, often shaped by third-party sources and a persistent association with military use. Risk perception also emerges as a major determinant, with concerns around privacy, safety and potential misuse forming significant barriers to adoption. Media narratives play an important role in shaping these perceptions, especially in contexts where individuals have little direct experience with the technology.

Despite the expanding literature on drone perceptions, many studies adopt a risk-deficit framing or rely heavily on survey-based data. These approaches often overlook how people make sense of drones through deliberation and dialogue, particularly in real-world or scenario-based contexts. This highlights a methodological gap in research, pointing to the need for more interactive and co-creative approaches that can capture how public attitudes form through situated engagement.

Privacy concerns remain a persistent issue requiring deeper reflection, particularly for the broader adoption of drones in civil airspace. Although delivery drones are often promoted for their environmental advantages, they are highly context-dependent. In rural areas, for instance, drones may help reduce CO2 emissions for smaller deliveries. However, urban environments pose limitations, including battery constraints and regulatory challenges. Furthermore, the environmental costs of lithium-ion batteries remain an underexplored but important consideration.

The literature on drone regulation highlights a number of persistent challenges, including privacy, safety, certification and regulatory inconsistencies. As drone technology continues to evolve, so must the regulatory frameworks that govern its use. Yet relatively few studies explore how the public interprets these evolving policies or their views when engaged through participatory tools. This represents a significant gap in understanding the socio-political dimensions of drone acceptance.

Similarly, research on safety and security issues highlights the difficulties of integrating drones into shared airspace, especially in urban areas. While technical advances and policy initiatives attempt to address these risks, few studies bring together technical and social considerations in a participatory format. This review, therefore, provides a foundation for exploring how the public makes sense of delivery drones and will help support the development of the serious game for this research by shaping its core themes to stimulate reflection on drone use.

These gaps point to a need for a more situated, participatory approach that moves beyond static attitudes and supports deeper engagement with the public.

## 3.0 Theory and Conceptual Framework

### 3.1 Introduction

This chapter outlines the foundational theories that have been explored and shape this study's approach to examining public views about delivery drones. As these emerging technologies are embedded in daily life, understanding public attitudes beyond trying to achieve acceptance is crucial. The chapter begins by discussing the Public Understanding of Science (PUS) concept, particularly addressing the traditional deficit model, which this study has chosen to reject. Rather than focusing on whether the public accepts drones, the emphasis here is on understanding people's views and perspectives.

The chapter introduces key theoretical frameworks and theories, such as the Diffusion of Innovation (DoI) and the Technology Acceptance Model (TAM). Each framework offers valuable insights into how attitudes and behaviours related to emerging technologies are formed and influenced, providing essential context for interpreting public opinions on delivery drones.

This chapter then explores Social Representations Theory (SRT), which serves as a primary lens for this study. SRT is explored in detail, focusing on its suitability for examining how collective beliefs and social knowledge about drones develop within society. Finally, Knowledge Co-creation Theory, specifically the SECI (Socialisation, Externalisation, Combination, Internalisation) model, is introduced to highlight how public knowledge and perspectives on drones are co-created within communities. These theories form a comprehensive framework for understanding the complex and evolving public views on delivery drone technology, emphasising insight rather than persuasion.

### 3.2 Public Understanding of Science (PUS)

Stilgoe and Cohen (2021) emphasise that the interaction between emerging technologies and the public is critical in innovation and transport policies. Simis et al. (2016) note that public attitudes toward science and technology are significantly influenced by knowledge. Although some researchers suggest a correlation between knowledge and greater support for specific

issues, factors like trust and pre-existing beliefs often dominate (Brossard et al. 2009; Allum et al. 2014; Mou & Lin 2014). This highlights the complexity of public attitudes towards novel technologies, which are influenced by more than just information, and positions Stilgoe and Cohen's (2021) argument as foundational for this study's critical stance on simple awareness-raising approaches.

Public attitudes towards technology are often studied within the Public Understanding of Science (PUS) framework, which emphasises scientific literacy and the communication of knowledge to create a more informed public (Pilt and Himma-Kadakas 2023). Rooted in the deficit model, PUS assumes that a lack of public understanding stems from insufficient knowledge, and scientists must address this deficit by educating the public (Durant 1999). Several deficit-related models have emerged, including the public knowledge deficit, trust deficit, expert deficit and a broader crisis of confidence in science (Bauer 2009). These models presuppose providing the public with information will resolve misunderstandings and encourage positive attitudes towards science. However, this approach overlooks the role of values, worldviews and ways of thinking in shaping public perspective (Hansen 2016), which is critical to this study as it explores public attitudes toward drones, a technology often associated with risks and uncertainties that extend beyond mere knowledge deficits. This critique helps frame this research within a broader understanding of social and cultural influences on technology perception.

Historically, the deficit model has been a dominant approach in science communication, emphasising the need to address perceived gaps in public knowledge by providing scientific facts (Simis et al. 2016). Miller (1983) introduced a widely recognised definition of science literacy comprising three key dimensions: (1) knowledge of basic scientific concepts and facts, (2) an understanding of how scientific processes work, and (3) an awareness of policies related to science. According to Miller's findings, most U.S. adults lacked scientific literacy, spurring initiatives to enhance science education and outreach. However, this model assumes that increased scientific knowledge will automatically encourage greater public understanding and support for science, encapsulated in the phrase "to know science is to love it" (Turney 1998). Critics have challenged this approach, arguing that public attitudes are shaped by deeper values, social contexts, and other factors beyond a mere knowledge deficit (Pilt & Himma-Kadakas 2023).

In response to these critiques, there has been a growing shift toward dialogue-based science communication models, which emphasise inclusivity and mutual understanding.



These models promote a two-way exchange between scientists and the public, treating audiences as active participants rather than passive recipients of information (Trench 2008). Dialogue-based approaches value knowledge from non-scientific sources, such as cultural and experiential knowledge, as much as scientific expertise (Dietz 2013; Reincke et al. 2020). This inclusivity encourages a more comprehensive understanding of public perspectives and helps bridge the gap between science and society. These ideas have strongly influenced the rationale for developing methods that aim to not only gather opinions but to enable the co-construction of knowledge about delivery drones, an approach that underpins the participatory direction of this research.

Despite the appeal of dialogue-based models, challenges remain in their implementation. Many scientists and institutions still rely on deficit-based practices due to institutional inertia and the comfort of established methods (Simis et al. 2016; Amelung et al. 2020). Poor communication, misinformation and information overload further complicate effective efforts to engage the public (Fährnich et al. 2023; Ecker et al. 2022). These issues highlight the importance of ensuring high-quality, inclusive science communication, especially in contexts of emerging technologies, where engagement is critical. Recent research on public attitudes towards delivery drones demonstrates the limitations of deficit-based approaches. Studies often focus on knowledge, concerns and technology acceptance, assuming that better public education will lead to broader adoption (Aydin 2019; Eißfeldt et al. 2020; Stilgoe and Cohen 2021). In contrast, research that contextualises new technologies within specific social and cultural frameworks has uncovered new insights without steering the public toward predefined acceptance (Batel and Devine-Wright 2015; Sherry-Brennan et al. 2010). This approach emphasises creating spaces for open debate and reflection, enabling participants to explore their understanding of logistic drones and their operational parameters without being influenced by preconceptions about acceptance.

This research aligns with participatory approaches that prioritise public engagement and knowledge co-creation (Section 3.5). By adopting a dialogue-based model, the design of a tool (such as a board game) provides a platform for inclusive dialogue, allowing participants to engage with diverse narratives and perspectives on delivery drones. This method moves beyond the limitations of the deficit model, emphasising the importance of shared meaning-making and mutual understanding in shaping public attitudes toward emerging technologies.

### 3.3 Theoretical Frameworks for Understanding Public Attitudes Towards Technologies

This section explores theoretical frameworks that provide insights into how the public perceives, evaluates, and responds to different technologies. Drawing from fields such as psychology, sociology, and communication studies, these frameworks offer diverse perspectives on the complexities of public attitude formation. From the cognitive processes that underlie individual acceptance of technology to the broader societal and cultural factors that influence collective perception, these theories help to understand how public attitudes and opinions are formed.

#### 3.3.1 Diffusion of Innovation Theory (DoI)

The Diffusion of Innovation Theory (DoI) describes how information about new ideas is shared within a social context (Rogers 1983). Diffusion signifies disseminating innovations, concepts, practices, or products through various channels within a social system (Rogers & Scott 1997, p.4). This theory is based on four fundamental elements: innovation, communication channels, time, and social systems (Minishi-Majana & Kipling'at 2005).

Innovation is 'an idea, practice, or object that individuals within a social system perceive as new' (Rogers & Scott 1997, p.5). The adoption rate is influenced by several characteristics, including 'relative advantage, compatibility, complexity, trialability, and observability' (Rogers & Scott 1997, p.5). Relative advantage describes how much innovation is perceived as superior to what it replaces, evaluated in terms of economic benefits, convenience, or satisfaction (Rogers & Scott 1997). Compatibility refers to the extent to which an innovation aligns with existing values, past experiences, and the needs of potential adopters, with higher compatibility leading to faster adoption (Minishi-Majana & Kipling'at, 2005; Rogers & Scott 1997). Compatibility may be particularly challenging for delivery drones as societal concerns about privacy and safety and the displacement of traditional delivery systems may reduce alignment with existing values and experiences.

Complexity denotes individuals' difficulty understanding or utilising an innovation (Minishi-Majana & Kipling'at 2005). According to the theory, simpler innovations are adopted more quickly, as potential adopters do not need to invest time and effort in acquiring new knowledge or skills to comprehend and use them effectively (Rogers & Scott 1997). However,

this perspective often overlooks complexity's social and cultural dimensions, particularly for innovations like delivery drones, where broader concerns shape public views.

Trialability refers to the degree to which an innovation can be tested or experimented before its full adoption (Minishi-Majana and Kipling'at 2005). Rogers and Scott (1997) posit that an innovation that can be tried may represent less uncertainty and will be adopted faster. Trialability is particularly limited for delivery drones. Delivery drone trials in the UK have been subject to temporary danger zones that restrict testing to specific, often isolated areas away from populations. This makes the process difficult and reduces opportunities for public exposure to the technology, limiting its perceived accessibility and the public's ability to engage directly with the innovation.

Observability refers to the extent to which an innovation's outcomes are visible and demonstrate its value or significance (Rogers and Scott 1997). Similar to trialability, observability is also constrained for delivery drones. Trials are conducted away from populated areas, so the technology's outcomes are not visible to the public. Hence, potential users and stakeholders cannot readily observe drone deliveries' impacts or practical applications.

While these factors, i.e., relative advantage, compatibility, complexity, trialability, and observability, may singly or in combination influence an innovation's adoption or non-adoption, their application to this study highlights significant challenges. The limited trialability and observability of drones reduce opportunities for public understanding, highlighting that while the theory might provide valuable insights, its assumptions about experimentation and visibility do not align with restricted testing environments and societal complexities surrounding drones. Furthermore, the theory overlaps with the deficit model, suggesting that innovations are more likely to be adopted if they are easier to understand or perceived as beneficial. Moreover, the theory's emphasis on knowledge acquisition aligns with the deficit model's belief that providing information is essential for adopting and accepting technology.

### 3.3.2 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), introduced by Davis in 1986, is a commonly used theoretical framework for understanding and forecasting user adoption of information technology. The model identifies two primary factors influencing an individual's intention to use a technology: perceived usefulness and ease of use (Davis 1989). Perceived usefulness denotes the extent to which an individual believes that using a certain technology will improve

their performance or produce beneficial outcomes, increasing the likelihood of acceptance and utilisation (Davis 1989; Venkatesh & Davis 2000). Perceived ease of use is the degree to which a person believes that using technology will require minimal effort; technologies perceived as more straightforward to use are more likely to be adopted (Davis 1989; Venkatesh et al. 2003). For example, if a mobile technology has a user-friendly interface, users are likelier to adopt it than a complex application requiring extensive training (Chan & Teo 2007). The relationship between these two factors is constructed, and user acceptance is mediated by behavioural intention, which leads to actual usage behaviour.

TAM has been extensively validated through numerous empirical studies and remains one of the most widely applied models in information systems and technology acceptance research (Legris et al. 2003; Venkatesh & Davis 2000; Teo & Jarupunphol 2015). In the context of research on delivery drones, TAM offers a valuable lens for understanding public acceptance, particularly in studies where drone services are already operational or where users can directly experience the technology. However, this study focuses on early deliberation and public perceptions (not acceptance) as drone delivery services remain in their developmental stages. Given the limited opportunities for individuals to gain hands-on experience with drones, perceptions of "usefulness" and "ease of use" are often shaped by media representations and hypothetical use cases rather than real-world interactions.

A critical limitation of this model is its focus on cognitive factors while neglecting emotional and social influences that can affect technology acceptance (Bagozzi 2007). For example, Wang et al. (2022) argue that incorporating motivational factors such as intrinsic motivation and social influence can enhance the predictive power of the model. This critique is relevant to the research as it considers emotional and contextual factors through engagement tools such as a board game, providing space for participants to engage with hypothetical yet relatable scenarios of drone use. Furthermore, TAM does not consider the influence of external variables such as user experience and individual differences on technology acceptance. As Venkatesh and Bala (2008) note, these contextual factors can significantly impact users' perceptions of usefulness and ease of use. For delivery drones, perceived usefulness is likely to depend on the use case, such as medical deliveries or humanitarian applications, which are more likely to generate positive views due to their societal benefits. This highlights how perceived usefulness is not static and can be shaped by context, particularly without direct user experience.

The model has also faced criticism for its linearity, as it assumes a straightforward and direct relationship between perceived usefulness, perceived ease of use, and behavioural intention without accounting for the potential complexity or interplay of other influencing factors (Bagozzi 2007; Chuttur 2009). However, user acceptance may be influenced by feedback loops and iterative processes that are not captured in the original model; for example, Venkatesh (2000) argues that users' perceptions of a technology's usefulness and ease of use evolve as they gain experience, which in turn influences their continued acceptance and usage over time. This dynamic is especially relevant to understanding how perceptions may evolve as drone trials become more visible, regulations are clarified, and societal discourse progresses.

### 3.4 Social Representations Theory

Social representations theory (SRT) was introduced by French social psychologist Serge Moscovici (1963). It can be defined as 'shared imagery, metaphors, values and practices that allow us to make sense of, navigate, and position ourselves within the social world' (Singleton et al. 2018, p.113 cited in Bigl 2019). Moscovici (1981, p.181 cited in Dickinson and Dickinson 2006) provides the following definition of SRT:

'A set of concepts, statements and explanations originating in daily life in the course of inter-individual communications. They are the equivalent, in our society, of the myths and belief systems in traditional societies; they might even be said to be the contemporary version of commonsense.'

Moscovici's use of the term "social" emphasises that representations emerge through interactions and communication within groups and communities. It also signifies that these representations are influenced by the historical, cultural, and economic environments and the practices and circumstances in which they develop (Höijer 2011). Social representations create collective meaning by enabling shared understandings of phenomena within societies, organisations, and groups. This shared meaning fosters social bonds, uniting individuals through common values and interpretations. Representations are particularly influential when addressing phenomena that evoke strong emotions, debates, or ideological struggles, such as climate change or emerging technologies like delivery drones. These representations shape and transform collective thinking by reflecting and navigating conflicts, ultimately influencing how groups make sense of and respond to such issues (Höijer 2011). These

representations can be collective cognitions, shared common sense, or societal thought systems and may also pertain to symbolic or social objects (Höijer 2011). SRT suggests that for a new phenomenon to be integrated into everyday thinking, it must be discursively anchored within a familiar interpretative framework, such as concepts, values, or practices already recognised and understood by the community (Moscovici 2000). Moscovici states that all representations' aim to make something unfamiliar, or unfamiliarity itself, familiar' (Moscovici 1984, p.24).

SRT demonstrates how collective understandings operate through the following mechanisms:

- 1- SRT offers a framework for understanding how collective thinking in society evolves and how new representations are formed by modifying existing ideas through public debate (Höijer 2011). These representations emerge in response to societal issues, such as advancements in communication technology, biotechnology, environmental risks, or global challenges like terrorism and violence. Social representations help communities make sense of the unfamiliar by situating new phenomena within familiar ideas.
- 2- SRT operates across various levels, from large societal groups to smaller subgroups, highlighting its applicability in diverse contexts (Moscovici, 2000, p.16). This adaptability allows for examining shared meanings within broad populations, such as national debates on policy, and more localised contexts, such as the dynamics within professional or activist groups.
- 3- Social representations are not limited to cognitive processes; they encompass emotions, attitudes, and judgments, making them rich and multifaceted (Marková 2003). They are embedded in communicative practices, including debates, dialogues, scientific discussions, and media discourse, which serve as channels for constructing and negotiating shared meanings. For example, media narratives can amplify certain representations, while interpersonal dialogues may contest or refine them.
- 4- Both Moscovici (2007/1961) and Marková (2003) emphasize the importance of communication in shaping social representations. Moscovici highlights the critical role of media as a central mechanism in developing and disseminating new representations, particularly for emerging technologies or societal issues. Marková, on the other hand, stresses the dialogical nature of communication, where

representations evolve through interactions within and between groups. Together, these perspectives illustrate how social representations are dynamically shaped through both mass communication and interpersonal dialogue, both key to this research.

Anchoring and objectification are the two mechanisms that generate social representations (Höijer 2011). The following section describes these in detail.

### 3.4.1 Anchoring

Social representations are established and maintained through communication, often connecting with pre-existing representations. This process entails integrating new representations into existing ones while simultaneously shaping the new ones. Over time, unfamiliar concepts become familiar as they are assimilated into a society's shared frameworks. Anchoring, in essence, is the process of linking new ideas or phenomena to familiar contexts or well-known concepts (Höijer 2011). Anchoring mechanisms include naming, thematisation, emotional association, and metaphors.

#### **Naming:**

Naming is one of the most common ways to make unfamiliar phenomena more relatable and understandable. According to Moscovici (2000, p.46), naming helps "extricate [a phenomenon] from a disturbing anonymity," providing it with a genealogy and situating it within the cultural framework of familiar language and concepts. For instance, a new disease might be called the Black Death, climate change referred to as "global warming," or a new political group labelled as "terrorists." In the media, naming frequently appears in headlines and introductions, helping to transform the unknown into something recognisable. For example, a Swedish tabloid might refer to climate change using terms like "climate threat," "weather," or "catastrophe." Moscovici (2000) further argues that naming makes phenomena comprehensible and adds new dimensions and qualities, enriching their meaning.

#### **Emotional Anchoring:**

While Moscovici does not explicitly identify emotional anchoring as a mechanism within SRT, he does acknowledge the role of emotions in shaping social representations (Höijer 2011). Joffe (2002, p.569) highlights this connection, arguing that social representations theory "keeps a space for symbols, infused with an emotional valence," positing that emotions often drive the formation of specific representations. Emotional anchoring involves associating a

new phenomenon with familiar emotions, making the unfamiliar more comprehensible. For instance, threats or dangers are often linked to emotions like fear or worry. Psychological research underscores the role of emotions in helping individuals interpret and evaluate social situations and objects (Bless et al. 2004).

Höijer (2011) notes that mass media frequently exploits emotional anchoring by portraying phenomena in sensational or speculative ways, using evocative language, photographs, or illustrations to elicit emotional responses. This study applies the concept of emotional anchoring to analyse how drones are represented in news media headlines, exploring the public's emotional reactions and perceptions toward this emerging technology. By examining the framing of drones in media, this research seeks to uncover whether emotions such as fear, excitement, or distrust are evoked and anchored to the concept of drones, thereby shaping public attitudes and understanding.

### **Thematic Anchoring:**

Moscovici (2000; 2001) introduces the concept of themes to explore the deeper structural levels of social representations, suggesting that general patterns of thought interact with specific contexts to generate new representations. These themes are socially and culturally constructed, sustained through social practices, and shaped by shared values and norms (Marková 2003; Moscovici 2000). According to Moscovici (2000, p.182), themes "never reveal themselves clearly," necessitating an analytical approach that moves beyond explicit language or visual content when examining interviews or media products.

This research employs thematic anchoring to analyse stakeholder deliberations about delivery drones during gameplay, uncovering how their underlying beliefs, values, and cultural frameworks shape their views on drone technology. The study identifies implicit themes that emerge during gameplay by applying thematic anchoring. These themes, informed by societal and cultural contexts, influence how stakeholders interpret and assess the role of drones in society. This approach facilitates a deeper understanding of the social representations of delivery drones, going beyond surface-level opinions to reveal the broader cultural narratives that underpin stakeholder perspectives (Marková 2003; Moscovici 2000).

### **Anchoring by Metaphors:**

Metaphors help make complex phenomena more comprehensible by framing them as familiar or relatable. For instance, in a study on the social representation of food surpluses in the EU, media-created metaphors like "milk lakes" and "butter mountains" were used to illustrate the issue (Wagner & Hayes 2005). Although some metaphors are universal, others are shaped



by cultural differences and exhibit significant variation (Kövecses 2005). According to Lakoff and Johnson (2008), metaphors are fundamental to human thought and communication, deeply embedded in everyday language and shaping how we perceive and describe the world.

### 3.4.2 Objectification

Objectification transforms the unfamiliar into something recognisable by shaping abstract and complex ideas into concrete objects or images, making them "almost tangible" (Moscovici 1984, p.29). For instance, polar bears stranded on melting ice symbolise climate change (Smith & Joffe 2009). Moscovici (2000) argues that objectification is a more active process than anchoring, occurring almost automatically when encountering new phenomena. In media, objectification often involves turning scientific concepts into visual representations; for example, "Dolly the sheep" became a widely recognised symbol of genetic engineering (Bauer & Gaskell 1999). Objectification can take different forms, including emotional objectification and personification.

Emotional objectification occurs when a strong emotional component is attached to an idea, often through evocative imagery. For instance, media coverage of climate change frequently features images of dead cattle on parched soil or forest fires to evoke urgency and despair (Höijer 2010; Smith & Joffe 2009). Similarly, drones depicted in the news media may feature imagery such as the NHS logo affixed to the drone to elicit a powerful emotional response from the audience, particularly during times like the COVID-19 pandemic.

Personification, on the other hand, involves linking a concept or phenomenon to a specific individual. This strategy is commonly employed in media to draw attention and add a human dimension to abstract ideas. For example, images of former Vice President Al Gore were often featured in climate change articles to personify the issue and make it more relatable to audiences.

### 3.4.3 Critiques of Social Representations Theory

SRT has drawn various criticisms that point to its limitations and the need for further development. A primary critique is that SRT is often seen as static and overly descriptive, potentially limiting its relevance to the fast-paced nature of modern society. Voelklein and Howarth (2005) argue that SRT would be more effective if it focused on how social ideas evolve and interact, as a static approach doesn't capture the full complexity of social life today.

Similarly, Hortaçsu and Ertürk (2003) point out that research in media often ignores the broader context influencing social ideas, which weakens the theory's ability to explain how these ideas are shaped in different environments.

Additionally, a significant critique pertains to "sharedness" within SRT. Verheggen and Baerveldt (2007) contend that assuming shared representations across social groups can be problematic, as it implies a level of consensus that might not be present. They propose that representations should be viewed as emerging from interactions rather than as static ideas within individuals (Daanen 2009). This view aligns with Wagner's (2016) perspective, which sees social representations as collective products of social interaction rather than isolated cognitive constructs. These critiques indicate the need for a more sophisticated understanding of how social representations are shaped and debated within varied social settings.

Moreover, the epistemological base of SRT has been questioned by critics who argue that the theory lacks clarity about how social ideas relate to specific groups, which risks suggesting a "group mind" without enough evidence (Jahoda 1988 cited in Psaltis 2012, p.375). This concern is amplified by the fact that SRT hasn't been extensively tested, making some claim its ideas are too vague to be scientifically validated (Psaltis 2012). Despite these issues, Höijer (2011) notes that SRT is still valuable for studying social ideas as long as it's used carefully and within its limits.

#### 3.4.4 Application of Social Representations Theory to this study

Social Representations Theory has been applied to various topics, including emerging technologies such as biotechnology (Bauer & Gaskell 2002; Wagner et al. 2002) and established phenomena like intermittency in energy generation (Devine-Wright & Devine-Wright 2006). However, it has not yet been applied to understanding how the public conceptualises a transport future involving delivery drones. This presents an opportunity to extend SRT to an emerging technology that raises significant societal, ethical and regulatory questions. The advantage of SRT in studying public perceptions of delivery drones lies in its conceptual framework, which integrates social psychological insights to examine both the individuals involved and the processes that shape their understanding (Sherry-Brennan et al. 2010). This approach is particularly well suited to analysing views about delivery drones as it considers societal debates and expert and lay knowledge interplay.

A key principle of SRT is its recognition of the coexistence and interaction between different forms of knowledge, such as expert knowledge and lay perspectives (Sherry-Brennan et al. 2010). This study considers such interaction central as public understanding, which is shaped by technical knowledge (e.g., drone functionality, safety measures) and lay perspectives that incorporate values, fears, and expectations. Jovchelovitch (2007) contends that defining public understanding purely as social knowledge can be problematic, as it overlooks the interplay of various processes such as memory, perception, information gathering, and cognitive dissonance—that collectively shape knowledge within a social context. These processes are critical when considering how the public negotiates complex, abstract concepts like delivery drones, often influenced by contrasting narratives in the media and personal experiences. To more effectively describe and explain knowledge within a specific social context, social psychology broadens its scope beyond cognitive processes to include standards, histories, values, myths, conventions and symbols, all contributing to forming common sense (Moscovici and Markova 1998). For example, delivery drones might be anchored to familiar notions such as courier services or surveillance tools, reflecting how public perceptions connect the new with the known. Such anchoring is a key representational strategy observed in media and stakeholder discourse on new transport technologies.

This perspective prompted Wagner (2007, p.7) to argue that 'our understanding of how the public understands science is incomplete as long as we do not answer the question as to why, under which conditions and in which form the public assimilate scientific background knowledge.' This assertion is particularly relevant to this research as it highlights the need to explore the public's thoughts and how and why these opinions are formed in specific contexts, such as through media narratives or public deliberations. Therefore, the "who," "how," "why," "what," and "what form" of knowledge (Jovchelovitch 2007) represent key factors that collectively influence social psychology. These elements shape a theory of social knowledge and phenomena, ultimately forming the foundation of Social Representations Theory (Sherry-Brennan et al. 2010). This framework helps inform the design of approaches that aim to surface representations of drones through public engagement tools and deliberative discussion.

Additionally, SRT sets itself apart from the Public Understanding of Science (PUS) approach and earlier research on public acceptance by offering a framework that integrates various levels of understanding and a range of factors influencing knowledge. From an SRT perspective, understanding is the process of generating and assigning meaning to an object, transforming the unfamiliar into the familiar. This involves assimilating scientific knowledge

into everyday common sense (Moscovici 1984). This transformation is key to this research as public views evolve from abstract, novel technology to tangible, relatable concepts integrated into everyday discourse. Given its ability to conceptualise how diversity shapes the co-construction of knowledge, SRT is deemed appropriate for exploring stakeholder deliberations on delivery drones. This approach builds on studies such as Hoijer (2011) and Batel and Devin-Wright (2015), who have demonstrated the value of using SRT to explore how contested technologies are interpreted within specific social and cultural contexts.

SRT's applications are also invaluable for media research, particularly in analysing how media shapes and reproduces social representations. It sheds light on how the media and the public connect and transform "new" scientific, political, or social issues into familiar concepts, supporting the process of shared meaning-making (Höijer 2011). Citizen meaning-making is a multifaceted process influenced by personal experiences and mass communication, where the news media play a central role and diverse forms of dialogic interaction (Carvalho 2010). For example, media narratives surrounding delivery drones that may highlight themes such as environmental sustainability or surveillance offer a framework through which the public integrates their observations and personal values (Kempton 1997).

News media is pivotal as an intermediary between science, politics and citizens, shaping public perceptions through agenda-setting and discourse framing (Olausson 2011). The dual role of media as both an amplifier and filter of information makes it a critical site for examining how delivery drones are socially represented. Studies have demonstrated that media influence on scientific knowledge varies—some show that knowledge plays a limited role in public sense-making. In contrast, others argue that knowledge significantly shapes beliefs (Olausson 2019). This study's interplay between information, representation and belief systems is essential to understanding how abstract technologies are grounded in everyday understanding. Social representations in the mass media encompass the totality of elements that define an issue (Bigl 2019) and move fluidly across different discursive spaces (Christidou et al. 2004). Media provide citizens with concrete and familiar tools to interpret abstract phenomena and link societal institutions with individuals, highlighting a complex yet critical relationship (Olausson 2011).

Understanding how delivery drones are represented, the media actively influences public debates, stakeholder deliberations, and policy discussions. Considering these dynamics, SRT provides a robust theoretical underpinning for examining how delivery drones are socially constructed through dialogue, media narratives, and shared cultural contexts.

### 3.5 Knowledge Co-creation

Despite their distinct meanings, knowledge and information are often used interchangeably (Roux et al. 2006). Information refers to organised or interpreted data, with Drucker (2001) describing it as structured raw data. This organisation involves human interaction, producing explicit information that can be easily shared (Roux et al. 2006). Conversely, knowledge comprises a combination of experiences, values, contextual information, and intuition, forming a framework for interpreting and assimilating new information and experiences (Davenport & Prusak, 1997). Nonaka (1994, p.15) conceptualises knowledge as "justified true belief," defining it as "a dynamic human process of justifying personal belief, as part of an aspiration for the truth."

Polanyi (1983) argues that a substantial portion of knowledge exists in tacit form. Tacit knowledge is deeply personal and challenging to articulate, as it is rooted in an individual's actions, experiences, values, ideals, or emotions (Roux et al. 2006). This type of knowledge is experiential and intuitive, often manifesting as hunches or instincts, such as familiarity with computers or technology (Polanyi 1966). When knowledge is expressed through words, numbers, formulas, or principles, it becomes explicit (Roux et al. 2006). However, explicit knowledge represents only a fraction of what is known, as human knowledge is inherently contextual; we always know more than we can articulate, and we can articulate more than can be documented (Roux et al. 2006). This emphasis on tacit knowledge is particularly relevant for studies exploring emerging technologies such as drones, where user experiences, perceptions and social context play a central role.

Codifying tacit knowledge into explicit form inevitably loses some original context, as explicit knowledge can only partially represent what is understood (Snowden 2002). Explicit knowledge, such as an understanding of legislation, is transferable formally and systematically, whereas tacit knowledge is less easily shared. Despite its limited transferability, tacit knowledge comprises a significant portion of human understanding (Polanyi 1966; Sudhindra et al. 2017). Importantly, tacit and explicit knowledge are not mutually exclusive but complement one another, interacting through social and collaborative processes between individuals and groups (Sudhindra et al. 2017; Alavi & Leidner 2001). The interplay of tacit and explicit knowledge is also evident in prior serious games literature, such as Farnese et al. (2019), which informs this study's design strategy.

These concepts align with the knowledge co-creation cycle introduced by Nonaka and Takeuchi (2007). Knowledge co-creation involves institutional processes that support learning and collaboration, especially within governance contexts. According to Nonaka and Takeuchi (1995), the knowledge creation process is built upon four modes of conversion between tacit and explicit knowledge: socialisation, externalisation, combination, and internalisation—collectively known as the SECI model (Figure 1). These conversions are the foundation for generating, sharing, and applying knowledge within and across organisations.

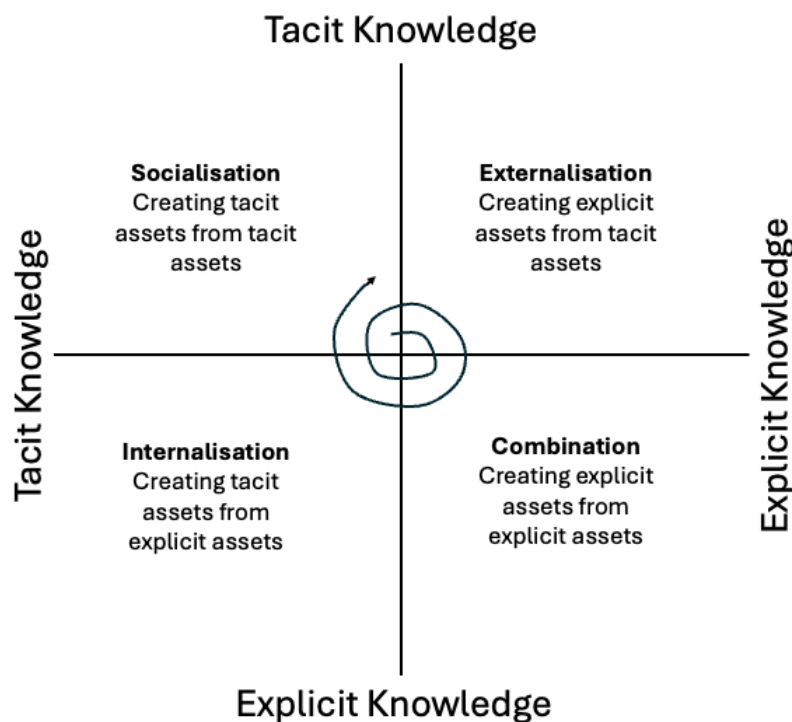


Figure 1: Knowledge co-creation process (adapted from Nonaka 1994)

In this research, the board game serves as a medium to facilitate these conversions by enabling participants to share and build on both their tacit and explicit knowledge of delivery drones. For example, socialisation occurs when people exchange tacit insights through discussion, while externalisation happens as they articulate these insights. Explicit knowledge provided in the research materials can be combined with participants' shared understandings, and internalisation occurs as they integrate new ideas into their mental frameworks. Game-based approaches can facilitate this interaction between tacit and explicit knowledge, creating an engaging space for participants to explore and discuss delivery drones from multiple perspectives. This builds on earlier applications of serious games in participatory contexts

(eg., Jean et al. 2018a; 2018b), by applying these principles to delivery drones, a relatively underexplored area.

Nonaka and Takeuchi (1995) propose that knowledge is created through a dynamic epistemological process involving converting knowledge between tacit and explicit forms, which is further amplified across different ontological levels—from individual interactions to groups and eventually the entire organisation. This interaction results in a spiral process of knowledge conversion that expands both the quantity and quality of knowledge. As Nonaka (1994, p.19) explains, "The assumption that knowledge is created through conversion between tacit and explicit knowledge allows us to postulate four different modes of knowledge conversion: (1) from tacit knowledge to tacit knowledge, (2) from explicit knowledge to explicit knowledge, (3) from tacit knowledge to explicit knowledge, and (4) from explicit knowledge to tacit knowledge." This spiral begins with the socialisation stage, where tacit knowledge is shared among individuals through direct interactions and shared experiences in social contexts (Farnese et al., 2019). This foundational stage sets the stage for further knowledge transformation across the SECI model's other modes.

The spiral (Figure 1) starts with the socialisation stage, where tacit knowledge is exchanged among individuals through direct interactions and shared experiences in social contexts (Farnese et al. 2019). Tacit knowledge, being deeply personal and context-specific, is difficult to formalise and is often acquired through direct interactions and shared experiences (Farnese et al. 2019). In the context of this research, the board game was proposed to facilitate the socialisation phase as it can foster face-to-face interactions among participants, enabling them to exchange tacit knowledge about delivery drones. As Wenger et al. (2002) note, this process heavily relies on trust built through interpersonal engagement, which is central to the board game's design.

During the externalisation stage, tacit knowledge is transformed into explicit knowledge through articulation and formalisation. Game-based approaches have been identified as a potential method to facilitate this process, as they provide structured opportunities for participants to express ideas through dialogue, metaphors and scenario-based interactions. Such methods have been used to help codify previously unspoken concerns or ideas, making them more accessible for discussion (see for example, Farnese et al. 2019). The structured format of the board game aids this process by prompting participants to formalise their perspectives on delivery drones, such as proposing specific policies or identifying key

operational challenges. This stage transforms personal, experiential knowledge into shared, accessible knowledge that can inform collective understanding.

In the combination stage, explicit knowledge is combined with other explicit knowledge, allowing it to be merged, refined, and processed into more complex and structured forms of explicit knowledge. Game-based approaches can support this process by providing opportunities for participants to engage with multiple sources of explicit knowledge, including information provided within the board game and participant interactions. Through structured deliberation, participants can explore different aspects of delivery drones, leading to more complex and organised forms of understanding. By fostering collaborative discussions, such an approach has the potential to facilitate the development of more nuanced perspectives on drone use by allowing participants to build on each other's knowledge. This responds to calls in recent drone engagement literature (e.g. Aydin 2019; Eißfeldt et al. 2020) for participatory methods that capture the complexity rather than simplification.

The spiral concludes with the internalisation stage, where individuals absorb explicit knowledge gained during gameplay and integrate it with their tacit knowledge base (Vat 2003). Participants deepen their understanding through reflection and experimentation during game play, connecting abstract concepts with their personal experiences or societal values. This phase ensures that newly acquired knowledge is not only theoretical but also practical and applicable to real-world contexts (Roux et al. 2006). The internalised knowledge is then reintroduced into the spiral, enriching future discussions and decision-making processes.

The interaction of these four modes of knowledge conversion collectively fuels the ongoing spiral of knowledge creation (Nonaka 1994). In the context of participatory research, game-based approaches serve as dynamic tools for knowledge co-creation, enabling participants to engage with both tacit insights and explicit information. While explicit knowledge, such as technical specifications, can be easily shared, transferring tacit knowledge often requires interpersonal engagement and trust. Interactive formats like board games have been identified as potential methods to foster these conditions, providing a structured yet flexible space for discussion and exploration. Roux et al. (2006) argue that successfully transferring tacit knowledge requires time, mutual understanding, and collaboration. Without these elements, it becomes challenging for others to fully grasp or apply new knowledge (Zahra and George 2002).

This research leverages the SECI model to highlight how the board game facilitates generating and amplifying knowledge about delivery drones. It enables participants to engage



in meaningful deliberations that capture the complexity of societal, ethical, and technical considerations, ensuring that tacit and explicit knowledge are valued and integrated into the collective understanding.

### 3.5.1 Collaboration and Trust in Knowledge Co-creation

Collaboration and trust are key components of the knowledge co-creation process, making them highly relevant to this study's use of a board game to facilitate deliberations on delivery drones. Collaboration is the extent to which individuals actively support and assist each other (Gupta and Govindarajan 2000), a concept that underpins this study's approach to participant interaction. Collaborative actions such as open discussions, shared problem-solving, and social interactions encourage the generation of new knowledge (Hedlund 1994), laying a theoretical foundation for the participatory design explored in this research. Within board game sessions, participants engage in collaborative dialogue, which helps them share knowledge, reduce fear, and increase openness (Nejatian et al., 2013). This collaboration fosters the development of a shared understanding, a critical component for co-creating knowledge (Holsapple and Singh 2003) about emerging technologies. This study builds on these insights by exploring how such collaborative exchanges may help shape public perspectives on delivery drones.

Trust, as a homocentric concept closely tied to beliefs, emotions, and intentions (Nejatian et al. 2013), also plays a critical role in these interactions. Its importance is consistently highlighted in prior work (e.g., Iansiti 1993; Hansen et al. 1999), and is treated here as a necessary precondition for meaningful engagement. A board game approach would provide a structured yet informal environment where trust can develop through face-to-face interactions, allowing participants to feel comfortable sharing tacit knowledge and voicing their opinions. In such an environment, trust reduces fear and uncertainty, enabling knowledge creation and circulation (Hedlund 1994). Conversely, distrust would hinder the effectiveness of the deliberative process, as participants may withhold valuable insights (Johannessen et al. 1999). In light of these foundational studies, building trust among participants is positioned as essential for fostering productive discussions and generating meaningful knowledge about delivery drones.

Despite the utility of the SECI model in explaining the knowledge co-creation process, critiques highlight several relevant limitations when applying it to this research. One critique is that the SECI model was developed within a specific cultural context (Japan), which may limit

its universal applicability (Glisby and Holden, 2003). This cultural specificity must be considered when facilitating board game sessions in diverse cultural settings, as participant interactions and knowledge-sharing behaviours may vary. Additionally, the model's high level of abstraction and reliance on anecdotal evidence has drawn criticism for lacking robust empirical support (Patriotta 2004; Gourlay 2006). These concerns will help inform this study's approach, which seeks to explore how the SECI model might be made more operationalisable through real-world engagement formats.

The tacit component of the SECI model is particularly challenging to evaluate and operationalise. In this study, the board game can act as a tool to surface tacit knowledge by encouraging participants to express intuitive and context-specific insights about delivery drones. While prior research has attempted to reflect the SECI model's four modes of knowledge conversion (e.g., Nonaka et al. 1994; Becerra-Fernandez and Sabherwal 2001; Lee and Choi 2003), results have been inconclusive. This highlights a gap that this project seeks to address through structured gameplay and deliberation.

The above suggests that this research can address key elements of the knowledge co-creation process while navigating the limitations of the SECI model by embedding collaboration and trust within the board game framework.

### 3.5.2 Application of Knowledge Co-creation to this Research

Various methods have been explored in the literature to support knowledge co-creation across diverse stakeholder groups. Deliberative workshops, design charrettes, consensus conferences and participatory mapping have all been used to facilitate inclusive dialogue and mutual learning (see for example, Chambers 2006; Brown and Wyatt 2010; Rowe and Frewer 2000). While effective in some contexts, these approaches can be limited in engaging the public with limited prior knowledge or in simulating complex decision-making environments.

A growing body of literature highlights the value of SGs as a means to operationalise the four phases of knowledge co-creation identified by the SECI model, i.e., socialisation, externalisation, combination and internalisation (Nonaka and Takeuchi 1995). Jean et al. (2018a), for example, argue that SGs offer a structured yet playful format that encourages participants to express perspectives, challenge assumptions and collaboratively explore complex issues. The interactive and scenario-based nature of games provides an accessible

entry point into unfamiliar topics, allowing players to test ideas, experience consequences, and learn through dialogue and reflection (Van Bilsen et al. 2010; Crookall 2010).

Games are particularly valuable for enabling socialisation, as they encourage informal peer interaction where tacit knowledge can be exchanged. They also support externalisation, offering opportunities for players to articulate previously unspoken assumptions or preferences (Jean et al. 2018a). During gameplay, participants are also exposed to a variety of perspectives and informational prompts that can stimulate the combination phase, i.e., merging explicit insights from others into more complex shared understandings (keijser et al. 2018). Finally, debriefing practices following game sessions are identified in the literature as critical for internalisation, supporting the transfer of insights into personal knowledge and real-world decision-making (Guillén-Nieto and Aleson-Carbonell 2012).

This body of work suggests that serious games are not only tools for engagement but also mechanisms through which meaningful learning and dialogue can occur. Compared to traditional focus groups or interviews, games create immersive environments where deliberation is grounded in tangible trade-offs, making them especially suitable for exploring emerging technologies like delivery drones. This literature informed the decision to adopt a serious game-based approach in this study, providing both methodological and conceptual alignment with the knowledge co-creation process.

### 3.6 Summary & Comparison of Theoretical Frameworks

This section compares the main theories discussed in this chapter to clarify their strengths and limitations. Table 2 summarises each theory's relevance, illustrating why the SRT and SECI models were best suited to guide this research.

Table 2: Comparison of theoretical frameworks and their relevance to this study

| Theory     | Focus                                                             | Strengths                                                          | Limitations                                                           | Relevance to study & Research Objectives                                                            |
|------------|-------------------------------------------------------------------|--------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| <b>TAM</b> | Individual acceptance of technology based on perceived usefulness | Widely applied, simple to operationalise, useful for survey design | Limited focus on contextual factors; assumes rational decision-making | Useful for framing survey items and understanding baselines user expectations about delivery drones |

|                   |                                                                |                                                                                                        |                                                                       |                                                                                                                     |
|-------------------|----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
|                   | and ease of use                                                |                                                                                                        |                                                                       |                                                                                                                     |
| <b>DoI</b>        | How innovations spread over time within a social system        | Highlights adoption stages; considers opinion leaders and communication channels                       | Doesn't explore meaning-making or deeper public understanding         | Helps situate drones within broader societal adoption trends                                                        |
| <b>SRT</b>        | How shared knowledge is formed and circulated                  | Explains how unfamiliar tech is anchored to known ideas; accounts for collective meaning making        | Abstract, difficult to quantify                                       | Core to understanding how participants interpret drones.<br><br>Relevant to Objectives 1,2,4                        |
| <b>SECI Model</b> | Dynamic model of knowledge creation through social interaction | Maps how tacit and explicit knowledge is shared and transformed; well suited to collaborative settings | Requires careful interpretation; designed for organisational settings | Key to understanding how knowledge was co-created through the board interactions.<br><br>Relevant to objectives 3,4 |

While several behavioural and technology acceptance models were reviewed in relevance to this study, SRT and SECI models were selected as the core conceptual frameworks due to their ability to account for meaning-making and collaborative knowledge construction and for providing complementary theoretical insights that strengthen the conceptual grounding of this study. SRT provides a foundation for understanding how shared meanings and social knowledge about delivery drones are constructed, particularly through discourse and dialogue. This theoretical lens is particularly relevant for Objectives 1, 2, and 4, which focus on how people perceive drones and how these perceptions are shaped within the public. The SECI model, on the other hand, is concerned with how knowledge, especially tacit knowledge, is created, shared and transformed through group processes. It is most relevant to Objectives 3

&4, which focus on the development and use of a participatory tool to facilitate deliberation and reflection. While SRT focuses on what is shared, SECI focuses on how this knowledge is generated, externalised and internalised during gameplay. Used together, SRT and SECI enable a richer understanding of knowledge creation by showing how participants draw on existing social representations and transform them through interactive, situated experiences, particularly during gameplay. This theoretical integration supports the design and analysis of the game-based focus groups, justifying its use to meet the study's co-creation and deliberation aims.

### 3.7 Conclusion

This chapter outlines the theoretical and conceptual frameworks guiding this study, focusing on the complexities of understanding public perceptions of delivery drones. By rejecting the deficit model of science communication, this research prioritises a participatory and dialogical approach to exploring how public attitudes are shaped by values, social contexts, and interactions. Key theoretical frameworks, including the Diffusion of Innovation and the Technology Acceptance Model, have been discussed for their relevance and limitations in understanding emerging technologies like delivery drones. However, these models often emphasise individual-level predictors and linear adoption processes, offering limited insight into how collective meaning-making and social negotiation shape responses to novel technologies.

In response to these limitations, SRT has been identified as the primary lens for this study. It provides a framework for analysing how collective meanings and shared understandings are formed through communication, media narratives, and societal interactions. Despite its relevance, few studies have applied SRT to investigate stakeholder perceptions of delivery drones, especially in participatory or co-creative contexts. This study addresses that gap by using SRT to explore how people make sense of delivery drones in deliberative settings.

In parallel, Knowledge Co-creation Theory, particularly the SECI model, highlights how tacit and explicit knowledge are dynamically exchanged and synthesised through collaborative processes. While the SECI model is well established in organisational learning, its application in public engagement contexts, particularly about serious games and emerging technologies, remains limited. By combining SRT with the SECI model, this research contributes a novel

theoretical approach to understanding how shared representations are co-constructed through interactive, game-based methods.

Together, these frameworks provide a comprehensive foundation for examining public perceptions of delivery drones, emphasising the interplay between individual attitudes, collective social representations, and the collaborative generation of knowledge. They also support the study's methodological strategy by justifying the use of a serious game as a tool for facilitating knowledge creation. In doing so, this research extends current theory by operationalising social representations and knowledge co-creation in a participatory design and engagement process. This chapter thus ensures the study's theoretical coherence and highlights its contribution to understanding the societal implications of emerging transport technologies.

The next chapter will examine the literature on how media shapes perceptions of emerging technologies like delivery drones.

## 4.0 Media's Influence on Public Perceptions

### 4.1 Introduction

This chapter investigates how media influences public perceptions, particularly in the context of emerging technologies. As a powerful tool for shaping public discourse, media is critical in determining how individuals and communities perceive new technologies and associated risks. This chapter begins by examining foundational theories on media influence, including framing, priming, and agenda-setting. It explores how these mechanisms contribute to positive or negative portrayals of events and issues. Research on media bias reveals how specific narratives are constructed to direct public perception, either amplifying certain aspects or minimising others.

The chapter then explores the media's role in framing risk, particularly concerning technologies like autonomous vehicles and artificial intelligence. This section highlights how media framing can impact public support or hesitation toward new technologies by examining how news stories often amplify risks associated with these innovations. Finally, the chapter considers the influence of media credibility and trust on opinion formation, discussing media literacy's role and perceived trustworthiness's effects on shaping informed views. Together, these sections provide a view of how media can shape societal views, with implications for adopting and understanding emerging technologies.

### 4.2 Media Bias and News Framing

The internet has revolutionised how people access information, consume real-time news, and share content (Garritzman et al. 2023). It has also enhanced self-determination, enabling individuals to gather knowledge, form opinions, and engage with socially relevant topics more independently (Mossberger et al. 2007). As a result, traditional media outlets such as newspapers, television and radio have seen a decline (Bremer and Burgisser 2023), pushing the industry to adapt swiftly (Sutrisno 2023). This shift has dramatically changed how we consume and share information (Sjoraida et al. 2024). Unrestricted access to unbiased information is crucial for forming a well-rounded understanding of current events. For many individuals, news articles serve as the primary source of this information (Hamborg et al.

2019). Media holds great power in shaping public opinions, particularly through continuous reporting and selective presentation of viewpoints (Khrais and Gabbori 2023).

Building on extensive research in science communication and media effects, the media acts as a bridge between scientific research and the public (Schäfer 2012), and both technological research and its mass media coverage have increased over time (Summ and Volpers 2016). Research on emerging technologies, such as nanotechnology and biotechnology, highlights media representations' significant role in shaping public perceptions. During the early stages of technological development, media coverage often serves as a critical source of heuristics for audiences who lack firsthand experience with these innovations (Scheufele & Lewenstein 2005; Nisbet et al. 2003). This insight is particularly relevant for delivery drones, an emerging technology that members of the public have not directly encountered, positioning media discourse as a key influence on their understanding.

Jeffres et al. (2018) note that while mass media contribute to bridging the knowledge gap between science and the public, it does not provide information equally to all readers. By selectively framing the information presented, media outlets can create uncertainty around certain issues, potentially hindering behaviour adoption and working against attitude change (Happer & Philo 2013). For instance, Broadbent et al. (2021) discuss how media portrayals of electric vehicles (EVs) can help foster a positive image, enhance visibility and acceptability among target communities, and influence attitudes toward EVs. However, it is equally important to question whether the media should solely focus on promoting acceptability, as negative aspects of EVs also deserve consideration. This study builds on these insights by examining how news media frames similarly shape societal acceptance or resistance towards delivery drones.

News media outlets often go beyond merely reporting facts and may introduce intentional or unintentional bias into their coverage (Yin 2018; Hamborg et al. 2019). The way news stories are framed, whether positively or negatively, can greatly influence readers' opinions and perceptions of various issues (Levin et al. 1998). This framing also interacts with psychological factors such as loss aversion, where individuals are more motivated to avoid losses than to seek equivalent gains (Kahneman & Tversky 1979). Media bias can be influenced by factors such as the ownership, revenue sources or political and ideological leanings of a news outlet and its audience (Hamborg et al. 2019).

The literature identifies several ways in which media bias emerges, such as the journalist's selection of events, sources and information to include in an article, with this



selection process inherently introducing bias (Hamborg et al. 2019). Additionally, journalists can shape readers' views through their choice of words, using terms with either positive or negative connotations (Grefenstette et al. 2004) or by assigning different levels of credibility to their sources (Baker et al. 1994; Oelke et al. 2012; Gentzkow and Shapiro 2006). A story's attention can also be influenced by where it is placed and how much space it is given in a publication or a website (Bucher & Schumacher 2006). For this research, such mechanisms of media bias are relevant to understanding how drones are portrayed in media. For instance, the journalists' framing of drones, word choices and the inclusion of specific perspectives or sources may shape public perceptions of their benefits or risks. Moreover, the selective amplification or suppression of certain narratives can contribute to polarised opinions on drone use and its implications for society.

Media bias significantly influences individual and public perceptions of events, often impacting political decision-making processes (Bernhardt et al. 2008; Gerber et al. 2009; Gentzkow et al. 2006). Most readers, however, tend to rely on a small number of news outlets due to factors like information overload, language barriers or personal preferences (Newman et al. 2015). This means that almost all news consumers are impacted by media bias (Hamborg et al. 2019). Media bias also nurtures the polarisation of public opinion (Sunstein 2002), complicating discussions on contentious issues. This polarisation is important to understand in the drones' portrayal in the media as it could influence the public understanding of emerging technology and impact regulatory discussions and the development of societal consensus. Because of these effects, some researchers argue that media bias challenges the integrity of democratic processes (Hamborg et al. 2019; Kahneman and Tversky 1984).

News stories often experience multiple layers of bias during their creation and development before being delivered to the audience (Hamborg et al. 2019). The reader's context, such as background knowledge, preexisting attitudes (e.g., hostile media perception) (Hamborg et al. 2019), social status, and nationality, further shapes how the news is perceived. This is relevant to this study as differences among readers will influence how they interpret media coverage of drones. For example, audiences with limited knowledge of drones may be more susceptible to biases introduced through news creation. Similarly, national or cultural differences could impact how people evaluate the benefits and risks associated with drones.

Social science research identifies three primary ways media bias influences news perception: priming, agenda setting, and framing (Druckman & Parkin 2005; Scheufele

2000). Priming suggests that news audiences evaluate topics based on their prior understanding, shaped by issues emphasised in earlier news coverage (Hamborg et al. 2019). Agenda setting refers to the media's ability to influence public perceptions of what topics are important by selectively highlighting certain issues (Hamborg et al. 2019). Framing, meanwhile, shapes how audiences interpret information by presenting news stories with specific perspectives or angles (Entman 1993). Journalists use framing techniques to construct narratives encouraging particular interpretations (Entman 2007). Frames serve as culturally embedded organising tools that influence individuals' perception of the social world (Reese 2007). These frames guide how elites structure information, affect journalistic decisions, appear in media content, and shape audience thoughts and attitudes. The significance of the framing concept, as Reese (2007, p. 148) explained, is to provide a model

“that bridges parts of the field that need to be in touch with each other: quantitative and qualitative, empirical and interpretive, psychological and sociological, and academic and professional. If the most interesting happens at the edge of disciplines . . . then framing certainly has the potential to bring disciplinary perspectives together in interesting ways.”

Framing effects refer to how news frames influence audience interpretations of issues, candidates, and events by highlighting specific information while leaving out other details (Entman et al. 2009). Druckman (2001, p.1042) explains that

“[emphasis] framing effect is said to occur when, in the course of describing an issue or event, a speaker’s emphasis on a subset of potentially relevant considerations causes individuals to focus on these considerations when constructing their opinions.”

Nelson et al. (1997) found that issue frames play a significant role in shaping how individuals prioritise conflicting considerations in their decision-making processes. Research has consistently shown that news frames can influence the prominence of certain issues or considerations in shaping political opinions, either amplifying or diminishing their importance (e.g., Matthes 2008; de Vreese et al. 2011). This thesis builds on such framing theories to examine how the UK media frames the implications of delivery drones. Framing effects are important to understand how media representations of drones influence public perceptions; for example, news frames that selectively highlight aspects of drones, such as the environmental benefits or safety concerns, while omitting others, like privacy issues or economic inequalities, can significantly shape attitudes. These frames may also guide how individuals prioritise conflicting considerations about drones, such as convenience versus risks.

However, individuals do not simply accept media framing; various factors determine the extent to which they are influenced by news frames. For instance, only frames that are repeatedly emphasised tend to have a significant impact (Matthes 2008). This repetition is critical in shaping dominant narratives around delivery drones, particularly when specific benefits or concerns are consistently highlighted. Additionally, framing effects are weaker when competing frames are present, which is common in modern democracies where political elites often contest frame definitions, and journalists more typically cover multiple perspectives (Chong and Druckman 2007). Media coverage that evokes strong emotional responses, such as fear of surveillance or excitement over innovation, may significantly impact public perceptions of drones. Frames that rely on weak arguments also exert less influence, while strong frames use convincing facts or evoke emotions like anger or fear (Chong & Druckman 2007). Finally, Framing effects are influenced by various factors, including the credibility of the news source, interpersonal communication and individuals' pre-existing attitudes (Druckman 2001; Matthes 2008).

Selective media framing has been linked to the denial of climate change (Pan et al. 2019). Traditional media has polarised coverage of climate change (Feldman et al. 2017), leading to varied public understandings (Bolsen and Shapiro 2018). Similar patterns of selective reporting on drones could influence public perceptions. For example, the media could emphasise either specific benefits or the potential risks of drones, shaping divided opinions within society. Research has found that reporters often adopt an opinion-driven style of journalism instead of presenting neutral information, influencing media debates on the issue (Brüggemann & Engesser 2017). Additionally, studies revealed that partisan media in the U.S. reinforced the climate views of like-minded audiences, with Republicans using media to dismiss climate change messages (Carmichael & Brulle 2017). The news media predominantly shapes public perceptions of climate change by serving as a platform for advocacy groups and political elites. In contrast, scientific facts have minimal influence on driving individuals' actions. (Carmichael et al. 2017).

News media outlets often have political and ideological perspectives (Hamborg et al. 2019). As a result, news stories are frequently tailored to suit the preferences of their current audience since readers may switch to other sources if the content contradicts their beliefs too often (Groseclose and Milyo 2005; Gentzkow and Shapiro 2010). It is important to understand how media outlets may frame drones differently, as this selective framing could shape how the public perceives drones. Additionally, news producers may shape stories to align with the interests of advertisers or owners, avoiding negative coverage of key sponsors or affiliated

companies (Gilens and Hertzman 2000; MacGregor 1997; de Vreese 2005). Similarly, news can be biased in favour of governments, as journalists often depend on them for information (D'Angelo & Kuypers 2010; Besley & Prat 2006). Ultimately, many news outlets are profit-driven companies, and providing unbiased information may not always be their priority (Paul & Elder 2004). Such biases and framing could influence how drones are portrayed to the public, potentially favouring narratives that align with the interests of key stakeholders such as technology companies or governments advocating for drone adoption.

News consumers often anticipate that commentators will adopt a position on key issues and highlight what they consider most significant (Boczkowski 2004). The news creation process generally consists of three stages: gathering, writing, and editing (Hamborg et al. 2019). During the gathering, journalists select facts based on what is most relevant to their audience or what will generate attention, shaping the story's perspective. In the writing stage, techniques like labelling and word choice can introduce bias by framing entities or events positively or negatively. Finally, in editing, decisions regarding the story's placement, the selection of images, and captions influence the story's attention and how it is interpreted (Hamborg et al. 2019). These stages of news creation are critical to understanding how drones are framed through selective fact-gathering, emotive language, and editorial decisions. For instance, using positive imagery or headlines could enhance public support towards drones, while negative framing might fuel resistance.

The media shapes public perceptions of emerging technologies like delivery drones. The rise of diverse news media exposes audiences to mechanisms like priming, agenda-setting, and framing, which influence interpretation and shape opinions. Media bias, often introduced through selective reporting, word choices, and alignment with the advertiser or owner's interests, significantly influences how issues are perceived, sometimes driving polarisation and complicating societal consensus. For those without firsthand experience, media frames play a crucial role in forming opinions, with audience context, such as background knowledge and social status, further shaping interpretation. Understanding these dynamics is essential for analysing media discourse, particularly concerning narratives around drones and other emerging technologies.

### 4.3 Media Framing of Technological Risks

The Social Amplification of Risk Framework (SARF) identifies the news media as a key social amplification station, magnifying signals associated with risks and risk events (Pidgeon et al. 2003; Kasperson & Kasperson 1996; Renn et al. 1992; Burns et al. 1993). Through selective reporting and emphasis, the media can heighten public perception of certain risks, influencing how these risks are viewed and responded to within society. These ideas are particularly relevant for this research, as media framing can amplify public concerns about drone-related risks, such as privacy violations, safety hazards or environmental implications while downplaying their benefits.

SARF is an integrative model that combines insights from media research, psychometrics, cultural studies, and organisational responses to risk (Kasperson et al. 2003). It explains how dangerous events interact with social, cultural processes, institutional and psychological processes, leading to either the amplification or reduction of risk perception and associated behaviours (Pidgeon et al. 2003; Burns et al. 1993; Renn et al. 1992; Kasperson & Kasperson 1996). It is important to understand how the media might dramatise specific drone incidents, heightening perceptions of risk and leading to increased public scrutiny or resistance. This dynamic of risk amplification could explain why public perception of drones varies, depending on how risks are presented and interpreted in the media.

In SARF, news media play a central role in amplifying or attenuating risks, shaping public perceptions and influencing behavioural responses (Burns et al. 1993). For individuals with limited direct experience, the media provides mental shortcuts to interpret complex technologies, as seen in public perceptions of genetic engineering (Scheufele & Lewenstein 2005; Donk et al. 2012). This study builds these concepts by exploring similar dynamics in the context of drones, where many lack first-hand experience and must rely on media narratives to form their views.

Media coverage not only frames risk within a broader social context but also filters and selectively emphasises risk signals, making certain concerns more visible while downplaying others (Kasperson et al. 1988; Pidgeon et al. 2003). Research shows that news outlets disproportionately highlight specific risks over time (Freudenburg et al. 1996), emphasise particular viewpoints (Hornig 1993), and dramatise certain issues (Bauer et al. 2001). As a result, repeated exposure to sensationalised media coverage can heighten public fears, regardless of factual accuracy (Kasperson et al. 1998). This selective framing directly

influences public discourse regarding drones, dictating which aspects are emphasised or downplayed and complicating discussions about them.

Without personal experience, people primarily rely on news media and peer networks to understand risks, making media framing a crucial factor in shaping public perceptions (Sarathchandra & McCright 2017). Sensationalised coverage, especially through symbolic terms like ‘Terminator technology’ or ‘Frankenfood’, has been shown to heighten public fears, as seen in debates around childhood vaccines and genetically modified organisms (Largent 2012; Stephan 2015).

Symbols, metaphors and narratives play a central role in amplifying or downplaying risk with culturally powerful imagery significantly influencing public views (Kasperson & Kasperson 1996). Regarding delivery drones, media portrayals can either escalate concerns or emphasise benefits, depending on how they are framed. Therefore, symbolic framing is key to understanding media narratives and their impact on public perception. SARF provides a valuable framework for analysing how media coverage influences risk perception and shapes public discourse.

In the context of autonomous driving, most people rely on mass media as their primary source of information (Lens & Friedrich 2015b). Media coverage shapes public interest (Kaur & Rampersad 2018; Simoni et al. 2019), but narratives often oscillate between optimism and sensationalism. Some researchers argue that reporting on self-driving vehicles tends to overemphasise benefits (Beiker 2015; Schlag 2016), while others suggest that negative incidents, particularly high-profile accidents, can dominate coverage, fostering public scepticism (Fleischer & Schippl 2018; Sharif et al. 2021). Seppelt et al. (2019) found that media reports on automated vehicle crashes significantly influenced public attitudes, highlighting the need for balanced, accurate reporting to prevent disproportionate fears.

Beyond risk amplification, inconsistent media terminology also complicates public understanding of emerging technologies (Jelinski et al. 2021). Studies show that vague or contradictory language in reporting on automation levels and usage scenarios leaves important aspects of self-driving technology underexplored (Lenz & Friedrich 2015a). This issue may apply to drones, where unclear terminology or incomplete explanations of operational scenarios can confuse audiences and obscure the technology’s benefits or risks.

Qualitative studies further highlight patterns in media coverage, showing certain themes such as security, technology and quality of life are often emphasised in reporting on

autonomous vehicles (Diehl & Diehl 2018; Taddicken et al. 2020). However, positive media evaluations tend to decline following accidents, leading to a shift in framing towards risk and safety concerns (Taddicken et al. 2020). Similarly, headline framing plays an important role, as research suggests that positive headlines increase public willingness to adopt autonomous vehicles while negative headlines reduce it (Anania et al. 2018). This dynamic is particularly relevant to drones to understand how media framing influences public views.

Ouchchy et al. (2020) note that early media coverage of Artificial Intelligence (AI) (e.g., in 2014) was optimistic and enthusiastic but has become critical and balanced over time. Fast & Horvitz (2017) similarly found that over 30 years of AI coverage in The New York Times, reporting shifted from initial optimism toward greater scrutiny, particularly concerning potential societal risks. This pattern suggests that media narratives about drones may evolve similarly, beginning with excitement about their potential before increasing focus on regulatory, ethical and societal challenges.

Media reports often take a neutral stance on sensitive topics like job loss due to AI (Ouchchy et al. 2020), while other times oscillating between utopian portrayals (e.g., AI as a transformative force) and dystopian fears (e.g., AI displacing human labour or threatening privacy) (Royal Society 2018). Similarly, media coverage of drones may frame them as futuristic or surveillance tools threatening privacy and security. This inconsistency in framing could shape public attitudes and policy responses.

In certain domains, AI has been portrayed as superior to human capabilities, particularly in medical applications, where personification is a common theme (Bunz and Baghieri 2021). While this framing highlights AI's efficiency, it can also create unrealistic expectations. Similarly, media narratives may depict drones as superior to traditional delivery systems (e.g., cheaper, faster and more efficient). Yet, such portrayals may overlook critical limitations, including technical failures, regulatory challenges and societal impacts.

Research has demonstrated that overly enthusiastic or sensationalised media coverage can mislead the public, creating unrealistic expectations about new technologies (Dubljević et al. 2014). Conversely, coverage that overemphasises risks, such as data scandals or technological abuses, can heighten public concerns and scepticism (Nguyen & Hekman 2022). This research aims to build on this by examining how such portrayals affect drone-related perceptions specifically. This imbalance in reporting shapes public discourse, potentially leading to polarised debates where optimistic and pessimistic narratives overshadow nuanced discussions (Dubljević 2014; Oren & Petro 2004).

Such portrayals influence public trust and impact policy development, as biased or incomplete reporting can complicate efforts to establish balanced regulations that address societal concerns and industry goals. Understanding how media narratives frame drones, whether as technological breakthroughs or threats, is critical for evaluating their role in shaping public perceptions and governance (Nguyen & Hekman 2022).

The media shapes public perceptions of risk through selective reporting and emphasis, which can amplify or attenuate societal views and responses. According to the Social Amplification of Risk Framework (SARF), news media is central in influencing behavioural reactions, particularly for individuals lacking personal experience, who rely on media and peer networks to understand risks. Regardless of accuracy, extensive or repetitive coverage can activate latent fears and heighten risk perceptions. Symbols, metaphors, and narratives further influence this process, with culturally significant imagery being particularly impactful. Additionally, research shows that overly enthusiastic or sensationalized media portrayals can mislead the public about emerging technologies, such as drones, creating unrealistic expectations about their capabilities. Understanding these dynamics is essential for evaluating how media discourse shapes public attitudes toward risk

## 4.4 Impact of Media Trustworthiness on Public Opinion

In democratic societies, media is crucial in shaping public understanding of scientific and technological issues by providing accessible and influential narratives (Solberg and Kirschhoff 2024). People often form perceptions of societies and technologies based on the information they consume (Stockwell 2006), making news quality critical in shaping public opinion and political perspectives (Chan 2007; Boomgaarden & Vliegenthart 2007). Studies indicate that unbiased media coverage significantly impacts public views, as media both disseminates information and frames interpretations (Entman 2003; Rahman 2014).

A key concept in media influence is the idea of cognitive misers, which suggests that people form opinions based on easily accessible narratives rather than extensive research (Nisbet & Myers 2011). This is relevant to this research, as limited exposure to drones means individuals rely on media coverage to shape their views. Media influence is further amplified when topics are socially and physically distant as audiences lack firsthand experiences to validate or challenge dominant narratives. As drones remain a novel and abstract technology, media portrayals play an outsized role in defining public views.



While media content plays a critical role, how audiences interpret and decode that content is equally significant. People selectively accept or reject media messages (Leaning 2017), but ambiguous or misleading content can complicate this process, potentially distorting public understanding (Al-Zou'bi 2021). This highlights the importance of media literacy, a multifaceted critical thinking skill that enables individuals to analyse, assess and make informed judgements about news content (Jeong et al. 2012; Potter 2010; Leaning 2017; Buckingham 2015).

Media credibility is defined as the perceived reliability and trustworthiness of information (Eisend 2006; Chung et al. 2012) and plays a crucial role in shaping public attitudes. Trust in media sources determines how positive or negative portrayals influence perceptions, with potential consequences for policy discussions and regulatory decisions (Tsfati 2014). If media narratives emphasise risks, public scepticism may arise, whereas credible coverage of drone benefits could encourage favourable policymaking. Since stakeholders, including government entities, advocacy groups, and the public, have diverse views on media credibility, understanding how drones are framed in news coverage is essential for assessing their broader societal impact.

Scholars have extensively debated the credibility of both the source and the message, yet message acceptance largely depends on how audiences perceive the credibility of the medium (Liao 2023). People are more likely to trust and be influenced by news when they perceive the medium, source, and content as reliable (Holland et al. 2002). Conversely, if a medium is seen as biased or unreliable, it may undermine trust in the message, regardless of its accuracy. This distinction provides important context for interpreting public responses to drone narratives in news media, which this study builds on. This is particularly relevant for drone news, where the platform, whether traditional media, online outlets, or social media, can shape audience perceptions.

In competitive media environments, credibility plays a key role in opinion formation, as audiences are more persuaded by trustworthy sources (Nisbet et al. 2017). This is especially significant for delivery drones, where media narratives promote contrasting viewpoints, either emphasising efficiency and innovation or raising concerns about privacy and security risks. This study contributes to existing research by examining how such contrasting portrayals may shape polarised or hesitant public views. While credible sources are more likely to shape public consensus, conflicting messages from equally credible outlets may contribute to uncertainty or polarisation. However, while numerous studies suggest that mass media

significantly influences public opinion, experimental research indicates that its power to change attitudes may be more limited (Hoffman 2007; Avery 2009).

Selective exposure research indicates that people seek out media sources that align with their pre-existing views, reinforcing trust in those sources and reducing openness to alternative perspectives (Fischer et al. 2005; Stroud 2011; Golan & Kioussis 2010). This dynamic can contribute to polarisation around drones, as audiences who repeatedly engage with media emphasising risks or benefits become more entrenched in their positions. Public attitudes may become more favourable if trusted sources frame drones as humanitarian tools. Conversely, scepticism towards media can limit its influence. People with low trust in the media are less receptive to messages, regardless of content (Miller & Krosnick 2000; Ladd 2010). Studies suggest that issue frames from unreliable sources have little impact, whereas the same frames from credible outlets can shape public perception effectively (Druckman 2001; Chong & Druckman 2007). This highlights the importance of analysing how trusted media outlets frame the benefits and risks of drones and the role of repeated exposure in shaping long-term public perceptions.

The recognition heuristic suggests that people judge media credibility based on familiarity; simply recognising a news outlet can increase trust in its content (Kam & Zechmeister 2013; Metzger et al. 2010). As a result, well-known media sources are more influential in shaping public perceptions of drones. At the same time, less familiar outlets often struggle to gain credibility, even when their reporting is accurate. However, audiences engage with news differently. Some deliberately avoid mainstream sources they perceive as biased (Tsfati & Cappella 2003), while others turn to alternative outlets, which may expose them to more polarised narratives. This divergence in information sources could amplify divisions in public attitudes toward drones.

Established media outlets, benefiting from routine reliance, also act as key agenda-setters (Mutz & Young 2011; Stroud 2008). Whether portraying drones as innovative solutions or societal risks, their framing strongly influences public understanding of this emerging technology. However, media reporting is often superficial, lacking technical details, research context, or methodological transparency (Jelinski et al. 2021). Studies on neuroscience reporting show that articles frequently omit critical information, covering only a fraction of relevant details (Racine et al. 2010; van Atteveldt et al. 2014, cited in Jelinski et al. 2021). Similarly, drone reporting may focus on broad narratives like efficiency or innovation, while downplaying limitations, technical challenges, or real-world implications. This gap highlights a

key opportunity for this thesis to contribute new insights by comparing media portrayals with stakeholder understandings derived from participatory research. This selective framing could skew public perceptions, amplifying either enthusiasm or scepticism. Furthermore, when media content lacks ethical standards or transparency, it can spread misinformation, mislead audiences, and contribute to poor decision-making (Alenezi 2023). Thus, the quality and completeness of news coverage play a crucial role in determining its trustworthiness and influence on public opinion.

Media credibility shapes public understanding, legislative decisions, and public discourse around emerging technologies like delivery drones. In democratic societies, people rely on trustworthy media to navigate complex scientific issues, with credibility significantly influencing opinion formation and regulatory discussions. Selective exposure further reinforces polarising attitudes, as individuals tend to engage with media that aligns with their pre-existing views, perceiving these sources as more credible through repeated exposure. The abundance of media outlets today emphasises trustworthiness and familiarity in establishing media reputations. This highlights the role of media credibility in influencing public perceptions of drones, emphasising the impact of selective narratives on societal attitudes and policy-making processes.

## 4.5 Conclusion

Media coverage is important in shaping public perceptions about emerging technologies such as delivery drones. Media content's quality, framing, and credibility directly influence how individuals and societies interpret technological advancements. Research highlights that while the media can encourage informed public discourse by presenting accurate, detailed, and balanced information, its coverage is often biased or superficial.

Bias in technology reporting, whether overly positive, overly critical, or sensationalised, significantly impacts public understanding. Selective framing, the amplification of risks or benefits, and the omission of technical details can skew societal perceptions. For instance, studies on autonomous vehicles (e.g., Taddicken et al. 2020; Seppelt et al. 2019) have shown that accidents involving emerging technologies, like autonomous vehicles or delivery drones, often receive disproportionate attention, amplifying public fears regardless of expert assessments. Similarly, repeated exposure to supportive or critical narratives reinforces

existing attitudes, particularly when audiences engage in selective exposure, seeking out sources that align with their pre-existing beliefs.

Media trustworthiness and familiarity are also crucial factors. Well-established media outlets with recognisable reputations are more likely to influence public opinion compared to unfamiliar sources, which often struggle to gain credibility. At the same time, audiences' trust in media can vary based on their political orientations, prior attitudes, or scepticism toward specific sources. This highlights the importance of media literacy, which empowers individuals to critically assess news coverage, recognise biases, and make informed judgments about technologies like delivery drones.

While the media provide an essential platform for public engagement with science and technology, they hold significant power to shape risk perceptions, public discourse, and policymaking. However, a key gap in the literature remains: although media bias and framing effects are well documented in studies of AI, climate change and autonomous vehicles, there is limited research examining how these mechanisms operate in the case of delivery drones, particularly within the UK context. Moreover, few studies link media representations to how publics make sense of these technologies through deliberative engagement or participatory methods.

This thesis addresses these gaps by combining a media analysis with a game-based participatory approach to explore how media framing of drones interacts with public understanding. In doing so, it contributes to bridging the disconnect between media representations and situated public responses, supporting a richer, context-sensitive view of drone perception.

The next chapter will explore the literature on the role of serious games, particularly board games, in participatory approaches.

## 5.0 Facilitating Discussion Using Serious Games

### 5.1 Introduction

This chapter examines the literature on the role of serious games in fostering public engagement and encouraging participatory discussions. Serious games, designed with educational, social, or research objectives in mind have gained prominence as tools to prompt meaningful dialogue and reflection on complex issues. The chapter begins by reviewing the definitions and characteristics of serious games, contrasting them with entertainment-focused games, and exploring their advantages in research and public engagement settings.

The chapter then focuses on board games as serious games, examining literature highlighting their strengths in creating immersive experiences that support collaborative learning and engagement. It then reviews studies on the design of board games, discussing different types of games and their purposes, the importance of game mechanics and user experience, and iterative design approaches. This section also considers research on elements contributing to an enjoyable and immersive game experience, such as balancing competition with enjoyment.

Lastly, the chapter addresses the literature on player dynamics, exploring how interactions among players shape the overall gameplay experience and encourage engaging thought-provoking discussions. By synthesising research on these topics, this chapter establishes a foundation for understanding how serious games, particularly board games, can effectively facilitate public engagement and generate insights within participatory research settings.

### 5.2 Serious Games for Public Engagement

Games are effective participatory tools that encourage understanding and present ideas intuitively. In research, they enhance public understanding, support citizen science, gather data on public perspectives, engage otherwise disinterested audiences, and help adults learn about innovations (Engasser and Saunders 2018). Serious games (SGs) are not only confined to digital formats; they can also encompass non-digital platforms (Fatta et al., 2019) and

include genres such as simulations, fictional reality, quizzes, answering questions to earn points, and navigating through environments or interacting with people in a non-confrontational manner (Galván-Pérez et al., 2018). A study conducted by Aubert et al. (2018) is a significant contribution that provides an in-depth review of 43 SGs whose purposes range from broadcasting a message to teaching or raising awareness, presenting direct or indirect exchange of knowledge (such as data or worldviews) and reproducing real-world situations with accurate reality. While examining their role in public policy, Olejniczak et al. (2020, p.345) defined SGs as ‘analogue or digital used within a well-defined space with a clear and primary purpose other than entertainment.’

SGs offer several attributes that support experiential learning and engagement in complex scenarios. They enable players to experience scenarios that are impractical to recreate in reality due to constraints like safety, cost, or time (Corti 2006; Squire & Jenkins 2003). Additionally, these games enable players to acquire knowledge and develop understanding through near-real-world circumstances, encouraging meaningful interactions and more profound comprehension of the subject matter (Rodela et al., 2019). They also offer players the opportunity to plan, negotiate, analyse, and make decisions while receiving immediate feedback, enhancing the learning experience (Allery 2014; Pope 2021). These studies offer a valuable foundation for this research, which seeks to integrate such principles into the design of a board game.

Games also provide participants with a space to engage diverse stakeholders and foster shared experiences (Dieleman and Huisingh 2006). Games can break down barriers between individuals with varying perspectives by immersing participants in a collective environment, encouraging dialogue. Such participatory processes are particularly valuable in addressing interdisciplinary or contentious issues, where collective problem-solving and inclusivity are essential. Another strength of games is their inclusiveness—they provide participants with equal opportunities and require no prior skills to engage (Allery 2014). Bousquet et al. (2001) is a key reference outlining games' roles in extending knowledge, such as simulating different schemes, hypothesis testing, and facilitating discussions across populations. The latter has been recognised as part of the game design for this research, as the game aims to encourage open dialogue among participants from diverse backgrounds. In doing so, the study builds on Bousquet et al.'s (2021) insights to encourage a space for sharing perspectives and collaboratively exploring the implications of drones, ensuring that a wide range of views is considered in understanding public and stakeholder opinions.

In addition to their generalised strengths, a benefit of using games for public engagement is their ability to reduce emotional barriers and enhance communication, a characteristic crucial for public engagement where communication is essential for fostering understanding and collaboration while supporting active participation and engagement (Enticknap-Seppänen, 2017). Jessen et al. (2018) demonstrated that game-like participatory activities can guide participants in exploring new ideas and addressing design challenges in health-related contexts. For example, in health education, SGs have emerged as powerful tools for promoting behavioural change and engaging users by providing immersive experiences that can improve knowledge retention and skill development (Funabashi et al., 2018; Thomas et al., 2020). Furthermore, SGs targeting health-related behaviours have been shown to motivate children to engage in healthier lifestyles, demonstrating games' potential to positively influence public health (Baranowski et al., 2011). Additionally, the design of these games often incorporates elements that enhance user engagement, such as relatable scenarios and social interaction, which are critical for effective learning (Nicholas et al., 2022).

Urban planning is another area where games have been effectively utilised to enhance public participation. The use of platforms like Minecraft in participatory design methodologies has demonstrated how commercial games can facilitate community engagement in urban development projects (Delaney, 2022). This study contributes to this growing body of work by applying such participatory principles to the context of delivery drones. This approach allows citizens to visualise and contribute to planning processes more interactively and enjoyably, thereby improving the quality of public consultations and fostering a sense of ownership among community members (Delaney, 2022).

SGs have also been shown to facilitate social learning outcomes, particularly in the context of sustainability challenges. Haan and Voort (2018) emphasise that these games can incorporate both the techno-physical and socio-political complexities of sustainability issues, allowing stakeholders to engage in role-play and receive in-game feedback that enhances their learning experience. This aligns with the research aim, enabling participants to explore the multifaceted implications of drone deliveries. However, the challenge lies in ensuring that these complexities are represented in an accessible manner, as overly intricate scenarios might alienate some participants, particularly those less familiar with the subject matter.

The collaborative potential of SGs is particularly relevant to socially sustainable decision-making. Kraker et al. (2021) highlight how SGs can support sustainable water management by enabling stakeholders to explore strategies collaboratively. Similarly, a game

on delivery drones could facilitate public discourse and stakeholder engagement, addressing concerns such as privacy, safety, and environmental impact. Wibeck and Neset (2020) discuss the use of SGs in enhancing climate change communication, emphasising their ability to encourage in-depth discussions. This insight is particularly valuable for engaging diverse audiences in emerging technology contexts. Tatar (2023) emphasises the importance of embedding real-world components into game environments through collaborative approaches. This allows participants to experiment and learn in a meaningful context. This participatory design process not only increases the relevance of the games but also ensures that they address stakeholders' specific needs and concerns, thereby enhancing their effectiveness as engagement tools (Tatar 2023). Therefore, tailoring a game for particular contexts and places would align with this principle for this research.

SGs offer significant potential for research on transport futures. They enable stakeholders to engage with complex scenarios, encourage collaboration and social learning, and provide an interactive platform for public perceptions of emerging transport technologies.

### 5.3 Board Games as Serious Games

Board games have been widely recognised as an effective medium for understanding learning owing to their simple yet structured game mechanisms (Horn et al. 2012). Defined as ‘games with rules, a playing surface, and tokens that allow interaction between players as they face each other and focus on the playing surface’ (Barbara 2017 cited in Bayeck 2020, p.413), board games create interactive and immersive experiences. Research on board games remains largely focused on those designed with educational purposes, commonly referred to as serious board games (Bayeck 2020), a key reference demonstrating their potential as tools for education, communication and engagement.

One of the defining characteristics of board games is their social and interactive nature. Pereira et al. (2012) categorise board games as social events, where players engage in face-to-face interaction, interpreting gestures and expressions while interacting with the board and other players. This interaction is further enhanced by feedback mechanisms embedded in the game mechanics, which promote a dynamic exchange of information (Tsai et al. 2021). These qualities make board games particularly relevant to participatory research as they provide an engaging platform for dialogue, decision-making and collaborative problem-solving. Together,



these studies provide an important understanding of how board games can support stakeholder deliberation.

Board games have emerged as powerful tools in serious game design, offering unique advantages for diverse applications, including education, health promotion, environmental awareness, and social interaction. Mackay (2013) highlights their ability to foster "collective learning," enabling participants to learn together through shared experiences. This concept is particularly important for this research, where a participatory board game on delivery drones could encourage stakeholders to explore the implications of delivery drones collaboratively. Similarly, Ghoman et al. (2019) emphasise the cost-effectiveness of board games in conveying complex information, which resonates with creating a board game that simplifies the complexities of delivery drones for diverse audiences.

Board games also offer a flexible and adaptable medium for SG design for example, Sousa (2021) demonstrates how existing games can be modified for collaborative ideation, enabling tailored experiences that meet specific educational or social goals. This is a significant contribution to methods that seek customisation and local relevance. This flexibility applies to this research, where a customised board game reflecting place-specific concerns about delivery drones would ensure relevance and resonance with stakeholders. Moreover, Fjællingsdal and Klöckner (2020) highlight how board games facilitate dialogue and simplify environmental communication. Similarly, for this research, a board game can help participants understand the broader implications of their decisions, encouraging responsibility and informed opinions on delivery drones.

While board games offer the aforementioned advantages, especially for participatory research, they also reduce the cognitive load associated with complex systems, encourage teamwork and communication, and promote problem-solving and collaboration (Tsai et al. 2021). These attributes are essential for this research, as leveraging these strengths can make board game design an effective platform for stakeholder engagement, learning, and meaningful dialogue.

In summary, board games are versatile tools for learning and engagement. They offer structured yet interactive experiences that foster collaboration and dialogue. Their adaptability and ability to simplify complex systems make them particularly valuable for participatory research. Leveraging these strengths, a customised board game on delivery drones could effectively engage stakeholders, promote understanding, and support informed decision-making.

## 5.4 Designing Board Games

SGs are increasingly considered practical tools for learning, research and behaviour change (Lamb 2024). McGonigal (2011) emphasises the importance of recognising differences in a game's intended use, whether for data collection, education and training, or transformative change, as these distinctions likely influence game development, testing, and evaluation. Table 3 (Rodela et al. 2019) illustrates the varying purposes of SGs, ranging from entertainment to intervention, providing a framework to guide game development.

Table 3: Different uses of serious games (Rodela et al. 2019)

| Game Type                 | Definition                                                                                                                          | Purpose                                      | Expected Outcome                                                    |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|---------------------------------------------------------------------|
| <b>Pure games</b>         | Game serving as a pass time designed for entertainment and challenge, and when played with others, it fosters social engagement     | To entertain and pass time                   | Enjoyment                                                           |
| <b>Games for research</b> | A game incorporated into research processes to gather data or validate models in alignment with specific research objectives        | To collect information and data for research | Data sets, new questions, validated scenarios and models of reality |
| <b>Educational games</b>  | A game utilized as an instructional tool and integrated into the curriculum to support specific educational and training objectives | To educate and train                         | Skills and knowledge gained                                         |

|                              |                                                                                                                     |                                                                                                             |                                                              |
|------------------------------|---------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| <b>Games as intervention</b> | A game designed to facilitate exchange, information sharing, and critical reflection on a specific issue or problem | To trigger and facilitate change. Usually done as part of larger projects that need to achieve larger goals | Transformation of practices, approaches, and social learning |
|------------------------------|---------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|

The SG designed for this research falls within the ‘games as intervention’ and ‘games for research’ categories. While the game does not aim to facilitate change, it would introduce participants to a subject area, delivery drones, that they may not have previously considered. Engaging with the game mechanics and interacting with other players will expose participants to new concepts and issues surrounding using delivery drones. This process encourages critical reflection and dialogue, with the game contributing to social learning, a key expected outcome within the intervention category. The game also aligns with the games for research category as it is designed to gather data on participant’s perceptions. Through gameplay and subsequent discussions, the game would generate valuable insights that can inform future studies on public engagement with emerging technologies. This dual role builds on earlier work, such as Olejniczak et al. (2020), that conceptualises SGs as hybrid tools for learning and research, helping address the gap in participatory methods for emerging transport technologies. The dual purpose of the game, both as an intervention and as a research tool, highlights its flexibility.

Cheng et al. (2020) identify critical features for designing board games:

- 1- **Multirole simulation:** Assigning different roles to participants allows them to understand not only their responsibilities but also the perspectives and contributions of others. This approach is particularly valuable for fostering empathy and collaboration. However, in the context of this research, the game aims to engage stakeholders with varying knowledge, and assigning roles might risk alienating players who are less familiar with the subject matter. It is also important to avoid complicating the game by adding too many game mechanics.
- 2- **Systemic situation:** Integrating procedural rules and feedback mechanisms simplifies complex concepts, making them accessible to participants. For example, the logistics and societal implications of drones can be represented through rule-based gameplay that highlights trade-offs between energy, route, and risk. While

this simplification is beneficial for engagement, it raises concerns about oversimplifying the nuanced realities of drone logistics. This concern has also been highlighted in serious game literature (e.g., Rodela et al. 2019), suggesting a need for balance between realism and playability, a factor this study seeks to navigate

- 3- **Reflective goal:** Reflective goals aim to engage participants' metacognition and encourage them to think critically about the topic. For this research, reflective goals are essential to promoting deeper discussions about the implications of delivery drones.
- 4- **Interactions of society:** Creating an interactive environment fosters dialogue and problem-solving among participants, particularly on public issues. For this research, the game would provide a platform for stakeholders to share perspectives about emerging transport technology, identify problems and collaboratively propose solutions.

These features collectively support autonomous learning, engagement, and social interaction. For the game developed in this research, these aspects, except multirole simulation, are central to encouraging meaningful stakeholder engagement and facilitating discussions about delivery drones. By adopting these principles, the research builds on the recommendations by Cheng et al. (2020) and contributes to extending their application to public dialogue on novel technologies.

A conceptual framework for game design organises features into categories of themes, mechanics and genres as proposed by Greenhalgh et al. (2019). This framework ensures that a board game's design aligns with its objectives and supports the intended outcomes. For instance, Hale et al. (2020) stress the importance of defining clear goals during the design phase to guide decision-making and evaluate the game's effectiveness. This structured approach, combined with iterative and participatory design principles, ensures that serious board games are engaging and purpose-driven. Mechanics influence player enjoyment, motivation, and learning outcomes (Yee 2006; Berland & Lee 2011). Themes, described as the "dressing" or fictional world of the game (Koster 2004; Sicart, 2009), can enhance immersion and provide context for learning. Genres, shaped by cultural and social factors, define gameplay conventions, such as game duration or openness of goals (Russel 1997; Squire 2011).

Ensuring accessibility is essential for broadening a board game's audience and enhancing its effectiveness. Thévin et al. (2021) emphasise the need for inclusivity in game

design, ensuring diverse populations can participate. This includes reducing cognitive overload (Chao 2023) and incorporating physical game components that encourage social interactions (Cross et al. 2023). Furthermore, engaging target audiences early in the design process through participatory principles, as Khaled et al. (2014) recommended, ensures that games remain relevant and impactful. Iterative testing, as highlighted by Mahatmi (2021) and Samarasinghe et al. (2021), allows designers to refine game mechanics, address accessibility concerns, and optimise player engagement.

By integrating these design principles, serious board games can effectively combine educational, social, and experiential elements to support learning and stakeholder engagement. The study aims to build on and extend such frameworks by adapting them to the context of delivery drones, an area that remains underexplored in existing SG literature. These insights will guide the game design of this research, which will involve developing a participatory tool that simplifies complex systems, encourages reflection, and fosters meaningful interactions about the implications of delivery drones.

### 5.4.1 Game Mechanics

Game mechanics are the structured rules, actions and systems through which gameplay unfolds and is central to the effectiveness of SGs in promoting learning, engagement and reflection (Kim 2015). These mechanics determine not only how players interact with the game but also how they engage with one another. In SG contexts, mechanics are often designed to simulate real-world processes, encouraging players to think critically about trade-offs and consequences. Marczewski's (2013) model, which conceptualises game mechanics through an input, process and output framework, highlights how carefully structured actions and consequences can facilitate meaningful player engagement.

Several scholars have highlighted key considerations for designing effective mechanics in educational and participatory games. Lameris et al. (2016) emphasise the alignment of learning objectives with core mechanics such as rules, goals and challenges, arguing that clarity in game structure is essential to maintain player focus and motivation. Feedback, whether in the form of rewards, progress indicators or direct consequences, has been shown to reinforce learning and sustain engagement (Mahyuddin 2024; Chowanda 2023). Similarly, maintaining player attention through dynamic challenges and evolving goals has been found to reduce fatigue and support deeper involvement in the game's themes (Guckelsberger et al. 2017).

Cooperative mechanics are another critical dimension of SGs. Games that require players to work towards shared objectives can promote collaborative learning, support, social bonding and facilitate the co-construction of knowledge (Ke et al. 2015; Vahlo et al. 2017). At the same time, Bedwell et al. (2012) stress the importance of offering players strategic control and agency, enabling them to meaningfully influence outcomes and apply their reasoning skills.

The ethical implications of game mechanics are also widely discussed in the literature. Petrovskaya and Zendle (2021; 2022) caution against manipulative or overly competitive mechanics, which can undermine trust or discourage participation. Instead, SGs should prioritise mechanics that support ethical interaction, constructive debate, and mutual respect among players.

These perspectives highlight the need for designers to balance engagement, a key consideration for designing a board game for this research, ensuring that the game remains accessible and respectful of participants' diverse experiences and capabilities.

#### 5.4.2 Design & Engagement Considerations

In addition to mechanics, a range of design considerations influence how players experience and respond to SGs. Accessibility, inclusivity and contextual relevance are critical to ensuring broad engagement and equitable participation. Passalacqua et al. (2020) and Fjællingsdal and Klöckner (2020) note that simplified rules, visual aids and onboarding mechanics improve the learning curve for new players, especially those unfamiliar with the topic. These design elements support cognitive ease and reduce barriers to participation.

Narrative design can further enhance player engagement. Games that embed scenarios within relatable or thought-provoking stories are more likely to elicit emotional responses, helping players to connect personally with the game's content (Laja et al., 2018; Inall & Wake, 2022). Cultural and contextual tailoring also plays an important role. As Kurniati et al. (2017) argue, situating games within locally relevant frameworks increases their resonance and relevance, supporting participants in relating in-game dilemmas to their lived experiences, a key consideration for the development of the board game for this research.

Ethical design also extends to managing the emotional and social dynamics of play. Volz et al. (2016) suggest that poorly balanced games may inadvertently cause frustration, disengagement, while Elliot et al. (2012) highlight the need to anticipate and mitigate problematic gaming behaviours. Importantly, the social nature of board games, as highlighted

by Cheung et al. (2012), creates opportunities for real-time negotiation, collaboration and interpersonal learning, making them well-structured for participatory research. Yet, such interactions must be managed carefully to avoid reinforcing social hierarchies or exclusionary dynamics (Daneva 2014).

Together, these insights provide a rich foundation for understanding how game mechanics and design strategies can be used to encourage meaningful engagement, knowledge exchange and ethical interaction in serious game contexts.

### 5.4.3 Iterative Game Design

Iterative game design is a development strategy focused on continuously refining a game through repeated cycles of prototyping, testing, and evaluation (Sezen 2018). Ampatzidou and Gugerell (2018) emphasise the importance of involving future players in this process to ensure that the game design is meaningful and contextually relevant, fostering player engagement and resonance. Their work represents a key contribution to participatory game design, offering a foundation that this study seeks to extend into the domain of delivery drones. This iterative approach allows designers to collect ongoing feedback, enhancing game alignment with player expectations and increasing its appeal (Ampatzidou & Gugerell, 2018).

Terlouw et al. (2021) highlight that prototyping is a critical component of game design, as it enables designers to test mechanics and assess their effectiveness in achieving specific goals. After each testing round, designers collect insights from players and stakeholders, using this feedback to guide further iterations (Ben Amara et al. 2024). This feedback loop is crucial for understanding player preferences, identifying areas for improvement, and refining mechanics. Terzioglu (2023) adds that iteration allows designers to detect missing elements and better understand the perspectives of the target audience, leading to a more cohesive game design. These studies highlight how iterative design enhances alignment between game intent and participant experience, an issue particularly relevant to emerging technologies like delivery drones, where public familiarity may be low. Additionally, Ampatzidou et al. (2022) note that contextual and relational factors can shape the iterative design process, guiding designers to adapt their games to better suit players' needs and the settings in which the game will be used.

Wilson et al. (2016) propose that an iterative evaluation framework can assess the effectiveness of SGs, ensuring they meet their intended educational objectives. This continuous refinement is vital for creating engaging and educational games that successfully

impart knowledge or skills. Moreover, an iterative approach promotes collaboration among team members, which is particularly valuable in serious game development, where multiple disciplines often intersect, as was the case in the E-Drone project. Kasurinen and Smolander (2017) emphasise that collaboration in iterative design builds a deeper understanding of the game's potential and the challenges it may face, ultimately resulting in a more well-rounded game.

Playtesting is one of the most crucial stages, where individuals outside the development team play the game to provide fresh perspectives (Parantham and Cooper 2019). According to Fathurrohman et al. (2022), this phase benefits from a structured approach in which developers observe players in a natural setting, identifying any confusing rules or mechanics that could disrupt gameplay. Usability testing focuses on the ease with which players can understand and interact with the game (Desurvire and El-Nasr 2013). This often includes qualitative and quantitative measures, such as surveys and observations, to assess player satisfaction and ease of navigation.

Iterative refinement follows these stages, when designers enter a feedback-driven cycle and make adjustments based on insights gained from playtesting and usability testing (Genov 2005). Hautopp (2023) emphasises that continual feedback during playtesting can reveal core mechanics and areas for improvement, which are crucial for enhancing the gameplay experience.

After extensive testing and refinement, a final evaluation is performed to ensure the game achieves its intended objectives. This comprehensive review includes assessing game mechanics, narrative coherence, and player engagement to confirm the game's overall quality and appeal. In the case of educational or SGs, expert reviews may be conducted to assess the accuracy and effectiveness of the content, often involving subject matter experts who evaluate whether the game successfully conveys the concepts it intends to teach. Each of these stages is vital in creating a game that is not only functional but also enjoyable and engaging for players.

#### 5.4.4 Enjoyment and Immersion in Board Games

Board games should provide intellectual stimulation and opportunities for social interaction, both of which are critical for player enjoyment, as emphasised by Rogerson et al. (2016), whose findings help inform the design priorities in this study. Woods (2012) found that social



interaction (60%), strategic play (27%), and intellectual challenge (22%) influence enjoyment in board games.

Rogerson et al. (2016) identified four key factors contributing to this enjoyment:

1. **Sociality:** Players value the social experience of play and the opportunity to connect with like-minded individuals.
2. **Intellectual Challenge:** Strategic thinking and the effort to solve a game's underlying systems are essential for engagement.
3. **Materiality:** While gameplay takes precedence, high-quality components and appealing design enhance the player experience and create emotional investment.
4. **Immediate Play Environment:** Comfortable settings, such as adequate lighting and appropriately sized tables, are critical for sustained gameplay and enjoyment.

These key design elements identified by Rogerson et al. (2016) have informed the design considerations of this project, where sociality is crucial for encouraging dialogue among stakeholders, while intellectual challenges can simulate decision-making and discussion around delivery drones and encourage knowledge co-creation. High-quality components and a well-considered play environment will enhance engagement, ensuring the game is accessible and enjoyable. This alignment highlights the importance of balancing social interaction, intellectual engagement, and design aesthetics in creating an effective participatory tool.

There is a debate on the concept of immersion in academic literature (Nilsson et al. 2016). Although some aspects of immersion are shared between board games and video games, such as problem-solving (Denisova et al. 2016), there is a lack of immersive features, such as the experience of high realism that video games provide (Groff et al. 2016). Similar to video games, players can feel immersed in board games through design decisions such as mechanics and physical pieces (Farkas et al. 2020). While there are multiple definitions of immersion in-game literature, immersion can be described as a 'cognitive phenomenon' (Farkas et al. 2020). Wake's (2019) research explores immersion from a theoretical perspective. It emphasises that board games provide a tactile experience, where players divide their attention between the game events on the table and interactions in their surroundings. It further theorises that the environment itself may contribute to the immersive experience.

Board games are differentiated from video games due to a lack of moving imagery and, in some cases, audio; therefore, theme and art in a board game become conditions of an immersive experience called a 'continuous stream of stimuli' (Witmer and Singer 1998). In the absence of stimuli within the board game, players can compensate by using their imagination or incorporating external elements, such as adding music or adjusting the game environment (Witmer and Singer 1998). Lacking visual stimuli, board games rely on text prompts, game art, and mechanics to help players construct a virtual world in their minds. Moreover, board games provide flexibility in terms of the interpretation of the game world, and Farkas et al. (2020) argue that this flexibility allows for a more 'customisable' form of immersion than video games.

To enhance immersion in board games, Farkas et al. (2020) suggest key considerations: allow players control over their experience; focus on narrative and theme as primary drivers, with elements like time pressure to deepen engagement; minimise distractions in the game environment; and acknowledge that immersion varies among players. While immersion is a critical factor, it is not the sole contributor to enjoyment, and incorporating out-of-game elements, such as soundtracks, can further enrich the experience.

Games can combine intellectual stimulation and social interaction, creating engaging and enjoyable experiences for players which was key for Game of (Delivery) Drones. Factors like sociality, strategic challenges, high-quality components, and a well-designed play environment contribute to player satisfaction. Immersion in board games relies on narrative, theme, mechanics, and the physical environment, with players often using imagination or external elements to enhance their experience. Unlike video games, board games offer a more flexible and customisable form of immersion, allowing players to shape their interpretations of the game world while encouraging engagement and creativity.

#### 5.4.5 Balancing Competition and Fun

Creating a competitive yet enjoyable gaming experience requires a delicate balance of game mechanics, engagement strategies, and social dynamics. Game designers must thoughtfully integrate competition in ways that keep gameplay rewarding and fun. Several techniques can help achieve this balance.

First, designing fair game mechanics is essential for a positive competitive environment. Ensuring game balance, where no player has an inherent advantage, maintains engagement and enjoyment. He et al. (2021) emphasise that multiplayer online battle arena (MOBA) games

achieve this by using matchmaking systems that pair players of similar skill levels. This approach enhances competition without discouraging less-skilled players. It encourages fairness and motivates players to improve, creating a satisfying competitive atmosphere.

Providing immediate, meaningful feedback on performance enhances players' sense of accomplishment. A study by Tondorf and Hounsell (2022) has been particularly relevant in highlighting how enjoyment stems from goal achievement and well-integrated competition, noting that enjoyment often stems from specific game elements, including competition and the satisfaction from achieving goals. Reward systems, such as points, badges, or leaderboards, create a sense of progression that keeps players engaged and motivated (Metzger et al. 2016).

Careful management of difficulty levels is another important factor. Building on Díaz-Furlong and Cosio (2013) contribution to adaptive gameplay, their work highlights the role of procedural content generation and difficulty curves, which help maintain appropriate challenges. Dynamically adjusting difficulty based on player performance ensures the game remains challenging yet manageable, preventing frustration and promoting a sense of achievement as players overcome obstacles.

Kafai et al. (2012) suggest that competitions become more engaging when they involve authentic audiences and opportunities for social interaction. Designers can strengthen player connections by facilitating communication and collaboration, building a supportive gaming community. Lastly, it's essential to recognise that fun is subjective and varies among players. Iacovides and Cox (2015) offer a key perspective here, noting that fun encompasses a range of emotional experiences beyond traditional definitions, so designers should consider diverse player preferences when developing competitive elements. This inclusivity broadens the game's appeal, enhances satisfaction, and fosters a vibrant gaming community.

In summary, creating a competitive yet enjoyable gaming experience requires careful integration of balanced mechanics, social elements, feedback systems, adaptive difficulty, and community-building strategies. By focusing on these aspects, game designers can create engaging experiences that challenge players while providing enjoyment and fostering connections.

## 5.5 Playing Together

Player dynamics significantly influence gameplay by affecting individual experiences and collective interactions within the game environment. The relationship between player behaviour and game mechanics demonstrates how personal choices can shape the overall gaming experience and outcomes (Nikitina, 2021).

Consalvo et al. (2016) argue that players often negotiate their moral frameworks while engaging with game mechanics, leading to diverse interpretations of gameplay and character actions. Embedding ethical dilemmas into gameplay in this research can deepen engagement and stimulate meaningful discussions, making it an effective tool for exploring the complex societal impacts of emerging technologies. This negotiation process influences how players interact with both the game world and each other, ultimately shaping the shared gameplay experience (Consalvo et al. 2016).

In urban planning games, Raghothama et al. (2022) emphasise the importance of understanding how players relate game constructs to real-world contexts. Their work serves as a key reference in illustrating how participatory games can shape understanding of applied issues. They argue that aligning game mechanics with player experience is essential to achieving meaningful outcomes in participatory settings, highlighting the need for designers to consider how interactions with game elements can shape real-world perceptions and actions (Raghothama et al., 2022). Similarly, this research needed to ensure that the game design and approach guarantee that gameplay facilitates not just engagement, but also critical reflections and discussions that can influence real-world perceptions and decisions about delivery drones.

Player interactions significantly impact the overall gaming experience, with social dynamics playing a particularly prominent role in board games. For example, Chen and Janicki (2020), found that the physical and tangible nature of board games heightened player engagement and strengthened social bonds in comparison to augmented reality. Furthermore, their results suggest that face-to-face interactions during gameplay fostered intimacy and social satisfaction, highlighting the value of direct player interactions in board games, which can significantly enhance the experience. Unlike digital games, where interactions are mediated by technology, board games offer direct, unmediated player-to-player interactions that enrich engagement and learning (Bayeck 2020). Bayeck's (2020) work is particularly valuable in distinguishing board games' unique capacity for unmediated social engagement.

This difference highlights the unique social dynamics in board games, where players actively interact without a digital interface, facilitating a more immersive experience.

Collaborative gameplay is another vital component of player dynamics. Peppler et al. (2013) found that players in cooperative settings are more likely to engage in positive behaviours, such as offering support and reading instructions to one another. This suggests that the design of board games can promote constructive social interactions, enhancing both the learning experience and creating a supportive environment among players. Sousa (2023) also highlights a growing preference for collaborative modern board games, indicating a shift in player demographics towards individuals who favour cooperative over competitive interactions. Moreover, strategic board games offer unique cognitive engagement opportunities through collaborative problem-solving. Berland and Lee (2011) studied how such games facilitate distributed computational thinking, showing that when players work together toward a shared goal, cognitive processes are effectively distributed among them. This dynamic enhances collective problem-solving skills and illustrates the potential of board games to support complex cognitive engagement through cooperative player dynamics. Together, these findings suggest that well-designed board games can encourage both social and mental growth, leveraging player interactions to create meaningful and enjoyable experiences.

In board game settings, there is a risk certain players can dominate gameplay through strategic decision-making, mastery of game mechanics, and skilful use of social dynamics. A key factor in player dominance is the ability to exert control over game mechanics and interactions; for instance, Bedwell et al. (2012) describe control as a core game attribute, indicating the degree to which players can influence gameplay and outcomes. Players who understand and effectively leverage this control can significantly shape the game's direction and improve their chances of success (Bedwell et al. 2012). This control may appear in various forms, including resource management, strategic positioning, or manipulation of game rules. Additionally, as discussed by Ampatzidou (2018), the concept of emergent gameplay highlights how players' tacit knowledge and assumptions can lead to dominant strategies not immediately visible to others. Players who adapt their strategy based on game mechanics and opponents' behaviours often gain a strategic advantage, allowing them to exploit weaknesses and further consolidate their influence (Ampatzidou 2018).

Player experience and engagement are also critical to dominance; Bayeck's (2023) research on the African board game Songo illustrates how players' cognitive and emotional

engagement can shape their strategies. Highly engaged players make more informed decisions, creating a feedback loop where successful outcomes increase their investment and, consequently, their dominance (Bayeck 2023). Social dynamics in multiplayer settings also contribute to player dominance. Daneva (2014) notes that players frequently negotiate rules and strategies within the game, leading to informal hierarchies or alliances. Players skilled in negotiation and communication can use these social dynamics to influence gameplay outcomes, particularly in games requiring collaboration or competition (Daneva 2014). This social aspect enables players with strong interpersonal skills to gain dominance through manipulation or persuasion.

The emotional and psychological aspects of gameplay also affect player dominance. Players who can maintain emotional composure and manage stress effectively are often better positioned to make calculated decisions. Olbertz-Siitonen et al. (2021) found that dominant players usually shape the social atmosphere within the game, influencing co-presence and shared experiences, which can yield a psychological edge over other players. This social influence can lead to intimidation or reduced confidence in others' strategies, amplifying the dominant player's control.

In conclusion, player dominance in board games arises from a mix of control over mechanics, adaptability to emergent gameplay, social negotiation, and emotional resilience. Recognising these dynamics can help players enhance their strategies and enable designers to create balanced and engaging gameplay experiences.

## 5.6 Serious Games in Practice: Key Examples

Serious games have increasing recognition as effective tools for stakeholder engagement and public deliberation, particularly in navigating complex socio-technical issues. Games allow for participatory exploration of abstract or unfamiliar futures by simplifying systems and promoting dialogue. This section reviews key game-based approaches that informed the development of the board game used in this study, with particular attention to AquaRepublica (Jean et al. 2018a; 2018b) and other relevant examples in planning, technology in participatory design.

AquaRepublica is a serious research game designed by Jean et al. (2018b), developed as part of watershed governance initiatives. Jean et al. (2018b) evaluated the game in the context of stakeholder dialogue and knowledge co-creation in integrated water resource management. Their study demonstrates how serious games can act as catalysts for boundary

crossing between diverse actors, enabling dialogue across professional, disciplinary and knowledge-based divides. Using the SECI model as an analytical lens, the authors demonstrate how game sessions prompted socialisation, externalisation, combination and internalisation of knowledge among players with different backgrounds and interests.

AquaRepublica created a shared space for participants to explore water-related trade-offs, enhancing their understanding of interdependencies and governance challenges in watershed contexts. This supports the view that games can simulate real-world systems in a simplified, interactive format that helps participants engage more deeply with unfamiliar policy or environmental issues. Importantly, Jean et al. (2018b) highlight how the game design encouraged an open-ended exploration and mutual learning, rather than guiding participants toward predefined solutions. These features are highly relevant to this study's focus on delivery drones, another complex, uncertain and emerging sociotechnical domain where public understanding may be limited and policy solutions contested.

The AquaRepublica case highlights the potential of serious games to surface values, challenge assumptions and support group-based sensemaking. It provides foundational precedent for this thesis's game-based approach, particularly in how gameplay can facilitate knowledge co-creation through interaction, negotiation and collaborative problem-solving.

Beyond AquaRepublica, serious games have been widely used in participatory urban planning, technological futures and transport innovation. Van Bilsen et al. (2010), for example, developed games to help local stakeholders co-create urban scenarios. Their design encouraged articulation of situated knowledge in informal, low-stakes settings, an approach shown to support both creative problem-solving and trust-building.

Ragothama et al. 2022 emphasised the importance of aligning game mechanics with real-world policy and planning frameworks. Their work on urban resilience planning demonstrated that players more readily engaged with future oriented decision making when gameplay scenarios mirrored known structures, such as regulatory systems or spatial constraints.

Ampatzidou (2018) examined how players navigate speculative city-making games and found that tacit knowledge and everyday experiences shaped how participants interpreted and prioritised in-game decisions. Her research highlights the potential of serious games to surface assumptions and explore future imaginaries that may be difficult to access through interviews or surveys alone.

Together, these precedents illustrate the growing application of serious games in complex, interdisciplinary settings. They show how structured gameplay can enable reflective discussion, expose tensions between competing values, and support knowledge generation, which is central to the aim of this study.

## 5.7 Limitations of Game-Based Method

Although serious games are designed to level hierarchies and encourage inclusive discussion, their effectiveness can be limited by several factors. First, power asymmetries can persist within game-based settings, where confident or knowledgeable participants may dominate the conversation, marginalising others (see for example, Barnaud and Paassen 2013). Less engaged or disempowered participants, such as those unfamiliar with gaming formats or unsure about the relevance of the topic, may feel excluded or hesitant to contribute (Jean et al. 2018b). Games that rely on verbal reasoning or rapid decision-making may also disadvantage participants with cognitive or linguistic differences.

Moreover, engagement is not guaranteed, while games are often assumed to be naturally appealing, some participants may view the format as trivial, especially in contexts involving serious issues. Without clear facilitation, tokenistic participation can occur, where players feel their views are collected but not meaningfully used (Brown & Wyatt 2010). There are also risks of cultural mismatch where gaming may not be viewed as an appropriate tool for dialogue, particularly in policy settings (Mayer 2009; Devisch et al. 2016).

Finally, transferability of insights is a known challenge. The dynamic, playful environment of a game may support reflection and experimentation, but the knowledge generated may not always translate into real-world action, especially if no follow-up mechanism is in place (see for example Devisch et al. 2016)

## 5.8 Conclusion

This chapter highlights the potential of SGs, particularly board games, as powerful tools for facilitating public engagement, fostering dialogue, and supporting participatory research. SGs offer unique opportunities to simulate complex scenarios, enable collaborative problem-solving, and generate insights into stakeholder perceptions. By providing inclusive and immersive experiences, these games encourage participants to explore diverse perspectives,



critically reflect on emerging technologies like delivery drones, and engage in meaningful discussions about their implications.

Existing research demonstrates the educational and deliberative value of serious games in domains such as climate change, health and transport planning. However, there is a notable gap in how such tools have been applied to the context of delivery drones, a technology characterised by low public familiarity, evolving regulatory frameworks, and contesting societal impacts. Few studies have explored how board games can be designed to support situated deliberation and co-creation of knowledge on technologies that are still emerging, uncertain and socially polarising.

Integrating effective game design elements, such as balanced mechanics, feedback systems, and context-specific themes, enhances participant engagement and learning outcomes. With their social and interactive nature, board games have been shown to promote intellectual stimulation, collective learning, and social connections, making them particularly valuable for engaging diverse audiences. Moreover, the iterative design process ensures that games remain relevant and impactful by incorporating player feedback and refining mechanics to address participant needs.

This research responds to the identified gaps by developing a novel board game that facilitates participatory exploration of delivery drone scenarios. By doing so, it contributes an innovative methodological approach to understanding how the public interprets, evaluates and deliberates on the implications of drone use, addressing the core research questions about public knowledge, attitudes and the co-construction of meaning around logistics drones.

While board games are effective tools for participatory research, challenges such as maintaining accessibility, balancing complexity, and avoiding player dominance must be addressed. With careful design and thoughtful execution, SGs can foster meaningful engagement, encourage collaborative learning, and support informed discussions on emerging technology issues.

The following chapters outline the methodology, detailing the approach to media analysis and the process of developing a board game.

## 6.0 Research Philosophy & Approach

### 6.1 Introduction

This chapter begins by outlining the theoretical foundations and research philosophy underpinning this study. It focuses on interpretivism to explore stakeholder perspectives on delivery drones. The research approach is qualitative, particularly focus groups facilitated by a board game that encourages participants to engage with the topic of delivery drones.

### 6.2 Research Philosophy

Research philosophy refers to a 'system of beliefs and assumptions about the development of knowledge' (Saunders et al., 2009 p.130). Throughout the research process, the researcher often makes numerous assumptions, whether they are consciously aware of them or not (Burrell and Morgan 2016). The research philosophy adopted by this study is interpretivism.

Interpretivism posits that individuals construct knowledge by interpreting their experiences, challenging the idea that knowledge is objectivist and exists to be collected and identified (Constantino 2008; Pascale 2011). It challenges the positivist idea by suggesting knowledge is subjective and grounded in our experiences resulting in ontological relativism (Greene 2010; Denzin & Lincoln 2005; Alvesson & Sköldberg 2009). Interpretivism aims to uncover the meaning and intention behind an individual's behaviour and interactions with society and culture (Whitley 1984). Pascale (2011 p.23) highlights the interpretivist belief that "to understand a situation ... researchers must understand the meanings the situation holds for the participants, not just their behaviours." Therefore, this approach is relevant for this study because it focuses on understanding participants' contextual meanings and how their perspectives are constructed through interactions.

From an interpretivist perspective, participants' understandings of knowledge are shaped by their experiences, while the researcher also brings their own world beliefs and interpretations into the process. Bruschia (2005) suggests that objectivist and interpretivist research methods are driven by distinct types of questions. While objectivist research seeks generalisable truths, interpretivist research investigates the 'lived world of human beings' (Bruschia 2005, p.83) and how they subjectively construct meaning. This study requires an

interpretivist lens to investigate how participants navigate complex, socially constructed ideas such as the implications of delivery drones, and how they make sense of limited to fragmented information.

The interpretivist epistemological perspective adopted in this research is constructivism. Constructivism challenges the idea of an objective human reality, asserting instead that it is shaped by individuals through their interactions with and interpretations of the world (Alvesson & Sköldbberg, 2009; Crotty, 1998). Meanings are not static; they evolve as new experiences introduce fresh perceptions and insights (Schwandt 2003). Constructivism clarifies phenomena by understanding the processes of meaning-making rather than providing cause-and-effect explanations (Constantino 2008; Schwandt 2003). This perspective is important for this study as it aligns with the aim of exploring how individuals construct their views on emerging technologies such as delivery drones, within specific social and cultural contexts.

Constructivist research aims to understand phenomena based on participants' perceptions (Denzin and Lincoln 2003). Guba and Lincoln (1994 p.111) describe this type of research as epistemologically transactional and subjective: "The investigator and the object of investigation are assumed to be interactively linked so that the 'findings' are literally created as the investigation proceeds." This interaction is essential for studies where participants' interpretations of new phenomena are actively shaped during the research process. For example, this study uses focus groups with a board game to facilitate participants' exploration of delivery drones. This interaction helped reveal how knowledge is constructed, negotiated and reshaped in real times, reflecting the core constructivist idea that knowledge is a dynamic, socially influenced process.

According to the constructivist viewpoint, data in human sciences are generated rather than collected, as they emerge from researcher-participant interactions (Mason 1998 in Aasgaard, 2005). Methods such as transcribing sessions, conducting open-ended interviews, and using narrative response questionnaires allow for reconstructing meanings ascribed by participants and researchers. In this study, the board game facilitated diverse perspectives, enabling participants to reflect on and reshape their views collaboratively. Similarly, the analysis of online news media headlines illuminated how limited or fragmented information shaped public understanding of drones, further justifying the constructivist approach.

By applying a constructivist lens, this research uncovered not only participants' perspectives but also the processes of knowledge construction. It provided insights into how emerging technologies are interpreted and how these interpretations evolve within social

contexts. This approach was critical for addressing the study's focus on understanding participants' socially and contextually influenced views of delivery drones.

## 6.3 Research Approach

Qualitative research methods are useful to 'explore the meanings of social phenomena as experienced by individuals in their natural context' and focus on people's social world and allow exploration of events experienced by individuals (Khanke et al. 2015 p.636). It enables a thorough comprehension of phenomena, experiences, and context by answering 'how' and 'why' questions and allows exploration of the complexity of everyday human experience within 'participants' natural environments (Wu and Volker 2009). These questions are particularly relevant to this study as they help uncover how participants build their understanding of delivery drones, including how social and contextual factors shape their knowledge. The qualitative method adheres to the concept that reality is a social construct, and that research inherently carries subjective values (Denzin 1998). The idea that reality is socially constructed suggests that it cannot be directly quantified—instead, it is perceived by individuals and the observer (Cleland 2017). Essentially, the reality is varied and relative, understood through interpretations that are both socially constructed and subjective (Carson et al., 2001).

In the qualitative research approach, various activities occur simultaneously, such as collecting and analysing data, developing and modifying theories, and refining research questions. Each of these activities impacts the others, and when combined, they lead to a useful model for qualitative research design (Maxwell 2008). This iterative approach is essential for this study, as the evolving insights from focus group interactions and thematic analysis of headlines allow the researcher to refine the understanding of how participants formed and negotiated their views on delivery drones.

Rather than relying on statistical analysis, qualitative data aims to uncover emerging themes, concepts, insights, and understanding (Patton, 2002). Miles (1994) describes the process of qualitative data analysis as (1) data reduction, (2) data display, and (3) drawing conclusions. The researcher must immerse themselves in the data to identify meaningful patterns and themes, make notes during data collection and analysis, and use these notes to develop a coding framework. This inductive approach is critical in allowing stakeholder views to emerge organically, building theoretical insights from public involvement and challenging the deficit perspective seen in other studies.

A qualitative approach was embedded in this research through questions integrated into the game design to explore the social representations of delivery drones. These questions provided a framework for participants to reflect on and articulate their views, highlighting the importance of 'how' and 'why' questions in understanding the process of knowledge construction. For example, understanding how participants engaged with and reshaped their perspectives during the game provided valuable insights into the dynamic and interactive meaning-making process. Additionally, news media headlines were analysed thematically to explore why certain narratives influenced public perceptions and how fragmented or limited information shaped participants' understanding of drones.

This study's qualitative approach allowed for deep engagement with participant views, capturing the complexity of their thoughts, interactions, and meaning-making processes. This was crucial for understanding how participants constructed knowledge about delivery drones in a social and contextual setting, providing a rich understanding of their perspectives and the factors influencing them.

## 6.4 Conclusion

This study adopts a constructivist epistemological stance, which assumes that knowledge is socially generated through interaction, experience and dialogue rather than discovered as objective truth. This perspective aligns with SRT (Moscovici 1981), which views public understanding as emerging through shared symbolic resources, and with the knowledge co-creation framework (Nonaka 1994), which emphasises collaborative meaning-making. Together, these frameworks support an interpretive, inductive methodology that seeks to explore how people construct meaning around delivery drones in different contexts.

Guided by this framework, the research design integrated three complementary methods, i.e., an analysis of news media headlines, co-design and game-based focus groups. Each method was selected to capture a different lens on public meaning-making. The media headlines explored the landscape through which people are exposed to drones, identifying dominant representations and framing devices. The co-design process was used to iteratively develop a serious game that reflected real-world concerns and context-sensitive scenarios, aligning with constructivist principles of stakeholder involvement. The game-based focus groups then provided a situated, dialogic environment in which participants could collectively construct and negotiate meanings, priorities and concerns. These methods were unified by a

commitment to understanding how social representations of technology are formed and reshaped through social interaction.

Figure 2 provides an overview of how each method aligns with the study's theoretical and epistemological foundations and illustrates how they contribute to addressing the research questions and objectives.

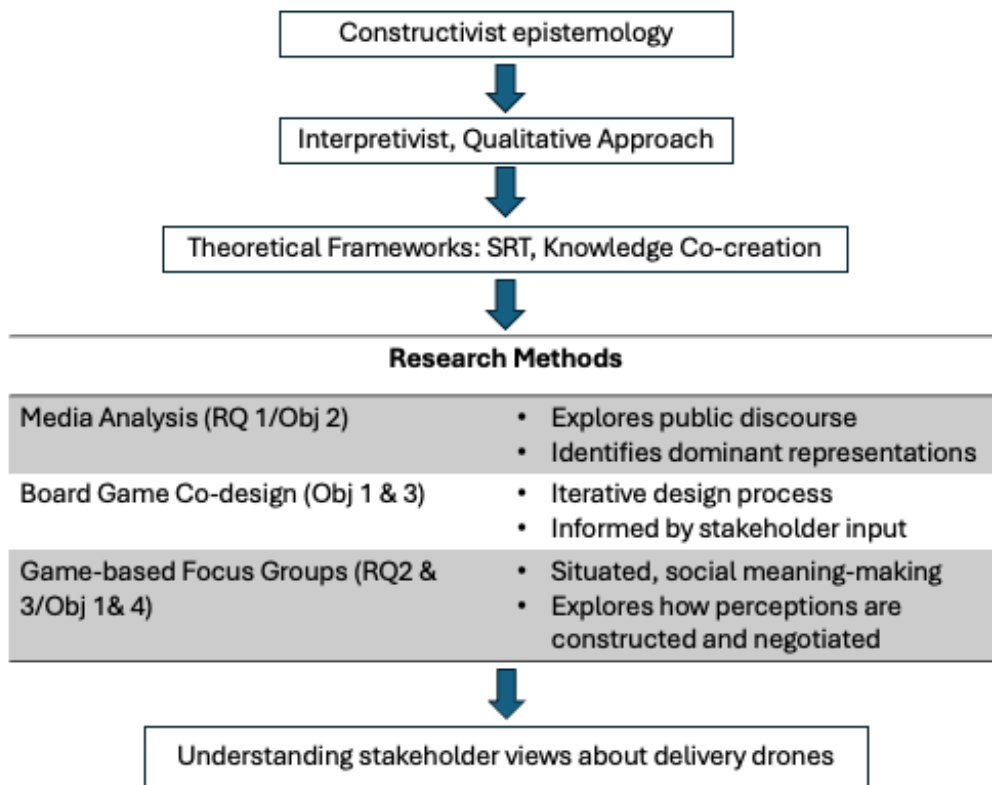


Figure 2: Integration of epistemology, theory and methods used in the study

While the overall approach of this study is interpretivist and constructivist, incorporating both inductive and deductive strategies enabled a richer understanding of how participants engaged with the game and constructed meaning. The deductive use of predefined frameworks (e.g., SECI model) did not serve to test hypotheses but to support the interpretation of knowledge co-creation in context, consistent with the study's epistemological stance.

The following sections will provide an in-depth description of the methodologies used to analyse online news media headlines and design a board game to examine participant views on delivery drones.

## 7.0 News Media Headlines

### 7.1 Introduction

This chapter explores how drones are represented in online news media, focusing on narratives and framing that shape public understanding of this emerging technology. It begins by outlining the methodological approach used to analyse media headlines, including the rationale for selecting specific sources, the criteria for inclusion, and the use of reflexive thematic analysis. The chapter then presents key themes identified in the media dataset, illustrating how drones are positioned within broader social and political discourses.

### 7.2 Methodology for News Media Headlines

This study's method is systematically structured to analyse how online news media headlines shape public perceptions of delivery drones. It aims to achieve the research objective: To analyse online news media headlines to understand how the public forms media representations around delivery drones. Data has been gathered from three primary online news sources in the UK over a defined period, ensuring a representative sample of media coverage. A qualitative thematic analysis approach is utilised to explore themes and narratives present in a diverse selection of headlines.

#### 7.2.1 Importance of Analysing News Media

Mass media serve as the primary source of knowledge for the public (Van Dijk 1998) and encompass various platforms for mass communication, including radio, television, newspapers, books, and the Internet. The media plays a vital role in influencing the public's interpretation of scientific progress (Donk et al. 2012; Ho et al. 2013; Michael 1998), shaping perceptions and evaluating emerging technologies, especially those that involve risk (Fischhoff 2013; Yang et al. 2014; Priest 1995). The way the media reports and discusses events and issues directly shapes public perception and thought (Fields 2006).

The media's role in shaping perceptions regarding significant political and social issues has long been debated (Wilson and Wilson 2001). Cohen (1963, p.13) states that 'the press may not be successful much of the time in telling people what to think, but it is stunningly

successful in telling its readers what to think about.' This illustrates the concept of agenda-setting, where the media decides the relevance of events or social issues for the public and focuses on these topics (Ivanova and Jocelin-Almendras 2021). Agenda-setting operates on the premise that the public's understanding of facts and their importance is shaped by media decisions (Ivanova and Jocelin-Almendras 2021), and it influences public opinions and attitudes toward specific issues (Ivanova and Jocelin-Almendras 2021). Historians have documented a typical pattern in the new technology lifecycle that starts with idealistic advocacy to a later phase of potential disappointment and coexistence with other technologies (Harvard 2020). A key feature of the initial phase of this cycle is enthusiastic media coverage of the new technology (Harvard 2020).

This enthusiasm in the media often interacts with public emotions and perceptions about emerging technologies (Cui and Wu 2019). Research demonstrates that the public's perception of the risks and benefits associated with new technologies can significantly affect their support for these innovations (Connor and Siegrist 2010). While TV and cinema might sensationalise or exaggerate the impact of emerging technologies, often portraying them as potential threats, professional journalism may aim to present them accurately and objectively (Kirby 2008). However, the public is frequently exposed to a wide array of information, which can lead to information overload, complicating how people feel and respond to these technologies (Cui & Wu 2019).

Media actors such as journalists, bloggers and commentators come from diverse social, academic or political backgrounds and construct realities based on their perspectives (Santos et al., 2022). Similarly, the public shapes reality based on cultural values (such as shared beliefs) and contextual events (Santos et al. 2022). This selective process limits the "knowledge" available to the public, ultimately shaping their understanding of the social world (Pissarra Esteves 2016). Metzger (2009) argues that despite the proliferation of the internet, traditional newspapers and their online versions continue to be the primary sources of information for many people.

However, the media's depiction of scientific research can frequently sensationalise findings or misrepresent nuanced conclusions, resulting in public scepticism or misunderstanding (Brown 2012). Hubbart (2023) emphasises the importance of balanced messaging in the media's representation of science, warning that sensationalism can distort public understanding and hinder informed decision-making. This issue is especially prevalent



in health-related reporting, where exaggerated claims about scientific discoveries can provoke public panic or foster misplaced trust in certain technologies (Dempster et al., 2022).

### 7.2.2 Rationale for Analysing Online News Media

Online news refers to a collection of information published across various digital platforms, including social media, and available on the World Wide Web, making it easily accessible to the public. In recent years, traditional print newspapers have experienced a decline, while online news outlets have become the primary source of information (Newman et al. 2023). People's online news consumption has changed dramatically, driven by technological advancements and the evolving media landscape. With the widespread use of smartphones and the rise of social media, individuals now increasingly access news through apps and social media feeds rather than traditional print media or television (Grote et al., 2023). However, this democratisation of information brings challenges, such as the spread of misinformation and difficulties in verifying sources.

The portrayal of specific topics, like drones, in online news reflects broader societal attitudes and concerns. Studies show how drone usage is framed in news articles and can significantly influence public perceptions of their legitimacy and ethical implications (Sheets et al. 2015; Pope 2016). In the UK, media coverage often highlights the benefits of drones in areas such as disaster response and environmental monitoring while also addressing concerns related to privacy and surveillance (Wang 2020). This dual approach highlights the need for critical engagement with news content, as individuals must navigate complex narratives that shape their understanding of technological advancements.

Trust in media sources plays a crucial role in online news consumption. Research shows that individuals who view news organisations as credible are more likely to engage with their content and trust the information presented (Duncan & Culver 2020). On the other hand, scepticism toward mainstream media can drive people to alternative sources, which may lack adherence to journalistic standards. This trend highlights the importance of media literacy initiatives that help individuals critically assess the news they consume and distinguish reliable information from misinformation (Bulger & Davison 2018). Table 4 illustrates trust scores of the three news sources used for this study.

Table 4: Brand trust scores (adapted from Newman et al. 2023, p.59)

| Brand | Trust | Neither | Don't Trust |
|-------|-------|---------|-------------|
|-------|-------|---------|-------------|

|                     |     |     |     |
|---------------------|-----|-----|-----|
| <b>BBC News</b>     | 61% | 17% | 21% |
| <b>Daily Mail</b>   | 25% | 24% | 51% |
| <b>The Guardian</b> | 51% | 27% | 22% |

By 2020, over two-thirds of people in Great Britain were downloading or reading news, newspapers, or magazines, over three times the number of online readers from 2007 (Figure 3). An Ofcom study (Ofcom 2023) found that television and the internet were more commonly used as news sources in all UK countries than traditional newspapers.

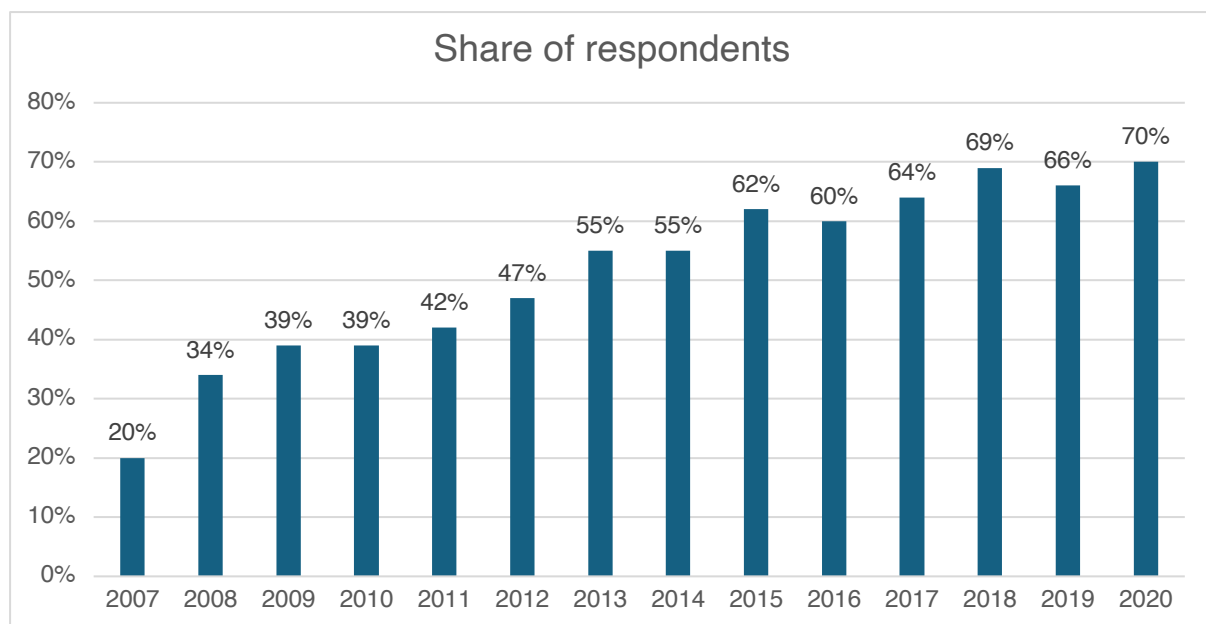


Figure 3: Share of individuals reading or downloading online news, newspapers or magazines in Great Britain from 2007 to 2020 (adapted from Ofcom 2023)

The data presented in Figure 3 illustrates a significant and consistent increase in online news and publication consumption over 13 years. The figure reflects the broader trend of the digital shift in media consumption and a shift towards online news consumption in the UK. The continuous growth in online news readership highlights the importance of digital platforms and the ongoing decline of traditional media.

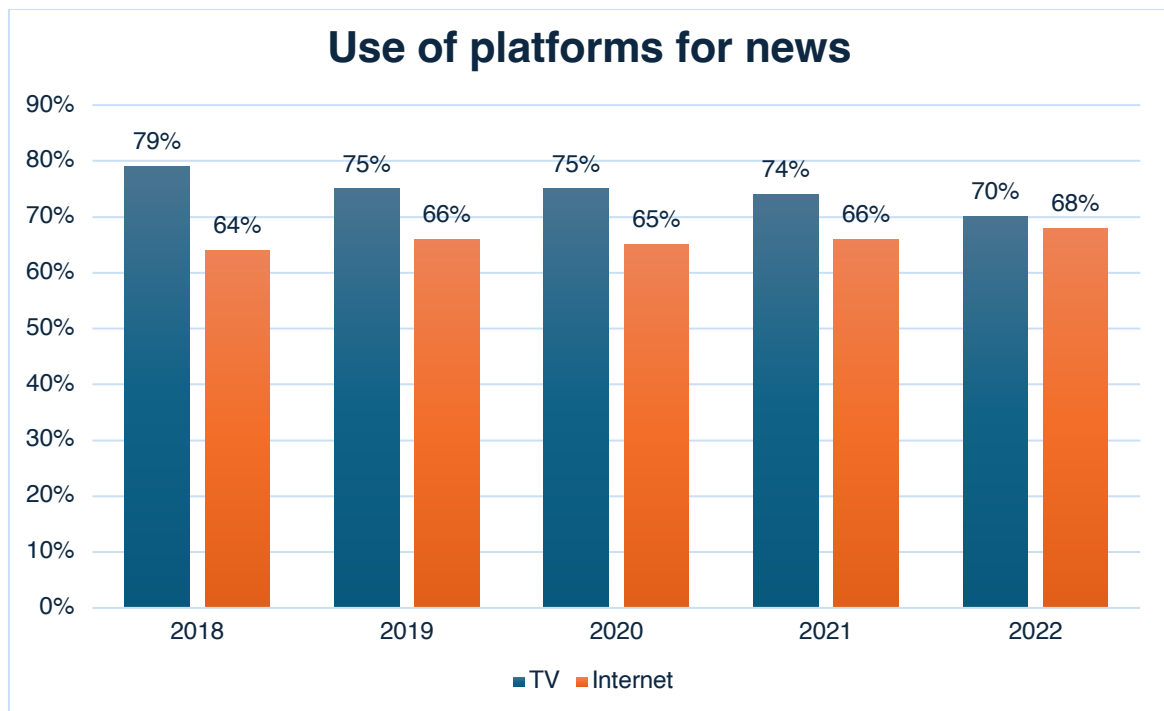


Figure 4: Use of TV and Internet for news in the UK (adapted from Ofcom 2023)

According to Figure 4, broadcast TV remains the leading platform, reaching 70% of UK adults. However, this marks a decline from 2022, coinciding with a 2% increase in internet news access from 2021 to 2022 (Ofcom 2023). Online news sources are the second most utilised, accessed by over two-thirds (68%) of UK adults. Despite fluctuations in the data, the prevailing trend highlights a steady decline in TV usage alongside a gradual rise in internet news consumption. This shift suggests a growing preference for online news, indicating a future where digital platforms may overtake traditional TV as the primary information source.

Media consumption habits vary significantly by age. Figure 5 shows the use of platforms by age, demonstrating that younger adults access their news online (83%) compared to the older generation, which accesses news using TV.

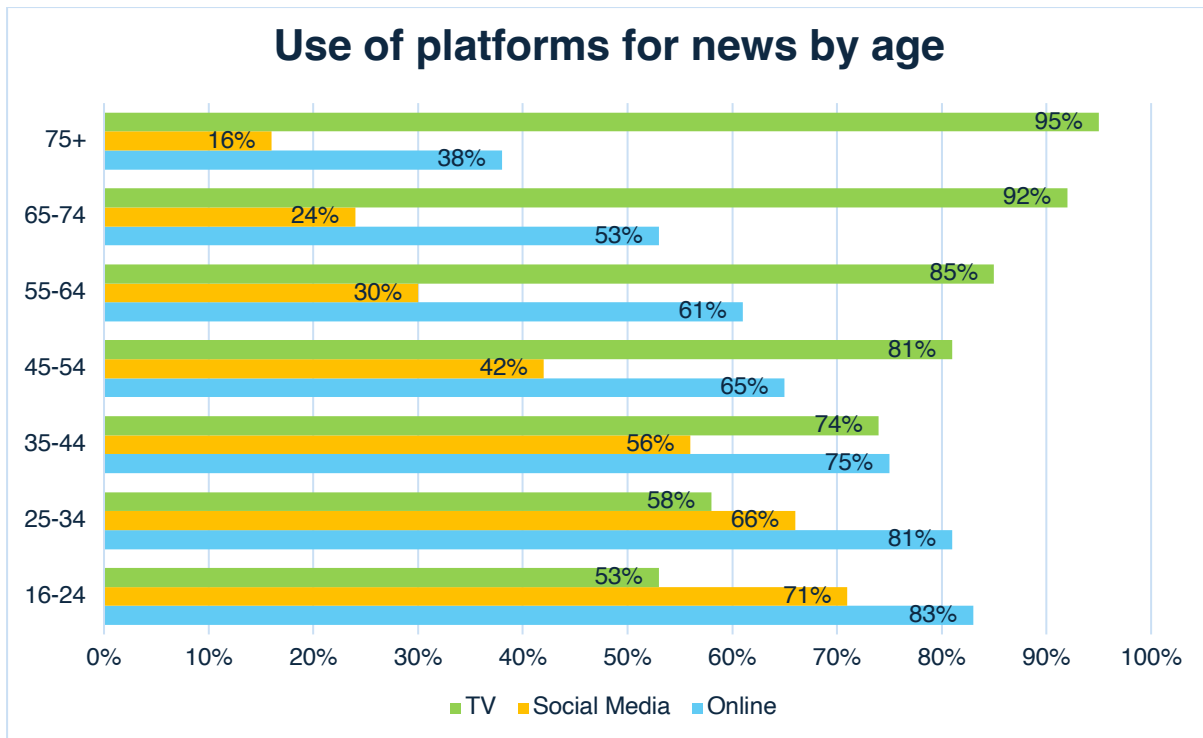


Figure 5: Use of platforms for news by age (adapted from Ofcom 2023)

The oldest age groups (65-74 and 75+) prefer TV as their primary news source, and social media plays a vital role among the youngest age group (16-24). In the middle age groups (35-54), there is a more balanced use of TV, online and social media platforms for news. This suggests an ongoing shift in the media landscape, where digital platforms are becoming increasingly central to news consumption.

It is useful to assume that media influences public perceptions, and little research has been done to examine the relationship between media and public perceptions of drones in logistics and their emerging social representations. Moscovici (1970) highlighted the influence of social representations in shaping the knowledge systems that guide our interpretation and response to events. Social representations construct the knowledge systems the public relies on to interpret and react to events (Moscovici 1970), making the unfamiliar familiar and enabling communication based on a 'shared code.'

This research has analysed the role of media, specifically online news media headlines, for the following reasons:

- 1- To understand how the media shapes narratives on (non-military) drones to reveal how meaning is created and shared in society.

- 2- Analysing the representation of drones in news media would provide insight into the (emotional) anchoring points.
- 3- To relate the results to findings from the board game focus groups to examine how media influences stakeholder opinions

Media consumption habits are rapidly evolving with a clear shift from traditional platforms like TV and print to digital platforms, particularly among the younger generation. This shift highlights the importance of understanding how online news impacts public discourse. By relating the media analysis to stakeholder views in the board game, the study aims to provide deeper insight into the relationship between media representation and public perception of drones, pointing to the significance of media influence in shaping technological discourse.

In addition to providing insight into public narratives, the media analysis also informs the design of the later stages of the research. The headline themes shape the structure and content of the board game and the prompts used in focus groups, ensuring alignment between dominant public framings and the deliberative tools used. In this way, the media analysis offers both conceptual grounding and methodological direction within the broader study.

### 7.2.3 Importance of Headlines

Headlines are of particular interest for this research for several reasons. They offer valuable insights into the social and cultural representations circulating within a society at a given time (Taiwo 2007). Many readers tend to skim headlines rather than read entire articles, making headlines highly effective in reaching a broad audience. Journalists employ various techniques, such as narrative mechanisms and sensational or provocative language, to capture readers' attention (Blom and Hansen 2015). Due to their strong linguistic features like puns and emotive vocabulary or other rhetorical devices, headlines are often memorable and impactful (Devolette and Rechniewski 2001). Studies have shown that many readers focus primarily on headlines, frequently skipping the full article and acting as 'cognitive shortcuts' (Ivanova and Almendras 2019).

One of the key advantages of analysing headlines is their ability to encapsulate and disseminate knowledge within society while creating and associating new meanings. Headlines derive much of their power from shared cultural, political, and general knowledge, drawing readers in with intriguing language and rewarding them with the intellectual

satisfaction of decoding their meaning. They reference cultural knowledge without needing explanations, depending on the reader to understand the context of the articles (Devolette and Rechniewski 2001).

Headlines, therefore, serve the following purposes:

1. Providing the reader with a summary of the news (Conboy 2007)
2. Attracting the attention of the reader by the choice of words (Conboy 2007)
3. Providing an initial indicator of the news in terms of the style and the value of the newspaper (Blom and Hansen 2015)
4. Establish the opening narrative and showcase elements that engage readers' interest in what lies ahead. (Andrew 2013; Ivanova & Almendras 2019)

Thus, headlines are pivotal in shaping how the public presents, perceives and understands news.

#### 7.2.4 Criteria for Selection

For this research, three online news sources were selected: BBC News, The Guardian, and The Daily Mail. The selection is justified because it represents a broad cross-section of the mainstream online news media in the UK.

Before 2022, BBC News Online reached 33% of UK adults, surpassing the 32% minimum target (Maher 2023). 91% of UK adults each week access BBC via television, radio, or online (National Union of Journalists 2020). Nielsen et al. (2023) report that the BBC is the most utilised news source in the UK, both online and offline, and is highly regarded for its trustworthiness. Nevertheless, individuals on the political right trust the BBC slightly less than those in the centre or on the left, though it is still seen as a significant conservative public service broadcaster (Nielsen et al. 2023). Notably, it is the only online news source in the UK that is more frequently used than search engines and social media (Nielsen et al. 2023). The tone and language of news headlines remain formal.

The Guardian is recognised as a national broadsheet (Shaw 2020) and is considered a left-wing news outlet that presents itself as 'serious and investigative.' It often critiques government policies, taking positions that are generally contrasting with most British press (Frew 2020). The headlines for The Guardian are also composed in a formal tone. It is positioned at the opposite end of the spectrum from the Daily Mail and is considered Britain's

most left-leaning newspaper, with the Mirror closely behind (Smith 2017). Furthermore, The Guardian is known for its coverage of environmental issues (Graham and Bell 2020).

The Daily Mail is right-leaning and has been considered a conservative supporting paper since 2010. The Daily Mail is classified as a mid-market tabloid targeting a lower-middle to upper-working-class readership (Toolan 2016; Shaw 2020). It frequently utilises 'hyperbolic language' to describe incidents and frames issues to emphasise danger or urgency (Jaspal et al. 2012). The Daily Mail is described as a right-wing paper (Smith 2017). Its readership comprises 54% female and 46% male, with a daily online audience of four million in the UK (Smith 2017). The average age of a reader is 56 (Smith 2017).

The headlines used in this study were gathered between 2016 and 2022 to ensure relevance to recent developments. UK online news outlets—BBC, The Guardian, and Daily Mail—were selected based on their readership numbers in 2021. Figure 6 illustrates the leading news websites in the UK in 2021 (Watson 2022).

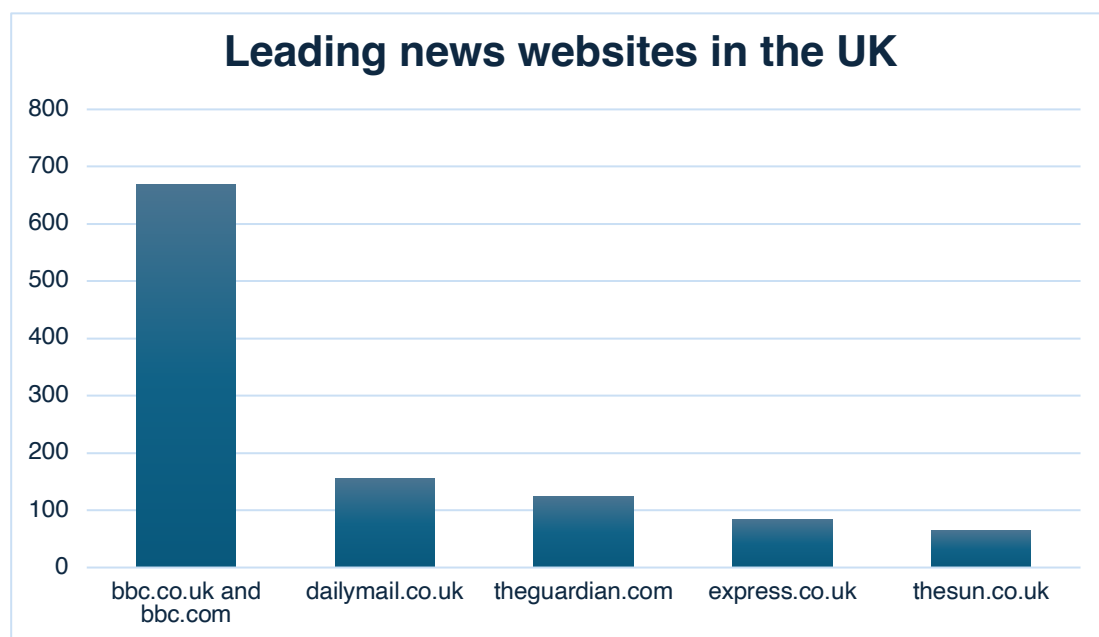


Figure 6: Leading news websites in the UK (2021) by monthly visits (adapted from Watson 2022)

In December 2021, BBC.co.uk and BBC.com had 669.1 million monthly visitors, making the BBC the most visited news site in the UK. In second place was the Daily Mail, with 155.8 million visitors, followed by The Guardian, with 125.1 million website visits. A keyword search

was conducted using the terms "non-military drones," "drones," and "UAVs." The military use case was excluded to focus on civilian applications of drones, which are still emerging and have a significant impact on civilian life, yet to be fully understood.

### 7.2.5 Data Preparation

The data for this study were compiled manually through a keyword search across search engines, specifically Google, and by directly visiting news websites. The primary focus was on identifying relevant news articles discussing civilian drones in the UK. The keyword strategy was used to filter out irrelevant news reports and to ensure a consistent dataset. The following information for each was collected upon identifying relevant news articles: the URL, the headline, a brief description of the content, and the publication date. This information was then recorded in an Excel sheet, which served as the primary database for the media analysis. The manual approach allowed for a careful selection of articles, ensuring only those relevant to the study were included in the dataset.

After compiling the initial dataset, the data was refined to improve its quality and relevance by eliminating repeated news headlines. Duplicate entries, often resulting from the same article appearing in multiple searches, were carefully identified and removed. This was important to ensure and prevent the analysis of repeated data. Throughout the data preparation process, careful attention was given to maintaining the integrity of the dataset. This was achieved by utilising a structured Excel sheet, which was designed to facilitate easy tracking and management of the data, ensuring it was ready for detailed analysis.

### 7.2.6 Analytical Framework

After data preparation, the headlines were analysed by assigning initial codes. Each headline was analysed to identify key themes or topics that were then used to assign specific codes. The preliminary coding involved categorising the headlines based on their tone and the issue they highlighted. These codes served as the foundation for a more detailed thematic analysis, facilitating the identification of recurring themes across the dataset.

After coding, the headlines were sorted into broader themes. This involved grouping the coded headlines based on similar topics or narratives, allowing key themes related to civilian drones in media coverage to emerge. The thematic sorting was essential in structuring the



data for subsequent analysis, enabling a focused examination of how civilian drones are portrayed in news media.

The final dataset was prepared for in-depth analysis, and the data was cleaned, coded, and thematically sorted. This preparation ensured that the data was organised to allow for a systematic examination of the themes and narratives present in media coverage of civilian drones. The final dataset was reasonably representative of a range of UK media and ready for further analysis to uncover the underlying messages conveyed through news headlines. The data preparation process provided a solid foundation for the subsequent stages of analysis, ensuring that the study could effectively explore the impact of media coverage on public perceptions of civilian drones.

The media headlines dataset was analysed using reflexive thematic analysis, as outlined by Braun and Clarke (2019). This approach was chosen for its flexibility and suitability within a constructivist epistemological framework where meanings are understood to be contextually and socially produced. Reflexive thematic analysis emphasises the active role of the researcher in identifying and interpreting patterns of meaning across a dataset and does not rely on pre-defined codebooks or inter-coder reliability (Braun et al. 2024). Instead, these are generated through a recursive process of interpretation, informed by both the data and the researcher's engagement with it.

The research followed Braun and Clarke's six stages of thematic analysis:

- 1- Familiarisation: The researcher immersed in the dataset by reading and re-reading the headlines to develop a deep understanding of the content and patterns
- 2- Initial coding: Codes were generated inductively at a semantic level, identifying recurring ideas and representations relevant to the research aim. Coding was conducted by the researcher without the use of a codebook
- 3- Generating initial themes: the researcher examined and grouped the codes into potential themes based on patterned meanings across the dataset
- 4- Reviewing themes: Themes were reviewed and refined to ensure they accurately captured the meanings in the data and addressed the research questions
- 5- Defining and Naming Themes: Themes were defined in terms of their key characteristics, and sub-themes were identified to capture more detailed variations within them

6- Writing up: Selected headlines were used to illustrate each theme. Themes were analysed and interpreted in relation to relevant literature and the study's broader theoretical framing.

This reflexive approach enabled a theoretically informed, context-sensitive understanding of how drones are framed in media discourse. The themes were not treated as objective findings but interpretive outputs constructed through engagement with the data, consistent with Braun and Clarke's (2024) guidelines for reflexive thematic analysis.

Eight hundred and thirty-six headlines from all three online news media sources were reviewed and analysed. Themes and sub-themes were identified in the data using thematic analysis, illustrated in Figure 7, and are discussed in detail later in this chapter (Section 7.3).

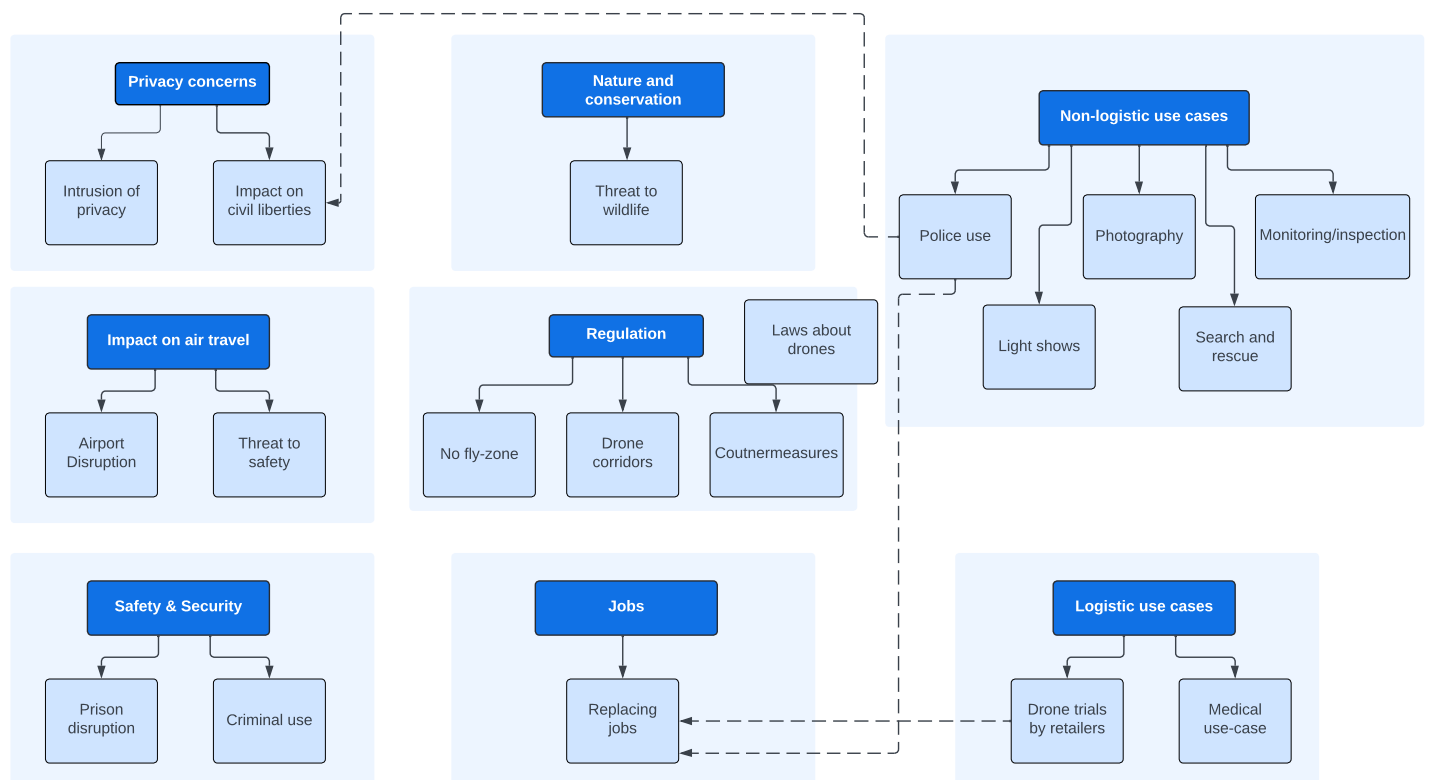


Figure 7: Themes and sub-themes for media analysis

### 7.2.7 Ethical Considerations

The data for this study were collected from publicly available news sources, and it is essential to respect the intellectual property rights of these sources. Each headline, URL and article description included in the dataset has been properly attributed to its source. This ensured that the rights of the content creators were upheld and the study adhered to the ethical use of

information. Moreover, the researcher chose the articles and headlines based on clearly defined criteria to minimise personal or ideological biases. The researcher applied the selection criteria consistently to ensure the dataset is representative of the broader media coverage of drones. Additionally, the coding process was conducted with transparency to minimise subjectivity. The study aims to provide a fair and balanced analysis by acknowledging the potential for bias.

The data in this study have been accurately represented, as headlines were recorded and presented as they appeared in their sources. During the analysis, care was taken not to misinterpret or oversimplify the content, ensuring that the findings reflect the true nature of the media coverage and ensure the credibility of the research.

This study has been conducted with a strong commitment to ethical research practices. It addresses intellectual property issues, bias, and accuracy to ensure its contribution to the field is both responsible and credible.

#### 7.2.8 Limitations

The researcher manually collected this study's data through keyword searches on search engines and direct visits to news websites. Although this method was thorough, there is a potential for selection bias, as the researcher's judgment influenced the choice of articles. Although efforts were made to minimise it, the researcher cannot entirely avoid the subjectivity in manual data collection. Furthermore, the manual approach may have led to the omission of relevant articles due to the limitations of search engine algorithms or the specific use of the keywords. Additionally, search engine results can vary depending on factors such as location, search history, and algorithm updates, which could impact the consistency and replicability of the data collection process.

Assigning codes to headlines, central to thematic analysis, is subjective. Since a single researcher conducted this study's coding, there was no opportunity to assess inter-coder reliability, a standard method for ensuring consistency in qualitative research. While the coding framework was carefully developed and applied, the potential for subjective interpretation is a limitation of this study.

The data was drawn from a limited number of online news sources within the UK. While these sources were chosen to provide a sample of a range of media coverage, the limited scope may affect the generalisability of the findings. Moreover, the data collection was limited

to a specific timeframe, which may not capture long-term shifts in drone media coverage. The selected timeframe may only provide a snapshot of coverage, limiting the ability to generalise the findings to different periods. Therefore, the study's conclusions are most relevant to a specific period.

These limitations highlight the challenges and constraints encountered during the research process.

### 7.2.9 Positioning Media Analysis within the Study

As part of a multi-method study, the media analysis serves as a foundational stage that informs both the design and implementation of subsequent methods. By identifying dominant representations, omissions and framings of drones in news discourse, the analysis influences the development of the serious game, particularly about scenario content, thematic focus and the prompts. This ensures that the game reflects issues present in public discourse.

In addition to informing the design of the research tools, the media analysis also provides important contextual grounding for participant discussions. Since participants' understandings are likely shaped by media exposure, the analysis helps situate their views within broader symbolic and discursive patterns. This contextual layer enhances the interpretation of participant responses during the game-based focus groups, allowing the research to explore not only what participants think, but also how those views may be influenced by prevailing narratives and representations in the media.

The media analysis, therefore, contributes both conceptually (for interpreting participant responses) and methodologically (grounding the design of the board game) in line with the study's interpretivist and constructivist stance.

## 7.3 Media Representations of Drones

This section presents the findings and analysis of online news media headlines. Its focus is on the research objective of analysing headlines to understand the media representations of delivery drones. It begins by summarising the key themes identified in the data analysis and then explores the media representations and emotional anchoring of headlines.

### 7.3.1 Overview of Themes

Eight hundred fifty-three headlines were analysed and sorted into eight themes. Table 6 compares the media coverage of drone-related themes across three UK news outlets: the

BBC, The Guardian, and the Daily Mail. This theme breakdown demonstrates each outlet's focus on different aspects of drone use, with the Daily Mail covering significantly more overall and especially on air travel impacts, safety/security, and regulation.

Table 5: Summary of themes

| <b>Themes</b>                    | <b>BBC (n=148)</b> | <b>The Guardian (n=92)</b> | <b>Daily Mail (n=613)</b> |
|----------------------------------|--------------------|----------------------------|---------------------------|
| <b>Privacy Concerns</b>          | <b>0</b>           | <b>4</b>                   | <b>13</b>                 |
| -Intrusion of privacy            | -                  | 2                          | 10                        |
| - Impact on civil liberties      | -                  | 2                          | 3                         |
| <b>Regulation</b>                | <b>30</b>          | <b>12</b>                  | <b>108</b>                |
| -No fly zone                     | 3                  | 1                          | 9                         |
| -Drone corridors                 | 2                  | -                          | 18                        |
| -Countermeasures                 | 17                 | 3                          | 39                        |
| -Laws about drones               | 8                  | 8                          | 42                        |
| <b>Impact on air travel</b>      | <b>15</b>          | <b>28</b>                  | <b>248</b>                |
| <b>Nature and conservation</b>   | <b>6</b>           | <b>4</b>                   | <b>8</b>                  |
| <b>Safety and Security</b>       | <b>9</b>           | <b>12</b>                  | <b>48</b>                 |
| -Prison disruptions              | 4                  | 4                          | 31                        |
| -Threat to public safety         | 5                  | 8                          | 17                        |
| <b>Jobs</b>                      | <b>1</b>           | <b>2</b>                   | <b>9</b>                  |
| <b>Use cases (non-logistics)</b> | <b>54</b>          | <b>13</b>                  | <b>71</b>                 |
| <b>Use cases (logistics)</b>     | <b>33</b>          | <b>17</b>                  | <b>108</b>                |
| -Medical use-case                | 16                 | 5                          | 41                        |
| -Trials by retailers             | 17                 | 12                         | 67                        |

### 7.3.2 Privacy Concerns

The headlines included privacy issues such as the criminal use of drone cameras and the legal use of cameras that could potentially impact civil liberties.

The Daily Mail reported on privacy intrusion by using language which amplified a sense of panic and danger, for example:

*"EXCLUSIVE: Britain's drone hot spots revealed as UK police forces investigate almost 900 complaints from the public including claims that paedophiles are using the devices to spy on young children."* Daily Mail, 14 May 2016.

The headline highlights an extreme case such as paedophilia to emphasise privacy violations caused by drones, emotionally anchoring the discussion around issues of child exploitation. Associating drones with paedophiles elicits a strong emotional response that connects drones to threats against children's safety, leveraging the availability heuristic (Kahneman 2011), which leads people to form judgements based on prominent, emotionally impactful examples. Furthermore, this characterisation reflects the wider dystopian narrative surrounding surveillance technologies (Lyon 2007), depicting drones as intrusive instruments that endanger personal and societal privacy. This framing not only shapes public perceptions of drones as threatening but also influences the discourse on their regulation, grounding it in emotionally charged, specific circumstances (Reese et al. 2001).

Another headline from the Daily Mail sparks fears of personal privacy intrusion, for example:

*"Mother's horror as she spots camera DRONE peering in through her bedroom window at 2 a.m."* Daily Mail, 24 July 2021.

The headline employs a dramatic narrative highlighting the problem: Drones can be invasive. The notion of being surveilled in a personal space, such as a bedroom, triggers feelings of vulnerability and fear. These portrayals align with risk communication frameworks (Adam et al. 2000), presenting technology as a threat to individual safety. The term 'horror' further intensifies the perception of drones invading personal environments, engaging the audience through emotional framing (Reese et al. 2001) that depicts drones as intruders, challenging conventional ideas of personal boundaries and security.

Headlines from The Guardian also highlighted public fears about surveillance for example:

*"Drone complaints soar as concerns grow over snooping."* **The Guardian, 3 April 2017.**

In comparison to the Daily Mail headline above, this headline is more muted and doesn't play on particular triggers. The headline reflects a growing concern about privacy intrusion related to drones, suggesting that the surge in complaints is indicative of a rising anxiety related to drones. Emotions in this headline are anchored in the fear of constant monitoring and being watched without consent.

Another headline from The Guardian groups drones with technologies such as DNA testing and data collection to relate to intrusion issues of drones:

*"Drones, DNA and data: please don't give the gift of privacy invasion." **The Guardian, 14 December 2018.***

The headline highlights technologies infringing on personal rights, and there is a sense of losing control and the growing influence of surveillance technologies. A headline from The Guardian highlighted civil liberty concerns, focusing on law enforcement's use of drones using cameras for example:

*"Civil liberty fears as police consider using drones that film from 1,500ft." **The Guardian, 29 October 2021.***

The specific mention of filming from a high altitude (1,500ft) highlights the risk of mass surveillance occurring without public knowledge. This raises concerns about authoritarian governance and the infringement of civil liberties, stirring fears of a 'Big Brother' state. Emotional anchoring is rooted in the constant fear of being watched, especially in places where surveillance may go unnoticed, echoing Foucault's concept of the panopticon (Foucault 1977), wherein the very chance of being observed influences behaviours and creates a sense of vulnerability.

The Daily Mail during the COVID-19 pandemic highlighted the use of drones by councils to monitor the public:

*"Now COUNCILS use talking DRONES to spy on people 'ignoring coronavirus isolation advice' - and order them back inside with loudspeakers." **Daily Mail, 27 March 2020.***

The headline evokes a dystopian narrative by focusing on the use of drones for surveillance of the public and non-compliance with government restrictions. The headline uses an alarmist tone and emotionally charged language to evoke fear and concern.

Analysing media headlines reveals that privacy issues related to drones are often presented in ways that heighten public fear and anxiety. For instance, The Daily Mail uses alarmist language and emotional storytelling to emphasise the threatening aspects of drones, associating them with extreme situations like paedophilia or government surveillance. In contrast, The Guardian takes a more measured stance, addressing broader issues concerning civil liberties and societal consequences. This contrast highlights the impact of media framing on public attitudes towards drones, portraying them as either dystopian tools of intrusion or as representations of the conflict between technological progress and individual privacy. Based on emotional anchoring and fear tactics, these narratives significantly shape public discourse and regulatory considerations, highlighting the need for balanced reporting to address the complex interplay between innovation and ethical boundaries.

### 7.3.3 Regulation

Three sub-themes emerged within the theme of regulations: no-fly zones, drone corridors, and countermeasures against drones. 150 headlines focused on drone regulations, and the laws around drone use in the UK. They called for a response to drone technology's challenges, threats, and opportunities.

*"What is the 'drone code'? Rules on flying drones safely and legally" **BBC, 26 July 2016***

The headline highlights a standardized rulebook governing the legal and safe use of drones in the UK. Its purpose is to educate both drone operators and the general public about the legal landscape of drone usage, stressing the importance of responsible operation. This approach reflects the agenda-setting theory (McCombs & Shaw, 1972), which suggests that media shapes public awareness and understanding of issues by highlighting their significance. Furthermore, framing the rulebook as a step towards safer and more regulated drone operations aligns with risk communication research (Adam et al. 2000), which underlines the importance of effective communication regarding regulatory measures to alleviate public concerns.

*"New law set to restrict drone use near airports" **BBC, 21 November 2017***

*"UK drone users face safety tests and flight restrictions." **BBC, 30 May 2018***



These headlines suggest a growing concern about drones in certain environments, such as airports, and indicate an upcoming law requiring safety around restricted areas.

Headlines also focused on the call for change in regulation after specific incidents such as disruption at airports for example:

*"Government vows to tighten rules on drones after Heathrow incident" **The Guardian, 18 April 2016***

*"How Gatwick disruption will renew calls for anti-drone systems at UK airports" **Daily Mail, 20 December 2018***

The headlines suggest a legal response to an airport drone incident and regulatory actions to prevent incidents, anchoring emotions into concern, caution, change (the need to tighten regulation around airports), and alarm (references to airport disruptions).

Headlines discussing drone corridors emerged as a prevalent subtheme, proposing the establishment of a vast drone corridor. For instance, on July 18, 2022, BBC stated, "UK set to have the world's biggest automated drone superhighway." The term 'superhighway' conjures images of significant infrastructure similar to that of road networks, implying a large-scale system for drones to function efficiently. This perspective aligns with conceptual metaphor theory (Lakoff & Johnson 2008), which utilizes familiar language to aid the public in understanding new and complex technologies. Moreover, referring to it as the 'world's biggest' also emphasises the project's scale and positions the UK as a global leader in drone technology. It is important to note that this has not yet been developed and remains a work in progress.

Another headline stated, *"Game of drones: Now airborne parcel delivery gets its air corridor as new traffic system set up for flying postal service."* **Daily Mail, 18 September 2020.** Similarly, this headline also discusses the creation of a new corridor designed for drone parcel deliveries, suggesting that drone corridors have moved from the experimental stage to becoming regular for logistics systems. The use of the phrase 'new traffic system set up' also suggests that drones would be managed carefully and safely, reassuring sceptics who might see drones as hazards in the skies. Another headline in the BBC suggests a *"Commercial drone sky highway 'could open this year'"* **BBC, 24 September 2020.** The use of 'could' suggests uncertainties but leaves room for speculation on whether it will happen as planned.

13 headlines informing the public about restricted or no-fly zones were also present in the data. *"Britain's no drone zones: Interactive map reveals the exclusion areas at airports in the wake of Heathrow and Gatwick chaos"* **Daily Mail, 21 February 2020**, *"Government restricts drone flying near Port of Dover"* **BBC, 12 November 2019** and *"No-fly zone for drones near airports to be extended next month"* **Daily Mail, 20 February 2019** highlighting the role of the government in regulating drone activities in sensitive areas such as ports and airports. These headlines are framed around government actions designed to mitigate the risk posed by drones with the emotional anchoring largely focused on response to past incidents.

Another subtheme in the headlines was the urgency to introduce countermeasures to drones, deploying them to safeguard critical infrastructure or public spaces. Headlines such as *All UK airports must buy anti-drone technology, says Defence Secretary* and *Airport staff could shoot down drones with net-firing BAZOOKAS under new laws to prevent a repeat of the Gatwick chaos* **Daily Mail, 08 January 2019** encapsulate concerns and countermeasures implemented by authorities after incidents at airports. Training of eagles to intercept drones as seen in the headline *"Eagles are being trained to grab drones from the sky"* **BBC, 01 February 2016** suggests a novel approach to tackle drones. A call for no-fly zones and drone detection systems highlights the ongoing technical and legislative evolution related to drones.

The call for urgency to develop countermeasures to address rising security concerns of drones was prominent in headlines for example, *"We are woefully unprepared to counter people flying drones with malicious intent"* **The Guardian, 23-December 2018** and *"Police chiefs could use 'death rays' to shut down flying drones."* **Daily Mail, 25 April 2016**. Headlines highlight the role of technology development in tackling drones and the need for detection systems as a solution to introduce countermeasures. Examples of headlines are *"Drone users warned detection systems can now be deployed nationwide"* **Daily Mail, 24 December 2018** and *"After Gatwick chaos, UK minister says detection systems can combat drones."* **Daily Mail, 24 December 2018**. These headlines collectively make the reader aware of the UK's regulatory approach to adopting drone technology to safeguard public safety and security.

These headlines illustrate a complex environment influenced by public concerns and notable advancements in drone infrastructure, including drone corridors. The topics of no-fly zones, drone corridors, and measures against drones highlight the conflict between the rapid evolution of drone technology and the regulatory frameworks necessary to manage its risks. This aligns with the risk society perspective (Beck 1992), emphasising how contemporary societies confront the uncertainties of technological advancements. While the headlines

suggest a transformation in logistics, they also resonate with the social amplification of risk theory (Kasperson & Kasperson 1996), heightening public anxiety by stressing the need for laws and restrictions to address potential hazards. By presenting these changes as essential precautions, the media aims to reassure the public while simultaneously portraying drones as potential threats that warrant careful regulation. At the same time, the emphasis on innovations like drone corridors embodies technological imaginaries (Hajer 1995), depicting drones as symbols of progress and innovation. Overall, the media's framing highlights both the opportunities and challenges associated with drones, shaping public perceptions through a combination of caution, urgency, and optimism regarding the evolving regulatory landscape.

#### 7.3.4 Impact on Air Travel

Two hundred and ninety-one news reports focused on disturbances caused by drones at airports, including main UK airports like Heathrow and Gatwick. The majority of these were reported by the Daily Mail (n=248). Some of the reports relate to government enforcement of drone regulation at airports. Reports also mention airports taking precautions, such as using anti-drone technology to tackle rogue drone use.

*"Stansted Airport: Drone came within 6ft of Boeing 737, report says." **BBC, 03 December 2021***

*"British Airways flight from Stockholm came within 50ft of smashing into a DRONE 8,000ft over London as it landed at Heathrow, report reveals." **Daily Mail, 20 June 2022***

*"EasyJet plane carrying 186 passengers came within 3 FEET of smashing into an illegal drone at 320mph just after leaving Manchester airport in 'UK's closest near-miss' between an airliner and an unmanned craft." **Daily Mail, 16 November 2020***

*"How dangerous are drones to aircraft?" **The Guardian, 20 December 2018***

*"Drone 'reduced safety' of passenger plane near Southend." **BBC, 24 March 2019***

The news highlights the dangers of drones near airports, emphasising the disruptions and consequences they can cause, such as grounding flights and close encounters. This supports research showing that media coverage often heightens public anxiety by focusing on dramatic and emotional stories related to new technologies (McHughen, 2007). Headlines commonly feature multiple close encounters between drones and commercial planes, suggesting these events represent larger safety concerns. This perspective aligns with findings by Lee et al.

(2005), which indicate that emotionally charged reactions, like fear from vivid reporting, can overshadow a clear understanding of the technology's real risks. Sun and Zhang (2024) also argue that sensationalised reporting on technological dangers fosters widespread public anxiety.

There is also mention of the frequency of drone-related incidents with reports of two near misses every week and over 400 incidents in the last five years, emphasizing the consistent threat drones pose to aviation using terms like 'catastrophic' to emphasise the threat, for example:

*"Pilots report TWO drone near-misses every week with more than 400 incidents in the last five years, investigation finds."* **Daily Mail, 04 January 2020**

*"Pilots can't spot drones 70 per cent of the time - and almost never if the craft isn't moving - shock experiment reveals."* **Daily Mail, 30 October 2019**

*"The engine might explode': Drone comes within 50 feet of a passenger plane over Manchester with experts warning that a collision could have been catastrophic."* **Daily Mail, 01 February 2016**

There is an overarching theme of the risk drones pose to aviation across these headlines, and their emotional anchoring focuses on fear and alarm by highlighting the number of near misses, pilots' inability to spot drones, and the potential of catastrophe in case of a collision.

The news reports on drone disturbances at airports consistently emphasize the risks and disruptions caused by rogue drone activity, particularly near major UK airports. The headlines focus on dramatic incidents and the potential for catastrophe, amplifying public fears and highlighting the urgency of regulatory and technological measures. This framing reinforces a narrative of drones as significant threats to aviation safety, shaping public perception and supporting calls for stricter control and enforcement.

### 7.3.5 Nature & Conservation

Headlines explored the relationship between drones and wildlife and the potential implications of drone disturbance for example:

*"They're territorial': can birds and drones coexist?"* **The Guardian, 30 September 2021**

*“British waterbirds are spooked by DRONES: Flying machines disturb large flocks and scare geese, swans and ducks away from winter feeding grounds, conservationists warn.”* **Daily Mail, 1 September 2020**

*“Stop drones spoiling our wilderness.”* **The Guardian, 24 July 2017**

*“Fears over protected wildlife disturbed by drones and Drones making seals 'agitated' by going too close.”* **BBC, 31 August 2018**

These headlines spark concern among readers and create alarm regarding the effects of drones on nature and wildlife, using terms like ‘spooked,’ ‘fear,’ and ‘distressing.’ They advocate for protecting nature and highlight drones’ possible dangers to wildlife. This emotive language mirrors patterns noted by Absattar et al. (2022), where emotional framing in media narratives is employed to trigger public concern and push for protective actions. These headlines raise ethical questions about the potential disruption to wilderness caused by drone usage. Drones have been prohibited in locations such as parks in London due to their adverse effects on wildlife (Peyer 2015).

Some positive news stories about environmental conservation include:

*“Drones are helping to clear up Britain's beaches: Scientists recruit members of the public to spot plastic litter in aerial footage of our shores.”* **Daily Mail, 09 March 2018**

The headline emotionally anchors on collective responsibility by highlighting drones as tools for environmental conservation and community action, fostering a sense of hope and progress.

These headlines highlight drones’ dual narrative as a possible danger to wildlife and a resource for environmental protection. They influence public opinion with emotive language that stirs concern, ethical reflection, and optimism.

### 7.3.6 Safety & Security Issues

This theme encapsulates headlines related to drones causing prison disruptions and the potential threat to public safety.

The most reported news on prison disruption caused by drones involves the use of drones to deliver drugs and phones into prisons, for example:

*“Drones seized over HMP Pentonville carrying drugs and phones.”* **BBC, 22 Aug 2016**

*"Gang who flew drones carrying drugs into prisons jailed."* **BBC, 26 Oct 2018**

*"Seven jailed over plot to fly drugs into UK prisons with drones."* **The Guardian, 26 October 2018**

According to these headlines, drones have been used for criminal purposes, such as dropping small packages containing contraband and phones into UK prisons. While these headlines emphasise the concern related to criminal activity, they also balance it by noting that law enforcement has intercepted these attempts and jailed the criminals.

There was a total of 31 reports by the Daily Mail on drug and phone smuggling and causing a disturbance in prisons.

*"Prisoners are using drones to smuggle drugs and phones into jail with more than 30 caught by the authorities last year."* **Daily Mail, 23 Feb 2016**

*"Drones are caught flying drugs or mobile phones into jail every five days: Specialist squad has seized 120 devices since the start of 2016 and convicted 17 people."* **Daily Mail, 21 Nov 2017**

*"Moment a drone delivers drugs into prison as brazen gang who airlifted £500,000 of class A's into seven jails are sentenced to more than 37 years behind bars."* **Daily Mail 26 Oct 2018**

The Daily Mail emphasised the regularity of these incidents by using expressions like "every five days" and "more than 30 apprehended by authorities," thereby creating a narrative that depicts a persistent and complex issue of drone-related criminal activities in prisons. This framing heightens public perceptions of urgency and fear. Fadhillah (2024) points out that the media's portrayal of criminal cases can intensify public worry, cultivating an increased sense of insecurity and encouraging public support for tougher measures. Additionally, Foreman et al. (2016) show that emotionally charged headlines, such as those highlighting frequency and severity—can influence public attitudes and views on criminal behaviour, ultimately fostering support for regulatory and technological responses. This emotional connection, combining alarm with relief at the disruption of some operations, raises awareness and provides a sense of control through proactive measures.

Furthermore, specific prisons are mentioned in the headlines such as HMP Pentonville and Liverpool indicating that the issue is not confined to one prison but is an issue in other prison facilities in the UK:

*"Drones carrying a haul of drugs and mobile phones are discovered by police after officers spotted a man trying to fly the stash into HMP Pentonville."* **Daily Mail, 22 Aug 16**

*"Jail targeted in drug drone blitz: Devices carrying contraband drugs, mobile phones and SIM cards crash lands in Liverpool prison."* **Daily Mail, 11 Dec 16**

Other safety and security issues with drones were also highlighted in the headlines for example:

*"We are woefully unprepared to counter people flying drones with malicious intent."* **The Guardian, 23 December 2018**

*"Police ground drones after reports they fall out of the sky."* **BBC, 30 October 2018**

*"Sky battles: Fighting back against rogue drones."* **BBC, 12 October 2018**

*"Could Amazon drones turn hostile? Experts warn UAVs may be hijacked by terrorists and hackers."* **Daily Mail, 01 August 2016**

The headlines emphasise the growing concerns about drones, particularly their misuse, technical failures, and potential cyber-attacks. They capture a sense of urgency and vulnerability, suggesting that the current systems cannot handle the risks posed by malicious actors or technical failures.

The headlines demonstrate that drones are used for smuggling contraband, including drugs and phones, into prisons. Additionally, broader security issues, like drone hijacking or technical failures, expose weaknesses in existing drone management systems. Such narratives significantly influence public perceptions of drones, as media framing highlights risks and heightens emotional responses such as fear and urgency. Nguyen and Hekman (2022) argue that how news frames technological risks impacts how the audience views and reacts to emerging technologies, often focusing on their potential for misuse and danger. Roslyng and Eskjær (2017, p.115) further illustrate that risk-centric reporting fosters a "mediatised risk culture," where media portrayals shape public sentiments about technology as controversial and necessitating regulation. These headlines, alternating between alarm and

concern, emphasize the need for proactive measures, like anti-drone technology, while also stressing the importance of clear regulations to build public trust.

### 7.3.7 Impact on Jobs

Headlines focused on the rise in automation through the use of drones and robots, highlighting the trend in replacing human labour across sectors such as farming, waste collection and warehousing:

*"How drones are replacing people in sewer surveys."* **BBC, 28 September 2022**

*"Intelligent robots threaten millions of jobs."* **Daily Mail, 14 February 2016**

*"Could drone-guided robots replace refuse collectors?"* **The Guardian, 29 February 2016**

*"The future of farming? Driverless tractors and drones grow barley without human help in a world-first."* **Daily Mail, 11 May 2017**

*"Rise of the Amazon ROBOTS: How 1,000 tiny drones that can scan orders and lift 1,500lbs are replacing humans in a warehouse the size of 28 football pitches."* **Daily Mail, 12 January 2019**

These headlines evoke a range of emotions, from enthusiasm for technological innovation to anxiety over job losses, illustrating the complexities of technological advancement. The media significantly influences public perceptions by presenting automation as both an opportunity for progress and a risk to economic stability. Ocal and Crowston (2024) explore how media's emotional narratives, particularly fears of job displacement, intensify societal worries, especially when automation is depicted as a substitute for human work. Furthermore, Willcocks (2020, p.287) points out that alarmist stories, like the "robo-apocalypse," heighten public fear by portraying automation as an unavoidable disruptor.

A headline from the Daily Mail focused on the failure of Amazon's drone delivery project in the UK and the resulting loss of jobs:

*"Amazon's desolate drone site: Aerial shots reveal UK test centre that would herald new age of airborne deliveries... but now looks abandoned after 100 staff lost jobs or were moved off 'dysfunctional' project."* **Daily Mail, 06 August 2021**



Media portrayals depict Amazon's drone delivery as a failure, despite its initial promise as a future delivery method. Coverage often evokes disappointment, especially for affected workers. Nguyen and Hekman (2022) emphasise how media narratives around automation shift from optimism to critique when unmet expectations impact public views on technology. Otmakhova et al. (2024) note that mass media framing influences audience interpretations of technology, often highlighting failures to address systemic issues. Chang (2009) highlights how failure narratives in media amplify public scepticism and diminish trust in technological promises amidst significant hype. Together, these narratives reveal media's crucial role in shifting public sentiment from hope to disillusionment with innovative tech projects.

In summary, these headlines reflect the dual nature of technological progress, balancing hopeful innovation with anxieties about economic upheaval. Media narratives significantly shape public perceptions, often transitioning from initial excitement to doubt when technological promises, such as Amazon's drone delivery, do not meet expectations. This framing highlights the media's impact in amplifying societal concerns about job losses.

### 7.3.8 Non-Logistics Use Cases

The headlines collectively depict the versatility of drones in the UK, from agriculture and law enforcement to search and rescue. They illustrate the trials and exploration of new drone applications, demonstrating the evolving capabilities of drone technology within the UK. A total of 138 headlines reflecting on the different uses of drones were analysed.

*"Robocrop: Growing barley with robots and drones." **BBC, 04 May 2017***

*"Crop-counting drone tech tested on Cambridgeshire orchard." **BBC, 19 October 2021***

The use of drones in monitoring crops reflects the potential of drone technology to enhance efficiency in farming practices. Headlines also report on the application of drone technology in other contexts that involve remote work leading to capability enhancements such as engineering, and surveying as illustrated in the headlines:

*"Drones will take to the skies to detect and repair small potholes by scanning roads for cracks and filling them with 3D-printed asphalt." **Daily Mail, 21 January 2019***

*"COULD AUTONOMOUS DRONES AND ROBOTS REPAIR BRITAIN'S ROADS?"  
**Daily Mail, 11 June 2018***

*"Drones used to survey Milton Keynes sewage system." **BBC, 24 February 2017***

These headlines expand on the roles of drones and autonomous technology in infrastructure maintenance. They anchor emotions in optimism about the future of technology and curiosity about its potential.

Other applications of drones such as search and rescue, environmental conservation such as littering, and photography include headlines such as:

*“Dangled drone sausage saves runaway dog lost on mudflats.” **BBC, 20 January 2022***

*“Flying to the rescue: Scottish mountain teams are turning to drones.” **The Guardian, 08 January 2022***

*“Fire service starts using drones as rescues go hi-tech: Brigades using equipment to put out blazes and find missing people.” **Daily Mail, 28 September 2016***

These headlines highlight the importance of drones in rescue operations, from saving a dog to playing essential roles such as firefighting and mountain rescue. The headlines create a sense of reassurance in the reader as the integration of drones in search and rescue makes responses efficient. Readers are left with a feeling of optimism about how drone technology is increasingly used to save lives.

Airborne photography in the field of photography, offers a unique visual perspective. Drones used for photography and fireworks are mentioned in the headlines:

*“Eye in the sky: Stunning photographs and videos taken by drone showcase the very best of Britain from 400ft up in the air.” **Daily Mail, 17 January 2017***

*“Norfolk by night: Drone captures spectacular festive colour.” **BBC, 20 January 2021***

*“Birmingham 2022: Drones light show mark one year to go.” **BBC, 28 July 2021***

*“Could drones replace fireworks in the UK?” **BBC, 26 February 2018***

The headlines are emotionally anchored in excitement as drones offer a new way to experience entertainment and sustainable alternatives to fireworks. Headlines illustrate the use of drones in law enforcement and security and their usefulness by the police:

*“Drones 'transforming policing' in Lincolnshire.” **BBC, 14 December 2022***

*“Police to send out drones to catch burglars: Quarter of forces plan to introduce devices as alternative to helicopters, dogs and officers in high-risk operations.” **Daily Mail, 05 January 2016***

*“Police drone finds girl, 16, who called 999 to report rape.” **The Guardian, 06 October 2018***

These headlines highlight the increasing role of drones in law enforcement, showcasing how police forces are integrating drones into their operations to enhance efficiency, safety, and effectiveness. Drones are positioned as transformative tools in policing, helping with everything from crime prevention to locating victims and catching suspects in ways that are faster and more cost-effective than traditional methods like helicopters and police dogs. The emotional anchoring revolves around reassurance for public safety, optimism about the future of policing, and empathy for the human lives that drones are helping to protect and rescue. Boyd et al. (2013) illustrate how media framing often highlights the innovative potential of such technologies, creating optimism about their societal benefits, particularly in critical scenarios like rescue missions. As drones become more integrated into police forces, they are reshaping how law enforcement operates, offering both technological advancements and practical benefits for society.

The data highlights drones' diverse use cases, demonstrating their transformative impact across various sectors. In these headlines, drones are portrayed as versatile tools revolutionizing policing, enhancing public safety and surveillance, and offering innovative solutions to societal challenges.

### 7.3.9 Logistics Use Cases

This section covers the news media headlines reporting on logistics use cases of drones.

#### (a) Medical Deliveries

A total of 62 headlines highlighting the medical use case were positively portrayed by all three news media sources including ‘Drones for good’- used by the NHS for transportation of medical supplies, the use of drones in response to COVID-19 for public space monitoring and guidance, and UK government investing medical drone deliveries.

The portrayal of drones focused on the possibility of medical deliveries by the NHS. For example, BBC and the Daily Mail reported:

*“Drones 'potential solution' to medicine deliveries.” **BBC, 29 January 2020***

*“Drones: Could they be used to deliver blood?” **BBC, 03 January 2020***

*“UK to trial drones to deliver medical supplies.” **Daily Mail, 24 April 2020***

These headlines indicate a shift towards the utility of drones for medical deliveries, highlighting a broader exploration of the technology to improve healthcare logistics. How drones are framed in these headlines emphasises hope and innovation, particularly regarding their potential to transform medical supply delivery. Freeman and Freeland (2016) discuss how media narratives prioritising benefits over risks are crucial in shaping public acceptance of emerging technologies, especially when these solutions meet essential needs like healthcare. Anbaroglu (2019) further explores how the media portrays drones as vital assets for humanitarian logistics, reinforcing their perceived societal significance. The specific language used in these headlines, including terms like "could," "potential solution," and "trial," evokes emotions of hope while also reflecting the early phase of this innovation, promoting cautious optimism among the public.

Furthermore, news reports also focused on the NHS and retailers such as Boots delivering prescription medicines in drone delivery trials.

*“Boots becomes first UK chemist to deliver prescription medicines by DRONE as it ships drugs to the Isle of Wight.” **Daily Mail, 27 July 2022***

*“NHS will courier chemotherapy drugs by DRONES to cancer patients as part of new trial to cut waiting times” **Daily Mail, 05 July 2022***

These trials explore the feasibility and impact of drone deliveries in real-world healthcare situations, which may determine their future applications. Headlines featuring terms like “first” and “new trial” generate excitement and an impression of advancement, nurturing the hope that drones could transform medical logistics.

During the COVID-19 pandemic, headlines introduced the concept of ‘pandemic drones’ and the UK government’s investment in drones to deliver medical supplies during that time:

*“Covid-19 antibody tests are being delivered to Scottish Islands by DRONE thanks to £1.1million funding boost from the UK Space Agency.” **Daily Mail, 10 July 2020***

*“NHS Scotland is using DRONES to carry Covid-19 samples and test kits up to 40 miles across remote parts of the country as part of £1.1 MILLION scheme.” **Daily Mail, 23 February 2021***

*“UK to invest £2.6 MILLION in drone and satellite technology to deliver vital supplies during the coronavirus pandemic and manage future infectious disease outbreaks.” **Daily Mail, 14 April 2020***

*“NHS drone takes to the skies in £28m scheme to fly life-saving medical supplies to hospitals during coronavirus lockdown.” **Daily Mail, 27-Apr-20***

*“Isle of Wight hospital to get emergency supplies via DRONE from British mainland as Transport Secretary Grant Shapps reveals an £8million trial programme has been brought forward to next week.” **Daily Mail, 24 April 2020***

Throughout the pandemic, the potential of drones to operate without human operators, enhance safety, manage diseases, and transform logistics was examined. Media coverage tied these advancements to a sense of hope, featuring uplifting headlines such as "drones saving lives" and "for the good," creating optimism regarding their effectiveness in solving logistical issues during crises. Baishya (2022) elaborates on how the media during the pandemic framed these technologies as vital components for resilience, crafting a narrative centered around progress and innovation. Additionally, research by Hildebrand and Sodero (2021) highlighted that media typically emphasizes the benefits of drones, depicting them as answers to societal problems while minimizing the technical and regulatory challenges involved.

The headlines reflect an optimistic narrative surrounding the use of drones for medical deliveries, emphasising their potential to revolutionise healthcare logistics. By framing drones as innovative tools for humanitarian and healthcare applications, the media fosters public hope and acceptance of emerging technologies. However, it should be noted that many of these headlines are uncritically reproduced press releases designed to inform stakeholders about new developments. As such, the information often comes from within the organisation itself (Catenaccio 2023), potentially presenting an overly optimistic view that emphasizes benefits while downplaying potential drawbacks (Sznajder 2016). This highlights the importance of critical media consumption to ensure a balanced understanding of the promises and challenges of emerging technologies.

## **(b) Drone Trials by Retailers**

96 headlines highlight retailers and service providers such as Amazon and Royal Mail trialling drones for deliveries.

Headlines such as *"Drones used on a remote island to deliver post"* (Daily Mail, 06 October 2021) and *"Drones carry post to a remote island in Royal Mail trial"* (Daily Mail, 06 October 2021) illustrate Royal Mail's exploration of drones to overcome geographical challenges and enhance logistics in remote areas. The narrative emphasises the potential of drones to revolutionise postal services, reflected in headlines like *"Royal Mail wants a fleet of 500 drones to carry mail to remote UK communities"* (BBC, 12 May 2022). This approach aligns with Richards (2018), who highlights that media headlines often play a crucial role in shaping public perceptions of unmanned aerial vehicles by framing them as innovative solutions. Similarly, Kellermann et al. (2023) underline how framing logistical innovations like drone delivery positively influences public attitudes by emphasising efficiency and accessibility. Additionally, Freeman and Freeland (2016) discuss how media narratives emphasising benefits, such as rapid delivery and environmental advantages, can outweigh concerns about unproven trials. These headlines demonstrate Royal Mail's strategic use of media to align public perceptions with their ambitions, despite providing limited details about the outcomes of their trials.

Amazon's efforts in achieving their first successful drone delivery are highlighted in the headline *"Amazon claims first successful Prime Air drone delivery"* (The Guardian, 14 December 2016). Such framing aligns with Duncan and Culver (2020), who discuss how media narratives of technological breakthroughs are designed to foster public optimism by highlighting progress and innovation. Conversely, headlines such as *"Amazon's drone delivery service struggles to get off the ground"* (Daily Mail, 06 August 2021) and *"Amazon's desolate drone site: Aerial shots reveal the UK test centre that would herald a new age of airborne deliveries... but now looks abandoned after 100 staff lost jobs or were moved off 'dysfunctional' project"* (Daily Mail, 06 August 2021) illustrate the challenges of scaling drone logistics. Additionally, Amazon's partnership with the UK government for drone delivery trials, as reported in *"Amazon to test drone delivery in partnership with the UK government"* (The Guardian, 26 July 2016), reflects the importance of institutional support in fostering public acceptance.

The headlines reflect a dual narrative surrounding the use of drones in logistics, highlighting both their transformative potential and the challenges of real-world

implementation. Royal Mail's media framing emphasises innovation and efficiency, portraying drones as solutions to logistical challenges in remote areas, while Amazon's coverage reveals both milestones and setbacks in scaling their drone delivery services. The positive framing of institutional partnerships and technological breakthroughs fosters optimism, aligning with efforts to build public trust. However, the challenges and limitations also emphasise the need for transparent communication about the feasibility and impact of drone logistics, underscoring the complexities of media influence on public perception

### 7.3.10 Conclusion

News media play a role in forming public perspectives, with headlines acting as the first point of interaction with a reader. This chapter has reported on analysing online news media headlines to understand how news media can influence stakeholder views about drones. Many of the public receive information from online news media, contributing to their opinions on drones.

A thematic analysis enabled the researcher to draw out media representations. It provided insights into the emotional anchoring used to represent drones within these headlines that will impact the social representation being formed by the audience. On the one hand, drones are negatively portrayed in the news with issues relating to privacy and civil liberties, impact on air travel, job losses and illegal use of drones, eliciting feelings of fear and concern amongst readers. On the other hand, drones are also represented positively when drones are used for good, such as in search and rescue missions, by police to fight crime and for other uses, such as use for photography. The medical use case is highlighted positively, and headlines anchor the readers' emotions in the hope that drones 'potential future' lies in 'saving lives.'

There are conflicting sides to the news headlines, from opposing drones to championing drones. The contradictory portrayal may reflect the uncertainty and complexities of using drones in the future and reflect the wider concerns about change among the public. To the researcher's knowledge, this is the first detailed analysis of the portrayal of civilian drones in the UK news media. The next chapter analyses the participants' deliberations about delivery drones during the game-based focus groups.

## 8.0 Designing the Game of (Delivery) Drones

### 8.1 Introduction

This section details the development process of the Game of (Delivery) Drones, emphasising the iterative design stages and refinements made based on participant and expert feedback. The development process was informed by the researcher's background in User Experience (UX) and interaction design. Drawing on prior experience in usability testing, interface optimisation and behaviourally informed design, the game was shaped to ensure intuitive play, clarity of rules and meaningful engagement. These skills supported the creation of a game that functioned as a research tool and encouraged participation and dialogue, particularly among participants unfamiliar with game-based methods.

### 8.2 Facilitating Public Views through Games

Stakeholder participatory approaches are gaining popularity in research (Parker et al. 2002, Reed 2008). These approaches provide several benefits: they improve solution quality by integrating non-scientific insights and experiences, enhance credibility and inclusivity by incorporating diverse stakeholder perspectives, and expand support for solution implementation (Van der Wal et al. 2016). Participating in a collaborative process can enrich stakeholder discussions and provide insights into decisions, actions, and outcomes within a simulated environment (Jiggins et al. 2007).

Serious games are engaging, participatory tools that stimulate public debate or activity (Rodela et al. 2019). They effectively collect real-time data on actual behaviours rather than self-reported ones (Gomes et al. 2021). This data can be gathered before, during, or after the game (Olejniczak et al. 2020). The educational benefits of serious games extend beyond mere entertainment (Susi et al. 2007) and are valuable for fostering public dialogue (Medema et al. 2020).

Serious games possess four key traits that underline their potential benefits: a universal language, the adaptability to examine uncertainties and complexities, the capacity to promote learning, and the chance to gather relevant data promptly (Olejniczak et al. 2020). These games allow players to navigate imaginative environments, fostering critical thinking as they form opinions through interaction (Gomes et al. 2021).



Games create opportunities for group discussions and enhance decision-making processes (Ampatzidou et al. 2018). A benefit of using a game that simulates an environment or technology is that when crafted and implemented with care, it can involve every participant in a complex scenario where each has a vested interest in moving forward (Bridge 2014). Furthermore, games are suitable for playful public participants in urban planning (Poplin 2012), including games focusing on the use of transport (see for examples Freese et al. 2020). From a planning perspective, serious games can provide space for experimentation, knowledge development, and an understanding of complexity while providing opportunities for players to give feedback to policymakers (Sousa et al. 2022). Board games are recognised as serious learning games, engaging participants in a face-to-face setting where they strive to meet game objectives (Cheng et al. 2020).

### 8.3 Board Game Design

Designing games is challenging; therefore, an iterative process was a helpful strategy for the design process. Macklin and Sharp (2016) identify a 4-step process for game design (Figure 8).

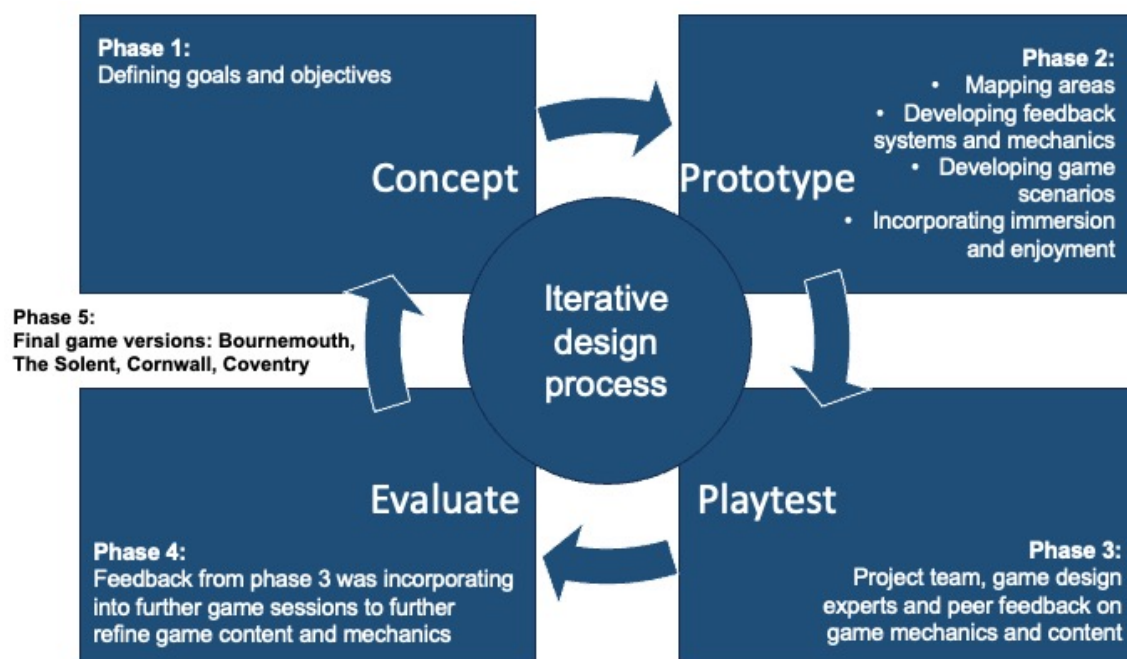


Figure 8: Iterative design process (Macklin and Sharp 2016) and description of phases of designing the board game

It involves a cycle of conceptualisation, prototyping, testing, and evaluation, in which the game designer repeats the process to improve until the final product is created (Macklin and

Sharp 2016). This model formed the basis for the game design employed in this research, and each step is described in the following sections.

### 8.3.1 Concept

The first step in conceptualisation was to understand the fundamentals of game design, which include theme, mechanics, and components (Figure 9) (Beltrami 2020).

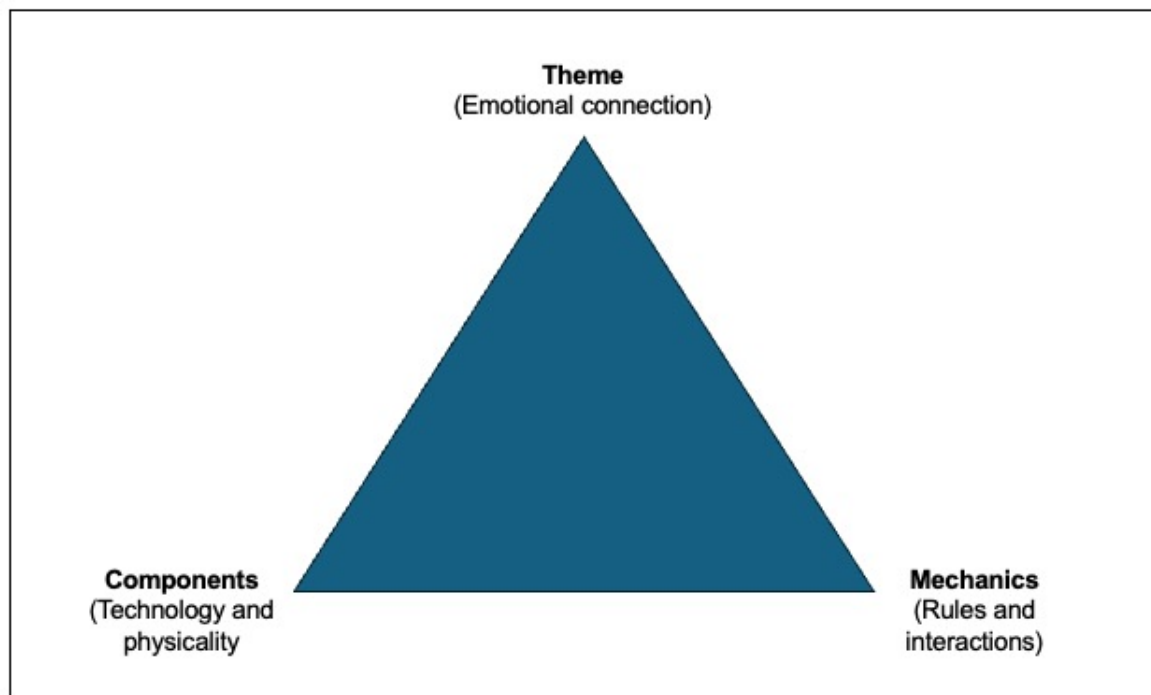


Figure 9: Fundamentals of a board game (Beltrami 2020)

The theme is how the game is understood and felt, forming an emotional connection between the player and the game. This can be achieved through storytelling, aesthetics, and how the game interacts with the player. The mechanics are the rules and interactions, along with the inner workings of the game as a system, defining goals and obstacles and the ways to overcome them. The components include the physical manifestations of the game, such as cards, dice, and the board. These factors interact with each other, impacting the player experience.

The core purpose of 'The Game of (Delivery) Drones' was to introduce delivery drones to an uninformed audience and enable them to express their opinions (or debate as a group). Setting the game objective was essential to create a meaningful experience. The game was decided to be location-based (real world) to engage the participants in a more meaningful

interaction. By incorporating real-world locations into the game, players can experience greater immersion and connect more deeply with the gameplay, resulting in a more engaging experience. Another important factor while designing was to consider the audience in terms of demographics, skills of playing, and the ability to understand and learn a new game. For this research, the audience was defined as any member of the public over 18 with little or no knowledge about delivery drones before playing.

### 8.3.2 Prototype

This section focuses on the iterations of the board game prototypes and the development phases.

#### Initial idea

The initial idea for the game took visual inspiration from games such as [Trekking the National Parks](#) (2018, Appendix 1), [Game of Life \(1960\)](#) (Appendix 2), and [Ticket to Ride \(2005\)](#) (Appendix 3). The board game components involved a board, tokens (energy, risk, and carbon emissions), money, card decks (characters, action cards, drone cards and mission cards), two dice, a stopwatch for each player and a leaderboard. A mood board (Figure 10) was created, taking examples of other board games and a prototype of the board game was developed (Figure 11).



Figure 10: Mood board



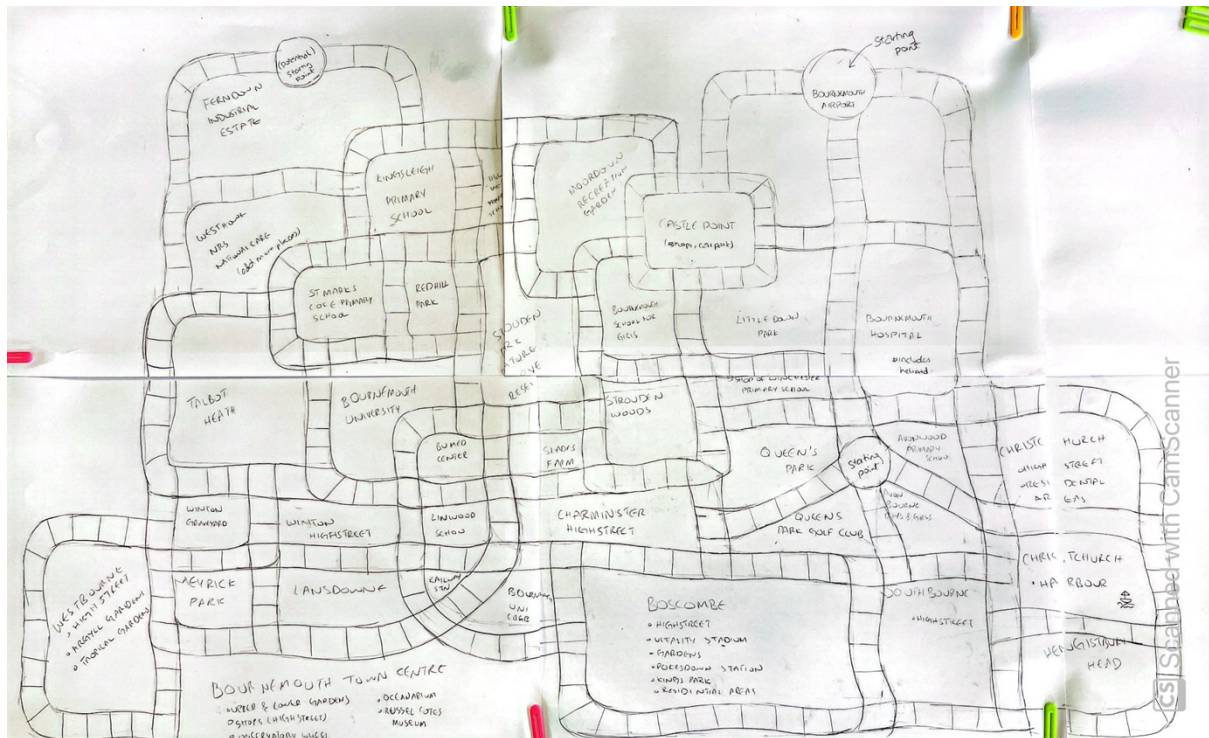


Figure 11: Board game version 1 with a predefined path

In this initial version (Figure 11), the prototype was based on a predefined path and involved players in picking a 'character card' that would define their persona (taking inspiration from games such as [Monopoly](#) and [The Summoner](#)), identify their strengths and allow players to explore multiple perspectives. Another card deck included information about the type of drone (model, battery life, payload capacity) each player would use to make a delivery, and each player would also be assigned a mission card that sets their objective. The game's objective was to make the maximum number of deliveries within the time stated on the mission card, and players could play multiple rounds using different personas to explore delivery drones. This version of the game was deemed too complicated as there were too many game mechanics, and the research team decided that the game needed to be redesigned to reach a wider audience.

## 8.4 Game Prototype One

The design for game prototype one was based on the initial idea and was developed into a complete prototype. To improve accessibility, the game was adapted to reflect the players' local environment, making energy, risk, and operational aspects more relatable and gameplay decisions more intuitive. The first step to simplifying the initial idea of the board game involved

changing the predefined map to a hexagon map (taking inspiration from games like [Civilisation](#), [Catan](#), and [Wizards](#). This choice enabled players to navigate the board freely in any direction, like a drone, and to chart their pathways. The map of Bournemouth was then adapted on a hexagon grid, and the risk was identified (Figure 12).

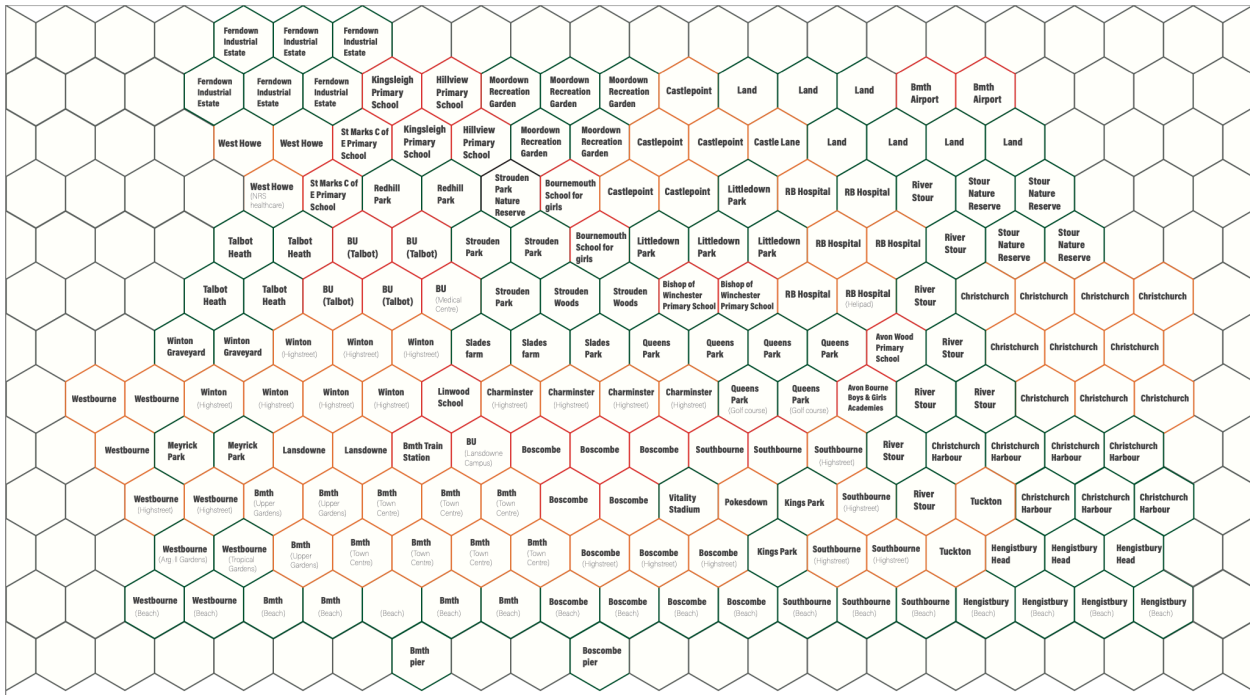


Figure 12: Game prototype 1, using hexagons instead of a predefined path

Each hexagon is red, orange, or green, indicating different risk levels. This classification is informed by a ground risk model established by Pilko et al. (2023), which assesses the likelihood of a drone malfunctioning in flight and resulting in a fatality, considering spatiotemporal population density. The board does not account for temporal changes and simplifies risk representation: red signifies high risk (linked to flying over densely populated areas), orange indicates medium risk, and green denotes low risk (related to flying over less populated regions). This framework prompts players to consider risk as they navigate the board. The goal of the game is to operate a drone delivery.

The next game design phase focused on pinpointing game mechanics (Table 7). There were 192 potential game mechanics from Board Game Geek (2022). Following several brainstorming sessions with game design experts, we selected the most uncomplicated mechanics to ensure the game was straightforward and user-friendly. These mechanics were then refined to suit the game's context and objectives, aiming to enhance gameplay

experiences, foster player interaction, and ensure accessibility for our target audience, the public (see Table 3).

Table 6: Game of (Delivery) Drones game mechanics (Nadeem et al. 2024 based on Board Game Geek 2022)

| <b>Mechanic</b>               | <b>Description</b>                                                                                    | <b>Application in the board game</b>                                                                                                                                                                                                            |
|-------------------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Action points</b>          | Each player has several points per turn to spend on actions as the player chooses.                    | Players are provided with a total of 100 energy points to complete the mission.                                                                                                                                                                 |
| <b>Board space abilities</b>  | Specific spaces on the playing field produce certain effects when a player lands their piece on them. | <ul style="list-style-type: none"> <li>- Players pick up a feedback card (Flight update) each turn.</li> <li>- Players pick up a comment card if they land on a space with a speech bubble icon.</li> </ul>                                     |
| <b>Deadline</b>               | Players must complete their goals before a set amount of turns or before a specific time passes.      | <ul style="list-style-type: none"> <li>- Players are given limited energy to complete a mission.</li> <li>- Players are provided with a limited amount of risk to complete missions. Ending on high-risk (15) will fail the mission.</li> </ul> |
| <b>Differing player goals</b> | Players are not directed to achieve one goal but are given autonomous goals.                          | Players are provided different missions to play and can decide their goals.                                                                                                                                                                     |
| <b>Individual decks</b>       | Players draw from separate decks.                                                                     | Flight update, comment cards.                                                                                                                                                                                                                   |

|                        |                                                                                                                     |                                                                                                                                                       |
|------------------------|---------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Press your luck</b> | Players can raise the stakes by taking bigger and bigger risks with large payoffs but with disastrous consequences. | Players can move via higher-risk areas, trading off risk to shorten their route and use less energy. Consequently, players complete at a higher risk. |
| <b>Race to end</b>     | Players compete to reach a certain ending point on the playing field before the other.                              | Leader board maintained for fastest delivery.<br>Mission failed/completed cards were handed out at the end.                                           |
| <b>Resource budget</b> | Players are given a finite resource and urged to spend it efficiently on game pieces or privileges.                 | Finite resources:<br>- Energy (100)<br>- Risk (15 boxes)                                                                                              |
| <b>Rewards</b>         | Instant feedback systems may be a summary of the learning activity that a player finishes or a form of feedback.    | Players gain energy depending on the feedback card.                                                                                                   |

---

Games have rules and constraints that challenge players to achieve that goal (Ferrara 2012, p.09) and reward for a sense of achievement. In this case, constraints and rewards were decided as feedback cards (Flight Update), Energy Tokens and a Risk Meter. By determining that a feedback system needed to be in place and distributed with good and bad cards (described in detail in the Flight Update Cards section below), players would not feel demotivated and uninterested while playing. Game components include Mission cards, flight update cards, energy tokens, and a risk meter.

#### 8.4.1 Risk meter and energy tokens

At the beginning of the game, players receive a risk meter and 100 energy tokens (see Figure 13). The risk meter indicates levels of risk ranging from green (0) to red (15), offering players

a clear understanding of ground risk. The meter adjusts based on the hexagon colour the player selects to move to: landing on red adds +2, moving onto orange adds +1, and landing on green results in no change. Players who reach red (15) on the risk scale will fail the mission but can still participate until the round concludes, allowing for ongoing discussion involvement.

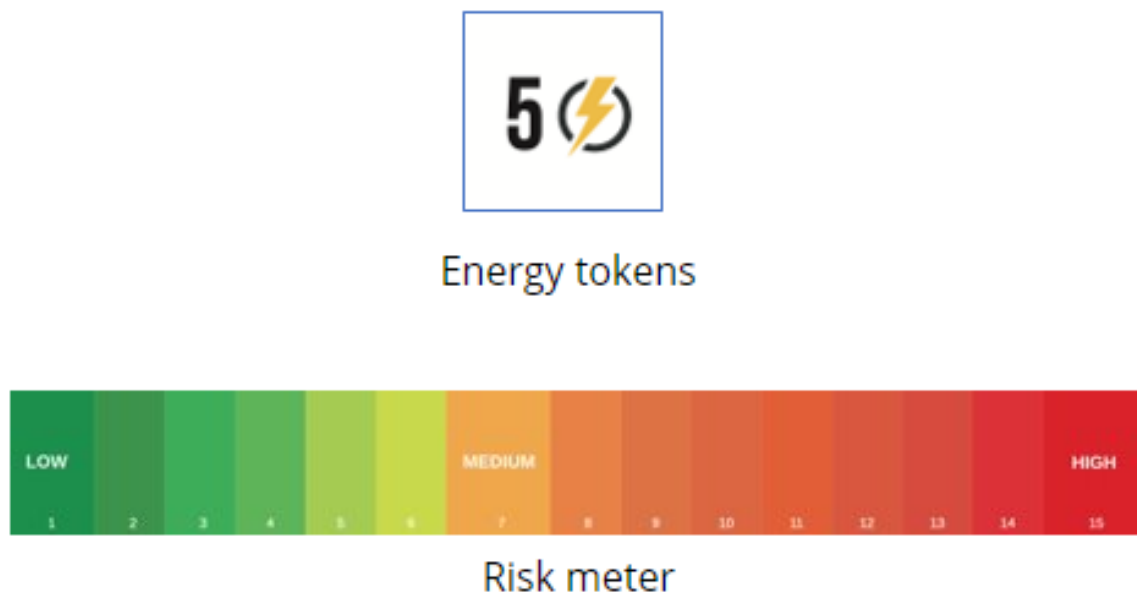


Figure 13: Energy Token and Risk Meter

Energy tokens determine how many moves players can make. Players spend five energy points each turn, losing the round if they deplete their energy. Players can acquire extra energy through flight update cards during the game. The balance between the risk meter and the number of energy tokens encourages players to carefully consider their route choices, helping them avoid excessive risk or energy depletion. Direct routes often carry a higher risk but require less energy to navigate.

#### 8.4.2 Mission cards

Mission cards set the game objective for each player or team (Figure 14). Two sets of four mission cards were designed to play two 20-minute rounds. The missions in the board game were designed to give every participant broadly the same number of moves and for each round to last 20 minutes. The game was flexible as it could be played until all participants completed their missions, and a leadership board would be maintained.



|                  |                                                                        |                                                                                                                                                                                                                                                                                         |
|------------------|------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <h1>Mission</h1> | <p>Deliver medicines from Royal Bournemouth Hospital to West Howe.</p> | <p>You are delivering a parcel to your friend. Identify the area you live in and place your counter on the take-off site and choose your friend's neighbourhood and mark it as a landing site. A minimum of 10 moves needs to be between both points and keep the risk scale to 12.</p> |
|------------------|------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Mission Card: Round 1

Mission Card: Round 2

Figure 14: Example of Mission Cards

In the first round, the missions were designed to help players understand the map and game mechanics and consider the risk and energy consumption associated with their choice of drone route. Players could then proceed to a more challenging round two, which imposed more restrictions on risk and energy.

### 8.4.3 Flight Update Cards

Flight update cards (Figure 15) are crafted to provide players with feedback on their drone flights while helping them grasp the operational parameters of drones. These cards illustrate a drone flight's negative and positive implications and revolve around specific themes such as complaints, route (good or bad), weather and local events (details of the cards are in Appendix 4 and 5). Each turn, players must pick up one flight update card that has a consequence on their next move.

|                      |                                                                                                                                            |                                                                                                                        |                                                                                                         |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| <b>FLIGHT UPDATE</b> | <b>GOOD ROUTE</b><br>Well done!<br>Gain 5 energy points and move one step.                                                                 | <b>YOU MADE THE NEWS!</b><br>Assistant dog learns to collect drone package for owner!                                  | <b>GOOD WINDS!</b><br>Looks like you have encountered good winds. Skip 1 step and gain 5 energy points. |
| <b>FLIGHT UPDATE</b> | <b>GOOD ROUTE</b><br>Move one step.                                                                                                        | <b>ENERGY EFFICIENT</b><br>Your flight has been energy efficient. Gain 10 energy points.                               | <b>SAFE ROUTE</b><br>Gain 5 energy points and move 1 step.                                              |
| <b>FLIGHT UPDATE</b> | <b>COMPLAINTS!</b><br>you have been flying too low. Lots of noise and intrusion complaints generated. Lose 5 energy points and fly higher! | <b>RECHARGE!</b><br>Your drone has been grounded due to technical fault, skip a turn while you wait for a replacement. | <b>HEAVY PAYLOAD!</b><br>Lose 5 energy points for carrying a heavy parcel.                              |
| <b>FLIGHT UPDATE</b> | <b>DISRUPTION TO LOCAL EVENT!</b><br>Bournemouth air festival stopped due to drone flying.                                                 | <b>STORMS ENCOUNTERED</b><br>Lose 5 points and skip a turn till the weather gets better.                               | <b>COMPLAINTS RECEIVED!</b><br>Intrusion complaints received. Lose 10 energy points and fly higher!     |

Figure 15: Examples of Flight Update cards

The flight update cards cause players to lose or gain energy points, advance, or skip a round. Sixty-nine flight update cards were used to prevent repetition and player boredom. These cards were arranged to maintain a suitable balance of positive (48 cards) and negative cards (21 cards), allowing players to complete their missions while fulfilling the research requirements for generating discussion.

#### 8.4.4 Comment Cards

Comment cards (Figure 16) are designed to spark discussions among players, functioning much like a question in a focus group. Speech bubble icons were placed intermittently on the board, and those landing on these must read the question to the group, who are all required to respond, allowing for more relaxed and pressure-free responses from participants, unlike in a focus group where the moderator poses questions.

|                                                                                   |                                                                                               |                                                                                                |                                                                                                    |                                                                          |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
|  | <p>Tell everyone your three main concerns about delivery drones being used in the future.</p> | <p>My recommendations on forming regulations around delivery drones would be:</p> <p>_____</p> | <p>Delivery drones should only be allowed to take off and land in places such as:</p> <p>_____</p> | <p>State what more you would like to find out about delivery drones.</p> |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|

Figure 16: Examples of comment cards

These questions are designed to engage players in the debate, providing an understanding of their knowledge and views about delivery drones. This also aimed to enhance knowledge co-creation and knowledge transfer among players. These questions prompted players to elaborate on their experiences (or lack thereof) with delivery drones, helping them reflect on the future challenges and benefits of delivery drones and understand the social representations of delivery drones in their conversations. Participants are prompted to respond so that there is discussion among them and little or no researcher input. These questions can be set in a particular order before the start of the game, depending on the participants and to meet the research needs, i.e., generating discussion relevant to the participants. A list of questions and rationale for each has been provided in Table 8.

Table 7: Rationale for the questions embedded in-game

| Rationale                                                                                                                              | Questions embedded in the game                                                                                                                                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Familiarity with delivery drones: Questions aimed as a thought provoker for participants to find out their most front-of-mind reaction | <ul style="list-style-type: none"> <li>State one word to describe your thoughts on drone deliveries</li> </ul>                                                                                                 |
| Concerns: The question allows respondents to express doubts or fears (literature: privacy, safety, jobs, etc).                         | <ul style="list-style-type: none"> <li>Tell everyone your three main concerns about delivery drones being used in the future</li> <li>The thought of seeing delivery drones flying makes me feel...</li> </ul> |
| Preferences (personal). Understanding participants' preferences towards delivery drones. These include questions prompting             | <ul style="list-style-type: none"> <li>What kind of drone deliveries do you think should be allowed?</li> <li>State what more you would like to find out about delivery drones</li> </ul>                      |

|                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                        | <ul style="list-style-type: none"> <li>• Delivery drones flying over my house makes me feel: _____</li> <li>• Drones should only deliver items like _____. State in the order of priority.</li> <li>• Delivery drones should be able to deliver food for me (Agree or disagree)</li> <li>• Do you think you would benefit from delivery drones?</li> <li>• Delivery drones should only be used for _____</li> </ul>                                                                                                                                                                                                                                          |
| Operational Parameters:<br>Understanding the respondents' understanding of how drones may fly, where they may fly and their preferences....Flyovers, times, take-off and landing sites | <ul style="list-style-type: none"> <li>• Should delivery drones be allowed to fly over national parks or areas of outstanding natural beauty?</li> <li>• Should delivery drones be allowed to fly over residential areas and schools during the day?</li> <li>• Delivery drones should only be permitted to operate within a fixed time. Discuss.</li> <li>• Drones should only fly over areas like: _____</li> <li>• I feel ____ about delivery drones flying over my house.</li> <li>• Delivery drones flying over populated areas make me feel_____.</li> <li>• Delivery drones should only be allowed to take off and land in places such as:</li> </ul> |
| Regulation: Questions to explore the respondents' opinions about the regulatory framework needed for delivery drones.                                                                  | <ul style="list-style-type: none"> <li>• My recommendations on forming regulations around delivery drones would be?</li> <li>• Drones used for emergency services should be treated differently to drones used by corporations/retailers for deliveries .(agree or disagree).</li> <li>• Regulation of drones should be the same in rural and urban areas.</li> </ul>                                                                                                                                                                                                                                                                                        |
| Potential impacts or benefits: Understand the respondents' perceived benefits                                                                                                          | <ul style="list-style-type: none"> <li>• The benefits of using delivery drones could be?</li> <li>• Do delivery drones offer benefits to society? Discuss.</li> <li>• The impact of deliver drones on the public could be?</li> <li>• Impact of delivery drones on the community would be?</li> </ul>                                                                                                                                                                                                                                                                                                                                                        |

- 
- I feel the impact of delivery drones would be: \_\_\_\_\_
  - The negative impact of delivery drones could be?
  - Do you think delivery drones would be more useful for rural communities than urban?
- 

## 8.5 Playtest and Evaluate

The third development phase involved testing prototype 1 with the project team and external experts in game design to refine the gaming experience further. The expert testing took place during a full-day session at the University of York and involved two professionals with extensive experience in interactive media and game design. Their feedback focused on improving core mechanics, adjusting player dynamics and ensuring that the rule structure supported both strategic decision making and participant engagement.

Additional feedback was gathered from the broader project team during a consortium meeting involving 14 people. This session helped surface interdisciplinary considerations, particularly relating to drone operations and real-world constraints, which informed revisions to the mission and flight update cards. For example, additional alterations were made to certain mission cards that were either too difficult or too easy to complete; more flight update cards were incorporated to enhance competition between players, and the scale of risk (initially set to only 10 boxes) was adjusted to 15 boxes, allowing players to finish their missions. These sessions also revealed the importance of simplifying rule instructions to allow for two full rounds of gameplay within the focus group timeframe.

The final testing involved gameplay with four PhD students from a range of academic disciplines to assess accessibility and timing from a non-expert perspective. This session lasted approximately 90 minutes and was conducted on campus. Feedback from this group focused on ease of understanding, intuitive design, and whether the game's length and mechanics would be appropriate for public engagement settings.

Following this, the game board was finalised with the assistance of an illustrator (Below: Figure 17)

### 8.5.1 Game of (Delivery) Drones final version: Bournemouth

The game board was finalised and is shown in Figure 17.



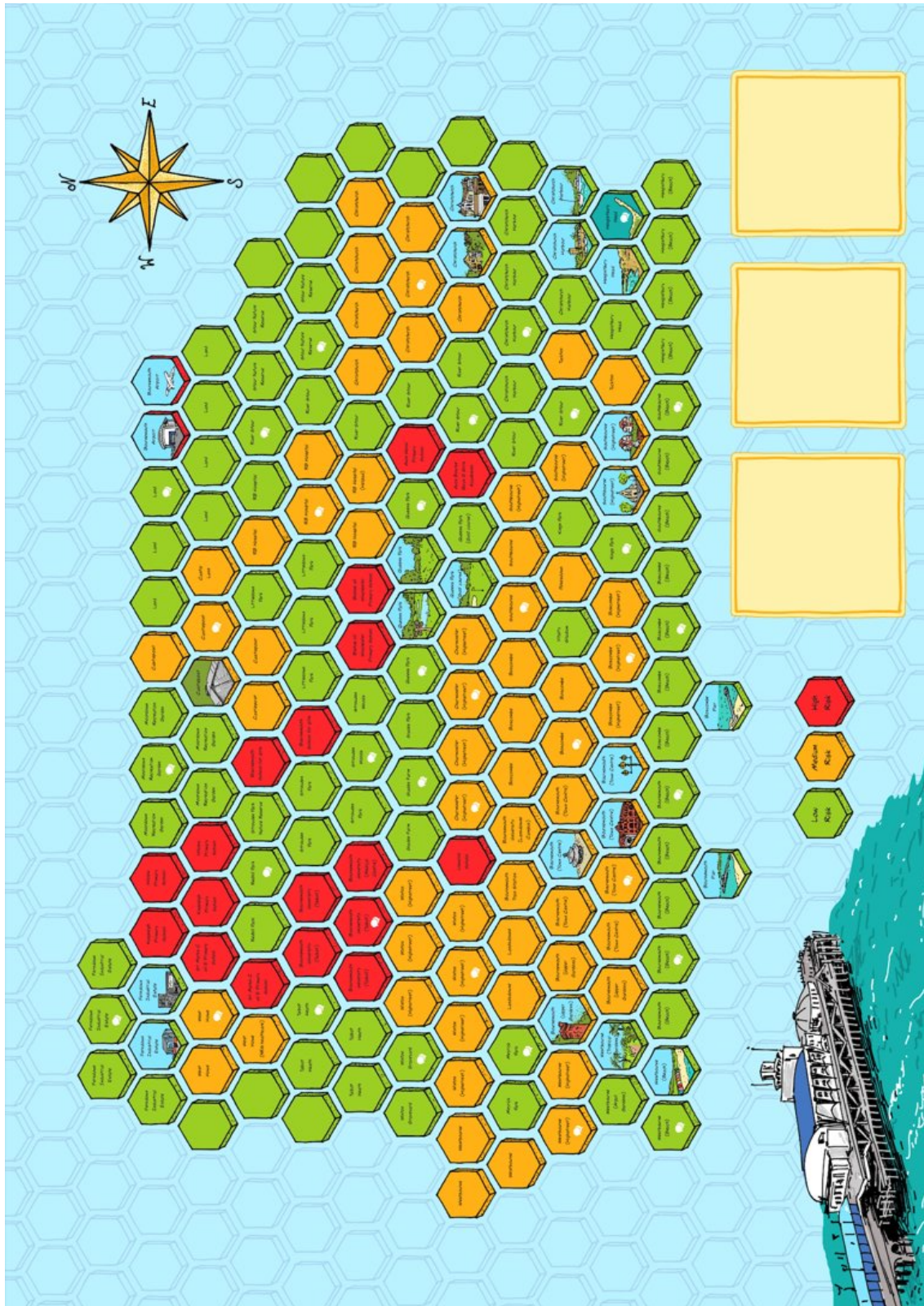


Figure 17: Game of (Delivery) Drones: Bournemouth

### 8.5.2 Adaptations of the Game of (Delivery) Drones

The game of delivery drones has been adapted to three other locations, i.e., the Solent, Cornwall, and Coventry.

### Game of (Delivery) Drones: Solent

Based on the successful application of the Bournemouth game, a new version of the board game was created for a research project ([Future Transport Zones](#)) based on the Solent area covering parts of the New Forest, Southampton, Portsmouth, and the Isle of Wight. The steps mentioned in the section above were followed, and regions were identified according to ground risk based on the population density map by the Office of National Statistics (Census 2021). While game mechanics remained the same, drone take-off and landing sites were added, restricting players from picking only the locations marked on the map. Furthermore, Flight Update cards were amended and added to make the gameplay more manageable, and some were contextualised to the area of the game.

Mission cards were contextualized to the location, and round 2 cards were changed to allow players more freedom in route plotting and delivery types, allowing more understanding of rationales and reasonings. Additional comment cards were added for stakeholder sessions (based on Q-sort research, which is part of the wider E-Drone project conducted by the University of Leeds), as the Solent version was used. These questions are described along with their rationale in Table 9.

Table 8: Rationale for Q-sort questions embedded in-game

| Question                                                                                                                        | Rationale                                                                                                                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| What are your views on asking the public to decide if delivery drones are desirable?                                            | What sits behind this? Perceived lack of knowledge?<br>Lack of clear forum for doing this? Why do this for drones rather than other things? Aren't trials the same thing? What does define legitimacy?                            |
| A national strategy for managing growth in deliveries is needed before the case for delivery drones can be considered. Discuss. | What is the role of national government in managing the rise of home deliveries? Should there be a national freight strategy? Should drones only be considered within that context? Why are drones different to vans?             |
| It was widely accepted that drones pose an additional terrorism risk. What approaches should be adopted to deal with this?      | Every group accepted this was an issue. Do some groups think this is a reason to stop development and others not? Who understands those risks?<br>Whose job is it to manage them? Do they exist with and without delivery drones? |

|                                                                                                                                               |                                                                                                                                                                                                                                                                                                                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Do you think we need to understand whether drone flights will impact some groups negatively before we proceed with their deployment? Discuss. | Are the arguments that we have not historically done this so why treat drones differently (i.e. why bother/don't stand in way of progress)? Which groups (e.g. blind or elderly or neurodiverse conditions impacted by noise). Or are there arguments that we need to limit operations so this is not an issue. |
| What, if anything, should local authorities be allowed to limit in terms of drone deliveries?                                                 | To what extent do groups see it as the legitimate role of the locally elected body to determine time of day, landing, routing etc.. rules (as they do for goods vehicles to some degree). Why/Why not? Is it that they should have a role but don't have the skills or that they shouldn't have a role?         |
| Do you think the adverse impacts on wildlife and domestic pets is enough to stop drones for deliveries?                                       | To what extent are known issues of intrusion recognised. Does the human response matter more than the animal response? Do people know or just think this is an issue?                                                                                                                                           |

Game instructions remained the same as the Bournemouth version. Figure 18 shows the final version of the board game map for the Solent



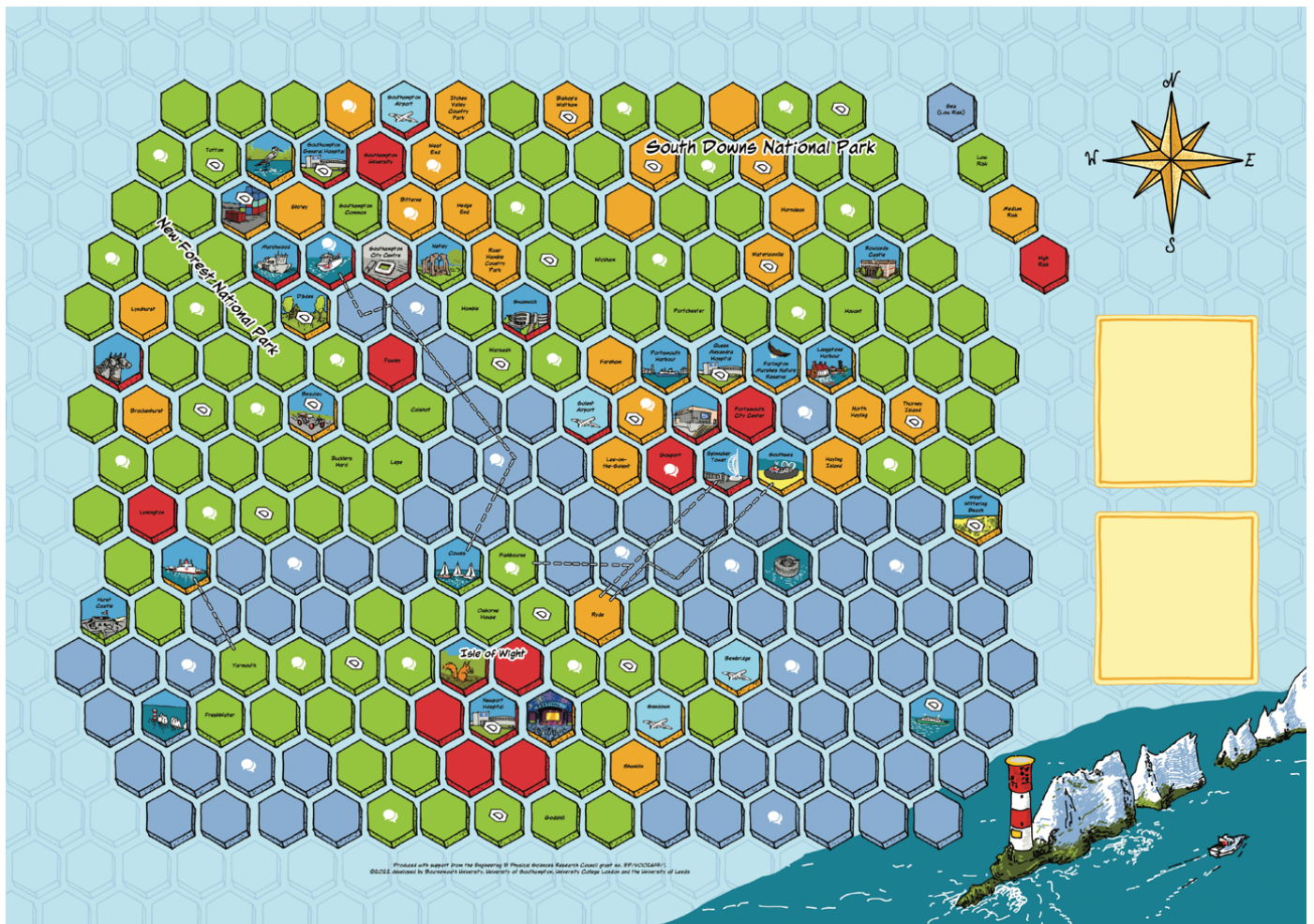


Figure 18: Game of (Delivery) Drones: Solent

The Bournemouth edition of the board game was later modified to match the mechanics of the Solent version.

### Game of (Delivery) Drones: Cornwall

The board game was adapted to Cornwall (Figure 19) for use in a second project, the Future Flight in Place Project (Chapter 1.1), following the same steps as the Solent version, and the game rules stayed unchanged. Slight additions to flight update cards were also made for local adaptation, such as the *Tall Ships Festival*, which was stopped due to drones flying. Skip the next turn.' Similarly, mission cards were also adapted to reflect local places.

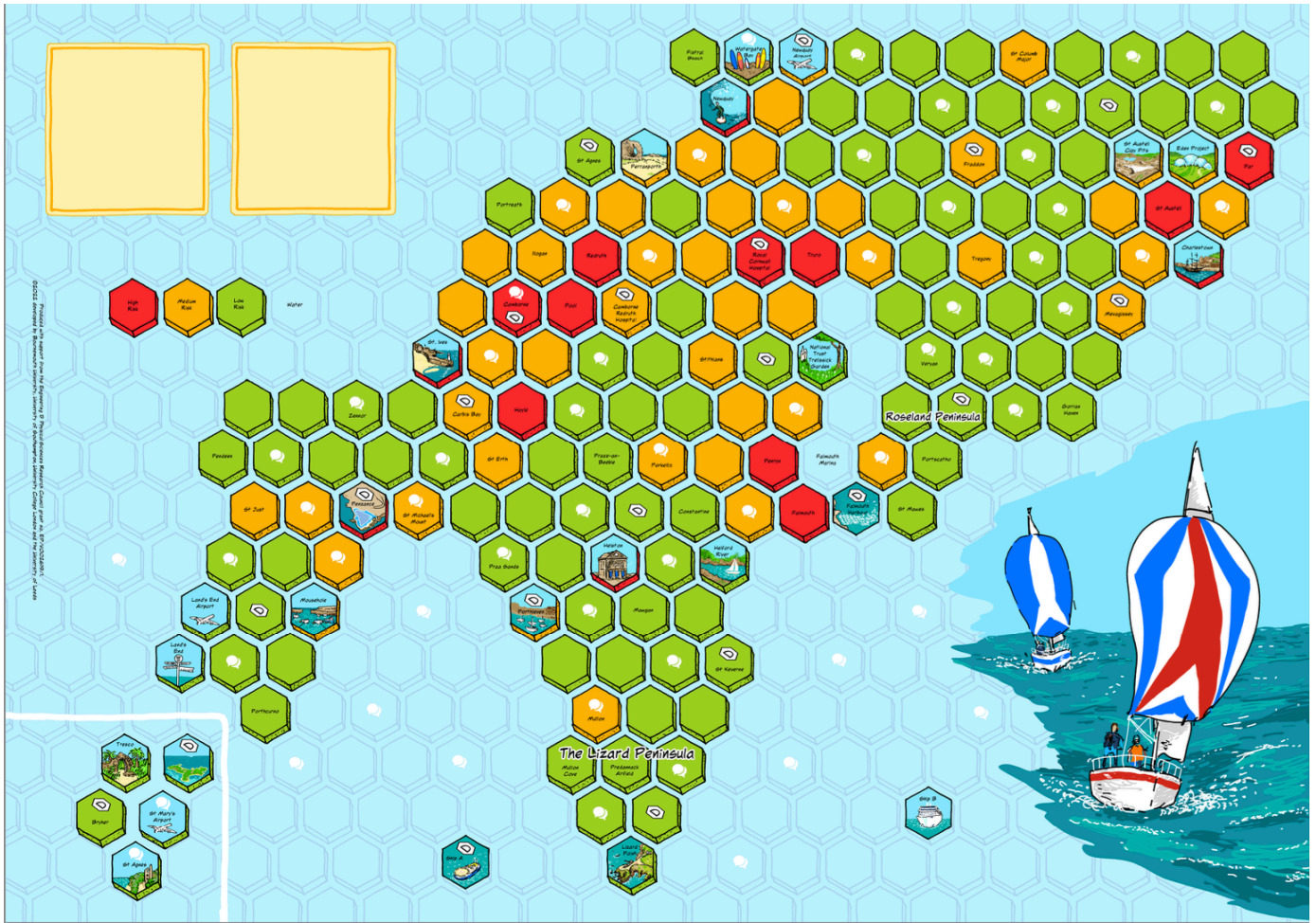


Figure 19: Game of (Delivery) Drones: Cornwall

### Game of (Delivery) Drones: Coventry

The board game was adapted to Coventry (Figure 20) following the same steps as the Solent version, and the game rules stayed unchanged. Mission cards were adapted to reflect local places. This adaptation was also created for the Future Flight in Place Project.



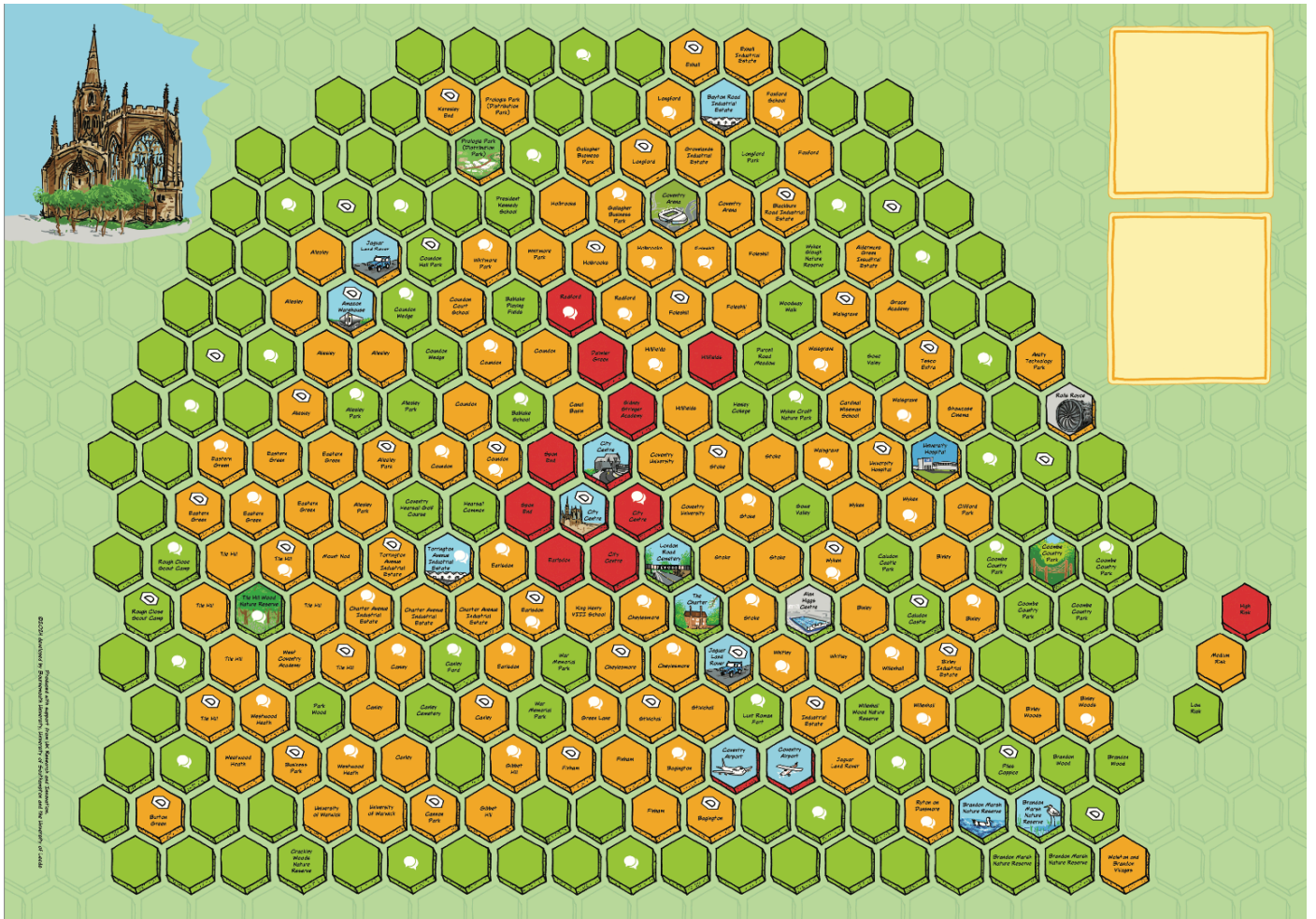


Figure 20: Game of (Delivery) Drones: Coventry

Game instructions remained the same and are illustrated in Appendix 12. A summary of the process of the board game is illustrated in Figure 21, demonstrating how the board game went through iterations and how game sessions were held with groups as the game developed:

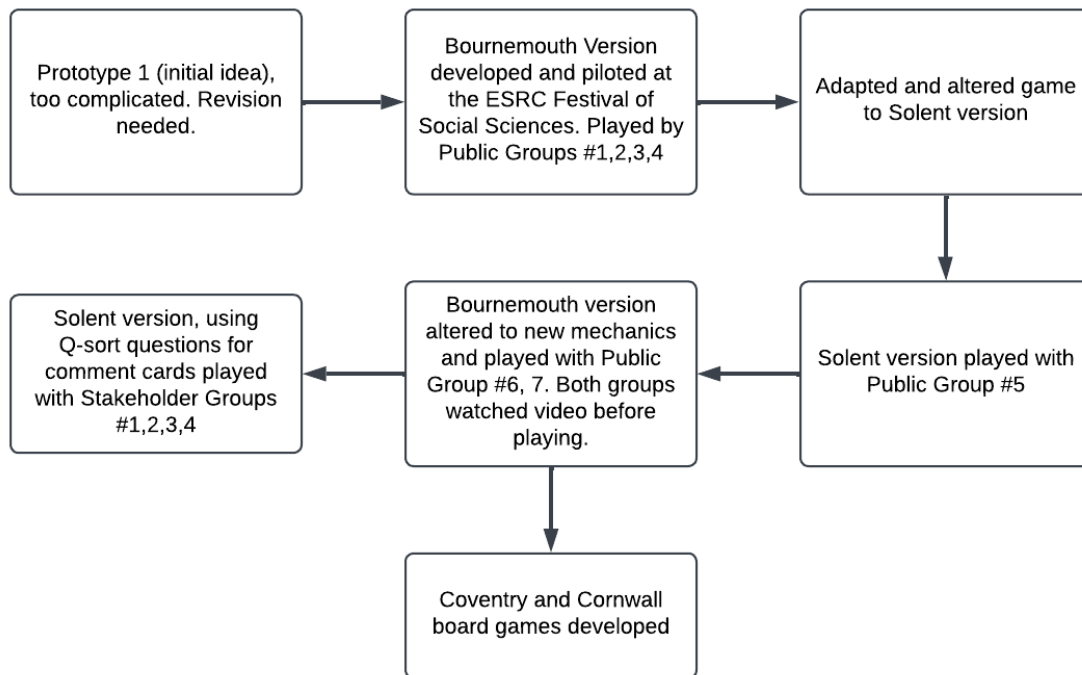


Figure 21: Summary of the process of the board game

## 9.0 Game-based Focus Groups

### 9.1 Introduction

Focus groups can be structured in various formats, tailored to specific research objectives. In this study, a board game was developed to create and test a tool to help participants envision a future where logistic drones operate in diverse environments. This chapter begins by outlining the rationale for using game-based focus groups and then details data collection and sampling, before concluding with a discussion of the ethical considerations that guided this research.

### 9.2 Focus Groups and Games

Focus groups gained popularity in qualitative social science research because they enable the observation of collective meaning-making in practice (Litosseliti 2003; Kitzinger 1994; Halkier 2017). This is important for this study as it seeks to understand how participants collaboratively construct their understanding of delivery drones through discussion and exchange of diverse perspectives within a social context. Focus group expert David Morgan (1996, p. 2) explains, "The defining characteristic of focus groups is their deliberate use of group interaction to yield data and insights that would otherwise be less accessible without such interaction." A well-structured focus group with a small number of participants can foster in-depth discussions, allowing them to expand on their perspectives and relate their experiences to those of others. There are multiple instances in literature where participants of focus groups question one another, promote the development of narratives and arguments, and reinterpret their individual experiences based on the accounts of other participants (e.g., Wibeck et al. 2007; Kitzinger 1994; Marková et al. 2007).

Games offer a unique format for focus groups that can support their progression and increase engagement (Wibeck and Neset 2020). Serious games have been highlighted for their ability to support the co-construction of knowledge and allow for exploring various perspectives and testing hypotheses (Wibeck and Neset 2020). A challenging game can encourage participants to consider previously unexplored options and solutions through negotiation (Wu and Lee 2015). The game's design can influence gameplay to facilitate a more conversational focus group dialogue, unlike the more structured interview setting (Wibeck and Neset 2020). Incorporating gaming into focus group methods offers various

challenges and opportunities for gathering and analysing data. A board game has been created to achieve the aims of this study research:

- 1- To develop and test a tool to help people understand a future involving delivery drones that can be deployed in different settings.
- 2- To use the tool to investigate people's views of delivery drones in specific settings to inform future policy.

Literature highlights the significance of having moderators in focus groups responsible for understanding the group dynamics that may influence their interaction (Kitzinger 1994; Morgan 1996). Moderators should be mindful of existing hierarchies that could negatively impact the discussion and prevent the exclusion of specific perspectives (Wibeck and Neset 2020). The moderator should steer the discussion to ensure inclusive participation, reinforcing that there are no right or wrong answers and that the goal is to gather diverse perspectives (Wibeck and Neset 2020). One crucial moderator's responsibility is to support individual reflection and lead debriefing sessions (Crookall 2010).

For this research, focus groups were organized to explore how participants form and share their perspectives on delivery drones, aligning with the tradition of using focus groups to study shared meaning-making in action (Halkier 2017; Kitzinger 1994). Incorporating a board game into these focus groups facilitated engagement and created a dynamic environment where participants could interact, negotiate, and co-construct knowledge about delivery drones. This approach reflects the literature on serious games supporting the co-construction of knowledge and encouraging the exploration of diverse perspectives (Wibeck and Neset 2020). Through this game-based approach, the research aligns with the broader focus group methodology, aiming to generate meaningful insights into public views on delivery drones.

### 9.3 Data Collection

Each board game session was 90 minutes and consisted of 3 phases:

#### *Introductory Phase*

Participants learned about the research project, and the instructions for the board game were clarified. Afterwards, they were asked to complete a pre-game survey. Later, groups (6 & 7) also watched a 3-minute [video](#) about drones in delivery to help address any misconceptions

they may have. This video was created for the wider E-drone project (Chapter 1). A survey (Appendix 6) was handed to participants before each game session, which collected demographic information and included. A question stating, *'What are your thoughts about delivery drones?'*

### *Exploratory Phase*

The exploratory phase consisted of two 20-minute gameplay rounds. During this phase, the researcher acted as the moderator by distributing cards, overseeing player movements on the board, addressing questions, facilitating group discussions, and promoting additional debate.

### *Debriefing Phase*

In the final phase, the players participated in a debriefing session that encouraged reflection on their game experiences and outcomes. This session was facilitated through discussions with other players and researchers (Medema et al., 2020). The environment also invited players to ask questions for clarification, enabling researchers to address and correct misconceptions.

## 9.4 Sampling

A purposive sampling strategy was employed, and 11 game-based focus groups of 4-7 participants took place. Twenty-seven participants were male, and 31 were female, aged 18 to 84 (see Appendix 7 for demographic data).

The sampling approach was iterative, with participant selection adjusted over time to ensure a diverse range of perspectives. This process involved the following phases:

1. Older Adult Groups: Initial focus groups (Public Groups 1,2 and 3) consisted predominantly of older adults (55+ years old). These sessions provided insight into how this demographic engaged in discussions on delivery drones.
2. Young adult group: Public Group 4 was formed, comprising younger adults, to compare discussions and perspectives with those of older participants.
3. Mixed age groups: Public Groups 5, 6, and 7 included a mix of younger and older adults, allowing the exploration of whether intergenerational discussions influenced viewpoints.

4. Stakeholder groups: The remaining four groups consisted of stakeholders working in transport, government agencies and land management:
  - i. Stakeholder Groups 1, 2, and 3: Participants from local authorities, transport fields, and government agencies.
  - ii. Stakeholder Group 4: Professionals with backgrounds in land management and conservation organisations.

This phased sampling strategy was purposeful, ensuring a broad representation of perspectives. The decision to introduce a mixed-age group after distinct older and younger adult groups was reflective, allowing for a comparison of whether intergenerational dynamics influenced discussions. Including stakeholder groups ensured that insights from industry professionals and policymakers were captured alongside public perceptions.

Participants in public groups were recruited through email invitations and advertisements on the University's research blog, as well as outreach via personal and university contacts to ensure a diverse participant pool. Stakeholder groups were recruited through the E-Drone and Future Flight in Place project networks to target individuals involved in drone delivery discussions. No prior knowledge of delivery drones was required, enabling genuine and uninfluenced engagement with the topic during gameplay.

The game-based focus groups were organised at accessible locations, including cafés and conference rooms, and scheduled at convenient times for participants. The sessions were recorded using an iPhone, capturing gameplay discussions and post-game reflections. Additionally, researchers took observational notes to document non-verbal engagement and interaction patterns.

Figure 22 shows pictures from the game-based focus groups held at the ESRC Festival of Social Sciences, playing The Game of (Delivery) Drones.





Figure 22: The Game of (Delivery) Drones played at the Festival of Social Sciences

## 9.5 Data Analysis

Similar to the media analysis, a reflexive thematic analysis (Braun and Clarke 2019) was used to analyse the game-based focus group data. This approach aligns with the study's interpretivist and constructivist foundations and supports an exploratory analysis of how participants make meaning during discussion. Reflexive thematic analysis provides flexibility to explore patterns of shared experience while acknowledging the researchers' active role in theme development (Braun & Clarke 2024).

The audio recordings of the sessions were transcribed and initial familiarisation with the data involved repeated reading and note taking to identify areas of interest related to gameplay, interaction and participant assumptions. Data was then coded inductively using NVivo software, with codes reflecting both semantic and latent meanings. These codes were iteratively reviewed, grouped and refined into themes that captured patterned meaning across the dataset.

Themes were not pre-determined but developed through the researcher's interpretive engagement with the data. This followed Braun & Clarke's (2006; 2019) six phases of reflexive thematic analysis: (1) data familiarisation, (2) generating initial codes, (3) constructing themes, (4) reviewing themes, (5) defining and naming themes, (6) writing up. A total of 11 transcripts

were analysed, resulting in eight final themes presented in Figure 23. These themes inform the dual focus of the findings: first, on the gameplay experience and the utility of board games as a research tool; and second, on the social representations of delivery drones as expressed during participant dialogue. The analysis is presented in Chapter 10.

In addition to this, two deductive analyses were carried out. First, participant interactions with game mechanics such as the localised game board, card decks, energy tokens and risk meter were examined to understand how these elements structured participants' decision-making, collaboration and scenario-building. Rather than seeking emergent themes, this layer of analysis was organised around the mechanics themselves, exploring how each design feature shaped intuitive reasoning and engagement with trade-offs in drone delivery. The findings and analysis are presented in Section 11.2.

Second, a deductive framework based on the SECI model (Nonaka & Takeuchi 1995) was applied to examine how knowledge was co-created throughout the gameplay. Participant interactions were analysed through the knowledge conversion process of the SECI model: Socialisation, Externalisation, Combination and Internalisation. This lens allowed the study to capture how tacit and explicit knowledge emerged, was shared and transformed through gameplay, particularly how group dialogue, collaborative strategy and reflection facilitated learning and meaning-making. The findings and analysis are presented in Chapter 11.

## 9.6 Ethical Considerations

According to Bryman (2016), ethical considerations are essential at all stages of research. This study took several ethical issues into account during its design, adhering to the guidelines established by Bournemouth University. An ethics checklist (Appendix 8) and a risk assessment form were submitted for approval by the Ethics Committee at Bournemouth University. Before each game session, participants received a Participant Information Sheet (Appendix 9), which explained the project and the study, respected participant rights, ensured confidentiality, and protected personal data. To encourage partaking, participants were initially offered an incentive of £10 (for Public Groups 1-3), which was later increased to £15 to compensate for their time commitment appropriately. This adjustment was reflected in the research ethics checklist and received approval from the ethics panel following Bournemouth University's Research Ethics Code of Practice.

At the start of each game session, participants were asked to state their names to help with transcription by linking voices to the participant. Still, they were informed that anonymity would be maintained in transcription and in reporting findings. Recording of audio data only commenced after asking for permission during the session. Steps were implemented to ensure the secure storage and disposal of collected data. Audio files were removed from recording devices and saved on the Bournemouth University network. In addition, encryption techniques were utilized to safeguard data against unauthorized access. Participants had to sign a consent form (Appendix 10) before engaging in the study research.

## 9.7 Conclusion

This chapter has detailed the development, implementation, and evaluation of this study's game-based focus group methodology. Combining serious game design with focus group techniques effectively engaged participants in exploring delivery drone technologies and their implications in a dynamic and interactive setting. The iterative design process, grounded in participant feedback and contextual adjustments, ensured the game's relevance and accessibility for diverse audiences.

Data collection and analysis were facilitated through structured gameplay sessions, thematic analysis of participant discussions, and the integration of qualitative insights to uncover social representations and public perspectives on delivery drones. Ethical considerations were addressed, ensuring participant confidentiality, informed consent, and secure data handling.

This methodology demonstrates the potential of game-based approaches to foster meaningful public engagement, stimulate critical dialogue, and generate rich data on complex technological topics. The following chapters will explore the findings derived from this methodology, including analyses of news media headlines, participant deliberations during board game-based focus groups, and how the game encouraged knowledge co-creation among participants. These insights will provide a comprehensive understanding of the potential of delivery drones and the role of innovative methodologies in public engagement research.

# 10 Participant Deliberations on Delivery Drone Scenarios

## 10.1 Introduction

This chapter presents the findings and analysis of the participant discussions about delivery drones during gameplay. It addresses the research objective of using a board game approach to investigate views and draw out social representations about delivery drones in specific settings. The chapter begins by examining participants' existing knowledge of delivery drones, before exploring their perspectives on key aspects of drone operations, including preferred delivery items, flight zones and regulatory considerations. Eight themes were identified in the data and are illustrated along with their sub-themes in Figure 23 below. Across these discussions, safety and risk consistently emerge as key concerns in multiple themes. This chapter concludes with a discussion of the social representations drawn out during participant discussions (summary presented in Table 10 in the conclusion of this chapter).

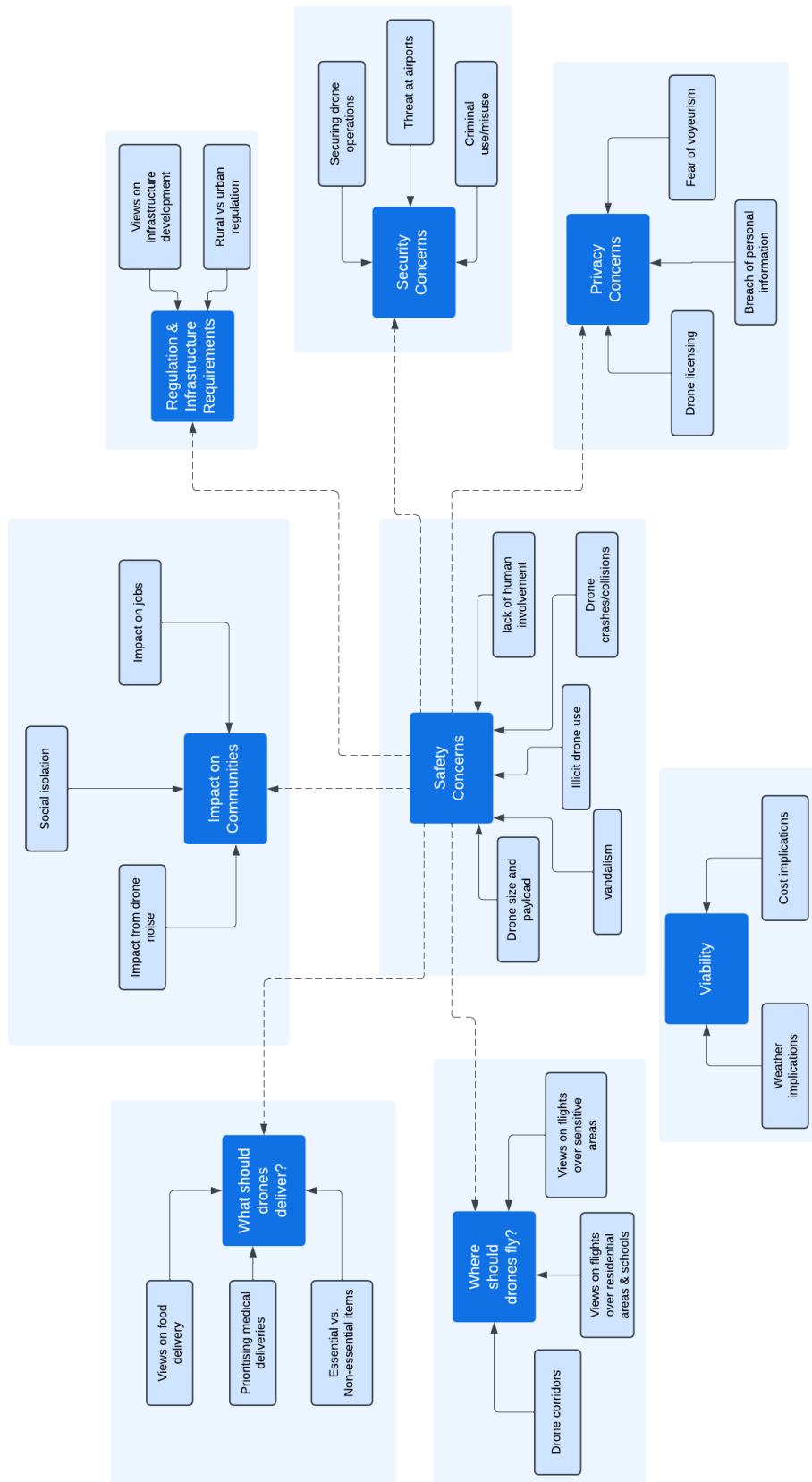


Figure 23: Themes and sub-themes

## 10.2 Knowledge of Delivery Drones

This section explores the prior knowledge the public and stakeholder groups brought to the game session. Furthermore, it highlights stakeholder groups' views on the importance of public inclusion in policy formation and collecting informed public opinions.

### 10.2.1 Public Knowledge

It was evident in focus groups with members of the public that, for the most part, participants had minimal knowledge about delivery drones before gameplay. Two participants confirmed their limited understanding of drones, for example:

Quote 1:

"I know very little about them." (Female Participant 3, Public Group #3)

Quote 2:

"...I just don't know enough to form an opinion." (Female Participant 1, Public Group #6)

Quote 1 was in response to a comment card stating, 'State what more you would like to find out about delivery drones.' Quote 2 was a mid-discussion with another participant about the environmental implications of delivery drones, where the participant, while suggesting her scepticism about delivery drones, also acknowledged her lack of knowledge. Both participants recognise that their exposure to information about delivery drones has been insufficient for them to develop well-informed perspectives.

Other participants reported that they had primarily heard of them in movies or news media, for example:

"I feel like it's just been on the news sometimes about them introducing new ways of delivering... but I haven't really heard about the massive drones like I've never really heard about this." (Female Participant 1, Public Group #4)

The response illustrates how some participants may hold incomplete or inconsistent knowledge influenced by selective reporting in the media, which often focuses on novelty or high-level applications without providing a deeper context. The participant acknowledges some awareness of drones being discussed in the context of new delivery methods, suggesting that her understanding is derived from surface-level, general news coverage rather than detailed or technical insights. Her response also reveals a gap in her knowledge about

the scale and capabilities of certain drones, highlighting the disconnect between media representations and the technical specifics of drones.

Quote 1:

"I saw a film about a drone, and they delivered something into prison." (Female Participant 3, Public Group #1)

Quote 2:

"The only thing I'd heard about was using them to get drugs into prison." (Male Participant 1, Public Group #3)

The comments suggest that these depictions may negatively influence their perception of drones and highlight how media representations, especially those focusing on sensational aspects, can strongly shape perceptions (see Chapter 7.3). These could also involve positive associations with drones. One participant mentioned that they had heard of trials moving medical items, for example:

"Only from what I've seen on the news about medical deliveries to St. Mary's Hospital on the Isle of Wight." (Male Participant 2, Public Group #2)

These quotes highlight the lack of information as a potential barrier to public engagement with delivery drones. Without sufficient knowledge, people may either refrain from forming opinions or rely on fragmented information, often shaped by limited media sources, restricting their ability to gain a deeper understanding and leading to hesitancy. While it's natural to be hesitant, this hesitancy can be compounded when there is little opportunity to move beyond these surface-level narratives. If a significant portion of the population shares the sentiment of not knowing enough, it could influence how the technology is perceived. Familiarity and knowledge level regarding drones are recognised as factors influencing attitudes (Smith et al. 2022b).

### 10.2.2 Stakeholder knowledge

Stakeholders are expected to have more in-depth knowledge because their professional roles often involve direct engagement with relevant technologies, policies or operational plans. Some stakeholders for these game sessions were involved in the drone industry, giving them greater exposure and understanding of the subject. However, for other stakeholders, the topic has been relatively new. Therefore, stakeholder knowledge in the focus groups was varied. A

pre-game survey (responses in Appendix 11) included the question 'What are your views about delivery drones.' capturing data about participants' views about delivery drones before gameplay demonstrating this.

Response 1:

"Neutral/sceptical. Not sure about the financial viability of the use cases, not sure about their social benefits. There may be some, but I don't think the public has been engaged much." (Female Participant 4, Stakeholder Group #2)

Response 2:

"Could bring benefits but probably not a cure-all..." (Male participant 4, Stakeholder Group #1)

Response 3:

"Lower carbon emissions? Scary + Futuristic if they fly around the streets, e.g., pizza delivery." (Female Participant 3, Stakeholder Group #3)

These responses suggest that while participants have some awareness about delivery drones, they also indicate a level of uncertainty about them. Response 1 indicates some knowledge but highlights gaps, such as understanding delivery drones' practical and societal implications. Similarly, response 2 demonstrates that while the stakeholder participants may have a basic understanding of delivery drones, they are unsure of the potential benefits and limitations. Additionally, response 3 indicates that while the participant recognises the possible benefits, she expresses uncertainty and discomfort about drones becoming a regular part of daily life, suggesting a more limited understanding of how they would be integrated.

While not explicitly stating it, some stakeholder group participants seemed to have limited knowledge about delivery drones. For example, one participant drew a comparison to electric cars, commenting on the novelty of the technology:

"It's really difficult when something's novel to try and get a valid opinion...I can tell you what I think about electric cars, but even that probably, and it has been a decade with electric cars, but I feel it's pretty new to me. So, I suspect most people wouldn't have a great opinion, an informed opinion. And that's the challenge you've got with this kind of thing." (Male Participant 3, Stakeholder Group #1).

The participant, who works in the innovation department of a delivery company, acknowledges the novel nature of delivery drones. He also recognises that forming a 'valid opinion' on



something new and unfamiliar can be challenging, which can prevent people from fully realising its implications. In this case, a 'valid opinion' may be informed and credible, developed through understanding the technology and critical thinking.

Participants from stakeholder groups demonstrate some awareness of delivery drones, indicating they are familiar with the basic concepts or have encountered discussions about them. However, the findings also highlight significant uncertainty, suggesting that their understanding may be superficial or incomplete. Even though stakeholders did not explicitly state their lack of knowledge, the findings indicate that some participants may have a limited understanding of delivery drones. This implicit knowledge gap could suggest that while stakeholders might be aware of drones in a general sense, they may not fully grasp the specific applications, technologies, or regulatory issues associated with drone deliveries. Some participants from stakeholder groups drawing comparisons between delivery drones and other transport could indicate a lack of knowledge about drones as they rely on analogies that are better understood to fill in the gaps.

## 10.3 What Should Drones Deliver?

This section explores participant preferences for items to be transported by delivery drones. Comment cards stating, 'What kind of deliveries do you think should be permissible using drones?', 'Drones should only deliver items like...state three in the order of priority' and 'Delivery drones should be able to deliver food for me. Agree or disagree' prompted discussion, allowing participants to reflect on the preferred delivery types. The theme investigates participant insights into delivery preferences.

### 10.3.1 Views on food delivery:

Participants in some groups were satisfied with the idea of getting food delivered by drones and reflected on their potential limitations:

"Delivery drones should be able to deliver food for me. Agree or disagree?" (Female Participant 1, Public Group #4)

"Agree." (Male Participant 7, Public Group #4)

"I'm not sure how the logistics work with hot food." (Female Participant 5, Public Group #4)

"Could be heated?" (Male Participant 7, Public Group #4)

"Yeah, but if the air is freezing, then the food is going to be cold." (Female Participant 5, Public Group #4)

The quote highlights that participants situate the idea of drones delivering food within their existing framework of understanding practical utility (e.g., keeping food hot) and transforming it into 'common sense' understanding. This shared belief about the limitations reflects an attempt to anchor the unfamiliar technology within familiar systems (e.g., logistical challenges) they understand. The anchoring process helps participants make sense of drones within their current knowledge, even as the technology remains uncertain and speculative. This aligns with the idea that emerging technologies create a knowledge gap for the public because of their complexity, unpredictability, and lack of clarity (for example Li and Li 2023). These considerations reflect participants' efforts to assess drones through the lens of known, existing challenges (e.g., maintaining food temperature in current delivery systems), suggesting a practical and reasoned approach to evaluating the technology.

Some participants argued about their personal preference towards getting food delivered by a drone and reflected on circumstances where they would, for example:

"Delivery drones should be able to deliver food for me. Agree... I can't cook sometimes, so I am relying on deliveries like that. Sorry. It's one of those." (Female Participant 1, Public Group #6)

"I don't need it, so I don't agree. It can do that for other people." (Female Participant 4, Public Group #6)

"If you had broken your leg, or in some ways can't get out, might you need it in some way?" (Female Participant 1, Public Group #6)

"Yeah, that's where, that's when I would maybe say that yes, or I would use." (Female Participant 4, Public Group #6)

By associating the use of drones to particular circumstances that justify their utility, participants anchor drones in a context they understand, i.e., practicality and situational appropriateness. This reflects a social representation where the use of drones is perceived on their usefulness and ability to meet specific needs. Perceived usefulness refers to the subjective judgement of how effectively technology can fulfil a particular need (Lin et al. 2007), and the idea that food drone deliveries are only acceptable under certain conditions demonstrates that practical and situational factors shape public opinion.

In another group, two participants rejected the idea of getting their food delivered:

“What about you, Participant 4? Would you use it? I mean, in if like in lockdown... if you were isolating something like that, would you have that, would you have food delivered by a delivery drone?” (Female Participant 1, Public Group #1)

“No. I'll go buy my food. I don't have it delivered...” (Female participant 4, Public Group #1)

“Right. So it's irrelevant...” (Female Participant 1, Public Group #1)

“None of us should do it.” (Female Participant 2, Public Group #1)

The quote illustrates how these participants (aged 55-64) anchor the unfamiliar concept of delivery drones within their familiar and preferred traditional shopping practices. By valuing familiar methods and resisting change, they anchor drones within a context they understand and choose. This anchoring reflects their values of independence, self-reliance and community norms and draws on broader societal discourses that associate traditional shopping with autonomy and community engagement. These discourses shape their perception of the technology, therefore reinforcing resistance. Research suggests that older adults are often constructed within sociotechnical systems as dependant, and activities symbolising self-reliance, such as traditional shopping, can be seen to reject technologies they perceive as catering to more vulnerable individuals (Zhang 2023). The attitude of being independent reinforces the idea that older adults may view certain technologies as unnecessary or incompatible with their lifestyle or self-image, even if the technology offers practical benefits.

These social representations reveal how public opinions are shaped by practical considerations and the perceived necessity of technology, traditional habits, values and social norms, all contributing to a nuanced and context-dependent view of food drone deliveries.

### 10.3.2 Essential vs Non-essential Items

A discussion in Public Group #4 indicated how participants reflected on what deliveries would qualify as essential:

“Delivery drones should only be used for blank. Essentials, I guess. Essentials.” (Female Participant 4, Public Group #4)

“Yeah, that's a good way of looking at it. Yeah, maybe it should be essentials and things that are about social good.” (Female Participant 2, Public Group #4)

“So what qualifies as essential because food for somebody can be essential. But you said that food's not important enough and it's self-indulgent.” (Researcher)

“Maybe not like take away food, maybe like grocery deliveries could be essential. If you can't actually get to the supermarket, maybe.” (Female Participant 1, Public Group #4)

“Yeah, but you could say that if someone can't cook then they might have to take away their food.” (Male Participant 3, Public Group #4)

“Or they could be like the marking criteria they've got to go through in order to have food delivered to them to see how vulnerable they are to actually not being able to get food.” (Female Participant 6, Public Group #4)

The participants situate their views into familiar social norms, prioritisation frameworks, and fairness. The belief that the importance of delivered items should justify drone use highlights the representation that aligns with societal norms of prioritising needs over conveniences. This differentiation between essential and non-essential items is further contextualised by individual circumstances, anchoring the technology within situational and personal contexts. Female Participant 6's suggestion to create eligibility criteria based on vulnerability highlights a representation of fairness, emphasising that drone use should be regulated to ensure access for those who need it. This perspective reinforces the perception of responsible and socially conscious drone use. Studies have demonstrated that people with collectivist attitudes tend to emphasise communal needs over individual preferences (Yuan et al. 2011), while egalitarian values enhance the prioritisation of needs over conveniences, encouraging public-oriented innovation (Liñán et al. 2020). Together, these representations suggest that participants anchor drones within a framework of social responsibility and based on needs and circumstances, reflecting collective and equitable values.

One participant suggested that essential items are those that are for the ‘social good’ and emphasised this point by bringing it up in conversation. She says:

“I think the food delivery is a different one. I feel like that's self-indulgent. Whereas the medicines feel like that's an important, like, social good mission.” (Female Participant 2, Public Group #4)

The quote reflects that participants' views towards drones are anchored in value-based judgements shaped by contextual factors, social norms and media representations. Deliveries perceived to contribute to social welfare, such as medical supplies, are prioritised over non-essential or indulgent uses like takeaways. This categorisation highlights the belief that drones

should align with socially responsible and ethical practices, emphasising communal benefit over individual needs. As noted by Warren et al. (2010), the emphasis on urgency and moral considerations and the influence of social norms and emotional responses, as highlighted by Feng et al. (2014), demonstrate how participants anchor drones within familiar value systems. Furthermore, the portrayal of drones as tools for social good in media narratives (highlighted in Section 7.3.9) reinforces these perspectives, illustrating how public attitudes towards emerging technologies are shaped by personal and situational factors and the broader discourses in media.

In another group discussion, one participant listed routine items such as bread and milk as essentials for delivery, which was contested by another participant who alleged she finds drones risky as they can be brought down:

“Daily necessities, like maybe bread and milk?” (Female Participant 2, Public Group #3)

“Actually, the opposite. I would say only deliver non-essentials because it’s too precarious a means of delivery. I wouldn’t like to be depending on drones.” (Female Participant 3, Public Group #3)

“In what way are they?” (Female Participant 5, Public Group #3)

“Well, they’re very easy to bring down, drones.” (Female Participant 3, Public Group #3)

Female Participant 3’s scepticism reflects a social representation embedded in distrust of drones. Her view that drones are ‘too precarious a means of delivery’ highlights a broader tendency towards risk aversion, particularly in high-stakes scenarios. This perspective aligns with established tendencies toward risk aversion, particularly in contexts where the potential for significant losses influences decision-making (see, for example Gächter et al. 2022; Kahneman and Tversky 1979). By anchoring drones within a framework of caution and unreliability, participants adopt strategies that prioritize avoiding significant losses (see for example Luce and Weber 1986). Media representations also play a role as drones are often portrayed through a dual lens of potential innovation and inherent risks. Participants’ familiarity with hobby drones may further objectify drones as fragile or unsuitable for critical applications. This process of linking drones to more familiar objects or uses illustrates how public attitudes are shaped by broader societal discourses and personal experiences, contributing to scepticism about the readiness of emerging technologies for essential tasks.

### 10.3.3 Prioritising Medical Deliveries

Across most groups, there was a consensus that delivery drones should be utilised for emergency services, particularly for the transportation of medicines. Participants were drawn towards the medical use case of delivery drones and prioritised medical deliveries as their strongest preference for drone delivery items. For example:

“What kind of drone deliveries should be allowed? Well, I think we discussed medical. I think medical is obviously a good one.” (Male Participant 5, Stakeholder Group #4)

“Well, I think we'll go for medical.” (Female Participant 3, Stakeholder Group #4)

The participants anchor the concept of drone deliveries into the familiar, socially valued background of critical health and emergency services. Male Participant 5's use of the word 'obviously' and Female Participant 3's agreement suggest that prioritising medical deliveries is a common and undisputed belief anchored in the societal importance of healthcare and emergency response. By positioning drones with essential services, participants ground the unfamiliar technology in a universally understood and valued context, shaping a social representation that drones are most appropriate for medical applications.

“I think surely things like medicine have to be prioritised.” (Male Participant 1, Public Group #7)

If they're secured in a box and stuff, yeah, medicine, high priority. High-priority stuff like medicine. (Male Participant 6, Public Group #7)

Maybe non-prescription to reduce risk a bit. (Male Participant 1, Public Group #7)

This quote highlights concerns about the safety and reliability of drones for transporting critical items. It demonstrates public opinion anchored in familiar risk assessment and safety protocol frameworks. The idea of securing medicines in a box to mitigate risk reflects participant views that while drones may help transport medical goods, significant safety considerations must be addressed.

Participants who prioritised medical deliveries discussed moving prescription medicines, especially in remote areas, citing the NHS as the primary stakeholder in such deliveries. Examples of participant quotes include:

Quote 1:

“Yeah, I think hospitals is the most useful. If they're getting low on a certain thing that they need for patients, they can order from the mainland and over, which they've

already done. They've done repeat prescriptions. St. Mary's on the Isle of Wight.” (Male Participant 2, Public Group #2)

Quote 2:

I see this as NHS for prescription delivery. (Female Participant 4, Public Group #5)

Quote 3:

Are there any specific applications or industries where you think delivery drones would be particularly useful? Medicine. NHS. (Female Participant 2, Public Group #5)

Participant views are anchored in familiar ideas of trust and credibility associated with institutions like the NHS, shaping their perceptions of drones as reliable tools for public benefit, especially in medical contexts. Explicit references to medical drone trials, such as those at the Isle of Wight, illustrate how participants further anchor these perceptions by providing evidence reinforcing the belief in drones' reliability for essential tasks. As noted in Section 7.3.9, uncritical media reports often reproduce commercial press releases without thorough analysis (see for example, Markowitz et al. 2023), reinforcing positive perceptions by excluding challenges or trial limitations. Rayner (2004) highlights that excessive hype and promotion of technological benefits may erode trust in government and scientific institutions. Focusing on novelty and immediate advantages can also foster public disappointment and scepticism (Rayner 2004). Smith et al. (2022a) argue that representing drones solely for medical deliveries can be deceptive if the long-term objective of the UK government is to implement drone deliveries for all purposes.

Similar to the discussion about food in the previous section, one participant also debated what would qualify as a priority within the medical use case, for example:

“What medicine is lifesaving and what's just like paracetamol, right?” (Female Participant 1, Public Group #7)

This quote reflects a social representation anchored in recognising the need to prioritise within a broader category of medical deliveries. This indicates that public opinion is complex. While they support using drones for urgent medical goods, they question their use for more routine items.

## **Drones Saving Lives**

Some participants who wanted to prioritise medical deliveries positioned drones as ‘lifesaving’ for example:

Quote 1:

“Generally, probably in medical terms, they probably could save lives as well from delivering.” (Participant 6, Public Group #7)

Quote 2:

“Potentially lifesaving for all we know, I mean, they could, it’s the whole gamut, isn’t it?” (Female Participant 2, Public Group #1)

These quotes exemplify this view as participants attribute a high societal value to medical deliveries by drones, suggesting that they could be vital in emergencies. The participants’ positioning of drones as potentially ‘lifesaving’ reflects a social representation where drones are seen as a convenience and a critical lifesaving service. Media and public discourse often frame emerging technologies such as drones as innovative solutions to pressing challenges, particularly in healthcare and emergency services. Section 7.3.9 demonstrates examples of news media headlines that may reinforce the belief that drones serve as vital lifesaving tools.

One participant from a stakeholder group highlighted that the perception of delivery drones needs to change to ‘lifesaving.’

“But you know... when we're talking about that perception and when we're talking about the risks and the dangers...We put that spin on publication to say, this is what it's doing, delivering medication, delivering for me, that's the implementation I'd like to take forward as in to say, right, these are saving lives. Drones are going to save lives. Once that perception goes out, that negative impact soon changes because in their heads it's actually saving lives and the gradual introduction.” (Male Participant 3, Stakeholder Group #2)

This participant’s suggestion reflects objectification within social representation theory, as it frames the abstract concept of drones within an emotionally resonant narrative of being ‘lifesaving.’ By emphasising their role in public communications as critical tools for emergencies, drones are made more relatable and easier for the public to understand. Rather than merely providing more information, this emphasis on drones as lifesaving appears to deflect attention from their broader potential uses, effectively narrowing the scope of public debate and critique. This aligns with the tendency of technology developers and supporters to



shape narratives that highlight positive, socially beneficial applications while downplaying less favourable or controversial uses. Rather than constituting a deliberate social representation strategy, this narrative framing by developers and advocates influences the discourse from which social representations subsequently emerge. Furthermore, this conflation of drones' emergency roles with other potential uses risks oversimplifying public perceptions and reinforcing assumptions that drones are primarily tools for the public good, potentially suppressing critical engagement with their broader applications.

### **Transporting Organs & Faster Delivery**

Participants also linked drones and organ transport. This emerged from discussions about what participants thought should be delivered by drones, qualifying organ transport as a medical emergency and therefore a priority, for example:

Quote 1:

“How about things like, from a hospital, if you had a transplant or something?” (Female Participant 3, Public Group #3)

Quote 2:

“When it says emergency services, what exactly will it deliver that is functional and usable? Human organs?” (Female Participant 4, Public Group #5)

Quote 3:

“I think it's those situations that we're not currently aware of, that our emergencies are when we are the ones needing the heart for the transplant. Things like that. If we have the ability to do this, to use it, and it can be useful for anybody, whether, you know, whether it is me or it's my neighbour, whoever. (Female Participant 1, Public Group #6)

Participants anchor their views on medical emergencies by situating drones with familiar concepts of speed and efficiency in high-stakes scenarios. This reflects an emerging social representation where drones are seen as overcoming logistical barriers where speed and efficiency are essential. This view reinforces a specific social representation that considers drones suitable for delivering high-priority medical items. However, this belief may overlook real-world constraints, such as the careful coordination required for certain organ transplants.

In response to a comment card prompting discussion about whether drones should only be allowed to operate within fixed hours, a participant argued that applying fixed operating hours for drones may be unhelpful and referred to organ transfer as an emergency that needs to be accommodated in medical deliveries. The participant highlights that certain situations like organ transfers should be exempt from such regulation:

“I think, once again, it's like a sort of differentiation between like medical into others. 'cause you obviously wouldn't want that on medical. It's like, oh sorry, it's two o'clock, you can't have your organ.” (Male Participant 4, Stakeholder Group #4)

The belief that regulatory restrictions, such as fixed operating hours, should be relaxed for emergency medical deliveries like organ transport highlights how drones are anchored in the context of lifesaving functions. The differentiation between medical and non-medical deliveries suggests a public preference for flexibility in cases with clear societal benefits. This aligns with the psychological tendency to perceive an activity or technology as low risk when its benefits are evident, as people seek to avoid cognitive dissonance (Alhakami and Slovic 1994). By valuing the critical importance of medical deliveries, the public may downplay potential risks, emphasising the need for regulatory systems that balance flexibility with safety, particularly for lifesaving uses.

Participants drawn to the medical use case were also observed reflecting that drones delivering medicines may be faster as compared to road transport, for example:

Quote 1:

“Medicines, I think, would be the most important. Get them there quicker than the road.”  
(Female Participant 5, Public Group #3)

Quote 2:

“It could be really useful. Like, because I'm delivering antibiotics, I could get there really quickly. Potentially. So like, I got stuck in two traffic jams this morning, because they're digging up the roads, but the drone would have just got there. So that could have been good.” (Female Participant 2, Public Group #4)

This perspective is formed through objectification within SRT, as the participant frames drones as transformative tools capable of overcoming traditional transport barriers, particularly in scenarios where time and accessibility are critical. By contrasting drones with conventional transport systems, the participant makes the abstract concept of drones more relatable by

highlighting their advantages in crucial scenarios. This representation simplifies the complexity of drones into a practical and reliable solution for overcoming logistical barriers, aligning with Feindt and Poortvliet's (2019) findings that people often form idealised expectations of new technologies based on limited information. These objectified views of drones highlight the importance of managing public expectations and ensuring the technology lives up to its promise in critical applications.

Participants see drones as serving a higher societal purpose when applied to medical situations, particularly critical ones. This representation places drones in a humanitarian role, helping to alleviate urgent medical needs and reinforcing the belief that drone use should be prioritised when it aligns with a mission of social good. These social representations reveal a public perception that values drones as uniquely suited for emergency medical scenarios, particularly organ transplants, and advocates for regulatory flexibility and prioritisation of these critical functions. This perception is partly idealised, reflecting an aspirational view of drones as life-saving tools despite potential practical constraints. These social representations highlight a public perception that drones offer distinct advantages for medical deliveries, particularly in speed and reliability. They reinforce the view that drones can enhance healthcare logistics by providing a dependable alternative to conventional transport, especially when road delays could impact medical response times.

## 10.4 Impact on Communities

This theme explores participant views on delivery drones' impact on communities. Participants expressed fears of losing human contact, leading to isolation for some individuals, and the replacement of delivery personnel with drones raised concerns about job displacement. Furthermore, drone noise was another concern highlighting potential disturbance, and the presence of cameras sparked worries about privacy intrusion. This section explores these concerns in greater depth, analysing the possible implications of delivery drones on communities.

### 10.4.1 Fear of Social Exclusion

A comment card stating, 'Tell everyone your three main concerns about delivery drones being used in the future' prompted dialogue about social exclusion. For example, two participants from the Public Group #7 group discussed:

“It's going to make everyone isolated, isn't it? (Female Participant 3, Public Group #7)  
“Yeah, cutting out social interaction... We're talking about the elderly people. If they have a person deliver it, you've got that human contact, which they might not get. Whereas with that, you're just going to get this thing that turns up at your door. And for me, I think human contact is important.” (Female Participant 2, Public Group #7)

The participants relate the concept of drones replacing human delivery personnel to existing concerns about social isolation and the importance of human interaction. By framing delivery personnel as vital social connections, participants anchor drones within a familiar context of social engagement and community support, especially for vulnerable groups. This belief aligns with broader fears, as Rogers (2010) highlighted, that technology might diminish meaningful human interactions, exacerbating isolation. Jungman and Cox (2017) further note that such fears are rooted in the social contexts of technology adoption, emphasising how embodied interactions and social engagement shape public attitudes. The participants' concerns highlight a representation that urges the need to balance technological advancements while preserving social connections.

This concern was also echoed by another participant who recounted her good relationship with their local delivery person to emphasise the importance of human contact. She commented:

“I was just thinking that drone deliveries would maybe make me sad because I quite like my local parcel delivery person. We have a chat about the kind of parcels that I get, and my partner gets, and we guess what's in it, and that's fun. And if a drone did it...I wouldn't have that chat with him. And it's the same person I have every time. So that would be a bit sad.” (Female Participant 2, Public Group #4)

The anecdote about the participant's pleasant interaction with her delivery person highlights the importance of these routine interactions in maintaining social bonds and a sense of familiarity. By valuing routine interaction with delivery personnel, the participant anchors drones in familiar ideas of social connection, emphasising the potential disruption to continuity in everyday interactions. While there is no direct evidence in existing literature about the use of delivery drones leading to isolation in humans, research shows that regular face-to-face interactions between the same delivery personnel and customers create a sense of familiarity and continuity in interactions (Bode et al. 2020). While automation through drones is seen as a potential threat to these interactions, this representation suggests a belief that technological progress can disrupt social bonds and human connection, which are seen as valuable aspects.

It provides novel methods for staying connected but poses the danger of depersonalising interactions (Antonucci et al. 2017).

Additionally, stakeholder groups focused on the negative impacts of delivery drones on low-income public groups with the potential to create social exclusion. One participant stated:

“I'm feeling like there is also an element of thinking from a public sector perspective. If a specific group of people is not getting any benefit out of this, isn't this also a bit unfair in a way that...you have low-income people that already have a lot of problems in terms of mobility and access not getting any benefit out of it. And this is negative in a way.” (Male Participant 4, Stakeholder Group #2)

The participants' views are anchored in fairness and equity, emphasising the need for drones to serve the collective good without marginalising vulnerable populations. He anchors the discussion of drones within societal expectations of inclusivity and public welfare. This aligns with Vavra et al. (2017), who note that fairness is linked to neurological processes (i.e., an intrinsic preference for fairness) that reward equitable resource distribution, though opinions are shaped by external factors such as personal goals and social contexts (see for example Bargh 2017; Cohn et al. 2014). The participant's emphasis on avoiding unequal benefits highlights a representation where drones must address public needs equitably. Decety and Yoder (2016) note that fairness is a dynamic process that requires ongoing attention to societal values, inequalities, and individual needs. Anchoring drones within an ethical framework suggests that addressing equity concerns is essential to meeting public expectations.

Participants also questioned how drones would operate without suitable take-off and landing sites, such as for individuals living in flats without outdoor space. This highlights their perception that the benefits of drones may not be equally accessible to everyone. For example, an quote of a discussion between participants in the group Public Group #2:

“...If we're awkward and we live on the fourth floor?” (Male Participant 4, Public Group #2)

“What do you do now if you're on the fourth floor?” (Female Participant 3, Public Group #2)

“How will they or where will they drop it if you are like in a flat on the fourth floor?” (Female Participant 5, Public Group #2)

“Well, the same place that the white van delivers the things now- in front of the house, inside the front door.” (Female Participant 3, Public Group #2)

“You mean the drones have to go inside?” (Female Participant 5, Public Group #2)

“No. They would drop it by the front door and then you'd have to come down and pick it up.” (Female Participant 3, Public Group #2)

The dialogue highlights concerns about the suitability of drones for urban environments, particularly for flats or buildings without outdoor access, anchoring the discussion in familiar issues of unequal access to technological benefits. This reflects broader societal concerns about the equitable distribution of technological advantages, as some groups may find drones more convenient while others face logistical barriers. These observations align with findings from Macnaghten and Chilvers (2014), who identified equity as a concern that consistently structures public responses to emerging technologies. They argue that these concerns are not isolated but interact and reinforce one another, shaping public attitudes about whether a technology should be implemented. In the case of drones, participants' views reflect a blend of equity-related scepticism and logistical concerns, suggesting that ensuring fair access to drone benefits and addressing infrastructure challenges is crucial.

A comment card stating, ‘Do you think we need to understand whether drone flights will impact some groups negatively before we proceed with their deployment? Discuss’ was placed in games, including only stakeholder groups to reflect on the population that might be excluded due to age, deprivation, or lack of access to outdoor space.

“Internet access now is obviously very high, but you've still got exclusion for sort of older population, potentially even people in rural areas as well. And also people depending on their living situation, who may not have a landing site or anything nearby, who will probably be more in deprived areas. So you then need to think about the impact of creating social exclusion where people with a garden, can then access these deliveries in, one hour. And then people who don't have a garden, don't have access to outdoor space, then, you know, you'll create like an issue.” (Male Participant 1, Stakeholder Group #2)

“It's a bit like EV charging.” (Male Participant 6, Stakeholder Group #2)

“Yeah, EV charging where you don't have access.” (Male Participant 1, Stakeholder Group #2)

Participants perceive that economically disadvantaged individuals, urban residents or those lacking infrastructure are less likely to benefit from drones, and they objectify it by comparing it to the challenges of electric vehicles (EV) charging infrastructure. This analogy makes the idea of inequitable drone deployment more tangible by associating it with a familiar example

of a technology that privileges certain groups over marginalising others. Such representations highlight the importance of addressing equity concerns in the deployment of drones, ensuring that benefits are distributed relatively while minimising risks, particularly for marginalised communities.

Addressing the same comment card, a similar discussion about the potential impact of drone deliveries on low-income groups in another group was sparked:

“... there's a sort of social, sort of demographic issue as well, where if there are impacts and ... where the routes are going. So, for example, if they're more towards main roads. And we see this with air pollution, where that's obviously affecting disproportionately lower income groups...I think this is really important. Ideally, we'd be part of a national sort of policy framework, but otherwise, it's going to fall to sort of authorities to sort of address that.” (Male Participant 2, Stakeholder Group #1)

“You talked at the start about doing some, sort of surveying in Cornwall, which is where I'm from, and I could see a big issue where, it's a very deprived place, and a lot of that's concentrated towards the centre and is increasingly sort of away from the coastal bits of which are very pretty and popular with holidaymakers. A lot of the really deprived people are sort of living in the centre of Cornwall, and I could see that you would then want to put routes through the centre because you'd want to avoid disrupting those pretty, nice places, but then the poorer people would have all of these drones going over the top of them. So I can see places like that being a really big issue.” (Female Participant 1, Stakeholder Group #1)

Participants compare air pollution and infrastructure inequities to make the abstract issue of unequal drone deployment understandable. Male Participant 2's comparison of drone routes to environmental inequity and Female Participant 1's concern about prioritising affluent areas ground their view about inequity into more concrete examples. These comparisons draw on past experiences of marginalisation, for instance, marginalised groups excluded from critical healthcare advancements (see, for example, Hoagland and Kipping 2024). Male Participant 2's call for a national policy framework highlights the need for centralised oversight to prevent such disparities. It reinforces the need for inclusive regulation that ensures drones serve all societal groups fairly.

These social representations demonstrate that participants see drone deployment as more than a logistical challenge; they view it as a societal issue with the potential to deepen

socioeconomic and geographic inequalities. This underscores a desire for technology to be introduced in ways that do not exacerbate existing divides, highlighting the importance of considering ethical and equitable approaches to new infrastructure and technology deployments.

#### 10.4.2 Impact on Jobs

This section explores participant views on the impact of jobs due to the implementation of delivery drones. This discussion primarily arose in response to a comment card asking participants about their concerns about delivery drones. Participants referenced Deliveroo in their conversations about job loss, for example, in a discussion among participants of the group Stakeholder Group #2:

“...one thing that we should also consider is that delivery drones have the side of people losing their jobs and all the other replica effects that come with it.” (Male Participant 2, Stakeholder Group #2)

“You’ve got Deliveroo who, you know, whether you like them or not, they are providing employment for a lot of people. And sort of a basis where you can just choose when to work. Sort of zero-hours contracts. And drones, if they replace those, then you’re replacing a whole market where people then are unable to work on the hours they wish to do so.” (Male Participant 1, Stakeholder Group #2)

“I just want to find out how massive or how big is loss of jobs as a result of some of these things.” (Male Participant 2, Stakeholder Group #2)

These views are anchored in concerns about job security and the value of flexible employment opportunities such as those offered by Deliveroo. This corresponds to the idea that people’s attitudes towards unfamiliar technologies are constructed on the spot, drawing from relevant associations (e.g., the perceived benefits of flexible work) to evaluate potential impacts (see for example Fazio 2007; Schwarz 2007). These attitudes highlight the importance of considering social and economic implications when implementing drones.

While some participants contemplated the implications for existing delivery drivers, others argued that the introduction of delivery drones might create new jobs, such as drone pilots. For example, an quote from a discussion between participants in the Public Group #3 group:



“What are Deliveroo drivers going to do?” (Female Participant 5, Public Group #3)

“Get a better job then?” (Female Participant 1, Public Group #3)

“They can become drone pilots? Better job than cycling everywhere isn't, it?” (Female Participant 2, Public Group #3)

The suggestion that delivery drivers could transition to ‘better jobs’ as drone pilots reflects a belief that automation might bring new employment opportunities. However, this optimism is mitigated by fears often fuelled by media narratives that portray that automation could remove human roles. Media coverage emphasising robots replacing humans (see Section 7.3.7) contributes to a social representation of future job insecurity and a fear of being replaced by machines. These concerns resonate with the idea that people evaluate technological risks and benefits based on their internal belief systems and prior experiences (Chaiken and Stangor 1987; Renn and Benighaus 2013). This anchoring of delivery drones within familiar concerns about automation highlights an interplay of media narratives (external information sources) and their cognitive evaluations (internal belief systems) of potential risks and benefits.

Another participant reflected on the concerns of automation concerning drones and the broader social and psychological roles that employment plays in people’s lives. She comments:

“I'm just wondering if it's like another thing that will be automatic in a way. What's the next technology like without human beings behind it? Like I know research and so on and so forth, but like another automatic thing that would make people work less, which on one hand is good, but work is important to people for different reasons, not just kind of, you know, money. It's more like people need a purpose... And when everything is automated, then there won't be jobs..” (Female Participant 4, Public Group #6)

The participant relates the implementation of drones to existing understandings of employment as a source of income, well-being, purpose and social interaction. By stressing the multifaceted value of employment, the participant anchors the concept of drones within familiar concerns about job losses and their ethical implications. Hanandini (2024) notes that such views emerge when technological advancements present ethical dilemmas, particularly about their transformative impact on the welfare of workers and the societal implications of unemployment.

Some participants had a more positive outlook on the impact on jobs. A participant who works as a delivery driver was questioned about the fear of losing his job and responded with optimism:

“...A lot of people don't need one or two things, they need big deliveries... I'm going to work at Home Bargains, they did cages, but they won't be able to deliver cages... I'd say maybe the smaller warehouses might be in trouble, maybe you do like little deliveries. But then realistically, they still need people in the warehouse, like packing it. So they lose some jobs, maybe...But a lot of people, they look at it as a factor, like it's probably cheaper to get and run this drone than to pay someone eight hours a day to deliver stuff. So, it'll probably do what it always does. It'll probably, close jobs off, but open up different jobs. And maintain them and have mechanics to the drones. And you have to have a backup as well because drones break. You need to get deliveries out. So I assume there's still going to be some sort of contingency where you'd have someone in who would do both maybe.” (Male Participant 6, Public Group #7)

The participant views technological advancements as reshaping rather than eliminating jobs, emphasising new employment opportunities alongside reduced delivery roles. This perspective highlights the continued need for human involvement in logistics and reflects an adaptive approach to workforce transitions in response to automation.

Another participant argued that delivery drivers would still be employed making the ‘last mile’ deliveries, therefore creating more employment opportunities, for example:

“If you have got the infrastructure where you've got the Vertiport somewhere close by, taking the point that all the deliveries are made there...and then distribute it locally. Those delivering, you've created more employment for them.” (Male Participant 3, Stakeholder Group #2)

The participant, a transport planner from the local government, suggests that building infrastructure like vertiports could stimulate job growth. This reflects a social representation that positions delivery drones as a system that may enhance local communities through job creation. But also, his professional positioning as someone actively involved in supporting the development of such technologies. His role and expertise likely influence this positive framing, aligning drones with community development and economic benefits. This representation counters fears about automation and job displacement, illustrating how individual beliefs and professional contexts shape attitudes towards emerging technologies.

While there's optimism about new roles, participants also exhibit underlying anxieties about job quality and security in automated industries. They question what types of jobs will be available and whether these roles (like drone piloting or warehouse work) will offer comparable stability, flexibility, and fulfilment as traditional delivery jobs. This representation reflects a broader societal concern that automation may bring new jobs but could reduce job security and quality for some workers. These social representations highlight participants' complex views toward introducing delivery drones. While there's recognition of the potential for job creation, there are also nuanced concerns about these new roles' quality, security, and sustainability. These discussions suggest a cautious optimism, where technological advancements are welcomed but with an understanding of the need for policies to ensure fair and meaningful employment in an evolving job landscape.

#### 10.4.3 Impact from Drone Noise

Participants expressed their concerns about the impact of drone noise on their mental health and discussed the potential implications of drones on individuals who have disabilities. They recognised that drone noise could be a possible trigger for specific populations, for example:

Quote 1:

"I think some people with autism... surely that might affect them more because of the sounds." (Female Participant 5, Public Group #7)

Quote 2:

"I think there are certain people who that's going to trigger like my son is autistic and certain noise... same with me, but I'm not autistic but... various noises might cause me to become distracted." (Female participant 1, Public Group #6)

By emphasising the potential distress caused by technology-induced noise, especially to vulnerable groups, participants anchor drones within the context of public health and mental well-being. This anchoring highlights the belief that technologies should prioritise inclusivity and minimise harm, reinforcing the importance of considering diverse needs in the future deployment of drones. This representation highlights societal expectations that technologies should be developed and implemented with mental health impacts and accessibility in mind.

Furthermore, concerns related to drones spoiling tranquillity were also brought up in conversation, for example:

“I think my main concern is the loss of tranquillity. And we're told, you know, very frequently that it's good for mental health to kind of get into a tranquil place, go for a walk, experience nature, but I would be concerned about the noise of a drone overhead disturbing that important tranquillity, especially in a national park.” (Female Participant 2, Stakeholder Group #4).

The participant relates drone use to familiar values of preserving peaceful environments to ensure public well-being. By stressing the need to manage drones in natural or tranquil settings, she anchors drones within existing concerns about environmental preservation. Peterson et al. (2015) note that the proximity to the issue and trust in responsible institutions strongly influence public attitudes toward emerging technologies. This representation highlights the societal expectation that drones should be deployed responsibly to protect valued environments while maintaining public trust.

This was argued by another participant who commented about drone routes being planned over certain areas, with experts taking account of where they fly. Therefore, this might not be a concern. For example:

“I get your point about the tranquillity, but I do think this is to try and, you know, this drone delivery isn't going to be a free-for-all all. It's going to be set, planned routes to make sure that all that has been taken into account.” (Male Participant 1, Stakeholder Group #4)

The participant suggests that regulating and planning drone routes could mitigate noise concerns by anchoring drones within proactive governance to minimise disruptions. This representation emphasises that effective planning and regulation are essential to reduce negative impacts, particularly in tranquil areas, reinforcing the expectation that emerging technologies should align with public needs.

Participants also drew comparisons of drone noise to other modes of transport, for example:

Quote 1:

“If they're noisy. Like the little planes that I get over my place from the airport. They really are disruptive. They make so much noise...” (Female Participant 1, Public Group #3)

Quote 2:

“I don't know if seeing them would bother me, but I can imagine the noise getting quite irritating. I think you do get used to it, but like, I live in Vauxhall and we have helicopters overhead a lot whenever there's anything going on around Parliament.” (Female Participant 1, Stakeholder Group #1)

These views are formed through objectification within SRT, as participants use analogies with traditional aircraft noise to make sense of the less familiar concept of drone noise. Schwarz-Plaschg (2018) highlights that in the absence of direct experience, people tend to rely on analogies with familiar phenomena to make sense of a new technology. This reflects the central role of analogies in public engagement with science and technology, where they serve as a tool for making sense of emerging technologies (see for example Marková et al. 2007; Wibeck et al. 2007). Using analogies to objectify drone noise helps participants transform it from an abstract idea into an understandable one. Participants' understanding of drone noise as a unique disturbance suggests that it could be more intrusive than other aircraft, mainly due to its potential proximity to houses. These findings highlight the importance of managing public expectations and concerns about drone noise.

Some participants reflected on whether they could hear the drone noise due to existing noise pollution in cities or get accustomed to the noise of aeroplanes. Others noted that drone noise is not an issue, and people would barely notice their presence due to existing noise. Some examples include:

Quote 1:

“Yeah. I think people are used to, in cities certainly, they're used to noises, whether it be blaring car horns or, you know, sirens and stuff like that.” (Female Participant 1, Public Group #6)

Quote 2:

“I think most people, I think people might just feel quite indifferent to it. Like, it doesn't really affect too many people. Some people or the people it will affect, they'll notice it. But, like I said, people probably won't even notice it's going on.” (Male Participant 6, Public Group #7)

Participant views about drone noise are anchored in the familiar context of urban background noise. By framing drone noise similar to existing sounds like horns, sirens and aeroplanes, participants anchor their perceptions within their everyday experiences of living in noisy environments. This representation suggests that people accustomed to urban noise may

perceive drones as less disruptive, expressing indifference or acceptance toward the potential impact of drone sounds. By anchoring drones within the broader category of urban noise, participants normalise their presence, minimising the perceived significance of this additional sound in their daily lives.

In their discussion, a group of female participants raised some concerns about drone noise. An quote from their discussion:

“So, delivery drones flying over populated areas make me feel...” (Female Participant 1, Public Group #3)

“Irritated.” (Female Participant 2, Public Group #3)

“I haven’t heard a drone sound ever.” (Female Participant 3, Public Group #3)

“A bit like a little... wasp.” (Female Participant 2, Public Group #3)

“It’s irritating. I’ve noticed it’s irritating. Let’s say this was nighttime and you’ve got children fast asleep. I just wonder how much sleep children would get if they were disturbed by the sound...” (Female Participant 5, Public Group #3)

“Most children sleep through a thunderstorm.” (Female Participant 2, Public Group #3)

“I wonder if it depends on your initial perception of it, because I love listening to trains in the distance at night, so I wonder where they are going. And I love the idea of travel. So maybe because you are already hostile towards drones, the thought of their noise.” (Female Participant 3, Public Group #3)

“The noise definitely... I do find it very irritating noise.” (Female Participant 2, Public Group #3)

“That’s understandable.” (Female Participant 3, Public Group #3)

The participants use speculative perceptions and comparisons to familiar sounds to make sense of the abstract concept of drone noise. These views demonstrate how individuals rely on assumptions and analogies to form a representation of drone noise in the absence of direct experience. This process highlights how anticipation shapes public attitudes toward emerging technologies (Barben et al. 2008). For delivery drones, limited knowledge leads individuals to imagine potential consequences, such as disruptive noise. This highlights the importance of addressing speculative concerns through transparent engagement to build public understanding of drones.

From the same group, Female Participant 2, who emphasised her irritation with noise, created a ‘good drone’ scenario and expressed willingness to accept the noise depending on the drone’s use. She states:

“But if that drone was doing good, i.e., it was a police drone catching two drug dealers, which you don't like at Boscombe. Wouldn't that make you think, oh, where's a little bit of noise, but it's actually going to take two drug dealers off the street? Well, I'm sat having a little swim. I'll stick my head under the water and I can't hear it anyway. And you've got two people off the street with the good...” (Female Participant 2, Public Group #3)

By expressing conditional acceptance of noise based on the beneficial purposes drones might serve, such as police work, the participant anchors their tolerance for such disruption within a narrative of social utility and moral justification. Macnaghten et al. (2015) argue that public responses to emerging technologies are not solely about maximising benefits or minimising harms but also about the moral meanings and purposes associated with the technology. This representation suggests that public tolerance for noise is based on its alignment with socially beneficial outcomes.

Participants also expressed how they feel about drone night flights with noise as a concern in mind, and some proposed implementing time restrictions on delivery drones if they operate at night:

Quote 1:

“People flying overnight, over their homes, landing next to someone next to you. They are quite loud when they come into contact. So I was like, it's telling us to put an aircraft stop at a certain time each night, so it'd be the same as drones, really. You can't have, like you said, you can't have continuous noise all the time. (Male Participant 1, Stakeholder Group #4)

Quote 2:

“I'd find it a little bit intrusive initially, but probably just, and the noise, I think like everything else you get, if it was, if it was in a daytime situation, it always doesn't bother me... If it was late at night, it would annoy me.” (Female Participant 1, Public Group #1)

Quote 3:

“Depending on the area, I guess. Yeah, I would say maybe not early. Like 1 am to like 5 am, because I don't think people would want to get in terms of like, yeah. Same reason you can't make too much noise outside of the house. Because if people are

trying to sleep, they don't want to hear like a massive drone going past them.” (Male Participant 1, Public Group #7)

Participants emphasise the intrusiveness of drone noise at night due to the absence of ambient sounds, anchoring their concerns within expectations for nighttime tranquillity and regulatory practices such as those governing construction noise. This representation highlights the belief that drone operations at night should be restricted for community well-being, especially in residential areas. By anchoring drones within existing norms, the participants frame their concerns as part of broader societal expectations that minimise disruptions.

The findings illustrate the participants’ nuanced perspectives on the mental health, tranquillity, inclusivity, and regulation implications of delivery drone noise. These social representations reflect a spectrum of attitudes toward drone noise, highlighting factors such as urban acclimatisation, conditional acceptance based on utility, and a general lack of firsthand understanding. These social representations emphasise participants’ preference for peace at night, the heightened sensitivity to drone noise during these hours, and a call for regulation to ensure that drone operations do not disrupt residents' nighttime routines.

## 10.5 Where Should Drones Fly?

Determining where drones should fly is an important issue that raises practical and ethical considerations. This section explores participant recommendations on the establishment of drone corridors, with an emphasis on managing drone flights to minimise their impact. Many participants expressed concerns about drone flights over residential areas and schools and proposed carefully regulating these areas. Moreover, participants encouraged the creation of no-fly zones in sensitive locations that may be prone to security risks. Participants also discussed flights over areas of natural beauty and provided insights about their preferences.

### 10.5.1 Predefined Paths or Drone Corridors

Most participants supported the idea of predefined routes for delivery drones, with many viewing drone corridors as a potential solution for managing the increasing number of drones in the sky, for example:

Quote 1:



“There's got to be predefined routes in the sky. They do it with aeroplanes, so somehow, they're going to have to bring it down to do it for drones.” (Female Participant 2, Public Group #5)

Quote 2:

“As we're building those superhighways in Skies. And what we're saying is that's the route that you're going to take... It's the M1. So rather than having that M1 in Skies, you say, okay, M1 can be used, but the post office, rather than you delivering... on your own, you will work with DHL, but that's your route. That's your corridor... you've got thousands of drones, and you haven't got the airspace to manage that. So, that's how I see it, and that is for me is critical.” (Male Participant 3, Stakeholder Group #2)

Quote 3:

“So you could have airspace corridors that were just for delivery.” (Male Participant 6, Stakeholder Group #4)

These quotes highlight social representations of structured airspace management for drones, emphasising the importance of predefined and regulated routes to ensure safety and efficiency. The participants use analogies with existing aviation norms, such as aeroplane routes and ‘superhighways in the sky,’ to make the abstract concept of structured airspace management for drones relatable. For example, Quote 1 illustrates a participant drawing a straightforward comparison to aeroplane routes, using familiar systems to conceptualise drone integration. In contrast, Quote 2 reflects a participant’s professional positioning, as they reference Project Skyway, a real initiative developing drone corridors. However, while this reference adds specificity, it remains grounded in speculative reasoning, as Project Skyway lacks detailed implementation plans. This shows how even informed perspectives rely on analogical imagination to fill gaps in knowledge, envisioning how these issues might be resolved in the future. Finally, Quote 3 succinctly illustrates the idea of dedicated airspace corridors for drones, reinforcing the broader theme of analogical reasoning. This approach, noted by Schwarz-Plaschg (2018), demonstrates how participants use familiar systems as a foundation for exploring and discussing the governance of emerging technologies, combining existing knowledge with innovative ideas.

One participant argued against the implementation of drone routes. She stated:

“Essentially, the benefit of a drone is getting somewhere quick. So, why would you impose... like, we found it doesn't matter how many cars you've got on a road, if you put in an extra lane, you get more cars. They don't reduce. So, why would you encourage a drone to go down the same route way, causing exactly the same problem in the air as you would on the ground?” (Female Participant 1, Public Group #6)

The participant incorporates ‘common sense’ by comparing drones and overcrowding on roads, framing drones as potential contributors to airspace congestion. This analogy objectifies concerns about scalability and unintended consequences, emphasising scepticism about whether drones can sustain their perceived benefits, such as speed in a shared and regulated airspace. By relating these concerns to familiar ground transport issues, the participant highlights the need for innovative traffic management to prevent replicating such problems in the skies. The public typically correlates perceptions of risk and benefit rather than evaluating them individually (Alhakami and Slovic 1994; Bearth and Siegrist 2016), and because benefits such as speed and efficiency are closely related to individual experiences, the public often perceives more significant benefits and undermines risk (Li and Li 2023). While the public often lacks the technical knowledge to assess risks scientifically, the risk is not purely objective; it is also shaped by values and lived experiences, which makes these social representations valuable.

One participant recommended setting drone corridors according to the population density and made a comparison of rural and urban areas:

“That's why I think it often comes down to the density of the population in those areas...in sort of whether aviation you can define corridors where you can concentrate the aircraft, in the knowledge that you can avoid affecting where people live. And for routes outside urban areas, that might be quite a good solution. You can't really do that in cities in the same way, so then the question is, do you try and define multiple corridors, or do you let it be more flexible?” (Male Participant 2, Stakeholder Group #1)

The participant highlights the potential for predefined corridors to work effectively in sparsely populated areas where routes can be designed to minimise disruptions to residential areas. He relates the concept of drone airspace management to familiar concepts such as risk perception, urban planning and regulatory adaptability by anchoring his views in context-specific considerations of efficiency, safety and disruption. The comparison to risk perception in aviation illustrates how participants anchor urban drone corridors to existing fears associated with densely populated areas, where the potential impacts of accidents are

perceived as more severe despite low probabilities (see for example, Scholz and Siegrist 2010).

Participants thought of predefined routes that would mitigate the potential ground risk, for example:

Quote 1:

“Explore what the risks are. And consider what you can do to mitigate that. Whether it's just about planning and checking where there's, like, critical infrastructure and planning routes, according to that.” (Female Participant 1, Stakeholder Group #1)

Quote 2:

“I mean a beach, a busy beach in the summer you shouldn't even go near it really... But for a company trying to think of the risks involved...they can justify the risk if they've made that decision to avoid the beach with the people.” (Male Participant 1, Stakeholder Group #4)

These quotes highlight social representations of risk management and responsible planning in drone operations. By advocating for careful assessment and mitigation of risks, mainly through route planning to avoid sensitive and densely populated areas, participants anchor drones within expectations of safety and responsibility in transport planning. This representation highlights the societal demand for proactive strategies to minimise potential harm and ensure that drone operations align with broader principles of public safety.

These findings suggest that while participants are generally open to expanding drone deliveries, they are also aware of the challenges that come with it. They advocate for careful planning of drone routes as a solution to managing growth, suggesting an understanding that if drone deliveries become common, there would be a need for designated flight paths to ensure safety. Preventing air space congestion is highlighted as a concern, demonstrating anxiety about the systems to manage high volumes of drones in the airspace. These insights highlight the need for carefully planned drone routes that consider social, environmental, and safety impacts and address potential risks while maximising the benefits of delivery drones.

### 10.5.2 Flights Over Residential Areas and Schools

In the discussion, participants showed lower concern regarding drones flying over public areas like parks, roads, or streets compared to private gardens or residential buildings. This dialogue

encouraged participants to reflect on proposed flight paths and airspace management, such as:

“I mean, I dunno ... you couldn’t enforce certain routes if people didn’t want them over their properties or whatever. That’s not something you could enforce really, is it?”

(Female Participant 2, Public Group #1)

“Well, I would say you, I know it’s, it’s quicker to go by the [drone], ... but then you are going across people’s gardens, et cetera, and you would have to have a lot of people to think that’s okay.” (Female Participant 1, Public Group #1)

“You will need airspace control...” (Female Participant 3, Public Group #1)

“Yeah, airspace control, that’s what you would call it. Because you know, as my granddaughter said, you can’t have ‘em flying over gardens.” (Female Participant 1, Public Group #1)

Participants anchor their perceptions about drone operations with familiar ideas of privacy and ownership, emphasising the need for regulation to mediate conflict between public and private spaces. Comments about requiring consent for drone flights over private properties highlight a belief that such practices must first be accepted collectively to gain legitimacy. By drawing parallels to existing transport systems, the idea of structured governance, such as regulated drone corridors, further anchors drones in the context of organised and controlled infrastructures. These views can be explained through the affect heuristic (Finucane et al. 2000) and implicit attitudes (Siegrist et al. 2006). The affect heuristic asserts that people’s risk perceptions are shaped by their overall emotional impressions of a hazard, with negative feelings amplifying risks. In this case, the emotional discomfort associated with drones intruding on private spaces heightens their perceived risks (such as loss of privacy). In contrast, potential benefits such as convenience are ignored (Finucane et al. 2000). Implicit attitudes further suggest that subconscious associations with hazards, such as intrusiveness or lack of control, influence how people perceive risk (Siegrist et al., 2006).

A comment card stating, “Should delivery drones be allowed to fly over residential areas and schools during the day?” prompted reflection:

“...Not schools.” (Male Participant 6, Public Group #7)

“But if they’re not out in the playground, it doesn’t make a difference, does it?” (Female Participant 5, Public Group #7)

“Yeah maybe, depending on as I said, if people are in trouble, yeah, maybe just know when the breaks are, when the kids are up, and then to be fair, they’ll be able to, like,

PE as well, probably... But to be fair..., schools aren't massive... it's not really much of a detour is it, if you've got to go around the school, you've just got to make sure. Yeah, I say residential areas are fine. Schools may be a bit more for the fact that like, the one per cent that does go wrong.” (Male Participant 6, Public Group #7)

Schools are socially represented as high-stakes areas where minimal risks are deemed less tolerable, and the public has a protective stance towards spaces associated with children. By emphasising the need for tailored regulations, such as scheduling flights outside active times or avoiding flights over schools, participants anchor drones within ideas of ethical decision-making and high-stakes risk management. These perspectives highlight an expectation that safety should be prioritised over convenience in sensitive contexts. Scholz and Siegrist’s (2010) concepts of speculative and pure risks further explain these views. In sensitive areas like schools, people tend to focus on the most severe imaginable outcome, such as danger to children, over statistical probabilities, which are often minimised in risk assessments by technical stakeholders. This difference in risk evaluation highlights why schools, as socially sensitive spaces, are perceived as requiring stricter precautions despite low-probability risks.

The findings reveal that participants are concerned about drone flights in their communities, particularly in residential areas, and safety around schools. The discussions indicate that participants are more comfortable with drone operations in less sensitive areas and suggest avoiding flight paths planned over areas that spark public apprehension.

### 10.5.3 Flights Over Sensitive Areas

Envisioning drone routes also led to reflection on no-fly zones in sensitive areas such as military bases or ports, for example:

“I wonder if, like, you know, Fawley Refinery is probably banned, you know because it's a sensitive location, isn't it? It could be, yeah. Well, let's suppose Fawley. (Female Participant 2, Stakeholder Group #4)

“The ban on the port is actually based on terrorists out there, probably would be the same for Fawley.” (Male Participant 3, Stakeholder Group #4)

“But that's what's weird, though, isn't it, is because someone says, well, I'm flying to, they don't, you just do it anyway.” (Male Participant 1, Stakeholder Group #4)

“Yeah. Well that goes back to your earlier point, isn't it? That people are just flying recreationally without asking anybody and not sticking to any rules.” (Female Participant 2, Stakeholder Group #4)

Participants discuss no-fly zones to emphasise security concerns related to sensitive areas which are perceived as likely targets for terrorism. They compare drones to previous technologies and highlight concerns about non-compliance among hobbyist drone users to objectify the concept of drone regulations. These representations convey the necessity for stricter enforcement mechanisms and greater accountability to ensure responsible drone operations, especially in high-risk areas. These views resonate with the concept of analogical imagination, which suggests that people can draw lessons from past experiences to inform governance for emerging technologies (Von Schomberg 2010). Even if previous technologies don't serve as perfect analogies, they offer critical insights that enhance anticipatory capacities, especially in regulatory contexts (see for example, Felt 2015; Sandler 2013). Building on existing traditions, precedent cases, and culturally established norms and values is essential for meaningful decision-making in governance processes (Aronovitch 2007). In the case of drones, the lessons learned from managing sensitive areas in traditional aviation or other technologies can inform the development of regulations to address the unique challenges posed by drone operations.

Another participant mentioned the introduction of flight restriction zones:

“The air navigation was updated following the drone sightings at Gatwick in 2019. And that led to the establishment of flight restriction zones around every aerodrome in the UK.” (Male Participant 6, Stakeholder Group #3)

This quote highlights the importance of flight restrictions implemented after drone-related incidents, emphasising their role in preventing future disruptions and ensuring safety and security. The participant's views are grounded in his understanding of drone regulations and familiar responses to threats. This reflects a social representation of regulatory responses as crucial for maintaining control in sensitive areas, including no-fly zones. As noted in Section 7.3.4, the influence of media coverage highlights how media narratives amplify public concerns and shape perceptions of drone threats. This aligns with the role of anchoring, where public understanding of drones is grounded in how the media frames regulatory responses as critical for maintaining safety. Since most people encounter emerging technologies through media rather than direct experience, these narratives heavily influence public beliefs (Nelson et al. 1997 cited in Peterson et al. 2015).

Participants' awareness of security risks associated with drones flying over sensitive areas highlights the perceived importance of strict regulation to prevent unauthorised drone flights in these areas. Furthermore, the discussion reflects public anxiety shaped by media coverage of such incidents and the need for stringent measures to ensure safety and security in airspace.

## 10.6 Regulation and Infrastructure Requirements

Regulation and infrastructure are two key factors that would ensure the effective integration of delivery drones. This section explores the participant discussions on regulatory differences between rural and urban areas, highlighting each environment's challenges. Participants proposed recommendations concerning the frequency of flights and time restrictions to minimise potential disruptions, especially in residential areas. Participants expressed the need to license drones and develop delivery hubs to support drone deliveries.

### 10.6.1 Regulation in Rural vs Urban Areas

A comment card stating, 'Regulations for drones should be the same in both rural and urban areas,' led participants to compare the risks of drone flights over urban and rural areas. Participants highlighted the need for place-specific drone regulations that account for the distinct characteristics of urban and rural areas.

Quote 1:

"I think it should be different in urban areas. There's less people. But then you don't want to destroy the countryside, do you?" (Female Participant 5, Public Group #7)

Quote 2:

"It should be associated with ground risk and the regulation needs to be designed such that it can account for ground risk and therefore you would have that distinction between urban and rural by default. But the regulation itself needs to be different. Yeah, it just needs to be a bit more distinctive." (Male Participant 6, Stakeholder Group #3)

These comments reveal social representations of context-dependent regulation, indicating that drone operations must adapt to specific features and challenges of each location, such as population density or environmental preservation. Participants anchor drones within localised governance and risk management systems by emphasising the need for tailored

regulations, highlighting the inadequacy of a one-size-fits-all approach. This aligns with findings in the social sciences on technological risk perception, which emphasise that risk is evaluated through subjective judgments formed by physical senses, social constructs, and contextual factors (Sun and Zhang 2024). Technological risk perception is not equivalent to objective risk assessments but instead is an adaptive process that integrates cognitive, emotional, and social elements (Brell et al. 2019). For example, the public perception of drones as riskier in urban environments may differ from those in rural areas as local priorities and societal values may vary. Moreover, as public risk perceptions often diverge from expert judgments, developing context-sensitive drone regulations must account for these subjective and socially constructed views to ensure public trust and effective governance.

Another participant compared air and ground risk in urban and rural areas:

“From an operator's point of view, between urban and rural...you've got ground risk and you've got air risk. Those are going to be the two differentials overall. So when you say regulation, my view is absolutely it should be different...in urban, the ground risk is likely to be horrendous compared to a rural area. But the air risk is likely to actually be a lot less because you're less likely to have manned aviation within an urban environment, right? As soon as you go into rural, the ground risk is less, but the air risk significantly increases because general aviation is operating around that, the military are operating around that area.” (Male Participant 5, Stakeholder Group #2)

By emphasising the unique risk posed in each environment, the participant anchors drone operations within the existing understanding of aviation safety concerns. This aligns with findings from Watkins et al. (2020), which outline population density and low-altitude aviation as key risk factors in urban areas.

Another participant challenged this view and emphasised that the ground risk would still be the same in both areas:

“For me, one life in an urban area is worth one life in a rural area, so I'd be approaching it from that point of view. Yes, okay, you might have different densities, but you've still got the same risks. At a human level, you've still got the same risks. Yes, there's a likelihood difference and a density difference, but the risk of a drone killing an individual argument wouldn't be different wherever the geography is.” (Male Participant 6, Stakeholder Group #2)



In contrast, this participant, who works as a flight operations manager (unmanned aircraft systems), challenges the emphasis on geographic distinctions by asserting the universality of risk to human life. He argues that at a human level, the risk of a drone-related fatality remains consistent, regardless of geographic context, despite differences in population density. This perspective contrasts with conventional ground risk modelling, which calculates a significantly lower fatality risk in rural areas due to lower population density and fewer potential exposure points. The participant's framing reflects an ethical stance that prioritises the equal value of human life over statistical distinctions, anchoring his argument in moral principles rather than technical risk calculations. He bridges ethical considerations and practical governance by emphasising common safety standards that treat all lives equally, irrespective of geographic factors. While this position departs from established risk modelling practices, it highlights how ethical values can shape the framing of technological risks and guide discussions on emerging technologies like drones.

The participants recognised the challenges presented by drone operations in urban and rural areas. In conclusion, these findings support a balanced approach to drone regulations, depending on an area's unique characteristics and respect for human life.

### 10.6.2 Development of Infrastructure

Players shared their thoughts on preferred landing and take-off locations for drones. During discussions, they envisioned combining various logistics methods with drones and suggested using specific depots or hubs to avoid encroaching on private property. Comment card prompts like 'My suggestions for creating regulations regarding delivery drones would be...' and 'Delivery drones should only take off and land in designated areas such as...' fuelled these dialogues.

An interaction from Public Group #3 illustrates this well:

"So, take off. Well, there'll be some kind of depots? (Female Participant 1, Public Group #3)

"But again, it's delivering...Your [person] is vulnerable and wants it on his drive." (Female Participant 2, Public Group #3)

"...it's a bit pointless if you're gonna put it in a lorry and drive it somewhere before it takes off." (Female Participant 3, Public Group #3)

“...Certainly not crowded places like a beach. You think of the beach on the day.”  
(Female Participant 1, Public Group #3)

“You need a body like the CAA that covers aviation.” (Female Participant 3, Public Group #3)

The participants compare drones to the current delivery systems and call for a regulatory body, such as the CAA, to translate drones into an extension of existing infrastructure, making the unfamiliar technology easier to understand. Objectification is further evident in how participants use analogies to established norms, such as traditional lorry-based logistics or safety protocols, to critique the practicality and integration of drones.

Discussion about take-off and landing sites also made participants envision delivery hubs or distribution centres in case of the absence of a drone landing. For example, an quote of a discussion between participants of the group Public Group #4:

“I don't think they should. Well, yeah, but then what about your takeaway? What happens if you live in an area that doesn't, there's a no take-off zone?” (Female Participant 2, Public Group #4)

“You could have like little like, if you did get it delivered somewhere like that, you can have a little zone, but you might just have to walk a bit further. So it gets delivered in a certain zone.” (Male Participant 3, Public Group #4)

Other participants gave the example of Amazon and their delivery depots:

Quote 1:

“I was thinking if, for example, like Amazon using it to deliver items, then it should be based at the Amazon depot, wherever that is. And that should be outta town.” (Female Participant 5, Public Group #3)

“Oh, you could say a registered base.” (Female Participant 3, Public Group #3)

Quote 2:

“I've been trying to sort of get across, is the likes of Amazon, and all the major distribution hubs. They should have a Vertiport within that, and at the end of our, sort of, regions, motorway links is where we would have another major distribution centre. So you would have the big parcels or the big loads coming into that and then distributing locally to the sort of developments or, yeah, last mile, the last mile or within

the city where we had the urban airport in the city centre.” (Male Participant 3, Stakeholder Group #2)

Participants anchor the unknown idea of drone deliveries into familiar systems such as Amazon depots or vertiports (a familiar concept to some stakeholder group participants) to imagine centralised hubs as essential for efficient operations while addressing challenges such as no-fly zones or restricted landing areas. Notably, the term ‘vertiport’ reflects the positioning of Male Participant 3, whose professional involvement with delivery drones influences his vision of how the technology should be integrated. Others propose more structured solutions, such as locating drone take-off points at major distribution hubs or depots outside urban centres, ensuring that drone operations align with existing infrastructure like motorway links. These representations are shaped by participants’ familiarity with traditional logistics models, such as Amazon’s operations, and societal expectations for efficiency and accessibility while also reflecting practical concerns about integrating drones into existing urban and rural frameworks.

Another participant proposed planning and building vertiports near housing estates. He suggests:

“...The planners have decided that we're building a new brownfield site, we're building a new estate, a thousand houses are going in there. In those thousand houses, we will have two vertiports. That's the standard planning. So that's the implementation. The ones that have already been built. Can we find a piece of green land, or can we find two parking, four parking spaces where we can put that vertiport?” (Male Participant 3, Stakeholder Group #2)

Male Participant 3, a transport manager in a local government, transforms the abstract idea of vertiports into tangible elements of urban infrastructure by comparing them to familiar shared resources such as parking lots or green spaces. His perspective reflects a professionally informed representation, likely shaped by his role and experience in urban planning and transport management. By framing vertiports as integral to urban infrastructure, he positions them as tools for integrating emerging technologies into city planning while addressing space utilisation and community needs. This representation suggests a more developed vision of how vertiports might function, informed by his professional insights and practical considerations, rather than a general public perspective.

A participant commented on having delivery or distribution centres with last-mile deliveries:

“If we've got distribution centres. You can also have delivery centres and, like the post office, deliver the last mile...drivers on motorbikes could deliver the last 200 yards.”

(Male Participant 4, Public Group #2)

The participant associates the concept of delivery drones with familiar models of hybrid delivery systems, integrating drones with traditional delivery methods. By framing drones as complementary to established processes, this perspective reflects the belief that drone technology should complement, rather than completely replace, existing delivery infrastructure to address logistical and social challenges.

These discussions reflect a proactive stance towards regulation, urban planning and an approach to using multiple delivery models.

## 10.7 Safety, Security and Privacy Concerns

This section explores participants' discussions around the safety implications of delivery drones, such as the physical risk posed by drones and the potential danger to populations in the event of crashes. Regarding security, participants discussed criminal activities and the risk of terrorism drones may pose to sensitive areas like airports.

### 10.7.1 Safety Concerns

During gameplay, participants reflected on the risks associated with delivery drones, such as ground and air risks, as evidenced in earlier findings. One participant describes her feelings about drones, relating them to risk. She expresses her worry about not just risk to people but how drones may be used, which leads to safety and security implications:

“Kind of mixed feelings. It makes me curious how it could work, but at the same time, worried is not a good word. I'm not worried about them, but kind of maybe slightly uncomfortable with potential risks. The risks are attached to anything, really. I'm more worried about people than the drones, to be honest, and how people would use them”

(Female Participant 4, Public Group #6)

The participant's cautious openness and apprehensions about misuse, whether irresponsible or malicious, anchor her views about drones within the idea of technology as a neutral tool, the impact of which depends on the intentions and behaviours of its operators. The social amplification of risk framework (SARF) explains how risk perception is shaped and amplified by social factors, including media coverage, peer influence and cultural processes (see for example Kaspersen et al. 1988; Kaspersen et al. 2003; Renn et al. 1992). People process risk signals based on their existing knowledge and experience, with perceptions influenced by social context (see Lermer et al. 2015; Raue et al. 2015). Over time, these perceptions are internalised through sociocultural learning and mediated by communication processes, leading to deviations from objective risk assessments (see for example Morgan 2002; Liu et al. 1998). The participant's apprehensions likely stem from amplified risk perceptions shaped by external factors like media narratives and social networks.

Other participant comments reflecting a social representation of drones as both physical risks and targets of human interference include:

Quote 1:

"Well, I hope I don't get hit by one, is what I'm saying." (Male Participant 2, Public Group #2)

Quote 2:

"There will be more risk from people just trying to down them." (Male Participant 2, Public Group #5)

These quotes demonstrate how participants relate the abstract risks of delivery drones to familiar narratives about the interplay between technological advancements and human behaviour. Concerns about harm to individuals and the potential for intentional vandalism anchor drones to existing public safety and security ideas shaped by past technology experiences. This anchoring highlights the influence of collective representations that frame technology as requiring strict regulation to mitigate misuse by people and ensure public safety. By framing drones within these familiar narratives, participants advocate for proactive measures to address risks, aligning drone implementation with societal norms prioritising safety and control.

Participants discussed drone routes, mainly focusing on incidents like crashes and collisions. The examples below illustrate how players reflect on the associated safety and risk

implications. They draw comparisons to other transportation methods and ponder if the risks are analogous:

Quote 1:

“What if two crashed into it? (Female Participant 1, Public Group #1)

Yeah. But cars crash every day...” (Female Participant 2, Public Group #1)

Quote 2:

“So, in a driverless car, you have sensors that can work out what's close by and will stop the car if it comes into contact or was due to come into contact with something. Could technology have the same effect for drones? Could you devise something that means if it sees it's going to hit something it either diverts its route or does something, you know, automatically jigs to the left or whatever so the other one will jig to the left as well so they won't come into contact? Is there some way the technology can be used so you don't have to go down a roadway? Don't know, it's a question.” (Participant 1, Public Group #6)

Quote 3:

“Now, there's already a lot of processes in place in terms of what's the same question as it struck me in the manned aviation aircraft, it's the same question as striking it to a car or a lorry.” (Male Participant 5, Stakeholder Group #2)

The quotes reveal a range of concerns, including the risk of drone crashes, but also highlight parallels with existing transportation systems where accidents are minimised through technology and regulation. Participants' familiarity with technologies like cars and aeroplanes and their associated risks shapes their perspectives, as does public discourse on advancements like autonomous vehicles and collision-avoidance systems. These influences likely strengthen trust in drones' potential to adopt similar safeguards. Analogies to well-regulated industries, such as aviation, further suggest that participants rely on established frameworks to conceptualise how drones could be integrated responsibly. This reflects a mix of cautious optimism and a pragmatic understanding of risks grounded in societal experiences with other technologies. Since attitudes are based on past experiences, they play an essential role in helping people make sense of their surroundings (Fazio 2007; Eagly and Chaiken 2007). In cases where earlier experiences are unavailable, such as unfamiliar technologies like drones, people construct attitudes on the spot to respond to new situations (Schwarz 2007). This explains why participants draw on familiar analogies and established systems

when forming their views on drones, using these references as a foundation for their expectations of safety, regulation, and integration into daily life.

Participants expressed their concern about the lack of human involvement and whether there would be systems in place or contingency plans in case something goes wrong, sparking debate about the autonomous nature of drones:

Quote 1:

“I would say, the drone already will have inbuilt risk, i.e., if it's low on battery, then because it knows the route it's gonna say, sorry, no capacity. I'm not even taking off. So a lot of the safety's gonna be built in apart from that. I agree. Then you literally focus on designated route.” (Female Participant 4, Public Group #6)

Quote 2:

“...So the safety measures would encompass piloting and having that knowledge of like different adverse events.” (Female Participant 5, Public Group #5)

Quote 3:

“I just think that there's room for error when you don't have a person involved. But that's my opinion!” (Female Participant 1, Public Group #1)

Participants form their views around familiar ideas of automation, human oversight and societal trust in technology. Confidence in built-in safety measures is likely influenced by advancements in automation, such as fail-safes in modern devices. At the same time, the emphasis on human oversight stems from societal reliance on human expertise in managing risks. These representations are shaped by participants' exposure to both the challenges and promises of emerging technology. Reliance on human expertise in managing risks further anchors participant perspectives, emphasising the importance of oversight to mitigate potential failures. Concerns about removing human involvement further reflect broader fears of losing control over technology and weakening a sense of agency, a common theme in cultural discourse about automation (see, for example, Ueda et al. 2021). Together, these perspectives reveal a cautious optimism toward drones, with trust hinging on the balance between technological innovation and human oversight.

Some participants were concerned that drones running out of battery mid-flight would cause a crash, for example:

Quote 1:

“But also, if you think about the Beryl bikes and where they end up. So let's say the drone runs out of battery and goes down in any place, so it could end up in the water.”  
(Female Participant 3, Public Group #5)

Quote 2:

“I was gonna say, what happens if it runs out of battery? I mean, imagine trying the energy usage of, like, say we were doing a food shop. You know, it's going to take a lot of energy to take off. You know, would the battery last long enough to get it where it's going?” (Female Participant 5, Public Group #4)

“Yeah. It just could be quite dangerous if it's in a large, populated area. Like, if maybe like, again like it loses battery or something, or if it just like falls down. Yeah. I feel like there's gotta be something to stop that happening otherwise it just... you wouldn't do anything.” (Female Participant 1, Public Group #4)

Participants anchor their views about the operational limitations of drones, particularly battery performance, to their existing experiences with battery-powered devices such as e-bikes and EVs. Concerns about battery failures and the potential consequences of drone crashes in urban areas are anchored in familiar narratives about the limitations of autonomous systems and societal expectations for safety. Their scepticism about the reliability of drones reflects broader cultural apprehensions shaped by societal and individual risk experiences. According to Renn and Benighaus (2013), risk perceptions are shaped by how individuals interpret media-reported risk elements through their existing frames and references. In this context, participant concerns about battery reliability may be amplified by media narratives, reinforcing pre-existing scepticism and expectations for fail-safe mechanisms in autonomous technologies.

Participants also expressed their concerns about the impact of the size of the drone, the weight, and the type of goods that they may carry might pose a risk, for example:

Quote 1:

“The reason dangerous goods become interesting is because suddenly weight isn't necessarily the danger...you could have a less than 15-kilogram drone carrying something that's potentially actually incredibly hazardous to a large population.” (Male Participant 5, Stakeholder Group #2)



Quote 2:

“You've got to be careful of, like, how they're secured and stuff as well.” (Male Participant 6, Public Group #7)

“And the weight, what they carry as well. Yeah. Just if it falls down, you don't want a big weight.” (Female Participant 5, Public Group #7)

Quote 3:

“... the fact that a drone is a machine, therefore it's fallible, and it can easily drop something if it's an industrial estate... what's in there? Boom!” (Female Participant 5, Public Group #3)

Participants transform their understanding of drones into tangible concerns about payloads, weight and operational fallibility. Participants concretise the idea of drones as potentially dangerous by framing drones within familiar contexts, such as aviation risks, hazardous material transport, and technological failures. This objectification process is influenced by their awareness of existing transportation regulations, such as those governing hazardous goods in shipping or trucking, serving as reference points for imagining how drones should be regulated. Media narratives about technological failures further shape these representations, reinforcing cultural narratives about the limitations and risks of autonomous systems. Furthermore, participants express the need for safety protocols and risk management measures by objectifying drones regarding their physical characteristics and potential hazards.

The findings reveal participant apprehensions towards the physical risks drones pose to individuals, such as vandalism or drone-related accidents. The comparison with existing transport systems highlights that existing systems can help mitigate accidents and protect drones from intentional harm. Concerns extend to privacy and security, suggesting strict regulations are essential. These discussions collectively call for comprehensive safety protocols and regulatory frameworks that ensure drones operate safely within public spaces.

### 10.7.2 Security Concerns

Participants highlighted their concerns about delivery drones being used for criminal activity:

Quote 1:

“The only other situation I've seen that has been detrimental is when they've been used in prisons and they've dropped phones or drugs or whatever. That's the only other mention I think I've heard off” (Female Participant 1, Public Group #6).

Quote 2:

“We need to go around to all the prisons and get an agreement with the prison we can fly in there. Because otherwise, we'll commit an offence.” (Male Participant 2, Stakeholder Group #3).

Participants base their views on widely reported media incidents (Section 7.3.6) and public discourse to understand drone risks and connect them to familiar societal narratives, particularly about contraband smuggling in prisons. The mention of requiring agreements with prisons further anchors drones within the familiar context of existing regulations and legal frameworks, making the abstract challenges of drone governance more comprehensible.

Other Participants discussed their security concerns, with discussions revolving around drone systems getting hacked, terrorism and vandalism. For example, a discussion between participants from Public Group #7:

“I think because it's a new concept, I think there's going to be problems with vandalism. I mean, that's one thing that struck me straight away.” (Male Participant 4, Public Group #7)

“Yeah, I think that's a good point.” (Female Participant 5, Public Group #7)

“With vandalism, and the fact that people will be watching and waiting for something to happen on their property to make insurance claims or whatever you're in.” (Male Participant 4, Public Group #7)

Participants draw connections between societal issues, like vandalism, and the context of drones, anchoring their concerns in ideas of technological vulnerability. The novelty of drones amplifies perceptions of their vulnerability, with participants drawing on prior experiences to interpret potential risks.

A comment card stated, ‘It was widely accepted drones pose an additional terrorism risk. What approaches should be adopted to deal with this?’ prompted participants from stakeholder groups to discuss the approaches that can counter the risk of terrorism:

Quote 1:

“Security at take-off and landing.” (Female Participant 3, Stakeholder Group #3)

“Remote ID.” (Male Participant 6, Stakeholder Group #3)

“Cyber security, counter UAV systems.” (Male Participant 4, Stakeholder Group #3)

“Geo-fencing, remote ID. Upgrading sensor systems from the police and security services.” (Male Participant 5, Stakeholder Group #3)

Quote 2:

“I think there's a lot of work already being done for the manned aviation point of view to be able to detect exactly where drones are, ground radar, masts, whatever it is to detect that signal, the RF signal coming from the drone, why not utilize that for the point of authorities and regulations to be able to monitor terrorism activity.” (Male Participant 5, Stakeholder Group #2)

The quotes highlight participants' technical knowledge of strategies for ensuring the secure operation of delivery drones, reflecting their professional roles and expertise. Rather than spontaneously anchoring drones within familiar systems, their responses appear shaped by the specific framing of the question, prompting them to draw on relevant technical knowledge. In particular, discussions around the potential misuse of drones, such as in terrorism, reflect the influence of societal and media-driven narratives, which amplify perceptions of risk. Skirpan et al. (2018) note psychological factors such as fear, voluntariness, and severity that resonate in such contexts. Fear, interacting with a perceived lack of control, often heightens risk perceptions beyond expert evaluations, anchoring drones within broader societal discourses on security and vulnerability. These professionally informed perspectives highlight the importance of a multifaceted approach combining physical security measures, technological advancements, and regulatory frameworks to address the risks posed by illicit drone use.

Another participant from a stakeholder group questioned whether the paranoia associated with drones is due to their perception as a new technology for society:

“Is it scepticism or worry around the new technology? Because an existing cargo bike or van or name any other mode can be used for terrorism and the risk is probably greater than these would be. So I think that's where I have a healthy degree of scepticism about the worry because I think is it a worry of the new versus not equating those similar risks with what's already out there.” (Male Participant 6, Stakeholder Group #2)

The participant situates the perceived risks of drones within the broader context of familiar transportation methods like cargo bikes or vans and anchors drones within familiar transportation and risk management contexts, challenging fears associated with their novelty. This view highlights how societal fears of emerging technologies, amplified by their 'newness effect' and limited understanding, contribute to heightened risk perceptions (see for example Salmon et al. 2024; Bonfanti 2017). Li and Li (2023) explain that risk perception is inherently subjective, shaped by intuition, experience, and overall judgment rather than objective scientific analysis. Emerging technologies, such as drones, exhibit higher levels of uncertainty and concealment, making them more likely to trigger public anxiety or panic than traditional risks (Zhang 2021). Risk perception of emerging technologies involves processing physical signals and information about potential hazards, with judgments shaped by individuals' knowledge and experience (Renn and Benighaus 2013). This explains why the unfamiliarity of drones amplifies concerns, reinforcing the importance of transparent communication and education to encourage informed evaluations of their risks and benefits.

One participant was particularly concerned about drone threats at airports. She states:

"They are a risk, drones. And several airports in Britain have had to close because of drone activity. And it is unlawful to go into controlled airspace." (Female Participant 3, Public Group #3)

She goes on to state that it is not delivery drones, but it is people with evil intent and comments:

"I know several British airports have had to close because of drone activity, and it's been people just playing with drones. It's not delivery drones, it's people with malicious intent." (Female Participant 3, Public Group #3)

The participant relates her apprehensions about delivery drones to familiar narratives of drone misuse, such as high-profile incidents at sensitive locations like Gatwick. Media coverage, such as the Gatwick Airport disruptions such as highlighted by the Daily Mail (Section 7.3.4), has amplified public concerns about drones posing risks to aviation. This apprehension may influence perceptions of delivery drones despite operating under strict regulations. The distinction drawn by the participant between delivery drones and hobbyist or malicious drones demonstrates an understanding that risks depend on operators' intentions rather than the technology itself. However, negative media framing of drone misuse reinforces their image as disruptive, especially in sensitive airspace. Media framing is vital in influencing public understanding of new technologies, as most people rely on these narratives rather than direct

exposure (Nelson et al. 1997 cited in Peterson et al. 2015). These views show participants differentiate legitimate uses, like delivery operations, from malicious or careless behaviour.

### 10.7.3 Concerns about Privacy

A comment card, 'Tell everyone your three main concerns about delivery drones', specifically, generated responses on privacy concerns and prompted participants to expand on their concerns regarding the voyeuristic nature of drones, for example:

"I don't trust a drone going up over gardens in the summer." (Participant 4, Public Group #1)

"Well, because some of them have cameras." (Participant 2, Public Group #1)

"...Kids that are swimming pools. They're running about in their garden. I just don't trust people." (Participant 4, Public Group #1)

The dialogue reflects several social representations regarding delivery drones, particularly concerning privacy, safety, and trust. Participants associate drones with cameras, surveillance, and intrusion into personal spaces such as gardens, drawing on familiar, existing uses of drones for photography, police surveillance, and recreational activities. This association materialises drones as symbols of potential invasions, embedding them within societal narratives about privacy and personal security. These views are shaped not only by emotional and cognitive dimensions, as highlighted by Skirpan et al. (2018) but also by the visibility of these established applications. While technologies may provide benefits, users frequently perceive privacy concerns outweigh these advantages. Contrary to the assumption of a logical trade-off between privacy and utility, feelings, comprehension, and reasoning patterns applied in real-world contexts often contradict this view (Yang et al. 2014; Skirpan et al. 2018). These representations frame drones as intrusive and potentially disruptive, shaped by their current societal role.

Participants also reflected on data protection and risk to their information:

"Indeed, but again, this is where data is important. So, I know the data is offsite, external, if the thing comes down. But because of my lack of knowledge, if the drone goes down, is my address and content going to be visible on a screen? So, as soon as something happens, what is the lock?" (Female Participant 4, Public Group #5)

“I think that's a really great point, because in terms of safety measures, you just brought up privacy of information, and whether that's health information, then that goes into a larger, like, you know, violation. But yeah, that does matter.” (Female Participant 5, Public Group #5)

Participants relate their concerns about data security and privacy in the context of drone operations to familiar anxieties about technological failure and data breaches. Female Participant 4 expresses apprehension about the safety of personal data during a drone malfunction, reflecting broader worries about the exposure of sensitive information. This concern stems from a perceived lack of data management and protection knowledge, revealing distrust in the technology's capacity to safeguard privacy in unforeseen circumstances. Female Participant 5 builds on this by linking data breaches to broader consequences, such as violations involving sensitive information like health records. Together, these views frame drones as physical risks and potential threats to information security, emphasizing the need for transparency, safety measures, and public trust-building through regulations and proactive risk mitigation.

A comment card stating, ‘My recommendations on forming regulations around delivery drones would be...’ also led to reflections on drone regulation, with player dialogue covering topics such as registration and licensing of drones. Players envisioned beyond the game and reflected on what they thought should be implemented in a real-world setting. For example, Public Group #3 discussed drone registration:

“Well, they're supposed to be registered, aren't they?” (Female Participant 4, Public Group #3)

“Should they have clear identification cards, so you know which drone you are reporting?” (Female Participant 3, Public Group #3)

“Registered. So you know which one.” (Female Participant 1, Public Group #3)

The two participants objectify drones by associating them with familiar systems such as vehicle registration or aircraft identification. These views are shaped by societal expectations for regulatory oversight of potentially disruptive technologies. Familiarity with systems like vehicle registration or aircraft identification influences the belief that similar mechanisms should apply to drones. Publicised incidents involving unregistered or untraceable drones likely reinforce these concerns, highlighting the risks of anonymity in drone operations. These representations underline the importance of robust identification and registration systems to promote accountability, public trust, and regulatory compliance in drone usage.

The analysis of participant concerns regarding privacy invasion reveals a general uneasiness and distrust about drones. The presence of cameras on drones intensifies fears of unauthorised surveillance, voyeurism and a threat to privacy in private spaces such as gardens. This threat is significant for participants when considering the privacy of their children. Additionally, the threat to data protection and the risk of information falling into the wrong hands further amplifies these anxieties.

## 10.8 Environmental Implications

On the environmental front, concerns were raised about the sustainability of drone operations. A comment card stating ‘The impact of delivery drones on the public could be...’ prompted some participant responses about environmental implications:

“... Drones are being used all around the world currently in warfare, delivering post, can be used to get to isolated populations. I think it's good thing, overall. I don't see, I mean there will be harm, there will be, there will be issues, things will happen, but essentially, they're better environmentally, they're better sustainably. I'm for them. (Female Participant 1, Public Group #6).

“I'm just thinking, like I don't know enough to be honest, to say whether they are really environment friendly. Like, I understand that they don't use as much fuel, let's say, as cars or whatever, but whether the production is environment friendly, I don't know that.” (Female Participant 4, Public Group #6).

Participants contextualised their views through familiar narratives about sustainability and technological innovation. The two perspectives reveal a tension between participants where, on the one hand, there is interest in the potential benefits, and on the other hand, there is a need for more information. The first participant's positive stance may be influenced by broader societal narratives highlighting drones' innovative applications and potential to address challenges like environmental sustainability and access to remote areas. Media coverage and promotional material likely reinforce the perception of drones as eco-friendly alternatives to cars or vans. In contrast, the second participant's scepticism is shaped by a lack of detailed information about drone production, reflecting a standard gap in public understanding of the lifecycle impacts of emerging technologies. These differing perspectives highlight the

importance of evidence-based communication in building informed public opinions about drones' environmental and societal benefits.

Female Participant 1 further adds to her comment and queries the battery disposal of delivery drones, questioning the environmental benefits as compared to other logistic modes. She states:

"Is there a real link between batteries and drones? Because we know the issues with batteries, and we know that they can be very bad to dispose of... the heavy leads and metals and whatever, all of that stuff going on... Does that automatically mean that a drone is a good thing because it's using that better technology?" (Female Participant 1, Public Group #6).

The participant transforms the abstract concept of drones' environmental sustainability into tangible concerns about battery production, disposal and lifecycle impacts. By framing drones within the broader context of battery-powered technologies, the participant objectifies drones as part of a technological ecosystem where sustainability claims are contingent on addressing the environmental costs of key components. The participant's focus on battery disposal and recycling highlight a societal narrative that questions the hidden environmental costs of emerging technologies, influenced by media coverage of e-waste issues and the impact of mining for battery materials. This objectification challenges promotional narratives that present drones as inherently sustainable and frames them as technologies requiring deeper scrutiny to substantiate environmental claims.

It was also noted in stakeholder discussions that dialogue concerning wildlife disturbance mostly revolved around birds. These comments were brought up in conversations about drone routes and noise, for example:

Quote 1:

"The noise that a drone makes would make most birds scatter, although that's not great in itself, but that could happen." (Female Participant 2, Stakeholder Group #4).

Quote 2:

"In areas where you might have like endangered bird species or something like that, where there could be a risk, I can see why you want to limit flight routes that way." (Female Participant 2, Stakeholder Group #1).



Quote 3:

“...Various birds with big raptors have taken drones out of the sky because they view it as a trespass in their territory... you have the issue that some of the birds around here will take out a drone.” (Male Participant 3, Stakeholder Group #4).

These quotes highlight participant concerns about the ecological disruption caused by drones, particularly their impact on bird populations, by anchoring their understanding of drones with established values of environmental preservation. This reflects social representations of drones as intrusive in natural ecosystems, emphasising the need to consider ecological factors in the planning and regulating of drone operations to minimise harm to wildlife. Similar concerns are echoed in broader discussions about land preservation, where individuals and communities that highly value natural aesthetics and environmental preservation often view visual and physical disruptions from new technologies as unacceptable (Peterson et al., 2015). These parallels highlight the importance of integrating ecological considerations into technological advancements.

## 10.9 Viability

Participants reflected on the operational parameters of delivery drones, such as their weather implications, and some on the cost of drone deliveries. This section examines these factors to assess perceptions of the viability of integrating delivery drones into mainstream logistics.

### 10.9.1 Weather Implications

Some participants discussed the impact of weather on drone flight feasibility and reliability:

Quote 1:

“So, if there was a need, Scilly Isles somewhere like that where the weather's rough, but it's rough quite a lot of the time, could they standardly use drones to deliver food just for the normal population who are going about their normal business, but purely because a boat can't dock?” (Female Participant 1, Public Group #6)

Quote 2:

“If a certain weather phenomenon or wind speed is, then no flights are even possible.”  
(Male Participant 4, Public Group #5)

Quote 3:

“Also, you're dependent on the weather conditions. The weather conditions. Because if it's rainy, windy, snowy, they're not going to be very effective because the winds are going to, like, take it off.” (Female Participant 6, Public Group #4)

Participants situate drones within real-world contexts by considering how they would perform under challenging conditions, such as adverse weather, and questioning whether the technology can handle these scenarios effectively. By referencing specific contexts, such as the Scilly Isles, they use common sense to evaluate the practicalities of drone operations in environmental conditions that impact logistics. These representations reflect a critical appraisal rather than personal experiences, as other transport methods are less affected by weather disruptions. While recognising the potential of drones to reach remote areas, participants highlight the need for robust systems that can adapt to varying conditions, questioning whether drones are sufficiently resilient to meet logistical demands in such environments.

Participants were observed reflecting on the routing from the board game, such as plotting a longer route, avoiding areas or going in a straight line. One participant considered factors such as adverse weather, which might impact drone routes, for example:

“You wouldn't necessarily do a to be in a straight line, you do exactly the same as you probably would a ship or a boat knowing that the wind may have an impact. So, you're going to have to set the course slightly differently, you'd have to have surely people who understand the environment and the weather, and they would be the ones who plot the routes not just us saying I need to go from Totten to Warsash in a straight line.” (Female Participant 2, Public Group #5)

The participant connects the concept of drone navigation to familiar transport like maritime and aviation, where environmental factors and skilled planning play essential roles. By comparing drones to ships or boats adjusting their courses for wind, the participant anchors drones within transportation practices that rely on human expertise and environmental awareness. Furthermore, rejecting a simple ‘straight-line’ approach reinforces the anchoring

of drone navigation as complex and situational, requiring dynamic strategies to account for real-world challenges such as unpredictable weather. These representations emphasise integrating advanced technology with skilled human oversight to optimize drone performance in real-world applications.

### 10.9.2 Economic Viability of Delivery Drones

Participants discussed the cost efficiency and the economic viability of delivery drones:

Quote 1:

“Is that going to cost more? Delivering by drone, one packet of Anadin?” (Male Participant 6, Public Group #2)

Quote 2:

“I was just thinking then, does this mean that we need a larger number of drones? And, you know the impact of that...financially also, how does it work, do we need too many drones to make this financially viable, then? That was my thought. If we cannot have a drone that carries, a 30-kilo package, and we can only have a drone that carries a 1 or 2-kilo package, then this means more drones, and then this means that it's necessary to make money out of it, and someone needs to make money out of it.” (Female Participant 4, Stakeholder Group #2)

Quote 3:

“Again, everything always comes down to money. Are you going to have 50 flights where it costs you exactly the same as one delivery person driving out?” (Female Participant 4, Public Group #5)

These views demonstrate that participants frame drones as economically uncertain technologies by linking their financial viability to familiar logistics practices. These views are shaped by participants' familiarity with conventional logistics and amplified media narratives emphasising the high costs of emerging technologies. Li and Li (2023) highlight that new technologies often entail explicit costs, such as financial investment, and implicit costs, including psychological resistance to transitioning from familiar systems.

Furthermore, participants discussed regulations associated with cost:

Quote 1:

“Probably how much you pass on to the consumer, I guess. If you're paying, you'll be paying for delivering bits and pieces, you probably want to cap on how much you're actually delivering. You're going to have to pay for it instead. Because there are probably people who are trying to force other costs back on the consumer if they're trying to...So maybe regulations on costings maybe around deliveries.” (Male Participant 6, Public Group #7)

Quote 2:

“Will there be a smart costing type thing, so at night it's cheaper, or at day it's cheaper? Are there going to be times of the day when it's going to be cheaper too, because we know who's going to muster in as a revenue-raising idea, and that'll be the Government?” (Male Participant 1, Public Group #5)

These discussions reflect concerns and opportunities regarding the cost implications of delivery drones. On the one hand, participants worry that companies might pass the implementation and operational costs onto consumers, potentially making delivery services expensive without regulatory oversight. On the other hand, there is optimism that drones' efficiency could lead to cost savings and lower delivery fees. The suggestion of smart pricing, including the possibility of government intervention, introduces a potential mechanism for cost management. These representations are shaped by participants' experiences with pricing models in industries such as transportation and delivery services, where costs are passed on to consumers. Concerns about affordability and fairness stem from broader societal narratives on economic inequality and rising service costs. At the same time, scepticism toward government intervention reflects historical tensions around taxation and public revenue policies. Venkatesh et al. (2012, p.161) define price value as the “consumers' cognitive trade-off between the perceived benefits of the applications and the monetary cost for using them.” This trade-off is essential for adopting consumer technology since users often incur the costs associated with these technologies. Positive behavioural intention is more probable when the perceived advantages surpass the financial costs (Venkatesh et al., 2012). These insights align with participants' views, suggesting that public views of drone delivery depend on whether its benefits justify consumer costs.

## 10.10 Conclusion

The findings demonstrate that participants make sense of delivery drones through social representations, using analogies and familiar frameworks to cope with unknowns and employing strategies like objectification and anchoring. Participants anchored drones within familiar contexts, values and societal norms and drew knowledge from existing knowledge of traditional transport, logistics, media narratives and societal experiences with other technologies to make sense of abstract concepts. Across diverse contexts, from food to medical use cases, impact on communities to economic viability, a dominant theme emerged, i.e., participants consistently evaluated drones through their perceived associations with collective benefit, fairness and societal priorities while proposing context-specific solutions to address uncertainty and managing risks. These views reveal issues with significant policy implications.

Participants emphasised prioritising essential and socially valuable uses of drones, such as medical deliveries, over non-essential use cases like food deliveries. By positioning drones within familiar narratives of lifesaving tools, they coped with uncertainty by framing drones as most appropriate in high-stakes scenarios where the potential benefits outweighed their perceived risks. This framing highlights that the public is more tolerant towards drone operations for social good, emphasising the need for precise regulation that prioritises communal needs and equitable resource distribution while addressing safety and operational challenges.

Drone risk and safety were essential factors that emerged across all themes. Participants managed their apprehensions about privacy, security and safety by proposing solutions such as airspace control, no-fly zones, identification systems, and tailored regulations for sensitive areas. These solutions reflect an adaptive approach to navigating areas of limited knowledge, where participants relied on analogies to existing systems like aviation, vehicle registration and logistics networks to conceptualise how drones could operate responsibly. This reliance on familiar frameworks highlights the importance of transparent communication and public engagement to help people with novel risks.

Fairness and equity were also crucial in participant views, where concerns about unequal access to drone benefits, potential job losses, and economic exclusion highlighted the need for inclusive policies. Participants proposed integrating drones into hybrid delivery systems, ensuring affordability through equitable pricing strategies, and stimulating job growth through infrastructure development like vertiports. These solutions reflect a broader societal

expectation that emerging technologies should complement rather than disrupt existing systems while addressing inequalities and encouraging communal benefit.

In areas where participants had limited knowledge, they navigated uncertainties by relying on media narratives, societal discourses, and personal experiences. Media coverage often amplified fears or shaped optimistic views, influencing perceptions of risks and benefits. Participants expressed scepticism when lacking detailed information, highlighting the need for transparent communication and public engagement to build informed opinions. Participants' engagement with environmental and economic considerations further highlights the interplay between optimism and scepticism. While drones are framed as innovative and potentially sustainable, concerns about battery production, lifecycle impacts, and high operational costs alleviated this enthusiasm. Participants coped with these uncertainties by emphasising the importance of evidence-based communication and cost-effective implementation to ensure that delivery drones do not exacerbate ecological or economic challenges.

These findings suggest that participants evaluate delivery drones through a multifaceted lens that integrates social priorities, ethical values, and practical considerations. Their approach to coping with unknowns involves contextualising drones within established frameworks and advocating for solutions that address individual and collective concerns. Policymakers should recognise the importance of these factors and incorporate them into developing future regulatory strategies. A summary of the social representations identified in the participant deliberations on drones is highlighted in Table 10:

Table 9: Summary of social representations identified in participant deliberations

| Theme                             | Social Representation                                                                                 |
|-----------------------------------|-------------------------------------------------------------------------------------------------------|
| <b>Views on Food delivery</b>     | Food delivery drones are evaluated through practical utility and logistical challenges.               |
|                                   | Drones must align with situational appropriateness and perceived usefulness.                          |
|                                   | Resistance to drones stems from values of independence and traditional shopping.                      |
| <b>Essential vs Non-Essential</b> | Fairness and communal needs guide the differentiation between essential and non-essential deliveries. |

|                                             |                                                                                                                                                                                                                                                                                  |
|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                             | <p>Socially responsible uses, such as medical deliveries, are prioritized over non-essential items.</p> <p>Scepticism about reliability reflects risk aversion in high-stakes scenarios.</p>                                                                                     |
| <b>Prioritising Medical Deliveries</b>      | <p>Medical deliveries are viewed as critical and universally accepted applications of drones.</p> <p>Drones need safety measures for the secure transport of critical items.</p> <p>Drones have the potential to save lives, perform critical tasks like transporting organs</p> |
| <b>Fear of Social Exclusion</b>             | Concerns about social isolation, absence of infrastructure leading to unequal benefits                                                                                                                                                                                           |
| <b>Impact on jobs</b>                       | Automation could create new job opportunities but raises fears about displacement.                                                                                                                                                                                               |
| <b>Impact from Drone Noise</b>              | Drone noise impacts mental well-being and demands inclusivity in technological design.                                                                                                                                                                                           |
| <b>Predefined routes or Drone Corridors</b> | Analogies to aviation emphasize the need for structured airspace management.                                                                                                                                                                                                     |
| <b>Flights over Residential Areas</b>       | Concerns centre on conflicts between public and private interests.                                                                                                                                                                                                               |
| <b>Flights over Sensitive areas</b>         | Security risks in sensitive areas like schools necessitate strict no-fly zones.                                                                                                                                                                                                  |
| <b>Regulation in Rural vs Urban Areas</b>   | Tailored governance is required for urban and rural settings due to unique risks.                                                                                                                                                                                                |
| <b>Development of Infrastructure</b>        | Drones should integrate with existing infrastructure to address logistical challenges.                                                                                                                                                                                           |
| <b>Safety Concerns</b>                      | Cautious optimism about drones balances technological trust and perceived risks.                                                                                                                                                                                                 |
| <b>Security Concerns</b>                    | Risks of misuse emphasize the importance of oversight and security protocols.                                                                                                                                                                                                    |
| <b>Privacy Concerns</b>                     | Drones symbolize surveillance, necessitating data security and privacy measures.                                                                                                                                                                                                 |
| <b>Environmental Implications</b>           | Sustainability claims must address lifecycle impacts, such as battery production.                                                                                                                                                                                                |

|                             |                                                                                  |
|-----------------------------|----------------------------------------------------------------------------------|
| <b>Weather Implications</b> | Adaptation to weather conditions is critical for reliable drone operations.      |
| <b>Economic viability</b>   | Economic viability hinges on balancing costs, savings, and public accessibility. |

The next chapter will examine how the game-based focus group facilitated knowledge co-creation among participants and how they understood complex scenarios involving delivery drones.



# 11 Board Games as Tools for Understanding Transport Scenarios

## 11.1 Introduction

The purpose of this chapter is to examine how the board game functioned as a methodological tool to support stakeholder engagement, deliberation, and knowledge co-creation around delivery drones. It responds directly to the research objective of understanding how game-based methods can facilitate more meaningful and situated discussions of complex transport futures.

The board game was selected as the most appropriate tool for this study because it enabled participants to engage with delivery drone scenarios in a tangible, interactive and place-based format. Unlike traditional interviews or focus groups, the board game offered an experiential space in which participants could interact with operational constraints, such as energy use, flight risk and regulatory trade-offs through situated decision-making. By embedding real-world scenarios into intuitive game mechanics, the board game facilitated knowledge co-creation, prompted reflection and encouraged dynamic discussion.

The chapter begins by examining how participants understood drone scenarios through game interaction, particularly through mechanics like the localised game board, risk meter, and mission prompts. It then explores how players drew on their lived experiences and collectively constructed knowledge in response to game elements. The chapter concludes by mapping these interactions onto stages of knowledge co-creation, showing how the game supported both individual reflection and group dialogue.

## 11.2 Understanding Delivery Drone Scenarios through Gameplay

The Game of (Delivery) Drones aimed to expose participants to hypothetical drone scenarios based on choices related to risk, route, energy, and other operational parameters. Prompts throughout the game encouraged reflection on these aspects within a structured, interactive format.

This section uses a deductive analytical approach, guided by game mechanics. Rather than identifying emergent themes, the analysis focuses on how participants interacted with specific elements such as the localised game board, risk meter, comment cards and other game mechanics to explore and make sense of drone operations. These mechanics served as analytical anchors, shaping discussion and revealing how meaning was co-constructed during gameplay.

This kind of interaction-rich format allowed participants to engage with an abstract technology in way that was tangible, contextualised, and collaborative. Unlike interviews or focus groups, the board game structured participation around shared problem solving and real time trade-offs, helping to uncover situated perspectives that might otherwise remain implicit.

The following sections examine each key game mechanic, demonstrating how it supported strategic thinking, surfaced concerns and encouraged a collaborative understanding of drone use in local contexts.

### 11.2.1 Localising the Game Board

The map-based game board reflected the participants' local environment, with each hexagon representing the level of ground risk in each location. This design encouraged participants to critically evaluate the varying ground risks across different locations and consider risks associated with their localities. Through the gameplay, participants engaged with key concepts such as drone route, ground risk, and energy use. As they plotted their routes, they actively made strategic decisions based on the risk and energy demands tied to familiar areas on the map.

By contextualising the game board to the participants' local environment, the gameplay became more intuitive by leveraging their familiarity with local landmarks and making navigation and decision-making natural. Therefore, their interactions with the board were more meaningful. A quote of a discussion between two participants from Public Group #7 illustrates the participants' recognition of localities on the board and the associated risk:

"Do we want to go to West Howe?" (Male Participant 4, Public Group #7)

"Well, I'd say that's a high-risk area." (Male Participant 6, Public Group #7)

"I'd say it's high risk." (Male Participant 4, Public Group #7)

The quote highlights the participants' quick recognition of West Howe as a high-risk area because of their familiarity with its local context and red identification on the board, suggesting that they could grasp the concept of risk. The participants' identification of the area as high-risk also demonstrates that they are considering the potential outcomes of their decision by evaluating the implications of navigating through or avoiding high-risk zones. Furthermore, the dialogue illustrates collaborative, strategic thinking, where participants collectively decide on their next move.

Participants plotted their route, associating their real-life knowledge of localities to the places marked on the board, for example:

Quote 1:

"We mustn't go there because that's air traffic control headquarters." (Female Participant 2, Public Group #5)

"Where?" (Male Participant 1, Public Group #5)

"Swanwick." (Female Participant 2, Public Group #5)

Quote 2:

"Slade's Park? Queen's Park? Slade's Farm." (Female Participant 4, PUBLIC GROUP #3)

"Slade's Farm." (Female Participant 5, Public Group #3)

"Slade's Farm, I don't know." (Female Participant 1, Public Group #3)

"That's where the Scout camp is." (Female Participant 2, Public Group #3)

Familiarity with specific areas on the game board influenced in-game decisions, reflecting an integration of real-world knowledge with game objectives. Group discussion demonstrates how participants collectively understood concepts such as risk in navigating the game. Through such interactions, they developed a shared understanding, allowing them to strategise more effectively as they based their decisions on the game rules and the collective knowledge of the places involved. This made learning more engaging, and participants could connect knowledge gained during gameplay with practical applications in their environments, allowing opportunities for exploration (see, for example, Melero & Hernández-Leo 2017).

This kind of interaction where participants mapped their lived experience onto structured decision-making may not have emerged through a traditional interview format. The game environment made abstract ideas like risk and drone routing more relatable and situated, prompting richer, place-based reasoning and collaborative sense making.

Pisor et al. (2020) argue that incorporating features of the real world into the game design ensures that players draw meaningful inferences about their preferences and behaviours in real-life contexts, in this case, delivery drones in their local areas. Furthermore, gameplay in a familiar context increases the relevance of implications for participants (see, for example, Aubert et al. 2019; Khoury et al. 2018; Pope 2021). Marini et al. (2018) suggest it can trigger emotions, especially risk-related. In this study, participants demonstrated heightened emotional engagement and sensitivity to risk when navigating familiar high-risk areas on the game board, illustrating how incorporating real-world contexts can evoke stronger, contextually grounded reactions to potential drone scenarios.

### 11.2.2 Risk Meter and Energy Tokens

Game mechanics such as energy tokens and the risk scale simulated real-world constraints such as energy (fuel) consumption and operational risks in drone deliveries. Game mechanics provide the foundational framework that governs the rules, challenges, and incentives that engage participants, enhancing the game's overall experience (see for example, Proulx et al. 2017; Plass et al. 2020). While the game mimics operational parameters of drones, such as energy and risk, both are identified as 'resource budget' in-game mechanics (Table 7), challenging participants to stay 'within budget.' Setting a budget at the start of the game encouraged participants to rethink their route strategy to safeguard their resources, for example:

Quote 1:

"Should we take high risk? Do I get a card?" (Participant 6, Public Group #2)

"Do we have energy?" (Participant 5, Public Group #2)

Quote 2:

"Plan straight- across and have energy. Yeah? 1,2,3,4,5,6,7,8." (Participant 4, Public Group #2)

Quote 3:

"I think it's school. We can go to St Mark's school?" (Male Participant 4, Public Group #7)

"Yeah, but it's red, Participant 4. That means, high risk." (Female Participant 3, Public Group #7)

Participants grasped the concepts of risk and energy through resource budget techniques of losing an energy token each turn and adjusting their risk slider according to the hexagon they occupied. Participants deliberately avoided high-risk areas to prevent increasing their risk level. They were also observed counting hexagons to calculate the energy required to complete their mission, and participants frequently checked their energy reserves and risk meters while plotting their routes. Incorporating the resource budget game mechanic influenced gameplay dynamics and enhanced participants' strategic thinking, encouraging them to think critically about their choices and the implications of their actions (Santos 2023). In addition to strategic thinking, it also encouraged player motivation as participants plotted their route each turn, thinking about the consequences of their decision. Furthermore, it facilitated social interaction and collaboration among participants as different perspectives were shared (Lloyd-Walker et al. 2014)

One participant engaged in critical thinking about the game mechanics, especially regarding how risk is managed and represented, and remarked:

"... every drone flight does have a risk, so you shouldn't start at zero. It should start maybe here. To see if you've mitigated the risk by flying over the sea or green or if you've gone the other way to take a short route or whatever. I feel like it should start there or somewhere." (Male Participant 1, Stakeholder Group #4)

By suggesting that risk should not start at zero but should be shaped by the starting point and actions, the participant understands risk as a key element in drone operations. This idea makes the game more realistic and challenging while encouraging participants to think strategically about managing risk from the beginning, enhancing both the game's realism and the learning experience.

On the other hand, one participant highlighted that risk and energy did not have much impact on him during gameplay. He commented:

"Yeah, that was another thing I was going to say. I feel like risk and energy, that didn't really feel like actually an issue in the end. I mean, I tried to take the low-risk route, but then I don't think it would have mattered." (Male Participant 4, Stakeholder Group #1)

The participant suggests that the intended challenge posed by managing risk and energy did not resonate with him. This might be due to the game mechanic 'press your luck' implemented in the game, where participants can raise stakes by taking more significant risks with large

consequences, resulting in different experiences for different participants. This might also reflect that the game mechanics were not impactful for some participants and possibly led to a disconnect between the participant's strategic thinking and the actual rewards or penalties within the game. This comment raises essential questions about the game's effectiveness, where participants perceive that their decisions related to risk and energy do not have significant penalties. This reflection also serves as feedback for improving the game, suggesting that increasing penalties for higher risk and managing energy are needed to enhance the overall gameplay experience.

Another participant also had a similar comment on improving the game mechanics associated with risk:

"I think you almost want more of a penalty for, like, than just the risk for the red areas. You want more of an incentive possibly to avoid the red areas?" (Male Participant 2, Stakeholder Group #1)

While the risk in the game was based on a ground risk model developed by Pilko et al. (2023), highlighted in Section 8.4, the participant's suggestion highlights the need for a more pronounced risk-reward dynamic within the game by increasing penalties for taking high-risk routes and providing more significant incentives to avoid them. Therefore, after multiple iterations, the game was adjusted to ensure that the takeaway would not simply be that drones are inherently high-risk but to provoke balanced reflection on the trade-offs between risks and rewards. While risk perception is subjective, Khaled (2018, p.23) notes that it is vital that "provocation needs to be well balanced for participant engagement." The adjustments aimed to maintain engagement while encouraging participants to critically evaluate risk within a broader context of decision-making and operational trade-offs.

The findings highlight that the game effectively translated abstract concepts like drone risk and energy consumption by setting a resource budget for risk and energy. The simplification of these concepts and the placement in known locations allowed participants to grasp these complex ideas and relate them to real-world scenarios (Aubert et al. 2019). This type of strategic, embodied engagement with operational trade-offs would have been difficult to replicate with verbal reflections alone. The game's use of physical tokens and visual risk meters made abstract system-level decisions more tangible and prompted participants to evaluate consequences in real time, something that would be less likely to emerge in traditional interviews or focus groups.

The mechanics also encouraged participants to think more critically about their in-game decisions while carefully considering the consequences of their choices. The need to manage risk and energy also prompted collaboration (Section 11.4.2) among participants, where they had to optimise their routes and resource management. However, some participants felt that the game mechanics lacked sufficient impact on their choices. This feedback suggests introducing higher penalties for more challenging scenarios could enhance the game experience.

### 11.2.3 Mission Cards

In round 1, participants were provided with mission cards that conveyed the type of delivery they were making and allocated their starting and end points on the board. In the first round of play, these cards enabled reflections on route decisions, where participants decided on the best route from point A to B, which influenced their decision-making to strategise a route to make an 'efficient' drone delivery. The second round provided more autonomy to participants in plotting their routes. In this case, the cards enabled reflection and sparked discussion on the type of deliveries drones would make.

It was observed that the mission cards generated engagement and excitement at the beginning of each round as participants were observed to be making route decisions. Participants were perceived to be eager to plot their route after reading their mission cards, for example, in round 2, where the mission required them to meet a specific requirement such as the number of hexagons covered:

"Is it 12 moves? As in the quickest possible route has to be 12? I wasn't thinking, I just don't trust my counting. What is the nearest stop from the airport to the airport? Is that the airport? Airport. We're going to board the airport." (Female Participant 1, Public Group #7)

The quote reflects the participant's thought process as she attempts to determine the best route to complete her mission. This was also observed with other participants, who calculated their moves, assessed the path to take according to risk, and demonstrated the game's ability to stimulate strategic planning. This sort of cognitive engagement indicates that participants were not just passively following game mechanics but were also involved in optimising their decisions to meet their goals. The mission cards shaped the gameplay by providing a clear objective and guiding the participants to concentrate on the core elements of the gameplay,

i.e., risk, route and energy. They also prompted communication and collaboration amongst participants as they asked questions about the directions to a specific location on the game board, or participants worked together to clarify the task and plan their next steps. This approach helped foster a sense of teamwork and communication while participants work together towards a goal (Lee et al 2016; Yang and Chang 2013). This highlights the game's social aspect, where mission cards were used for individual decision-making and encouraged collective understanding and problem-solving. The mission cards contributed to a rich learning experience where participants applied their game mechanics knowledge, considered different strategic options and collaborated to achieve their goals.

For round 2 of the game, mission cards prompted participants to specify the deliveries they would like to make while plotting their routes. Some participants chose playful items and created scenarios, while others approached them more seriously, for example:

Quote 1:

"I'm delivering the senior consultant's favourite golf club that he's left behind at home from there to there." (Female Participant 1, Public Group #5)

Quote 2:

"Well, I'm going to deliver a dog. I'm delivering somebody's dog." (Female Participant 2, Public Group #1)

Quote 3:

"One packet of Anadin. Because it's nice and light, should be quick." (Male Participant 2, Public Group #2)

Quote 4:

"We've had someone at West Wittering Beach order suncream. The suncream's getting delivered to us to West Wittering Beach." (Male Participant 1, Stakeholder Group #4)

The responses showcase a range of creative and personalised delivery choices, from a golf club and a dog to suncream and paracetamol. Mission cards allowed participants to introduce their personalities and interests in the gameplay, making the experience more relatable and accommodating different types of engagement. The items chosen by participants demonstrate that some approached the task light-heartedly. In contrast, others were more strategic,



considering factors like weight and delivery speed, aligning with the game's theme. The diversity of responses highlights the game's social aspect, which prompted discussion and encouraged bonding among participants, contributing to an enjoyable and socially cohesive game experience.

One participant acknowledged the usefulness of mission cards to captivate interest at the beginning of the game and provide a challenge to participants:

"If they get hooked like I have, that's interesting to say, okay, we want to fly. Because the first thing when you said, that's your drone, what's your flight path? Because we were engaged, and the challenge is they don't understand drones at the moment..."  
(Male Participant 3, Stakeholder Group #2)

The participant mentions getting hooked and engaged when tasked with a challenge like plotting a drone route. By providing participants with clear missions to accomplish, the cards drive the gameplay and ensure that participants are involved from the beginning. The participant's reflection indicates that the mission cards are effective in helping players understand drone operations, helping them think critically about drone operational parameters, and fostering cognitive engagement.

By providing clear objectives and stimulating group interaction, mission cards helped create a dynamic environment where players could explore and internalise key concepts related to drone delivery scenarios (see Jean et al., 2018b). This approach made the game enjoyable and informative, fostering a deeper exploration of its strategic elements. The mission cards encouraged various responses that blended creativity, practicality, and scenario-building, demonstrating the game's flexibility in catering to different engagement styles.

These varied, often imaginative responses may not have emerged in more traditional methods such as interviews or focus groups, which are less likely to invite playful experimentation or collective sense-making. The cards created a shared task that grounded abstract concepts in action, helping participants articulate views they may not have formed in more static settings. This flexibility also highlighted potential real-world applications of drone deliveries, prompting participants to think critically about the types of items drones could transport. Additionally, the social interaction generated by these varied responses facilitated meaningful dialogue and shared experiences, enhancing the game's overall value.

### 11.2.4 Comment Cards

Embedded within the game were comment cards that players encountered when landing on hexagons marked with a speech bubble. These cards posed questions designed to spark discussion on various aspects of delivery drones and encourage participants to engage in meaningful debate. Participants were observed to be eager to move to hexagons with comment cards, for example:

"I'm gonna get discussion. He's got to have a discussion now." (Participant 1, Public Group #7)

The comment cards facilitated equal group participation, as all participants had to contribute to the discussion. Since each player had the opportunity to pick up and read a card, even the most reserved participants were drawn into conversation, ensuring a more balanced and inclusive discussion. This format encouraged broader participation than traditional interviews or focus groups, which can often be dominated by more vocal individuals or shaped by researcher prompts. By embedding the discussion in the flow of gameplay, the comment cards facilitated spontaneous peer-led conversation that supported more equitable knowledge sharing.

For example, one participant acknowledged:

"Also, the fact that you have the comments and that you can speak, because sometimes in a focus group, it's very... you get someone speaking too much, and I felt like there was some balance, and I like that." (Participant 4, Stakeholder Group #2)

The comment cards enabled participants to lead the discussion, removing the researcher from posing questions. As a result, the conversations felt more organic, with participants freely expressing their thoughts and engaging in debate without feeling influenced by the facilitator. Furthermore, participants appeared at ease as the absence of direct questioning from the researcher or moderator created a more relaxed environment, contributing to the depth of the discussions. As participants engaged with comment cards, the resulting discussions fostered a sense of group cohesion. Whether finding common ground or respectfully debating differing viewpoints, sharing and discussing ideas helped to ensure a collaborative environment. Only occasionally did the researcher have to interject when a participant was seen dominating the group discussion.

The exchange of diverse opinions and perspectives is highlighted in Chapter 10. It demonstrates how the comment cards effectively stimulated critical thinking around the practical applications and broader implications of emerging technologies like drones, for example:

"I think this is brilliant because I like the conversation piece because it triggers other thoughts that you wouldn't normally do, I find it quite... the eVTOL, obviously we're interested in it. We've done little bits in it. I'm interested in use cases and outcomes, so I find this fascinating and listening to those views together." (Male Participant 6, Stakeholder Group #2)

The participant highlights the value of discussion in sparking new ideas and perspectives, indicating that the game effectively pushes participants beyond their usual thinking and encourages them to explore the concepts and scenarios they might not be exposed to or otherwise consider. By highlighting that the conversation 'triggers other thoughts,' the participant suggests that the discussions prompted reflection, allowing participants to actively engage, question their assumptions, and consider different viewpoints. The participant's positive feedback validates the game's design, particularly its ability to use conversation to deepen the understanding of delivery drones.

Participants also highlighted that the game facilitated an open and relaxed discussion, encouraging reflection on drone scenarios, for example:

"I think even taking it generally, not limiting it to drones, the concept of having a game to discuss a very serious topical issue is fantastic. Being in some stakeholder consultation, people come with sort of, some strong views. So in a relaxed atmosphere like this, playing a game, you laugh, you still sort of come up with your views, but it's the role you're taking..." (Participant 2, Stakeholder Group #2)

The game format and prompts from the comment cards created a relaxed and open environment where participants engaged with complex issues without the pressure of taking a firm stance. This encouraged incorporating diverse views and knowledge co-creation (see Section 11.4), making it a valuable tool for exploring and understanding the topic constructively and inclusively.

Discussions initiated by the comment cards often led participants to draw connections between the game's scenarios and real-world implications. For example, a question about the

regulation of drone routes led to a broader conversation about how such laws might affect residential areas, highlighting the practical relevance of the game's themes, evidenced in Chapter 10. Khaled (2018, p.23) suggests that games provide a 'space for interpretive flexibility to encourage construction for reflection and meaningful questions over answers.' Furthermore, the comment cards sparked debate and critical thinking. They contributed to a positive social dynamic among participants, demonstrating the value of integrating interactive elements like discussion prompts into serious games. This approach deepened the participants' understanding of the subject matter and made the learning experience more engaging and memorable.

### 11.2.5 Flight Update Cards

Flight update cards were embedded in the game so that participants could understand the implications and experience the varying conditions of their drone flights. In response to a scenario presented by a flight update card, one participant commented:

"Bournemouth Air Festival Stops stopped due to drone flying. That's a possibility. That's a good one." (Female Participant 2, Public Group #3)

The scenario on the card highlights a major local event, and the participant acknowledges the potential impact of drones on a public event. Therefore, the scenarios presented on the cards resonated with the participants.

Moreover, the cards introduced elements of unpredictability and excitement into the game, adding a dynamic layer to the gameplay, for example, a discussion between participants about flight update cards:

"... I thought the flight updates were really cool because even if it just felt as if like you did something else besides, you know, everyone commenting, that was good. It's like, oh, I get another card." (Female Participant 5, Public Group #5)

"Because it makes it more unpredictable." (Female Participant 3, Public Group #5)

"I think because there's so much happening with the red cards, I think that gives a lot of excitement of other people being blocked and being drawn back. It is the odds of what you pick up, isn't it? It is the unpredictability of it, which I guess in many respects would be one of the challenges of drones anyway because so many additional, unpredictable

things that can happen. Because you're going into another space." (Participant 2, Public Group #5)

The unpredictability in the game mirrored the real-life uncertainties with drone flights, making the game more realistic and challenging. One participant also highlighted the educational aspects of the flight update cards to understand drone operations that involve navigating in less predictable environments, much like the varied outcomes dictated by the cards. This discussion also touches on the game's balance between strategy and chance. While players plan their routes and make strategic decisions, the flight update cards introduce an element of luck that can disrupt or enhance their plans, contributing to the game's competitive nature. The possibility of a negative card affecting an opponent adds a layer of competition where players must not only manage their risks but also consider the potential impacts on others, driving engagement and making the game more challenging. Calleja (2022) notes that uncertainty is designed into games to keep participants engaged. This is consistent with the works of Malaby (2007) and Costikyan (2013), who state that uncertainty is a key element in game design that gives rise to anticipation during gameplay. The flight update cards added depth to the gameplay, encouraging participants to think critically and adapt to changing circumstances, much like they would need to in real drone delivery scenarios.

One participant reflected on how flight update cards stimulated critical thinking and raised new questions, for example:

Quote 1:

"I think, for me, it's raised loads of questions about it. Like, some of those cards were talking about, like, you get more points for flying at night, which makes me think there's something better about flying a drone at night than in the daytime." (Female Participant 2, Public Group #4)

Quote 2:

"I think the flight update cards were quite good, just for prompting thoughts about different issues..." (Female Participant 1, Stakeholder Group #1)

These quotes demonstrate that the flight update cards prompted participants to consider previously overlooked aspects of drone operations, serving as a stimulus for deeper reflection on the factors involved. The participant's curiosity about night flights (Quote 1), sparked by the game, illustrates how mechanics drove engagement and fostered a desire for further exploration and understanding. Assigning different outcomes to various flight conditions

enabled players to understand the complexities of drone operations, such as operational choices, with different outcomes.

Participants also acknowledged the added value of the flight update cards in the game despite encountering the negative ones, for example:

"I thought this was fun! Apart from all the bad cards we got! It was fun- I enjoyed it!"  
(Participant 2, Public Group #2)

The comment indicates that by including positive and negative outcomes in the game, mechanics ensure that players remain engaged and invested in the outcomes as they navigate setbacks and opportunities. The ability to stay positive and involved despite difficulties indicates that the game effectively encourages participants to think strategically and reflects resilience.

Some participants thought that the flight update cards were too repetitive and, therefore, more needed to be added, for example:

"One thing, the cards are quite repetitive. Yeah, they are. Come up with more, um..."  
(Female Participant 2, Public Group #1)  
"Specific? problems?" (Female Participant 3, Public Group #1)  
"Both the cards?" (Researcher 1)  
"Yeah." (Female Participant 3, Public Group #1)  
"Vary those a little bit... Yeah, they could have a few more scenarios." (Female Participant 2, Public Group #1)

The quote suggests that the flight update cards became predictable and required variation to maintain engagement. While the flight update cards successfully introduced important delivery drone concepts, the participants felt that expanding the range of these scenarios would make the game more engaging. The participant's proposal for more varied scenarios suggests they actively engaged with the game and pursued a more profound learning experience. This participant's feedback from the first group was incorporated into versions of the board game that were created later. This also highlights that various challenges embedded within the game can help sustain engagement. Providing participants with more varied scenarios would likely strengthen the gameplay and make each turn more unpredictable, which is essential for maintaining the competitive dynamics of the game.

The flight update cards presented scenarios that added unpredictability and excitement to the game, making it more dynamic. The unpredictability introduced by the cards mirrored the real-life uncertainties of drone flights, such as weather conditions, technical malfunctions, or unexpected obstacles. Eberle (2014) argues that the element of surprise in board games brings positive effects, as it keeps participants playing. Similarly, Malaby (2007) describes uncertainty as a key element that attracts players to keep playing.

Participants had to adapt to changing circumstances, which mirrors the strategic thinking required in real-world scenarios. The cards also added depth to the gameplay by encouraging participants to think critically and adapt to new situations. Furthermore, the flight update cards prompted participants to reflect more deeply on the various factors involved in drone use. This form of reflection and feedback, enabled by the game and discussions, plays a vital role in knowledge co-creation (Kosonen 2015; Medema et al. 2017). By introducing scenarios, they might not have previously considered, the cards served as a stimulus for reflective thinking, encouraging participants to broaden their perspectives on drone operations. These scenario-based disruptions helped simulate real-world complexity in a way that interviews or focus groups would struggle to replicate. Rather than discussing possibilities in the abstract, participants had to adapt to in-game events, making sense of shifting conditions collaboratively and often emotionally, which supported deeper, more situated engagement. Including positive and negative outcomes in the game, mechanics ensured that players remained engaged and invested throughout the game. The observation of repetition in the flight update cards suggests that while they were effective, a greater variety of scenarios could enhance engagement.

## 11.4 Knowledge Co-creation and Reflection

Knowledge sharing refers to exchanging information, insights, or expertise to enhance understanding and foster the creation of new knowledge (Savolainen, 2017; Abu-Rumman, 2021). It facilitates the transfer of ideas and experiences between individuals, promoting collaboration and innovation (Bada & Olusegun, 2015). This section examines the four stages of knowledge co-creation outlined in the SECI model (Section 3.5) and explores how participants navigated each stage during the game-based focus group. Each stage is discussed in detail, with evidence illustrating how knowledge co-creation was achieved in practice. The game provided a shared, interactive environment that enabled all four stages of the SECI model, from sharing tacit knowledge to reflecting on outcomes, in ways that would be difficult to achieve through individual interviews or more structured focus groups.

### 11.4.1 Socialisation

Due to its proximity requirement, the board game offered participants direct interaction, stimulating them to discuss it with each other, similar to a study by Jean et al. (2018b). Socialisation can be observed through various forms of player interaction, cooperation, competition, and shared experiences that contribute to knowledge co-creation.

Running game sessions in small groups and assigning them tasks encouraged participants to engage in discussions with one another. Throughout the game, participants are frequently involved in debates about strategy, sharing their thoughts on potential moves, and demonstrating a high level of social interaction and cooperation, for example:

"That's red, Participant 4! We don't really want to do that one, do we?" (Female Participant 3, Public Group #7)

"That's a risk you'll take. High risk overall." (Male Participant 6, Public Group #7)

"We can just go there, can we? That's a green." (Female Participant 3, Public Group #7)

"And what was that?" (Male Participant 4, Public Group #7)

"Ferndown Industrial Estate." (Female Participant 3, Public Group #7)

"Alright, yeah, we're good." (Male Participant 4, Public Group #7)

The dialogue demonstrates collaborative decision-making where participants navigate the game together, discussing and validating their choices with each other. The decision-making aspect of the game allowed them to exchange and reinforce their understanding of the game rules and strategies. Almås & Giæver (2024) note that collaboration in serious games involves managing diverse mindsets, adapting to group dynamics, pursuing shared goals, and encouraging unique interactions that enhance learning outcomes. The quote also illustrates how participants learnt from each other as they interacted, with information being clarified and confirmed through conversations, building a shared understanding of the game mechanics, in this case, assessing risk. This shared understanding is an essential outcome of the socialisation process that involves tacit knowledge, which is challenging to express directly and transform from one context to another (Carlile 2002; Hinds and Pfeffer 2003). In this context, participants share their understanding of risky areas and strategic decision-making through conversation rather than formal instructions or explicit teaching.

Similarly, in another group, participants were seen reflecting on how close their drones were to each other on the game board, for example:



"You don't start on an orange, do you?" (Female Participant 2, Public Group #5)

"You do look like you're high up." (Researcher 2)

"You should have started there." (Female Participant 5, Public Group #5)

"Oh right, I'm down there then." (Male Participant 1, Public Group #5)

"You're going to have to think about where you're moving because I'm kind of behind you, but now I have to almost go back now because I have to leave a space." (Female Participant 3, Public Group #5)

The dialogue illustrates how participants collectively build a shared understanding of the game and correct and adjust each other's actions based on mutual understanding. The correction is essential to socialisation as participants learn by doing and receiving immediate feedback from their peers (Plass et al. 2020). The interaction helps reinforce players' tacit knowledge about the game; by openly discussing moves and decisions, they validate their understanding and help others solidify theirs. Collective reinforcement is also vital in socialisation as knowledge gets shared and deeply ingrained through social exchange.

As the game progressed, participants began to develop inside jokes and references, indicating that the shared experience was fostering stronger social bonds and group cohesion, for example:

"Storms encountered. Lose five energy points and skip a turn until the weather gets better." (Male Participant 1, Public Group #5)

"In your words exactly, it the luck of the draw." (Female Participant 5, Public Group #5)

"It's like snakes and ladders, isn't it?" (Male Participant 1, Public Group #5)

Participant bonding is crucial in encouraging a collaborative environment where knowledge can be exchanged and internalised, facilitating learning. The comparison to something familiar, like snakes and ladders, demonstrates how participants developed a shared language and set of references unique to the group. This shared context helps them relate new concepts to familiar ones, making navigating the game and engaging in meaningful discussions easier. The ability of participants to recall and build on previous interactions illustrates cumulative learning, as each interaction builds upon prior experiences to create a shared group history. The reference to randomness in the game as "the luck of the draw" highlights how humour and shared jokes contribute to a relaxed atmosphere, encouraging participants to engage more actively and contribute to group discussions. This collaborative and supportive environment enhances group cohesion and promotes deeper reflection, critical

thinking, and the internalisation of new knowledge, demonstrating the powerful role of social interaction in learning.

Some participants called each other out on potential rule violations, indicating that the group was collectively monitoring each other's actions to ensure fair play, for example:

Quote 1:

"Did you not already move beforehand? I know you said you'd cheat, but did you not already move at the very beginning?" (Female Participant 2, Stakeholder Group #3)

Quote 2:

"Have you put your energy points over?" (Female Participant 3, Public Group #7)

"Oh, cheating!" (Female Participant 5, Public Group #7)

The quotes highlight elements of social dynamics, trust and accountability within the group, suggesting a mix of humour and seriousness in their interaction. The playful tone of the comments indicates that the group was comfortable with each other and engaged in light-hearted teasing, which can enhance social bonds between participants.

The game mechanics required input from each other, ensuring that all participants were actively engaged and contributing to the group discussions, promoting a strong sense of inclusivity, for example:

"I also like the fact that you have the comments and that you can speak because sometimes in focus groups... you get someone speaking too much, and I felt like there was some balance, and I like that." (Male Participant 4, Stakeholder Group #2)

And some were observed to be dominating the conversation, with one player commenting at the end of a discussion:

"Sorry, I don't want to dominate." (Male Participant 6, Stakeholder Group #2)

The participant's decision to step back from dominating the conversation indicates a commitment to ensuring that others could contribute, fostering a more inclusive environment. By consciously stepping back, the participant encouraged active engagement from quieter group members. Additionally, in some groups where a participant was dominating a conversation, the researcher had to step in to ensure everyone got an opportunity to speak,

creating a safe space where everyone was welcome to input and ensure dialogue was not dominated by one or two participants. The role of the moderator was crucial in guiding discussions and ensuring all participants contributed, echoing the importance of managing group dynamics to prevent exclusion (Kitzinger 1994; Morgan 2012).

Participants frequently expressed excitement and frustration during the game by responding supportively to each other, reinforcing the social connections among them for example:

Quote 1:

"Good payload. Your parcel is the right weight for your drone gain. Five energy points."

(Female Participant 3, Public Group #1)

"You're doing well girl!" (Female Participant 2, Public Group #1)

Quote 2:

"Disruption to animals. Your drone has disturbed birds. Move back one space, adjust your risk slider, and lose five energy points accordingly. Change route on next turn."

(Male Participant 1, Public Group #7)

"That's a really bad one." (Female Participant 2, Public Group #7)

"That's a really hefty one." (Female Participant 3, Public Group #7)

The excitement and frustration during the game indicate that participants are emotionally engaged in the activity, encouraging socialisation. Another observation was that participants would cheer and applaud for the round winner. There was collective excitement after completing a mission, demonstrating the power of shared experiences in strengthening social bonds to enrich knowledge sharing. By responding positively to each other's achievements, participants reinforce social connections and create a positive group dynamic where everyone feels valued and encouraged.

Socialisation in knowledge co-creation occurs when participants share their emotions and experiences. For example, one participant expressed:

"The thought of seeing delivery drones flying makes me feel sick... it's too much!" (Male Participant 3, Public Group #6)

The participant openly shares a strong emotional response to witnessing delivery drones. Emotional sharing is a key element of socialisation, as it allows participants to connect deeper beyond exchanging factual knowledge. When participants feel comfortable sharing their

emotions, a safe and trusting environment is established within the group, enriching the knowledge co-creation process (Jean et al., 2018b).

Participants also opened up and shared their personal experiences about drones, even if they did not know them personally. This demonstrated the mutual trust that was developed during gameplay for example:

"I mean, when I saw the one in Boscombe, I couldn't, well, I couldn't see it, but I could feel it." (Female Participant 5, Public Group #3)

"Right?" (Female Participant 2, Public Group #3)

"And that irritated me even more because I couldn't judge how high up it was and what was it doing there. Why was it there? So it made me question, so instead of wanting to have a time of peace and quiet for my mind, I was irritated and it wasn't my fault, and I couldn't get out of the situation because I was stuck on the pier..." (Female Participant 5, Public Group #3)

Sharing a personal story reflects the process of socialisation where participants feel comfortable enough to bring their own lived experiences into the group discussion. Her detailed account suggests that the participant feels safe and supported in the group environment, indicating a level of mutual trust. Trust fosters open, meaningful, and persuasive information exchange (Iansiti 1993; Hansen et al 1999). The participant's willingness to discuss her frustration in a public setting with people she may not know suggests that the gameplay environment fostered a sense of trust and openness among the group members. The knowledge co-creation process is key when individuals share feelings, emotions and experiences, contributing to the transferring of knowledge (Jean et al., 2018b).

Moments of laughter were also observed during the game with one participant expressing:

"It was really good, the discussion though. Because I had no idea what to expect. It was good. We've had a little bit of giggles." (Female Participant 2, Public Group #7)

The mention of the group having "*a little bit of giggles*" reflects the social learning aspect of the game. Participants exchanged knowledge about delivery drones and built social bonds and group cohesion through such interactions. This social aspect of learning is important, as it can enhance the retention of information and make the learning process more enjoyable and memorable (see for example, Katual et al. 2023). The balance between serious discussion

and enjoyment is essential in informative games, as it helps maintain participant engagement while ensuring that the learning objectives are met. The participants' laughter and enjoyment while discussing complex topics like delivery drones suggest that the game successfully fostered a relaxed and open atmosphere favourable to learning.

The collaborative and embodied nature of the board game created opportunities for spontaneous interaction, humour and emotion-sharing that would be difficult to replicate in traditional focus groups or interviews. The shared activity of gameplay offered a social structure through which tacit knowledge could surface organically, rather than being extracted through direct questioning.

The findings indicate that knowledge is developed in social interactions through a collaborative process that involves sharing information, engaging collective reasoning, negotiating meaning and co-creating new understandings. Through these interactions, the board game enabled the merging of perspectives through dialogue facilitated by game mechanics and components such as comment cards and flight update cards that prompted participants to speak about their experiences with drones, developing mutual trust and shared understanding of delivery drones. The development of shared knowledge resulted from the collaborative process, which promoted mutual interaction and encouraged equal exchanges among group members (Fu and Hwang 2018). Jordan and Henderson (1995, p.41) highlight that knowledge resides not solely in an individual's mind but within "social and material ecologies." It can only be identified and shared within a community by analysing interactions and the dynamics of relationships.

### 11.4.2 Externalisation

Externalisation refers to the reflections about the actions taken during the game and peer-to-peer dialogue (see for example, Jean et al., 2018a). It is the process by which participants articulate and share their internal thoughts, strategies, knowledge, or decision-making process during gameplay. It involves making tacit knowledge explicit so others can share and understand it. Externalisation refers to the peer-to-peer dialogue and the reflection that comes with it (Nonaka and Takeuchi 1995).

During the game, some participants verbalised their thought process, explaining their strategic decisions and how they aligned with real-world drone operations. This clarified

individual actions and helped the group collectively understand key concepts related to delivery drone navigation, risk assessment, and operational challenges.

For example, one participant rationalised his decision to select a specific flight route, considering potential risks associated with flying over people versus other environmental factors:

"Can I just quickly explain why I went for the bird option? Just to cover my back. So, I feel like based on my own experience, you fly over certain areas, a lot of the concern naturally anyone will have will just be based on the height you're flying at... if it's birds. And so to me, anything over that is lower risk than flying over people and especially if the beaches are busy in the summer, it's much, it's lower risk for us to fly over there at a certain height rather than risk it landing up here." (Male Participant 1, Public Group #1)

This participant, who mentioned having prior experience operating drones, justified his choice by prioritising flight safety and flying over areas with birds rather than crowded human spaces. He reasoned that risk perception varies based on altitude, suggesting that people are more likely to be concerned about drones flying at lower heights. In contrast, birds might be accustomed to objects at similar altitudes. This example illustrates how experiential knowledge influenced decision-making, helping the group engage with broader discussions on risk assessment, route optimisation, and regulatory considerations in drone deliveries. By verbalising their reasoning, participants connected in-game scenarios to real-world drone operations, critically assessing factors such as airspace management, environmental risks, and public safety. This collaborative reflection deepened the group's understanding of the complexities of navigating drone delivery logistics.

When faced with a challenging scenario, the group engaged in discussion resulting in collective brainstorming leading to a more effective in-game strategy such as plotting routes, and demonstrating the value of shared knowledge for example:

"Well, I'm looking at anywhere where it's just green." (Female Participant 2, Public Group #3)

"Okay. Yeah. So this is, this is a risk." (Female Participant 1, Public Group #3)

"This is, you've got 10 green here or along the bottom." (Female Participant 2, Public Group #3)

"Yeah, that might be the best way." (Female Participant 3, Public Group #3)

"Should we go along south to the top and Bournemouth Airport airport's a good starting point." (Female Participant 2, Public Group #3)

Participants were observed to be verbalising their strategies, such as enunciating their focus on green areas perceived as low-risk zones. This act of verbalising what might have been internal and intuitive is an example of externalisation where personal insights are made explicit and accessible to the group. Much knowledge is tacit, profoundly personal and challenging to express or communicate, such as personal insights, intuitions, and gut feelings (Polanyi 1983; Sudhindra et al. 2017). As the discussion progressed, participants built on each other's contributions, which led to a shared strategy and understanding of complex ideas such as risk.

Participants externalised their tacit knowledge during the discussion by sharing their personal experiences.

"If they're noisy like the little planes that I get over my place from the airport. They really are disruptive. They make so much noise. Far more than the little planes taking off from Bournemouth Airport because I'm on the flight path." (Female Participant 1, Public Group #3)

By articulating her tacit knowledge, which is context-specific and rooted in her experiences of living on a flight path, the participant transforms it into explicit knowledge by providing an example that others can relate to. Sharing personal experiences encourages other participants to reflect on their own experiences and engage in dialogue, leading to a deeper exploration of the topic. This is important for externalisation as it allows for knowledge creation through collective reflection.

Tacit knowledge is often difficult to express as it is embedded in personal, subjective experiences. Participants were able to externalise their concerns about drones for example, explicitly, one participant commented:

"I'm really susceptible to noise, I have horrendous tinnitus, and certain noises trigger me quite badly. So I have a concern that the whining noise might be a trigger for me. That's just me personally." (Male Participant 6, Stakeholder Group #2)

This quote demonstrates how tacit knowledge, which emerged from personal health experiences and sensitivity to noise informs the participant's concerns about drone noise. The knowledge expressed is contextual and specific to the participant. It is directly related to their experience with tinnitus, which others might not share or understand without similar

experiences but is still valuable to the conversation. This personalisation is essential in the externalisation process as it allows participants to contribute a unique perspective that might not be considered otherwise. Furthermore, by highlighting a specific health concern, the participant has enabled the group to think more in-depth about the noise implications, enriching the discussion.

In some participant discussions, it was noted that there was an interplay between tacit and explicit knowledge for example:

"I do understand, I get that, but these people will be having to work within strict regulations, whereas, in your national park, you could have 100 people flying their own drones around with no regulation at all, disturbing you." (Male Participant 1, Stakeholder Group #4)

"If it's over forestry England land you have to get permission." (Female Participant 2, Stakeholder Group #4)

"They would just fly a hobbyist, like a tiny little drone. And there's no way of regulating it... you could set corridors at the, I think that's the aim, like, you know, you could set corridors you could fly in... I'm just talking from my frustration that I've had. We'll be applying to Natural England, to the council, to fly under very strict CAA rules, and NEA rules... we go down there and watch ten people flying their drones around with no rules at all. And we're like, we're doing it, we're setting height limits for birds, we're doing it. And they're like just zooming around everywhere and there's no way of enforcing it. So that's what I find frustrating." (Male Participant 1, Stakeholder Group #4)

"Well, it depends on where, because we do, we have kicked off people on our land who we find flying drones. So some people, land managers do kick off people that we find on our land." (Male Participant 3, Stakeholder Group #4)

This interaction highlights differing perspectives on drone usage, regulations and personal experiences with elements of both tacit and explicit knowledge. The participants express their tacit knowledge including their frustration, experiences and insights and transform them into explicit knowledge that the group can share and use to build a collective understanding of the issues. Sharing their insights triggers a ripple effect that inspires others to follow suit, fostering a culture of ongoing knowledge exchange (Pasher & Ronen 2011; Shao et al. 2012). The participants contribute their knowledge and experiences to the group, helping to build a collective understanding of the challenges associated with drone regulation and allowing the group to consider a wide range of perspectives and experiences. Male Participant 1's



frustration is fixed in tacit knowledge gained through direct experience with regulatory processes, while his understanding of the specific rules and the challenge of enforcement reflects explicit knowledge. Researchers have discovered that tacit and explicit knowledge are interconnected rather than distinct, engaging with each other through interactions among various individuals and groups (Sudhindra et al. 2017; Alavi and Leidner 2001; Nonaka and Van Krogh 2009; Nonaka et al. 1996; Nonaka 1994).

Externalisation also involves communicating tacit knowledge and transforming it into explicit knowledge that can be shared and discussed with others. Participants had questions they would direct at the researchers during the game or the debrief. The researcher in turn transformed participants' tacit knowledge into more explicit knowledge by debunking their assumptions about delivery drones for example:

"So do the parcels have parachutes attached to them or something?" (Female Participant 1, Public Group #6)

"I think I've seen they have a kind of big crash mat. It's like a very soft, you know, it's like the kind of thing you'd imagine if a stuntman was jumping off a building." (Researcher 1)

The participant externalises their internal curiosity by asking a question about the logistics of how drones deliver parcels, reflecting uncertainty. By asking the question, the participant is taking their internal thoughts and making them explicit, allowing the researcher to add to the group's collective knowledge. The researcher uses a familiar analogy (a crash mat for stuntmen) to make the concept more understandable. According to Crookall (2010), debriefing creates opportunities for deeper reflection and the exchange of knowledge, particularly during the externalisation phase, which demands continuous commitment to reflection.

Other similar examples of participants asking questions aimed at other members of the group and researcher included:

Quote 1:

"Are they battery these drones?" (Female Participant 4, Public Group #3)

"It can be mostly, but you can also get petrol-driven ones, which can go further. Rechargeable, atteries can be rechargeable." (Researcher 1)

Quote 2:

"Do drones have floodlights on them? Do they have lights?" (Female Participant 2, Stakeholder Group #4)

"You could light the lights on them." (Male Participant, Stakeholder Group #4)

By asking these questions, the participants invite responses from others in the group and the researcher, contributing to the group's collective knowledge. The responses help clarify and expand on the participants' initial thoughts, creating a richer, more detailed understanding of the topic.

The game provided a structured but flexible setting that prompted participants to think aloud and articulate their decisions in context. Unlike traditional interviews, where reflection is often retrospective, the game enabled real time externalisation of thought processes and experiences, deepening engagement and peer learning.

The findings highlight how the externalisation stage of knowledge co-creation was facilitated during the game. Participants verbalised their thought processes and strategic decisions, which helped the group develop a collective understanding of both the game dynamics and delivery drones. By sharing personal experiences, participants externalised tacit knowledge, prompting deeper dialogue and reflection within the group. Knowledge sharing is crucial because it enables individuals to benefit from one another's experiences and expertise (Lin 2007; Krishnaveni & Sujatha 2012). This sharing process made unspoken knowledge explicit and contributed to new knowledge creation. The interplay between tacit and explicit knowledge was evident as participants expressed concerns and assumptions about drones, which researchers further clarified. Tacit knowledge stems from personal experiences and is shaped by individual beliefs, values, and emotions, whereas explicit knowledge can be conveyed through formal and structured methods (Roux et al. 2006; Grohn et al. 2017). The game successfully encouraged knowledge externalisation, fostering a richer and more informed group discussion.

### 11.4.3 Combination

The combination phase of the knowledge co-creation includes integrating explicit knowledge into conversation. Participants take the explicit knowledge that has been externalised such as ideas, observations and insights shared during discussion and combine these different pieces of information to form a more comprehensive understanding. The groups consisted of participants with varying levels of expertise and experiences with drones, bringing a unique perspective. During this stage participants worked together to synthesise the various explicit ideas and perspectives that had been shared, finding connections between different concepts

or merging ideas. As participants combine their explicit knowledge, they often develop new explicit knowledge that reflects the group's collective understanding that results from synthesising the group's ideas.

During discussions, participants were noted to be integrating and expanding on each other's ideas to form a more comprehensive understanding of the potential issues related to delivery drones for example:

"I'm sure it's going to make more people lazy as well..." (Female Participant 5, Public Group #7)

"Yeah, it's going to make everyone isolated, isn't it?" (Female Participant 3, Public Group #7)

"Yeah, cutting out social interaction... And for me, I think human contact is important." (Female Participant 2, Public Group #7)

"Yeah, definitely." (Female Participant 3, Public Group #7)

"I agree with that." (Male Participant 1, Public Group #7)

"...I think there's going to be problems with vandalism..." (Male Participant 4, Public Group #7)

The comments illustrate how participants merge their concerns and ideas to create a broader understanding of the social implications of delivery drones. This integration demonstrates how the group is collectively building a wider discussion of the challenges associated with drone deliveries. The process of agreement and expansion aligns with Habermas's (1984) concept of communicative action where dialogue serves as a tool for reaching mutual understanding. These interactions help solidify a collective perspective on a topic, demonstrating how shared knowledge emerges through the integration of multiple viewpoints (Jakubik 2011)

Participants were also noted to be integrating and building on each other's ideas to develop a more comprehensive understanding of the issues surrounding delivery drones for example, one group discussed terrorism risks and security measures:

"It was widely accepted that drones pose an additional terrorism risk. What approaches should be adopted to deal with this?" (Male Participant 6, Stakeholder Group #3)

"Security at take-off and landing." (Female Participant 3, Stakeholder Group #3)

"Remote ID." (Male Participant 6, Stakeholder Group #3)

"Cyber security. Counter UAV systems." (Male Participant 4, Stakeholder Group #3)

"Geo-fencing, remote ID. Upgrading sensor systems from the police and security services." (Male Participant 5, Stakeholder Group #3)

"Can you counter a drone? I don't think you can." (Male Participant 2, Stakeholder Group #3)

"As in, get rid of it?" (Female Participant 3, Stakeholder Group #3)

"Well yeah, mitigate, I believe you'd call it. Mitigate. How can you mitigate it?" (Male Participant 2, Stakeholder Group #3)

"Well how, but only advanced drones generally can do that, isn't it? So if it was a publicly available drone that might be causing that risk, then maybe you could put some interruption into, I dunno, could you interfere?" (Male Participant 4, Stakeholder Group #3)

Participants contribute their ideas and critically engage with each other's suggestions, asking questions and refining the concepts. This reflects the combination stage as synthesising technical and practical knowledge contributes to a more refined understanding of the risks and potential solutions. This aligns with Wenger's (1998) concept of communities of practice, where collaboration encourages the co-creation of meaning and actionable insights. By piecing together an approach that addresses multiple aspects of the issue, the participants demonstrate collective problem-solving, an essential element of social constructivism (Vygotsky, 1978). This shared understanding results from combining their insights into a more comprehensive perspective. This demonstrates how the combination stage transforms individual knowledge into shared strategies and solutions that are more informed and effective.

Another example of the combination stage in the knowledge co-creation process includes:

"Maybe that's about safety. And also the weight issue has made me think, well, do they need to be really specific?" (Female Participant 1, Public Group #4)

"So, like, you can only take very specific things with one type of drone? So do you need to have a fleet of ten different drones that can cope with different weights and sizes of parcels or of products to be viable? So, I think it's made me think that they're very specific. And like the weather, as you said, that's also an issue. So is it actually that they're not really for everyday reliability, are they?" (Female Participant 2, Public Group #4)

Through this dialogue, participants synthesise different pieces of knowledge about safety, weight, parcel size, and weather conditions to reach a more comprehensive understanding of the challenges and limitations of drone deliveries. Individual insights are represented in a more holistic view to reach a new shared understanding of the challenges related to delivery drones.

The structure of the board game helped facilitated the combination of explicit knowledge by encouraging collaborative synthesis. Rather than collecting isolated opinions, the game created an environment where participants built on each other's ideas in real time. This made it especially effective for developing shared strategies and surfacing complex insights, demonstrating its value as participatory tool.

The findings illustrate how the combination stage of knowledge co-creation was effectively facilitated during the game. Participants with varying levels of expertise and experiences with drones brought unique perspectives, and through discussions, they worked together to combine these diverse ideas. Synthesis involved integrating and expanding on each other's thoughts, leading to a more thorough understanding of concerns related to delivery drones. The process of agreement and building on one another's ideas solidified a collective perspective, an essential aspect of the combination stage where shared knowledge emerges from integrating multiple viewpoints. As participants discussed safety, weight, parcel size, and weather conditions, they merged individual insights into reaching a new, shared understanding of the challenges associated with delivery drones. This collaborative effort reflects the essence of the combination stage, where explicit knowledge is combined to form a complete perspective. Through this shared experience and the exchange of perspectives, participants built a shared understanding and developed mutual trust (see for example Nejatian et al. 2013; Jakubik 2011).

#### 11.4.4 Internalisation

The internalisation stage of the knowledge co-creation process involves the participants integrating the explicit knowledge shared during discussion and integrating it into their tacit knowledge. This process results in participants gaining a deeper understanding or developing new insights based on external and combined information. In this stage, participants internalise the knowledge they have acquired, which may influence their attitudes or future decisions.

A few participants expressed how their understanding had changed after playing the game or deepened as a result of the discussion for example:

"But the game's changed me. I came here thinking I probably was a little bit negative about drones 'cause I certainly was when they first came out and if you say they were buzzing around everywhere. But no disrespect Researcher 3, but because of some of the negative views, it's made me take the opposite way and look at it quite positively because there's been a quite a bit of negativity about them. It's actually made me take the devil's advocate view and go, well, actually let's have a look at what's good about them. And I think, on the whole, they're gonna be a really positive thing. Like most innovation is. But we are at that age group where we go Ohh...change." (Female Participant 2, Public Group #3)

The participant reflects on how the exposure to both positive and negative views during the game made her reconsider her initial viewpoint, indicating that she has incorporated the new information into her understanding, leading to a shift in her attitude. The participant also demonstrates self-reflection which is a part of internalisation as it shows that the participant has internalised the broader implications of what she has learned.

Another participant was observed to be engaging in critical reflection on the ideas presented in the board game for example:

"Yeah, but that's a rule that I wouldn't take on board. I would be looking at alternatives. I'm looking strategically because essentially, the benefit of a drone is getting somewhere quick. So, why would you impose the... like, we found it doesn't matter how many cars you've got on a road, if you put in an extra lane, you get more cars. They don't reduce. So, why would you encourage a drone to go down the same route way, causing exactly the same problem in the air as you would on the ground? Stupid, you know, wouldn't be sensible. So, you'd need to look at how they work in order to get the best benefits out of them. And that would be as the crow flies." (Female Participant 1, Public Group #6)

The internalisation is evident as they synthesise these ideas to form a reasoned argument. The participant demonstrates that she has internalised the knowledge and is forming her perspective on how drones should operate, reflecting Kolb's (1984) view of experiential learning as transforming knowledge into strategic insights. Her statement illustrates strategic thinking, showing how integrating new knowledge leads to a deeper understanding and

optimisation of drone operations, as highlighted in transformative learning theory (Mezirow 1991).

Similarly, in another group, a participant took the knowledge and experiences from the board game and integrated them into their understanding of drone operations for example:

"I think just, also when we just got started to get quite close together on the board, that just helped prompt a bit of thinking about the reality of having lots of different ones trying to go to the same places, in a quite small area." (Male Participant 1, Stakeholder Group #1)

The quote reveals an awareness of the complexity involved in managing multiple drones in proximity. It suggests that the participant has internalised the concept of airspace congestion and is considering how it may impact drone operations. The participant is not only engaging with the game superficially but also using it to think critically about real-world logistics and operational challenges.

One participant acknowledged that they had learned from others during gameplay, he expressed:

"Yeah, I also enjoyed it a lot. I think, as you said, it stimulated discussion. I feel like I also learned a few things from others. I may reflect a bit more, I think, you know. I have never thought about all of these other practical, you know, complex, but yeah, there are mentions. So yeah, I find it quite useful. I also like the fact that you have the comments and that you can speak, because sometimes in focus groups it's very... you get someone speaking too much and I felt like there was some balance and I like that. So yeah." (Male Participant 4, Stakeholder Group #2)

This quote is a strong example of internalisation. The participant acknowledges that he has learned new things and gained new perspectives and reflects on how these insights changed his understanding. Additionally, the participant's appreciation for the balanced discussion format resonates with Wegerif's (2011) concept of dialogic learning, highlighting how meaningful dialogue facilitates the internalisation of knowledge. Their intention to continue reflecting on complex issues underscores the transformative potential of reflective practices in learning (Mezirow 1991).

The board game was especially effective at fostering internalisation because it combined hands-on engagement with peer dialogue, prompting real-time reflection during game-play

and the debrief. Unlike interviews or surveys that often capture surface level views or post hoc reflections, the game created an immersive, participatory setting where participants could actively explore scenarios, test assumptions and absorb alternative viewpoints as the discussion unfolded. This supported deeper learning and allowed participants to meaningfully integrate new insights into their own thinking.

The internalisation stage of knowledge co-creation is vital as participants move beyond just information exchange to deep reflection and integrating new insights into their thinking. Through the analysis of participant discussions, it is evident that the board game not only facilitated the sharing of knowledge but also fostered shifts in perspectives regarding the use of delivery drones. Participants demonstrated an awareness of the complexities of drones, with some expressing a change in their views due to playing the game. Participants' recognition of new insights marked internalisation, their application of learned concepts to real work scenarios and their ongoing reflection. The interactions demonstrate how a collaborative, interactive environment can stimulate critical thinking and produce more refined, informed opinions.

## 11.5 Reflections on the Value of the Board Game

Games have been utilised in policymaking for years (see, for example, Duke 1995, 2000; Mayer 2009; Gandziarowska-Ziołicka and Stasiak 2019) because they effectively promote dialogue among various groups, foster idea-sharing, and close knowledge gaps (Geurts et al. 2007). Participants actively explored each other's views, contributing to shared understanding and knowledge exchange. As discussed in previous sections, the gameplay involved identifying drone routes in a familiar location, with participants raising concerns about delivery drones and discussing them with others. This method enhanced the game's accessibility, which is crucial for a one-time event. Participants asked questions to researchers, who shared explicit insights during the debriefing session, illustrating knowledge co-creation.

The game allowed participants to explore drone scenarios in a simulated environment, where they could experiment with different strategies and decisions and immediately observe the consequences. This deepened their understanding of abstract concepts such as drone route, risk and energy. The game encouraged participants to engage in decision-making and critical thinking by evaluating potential outcomes, enhancing their understanding of the implications of drone operations. It served as an effective tool to engage a general audience,



often distant from the policy planning process. It allowed participants to remove themselves from their daily routines and explore other viewpoints and perspectives (Ampatzidou et al., 2018), which were collectively shared, constructed, and negotiated. The board game proved successful in helping participants to understand complex scenarios, sparking discussions about topics they might not otherwise consider, and offering a space for reflections (see for example Gee 2006; Crookall 2010; Ampatzidou et al., 2018; Jean et al., 2018a).

Due to the competitive and collaborative elements of the game, the participants acknowledged learning from each other and the game which led to discussions and debates, facilitating knowledge sharing. The game environment allowed participants to externalise their thoughts and challenge each other's ideas, co-creating knowledge that is difficult to achieve in traditional settings. The game also facilitated the exploration of diverse perspectives, highlighting different viewpoints on various aspects of drone deliveries. The game made complex issues more accessible by integrating them into game mechanics, such as route navigation and risk and energy management, helping participants engage and grasp these concepts.

The game successfully included the public and stakeholders in discussing delivery drones through an accessible, fun format that encouraged knowledge sharing, but it also highlighted several challenges and limitations. The complexity hindered some participants' full engagement and understanding of the mechanics and broader issues. Group dynamics sometimes led to uneven participation, where vocal participants dominated the discussion, potentially suppressing quieter voices. Stronger personalities also influenced group discussions and decisions, leading to biases in some discussions and gameplay outcomes. Some participants with less assertive communication styles likely felt overshadowed, resulting in the underrepresentation of their ideas. Additionally, due to a gamified environment, some participants did not fully consider the real-world implications of their decisions and the implications of delivery drones.

The board game format was particularly effective in supporting knowledge co-creation because it embedded abstract issues within concrete, interactive scenarios that were easy to grasp and react to. Unlike interviews or focus groups alone, the game prompted participants to make decisions, reflect on consequences, and negotiate meaning with others in real-time. This performative and embodied engagement brought tacit assumptions to the surface and enabled experiential learning, which is especially valuable when exploring unfamiliar or emerging technologies like delivery drones.

In conclusion, the board game helped engage participants in complex scenarios and discussions about the practicalities and implications of delivery drone operations. Its interactive nature facilitated exploring, reflecting, and internalising key concepts such as route planning, risk management, and energy consumption. Despite its challenges, the game successfully fostered knowledge co-creation and broadened participants' perspectives on the subject.

# 12 Discussion and Conclusion

## 12.1 Introduction

This study sought to enhance the understanding of stakeholder deliberations and the policy implications associated with delivery drones by applying the Social Representations Theory. This chapter begins with a review of the study objectives and then explores the social representations of delivery drones and recommendations for future policy development. Section 12.4 emphasises the benefits of incorporating a board game methodology in focus group discussions, while Section 12.5 elaborates on the study's contributions to methodology, policy and knowledge. The chapter concludes in Section 12.6, addressing the study's limitations and proposing areas for future research.

## 12.2 Review of Objectives

The study aimed to achieve four key objectives, each of which is addressed as follows:

*1. To understand the attributes of drones in logistics to build realistic scenarios for the public to respond to.*

A comprehensive literature review explored drones' characteristics and challenges in logistics. This review identified key themes, including operational constraints, regulatory considerations and public concerns, shaping realistic scenarios for the game-based tool. The scenarios were further refined with input from the wider E-drone team, ensuring that they reflected real-world applications of delivery drones. By incorporating insights from existing research, the tool was designed to prompt engagement with both the practical and societal implications of drone logistics, allowing participants to consider their potential roles in different settings.

*2. To analyse online news media headlines to understand how the public forms media representations around delivery drones.*

853 headlines from the BBC, Daily Mail, and The Guardian were analysed to examine how media portrayals shape social representations of delivery drones. The findings reveal dual narratives, where drones are framed as a societal risk (linked to privacy concerns, job losses, and security threats) and as a technological innovation (particularly for medical and

emergency applications). These conflicting portrayals contribute to uncertainty, reinforcing optimistic and cautionary media representations shaping how people conceptualise drones.

*3. To develop and test a tool to help people understand a future involving logistic drones that can be deployed in different settings*

The Game of (Delivery) Drones was developed and tested to help participants construct and negotiate social representations of logistic drones in various contexts. The tool enabled engagement with future drone scenarios and encouraged discussion on risks, benefits, and operational challenges. An iterative design process incorporating the research team and focus group feedback refined the game's ability to simulate real-world complexities and encourage reflection. The game's adaptability across different settings highlights its potential for public engagement and stakeholder dialogue on drone integration. Four versions of the game were created.

*4. To use the tool to investigate people's views of logistic drones in specific settings to inform future policy*

The game-based tool was deployed in focus groups to investigate participants' views on using logistic drones in specific scenarios. The insights gathered from these discussions provide valuable input for shaping future policy and regulatory frameworks, ensuring they are aligned with public concerns and expectations. The findings illustrate that public attitudes towards drones are shaped by familiar analogies, media portrayals and broader societal values rather than purely technical assessments of their functionality. Key social representations identified in the participant discussions include:

- Drones as necessity vs luxury: Medical deliveries were framed as a "social good," reinforcing drones as lifesaving tools, while food deliveries were questioned as frivolous conveniences. This reflects an ethically driven evaluation of technological use.
- Media as an amplifier of social representations: Participants' understanding of drones was influenced by dominant media narratives, which framed them as symbols of efficiency and innovations while overlooking practical limitations. However, participants also resisted these portrayals, introducing counter-representations based on lived experiences, such as privacy risks, security concerns, and environmental sustainability.

- Drones as social disruptors: Participants portrayed drones as either a threat to employment or creators of jobs and potentially contributing to social isolation. This aligns with wider automation debates that view technology as both disruptive and transformative.
- Environmental and operational uncertainty: While the media framed drones as eco-friendly technologies, participants highlighted battery disposal, noise pollution and weather constraints, questioning sustainability claims.
- Trust, governance, and equity: Participants trusted drones more when associated with public institutions (e.g., NHS) than private corporations, linking them to fairness, accessibility, and social good. Concerns about economic inequality framed drones as potentially favouring wealthier areas while excluding marginalised communities.
- Place-specific regulation and risk perception: Participants emphasised the need for location-based drone governance, reflecting concerns that risks and benefits vary between urban and rural areas. Urban settings were framed as higher risk, requiring stricter oversight, while rural areas were seen as more viable for drone integration. Analogies to aviation and road transport systems were used to conceptualise structured airspace management for drones.

Through collective meaning-making, participants anchored drones within a familiar societal framework. These discussions illustrate that views are actively constructed, debated and shaped by ethical and contextual considerations.

In addressing these objectives, this thesis makes several key contributions to the fields of technology communication, public perception and emerging transport policy. Methodologically, it introduces a game-based focus group approach that enables participatory exploration of future drone scenarios. Theoretically, it advances the application of SRT to understand how emerging technologies are socially constructed through discourse, place-based concerns and media narratives. Empirically, it reveals how public attitudes towards delivery drones are shaped by ethical, contextual, and institutional factors, contributing to new insights for policy design. Finally, it provides suggestions for policymakers on context-sensitive and inclusive regulations of delivery drones. These contributions are discussed in detail in Section 12.5.

## 12.3 Critical Reflections on Theory and Method

The combination of SRT and a serious game-based focus group method shaped not just the form of stakeholder engagement but also the kind of knowledge this research was able to

produce. SRT enabled the study to move beyond recording individual opinions, offering instead a way to understand how delivery drones were collectively framed, anchored in prior experience and made sense of through shared discourse. This theoretical lens foregrounded the social and contextual nature of public meaning-making, allowing for the identification of recurring representational patterns across settings.

At the same time, the use of a game-based methodology created conditions for participants to encounter realistic trade-offs and simulate decision-making processes. The design encouraged deliberation around both practical and ethical dilemmas, prompting participants to articulate their assumptions, contest dominant narratives and reflect on the situated impacts of drone deployment. This participatory format was especially effective at surfacing concerns that may not emerge in more conventional methods such as surveys or interviews, particularly concerns around equity, trust in governance or infrastructural feasibility.

Together, the theory and method did more than gather descriptive data on attitudes; instead, they encouraged the co-construction of socially embedded knowledge. This approach helped generate insights that are actionable for policy and regulatory development, especially in highlighting place-based risks, identifying conditions under which public trust may be built and foregrounding community values that may otherwise be marginalised. By combining an interpretive theoretical framework with an interactive methodological tool, this study contributes to more reflective, responsive and grounded technology governance.

## 12.4 Reflections on the Social Representations of Delivery Drones and Suggestions for Future Policy

This study aimed to facilitate people's understanding of delivery drones and provide opportunities for them to give more informed views that may feed into future policies. Studies on people's understanding of delivery drones often emphasise what people think, examining their opinions and concerns rather than exploring how they form these perceptions and make sense of the technology. This study addresses this knowledge gap by demonstrating how social representations are constructed by generating new understanding through dialogue and media representations. Earlier research has primarily focused on quantifying concerns such as privacy, safety and acceptance (see for example, Reddy & DeLaurentis 2016; Aydin 2019; Lidynia et al. 2016) but has seldom explored the processes through which these concerns emerge and evolve in social contexts. Instead of viewing *public perceptions of science* as issues of misconceptions or *lack of scientific knowledge* to be addressed through

communication and education, studies grounded in social representations theory examine how abstract scientific knowledge is converted into common, everyday understanding (Olausson 2011). Additionally, representations are created, influenced, and adjusted through social interactions among individuals (Chaib and Orfali 2000).

Focus group methodology was ideal for studying social representations because it allowed for their expression and negotiation within a group setting (Marková et al., 2007), and mass media was examined as this is seen as an important factor in influencing public awareness and views (see for example Ryghaug et al. 2011; O'Neill and Nicholson-Cole 2009; Nisbet 2009). This complements prior literature highlighting the role of media framing and selective reporting in shaping perceptions of emerging technologies (see for example, Jeffres et al. 2018; Happer & Philo 2013; Broadbent et al. 2021). Social representations of delivery drones should be understood in the broader context of how individuals interpret this technology, considering focus group comments on community impacts and safety concerns within their specific contexts. It is essential to focus on how the dialogue and exchange of ideas during these sessions contribute to shaping collective perceptions of delivery drones. Additionally, it is crucial to explore how the representations formed and debated among participants connect with wider societal narratives, such as those depicted in the news media.

According to Moscovici (1984), a primary function of social representations is to conventionalise objects, people, and events by placing unfamiliar concepts into familiar contexts, making them understandable to the public. In the context of focus group game sessions, there is a process of conventionalisation where different interpretations of delivery drone impacts were negotiated. According to Rodari (2008), dialogue is considered a key aspect of effective science communication. Therefore, involving the public in discussions about delivery drones is essential, as this technology has potential to have a significant impact on their lives. This aligns with earlier critiques of deficit-based approaches to science communication (e.g., Nisbet and Scheufele 2009), which overlook how values and social contexts shape public attitudes. Engaging the public in these conversations helps them understand various scenarios related to delivery drones, exposing them to both the potential benefits and drawbacks, and enabling them to form informed opinions. This contrasts with online news media, which portrayed delivery drones as a matter of technological progress and efficiency, often overlooking the negatives in some cases.

While previous studies have identified framing biases and selective reporting in media coverage of drones and other automation technologies (see for example, Scheufele &

Lewenstein 2005; Nisbet et al. 2003), this research builds on and extends that work by examining how media narratives interact with collective sense-making in participatory settings. Many studies on people's perceptions of delivery drones reflect elements of the much-criticised 'deficit model' of science communication (Nisbet and Scheufele 2009; Brossard and Lewenstein 2009), which assumes that people reject a technology due to a lack of knowledge and that increasing their knowledge will lead to acceptance. While some focus on public acceptance, often from a deficit perspective, others simply measure concerns, such as privacy, without deeper engagement with underlying attitudes or values. By contrast, this study focuses on the interpretative processes by which such concerns are articulated and negotiated. This study challenges the assumption that increasing public acceptance of drones solely depends on providing more information about their functionality and benefits. However, this approach overlooks other issues, such as people's values, beliefs and social context, which also impact how they perceive and respond to delivery drones.

This research has explored the multifaceted perspectives of delivery drones, highlighting the complex interplay between public perceptions, media narratives, and the potential regulatory landscape. Through game-based focus groups, participants revealed a range of social representations (Table 10) that also challenged the often simplistic and optimistic portrayals of drones found in media coverage. These findings offer valuable insights into how people construct their views on delivery drones as they construct meanings and debate concerns about safety, security, economic viability, environmental impact, and social equity.

Participants expressed various attitudes and contrasting views towards delivery drones, from curiosity to scepticism and aversion. For example, some participants described drones as frivolous for food deliveries, reflecting a social representation of these services as luxury conveniences rather than essential needs. In contrast, medical deliveries were seen as a 'social good mission' and lifesaving. This distinction highlights that participants were negotiating the role and value of delivery drones based on perceived urgency and societal impact, framing medical deliveries as important while questioning the appropriateness of using drones for non-essential goods. This builds on earlier findings that people's acceptance of drone use depends on contextual factors (see for example, Smith et al. 2022a; Boucher 2016; Reddy & DeLaurentis 2016).

The media portrays medical delivery drones as innovative solutions for logistics, highlighting convenience and efficiency. This portrayal can contribute to a generalised, over-optimistic social representation that overlooks the complexities and concerns raised by the



public. While participants questioned the feasibility and advocated for clear regulation to ensure responsible use, the media highlighted factors such as the speed of drone deliveries. These findings suggest that policy development should recognise media-driven narratives and address the public's understanding of delivery drones. To align policy with public views, establishing clear guidelines for essential versus non-essential drone use would resonate with the public's concerns, as evidenced by the participants' emphasis on minimising risk and prioritising critical deliveries. As discussed in chapter 4, media framing plays a pivotal role in constructing such narratives, often privileging efficiency over equity (see for example Dubljević et al. 2014; Nguyen & Hekman 2022)

The representation of drones in participant discussions as socially isolating contrasted with news media portrayals that framed drones as a technological solution to logistical challenges, rarely acknowledging the social implications. While the media depicts drones by highlighting efficiency and accessibility, participants perceived these as skewed benefits to only a certain demographic, such as those living in wealthier areas. Media narratives rarely addressed the implications of infrastructural and socio-economic barriers such as landing and take-off sites or drone flight paths, highlighting a social representation of drones as symbols of inequality. Policymakers should consider this to develop regulations that promote equitable access such as investing in infrastructure and planning flight paths to avoid further marginalising low-income communities. These reflections extend the critiques found in media studies that call for more inclusive representation of technology impacts see for example Taddicken et al. 2020; Seppelt et al. 2019). Furthermore, participants also raised concerns about job losses that were also present in news media headlines that framed it as 'robots replacing humans.' There was also a duality noted in the social representations: some thought of drones as a potential threat to employment, while others considered them a potential source of employment.

Participants expressed concerns about the impact of noise on the community and the social perceptions of drones as potential disruptors, indicating the need for regulation on managing noise and operating hours for delivery drones. There was no mention of the implications of drone noise in the media, however, it moderates such issues by mostly focusing on the positives. Privacy concerns were dominant in both news media and participant discussions. Media narratives framed drones as invasive, which was also noted in participant discussions, highlighting the social representation of drones as intrusive and threatening to personal privacy, calling for strict regulatory measures. The public's privacy concerns regarding using cameras, data collection, and drone flight paths over private properties

highlight key areas for policy consideration, particularly in ensuring transparency and public trust in drone operations. These concerns reflect themes identified in Chapter 2's review of public attitudes where privacy consistently emerged as a barrier to acceptance (see for example, Pedrozo & Klauser 2017; Bajde et al. 2017)

Drawing analogies to existing transport systems like roads and aeroplane routes, participants supported the idea of establishing drone corridors. The media also mentioned the development of 'drone highways,' praising the government's effort to establish a drone corridor, with little information on when it would be implemented or what it would be used for. This representation of drones is analogous to other forms of aerial transport, suggesting a public desire for structured and safe airspace management systems. Moreover, participants emphasised risk assessment and drone mitigation, especially in densely populated areas, reflecting a social representation of drones as inherently risky technology. Participants also highlighted the need for strict regulations around sensitive areas, drawing attention to security risks associated with unauthorised drone use. Such concerns mirror broader anxieties about payload safety and the consequences of crashes in populated areas (see for example Nentwich and Horváth 2018; Grote et al. 2022). This concern was also reflected in news headlines reporting high-profile incidents of drones causing disruption at airports or breaching security parameters. The social representation of drones as potential security and safety threats calls for strict policies to ensure public safety and mitigate apprehensions about drone misuse.

Participants articulated the need for drone regulations that are tailored to the distinct characteristics of urban and rural settings. This social representation of place-based regulation reflects a sophisticated understanding that drone operations should adapt to the unique demands of different settings. Such situated perspectives align with studies showing how local context shapes views of emerging technologies (see for example Smith et al. 2024). This perspective is challenged in media coverage, which typically promotes the widespread adoption of drones without addressing the specific needs of different communities. Media narratives often depict drones as a one-size-fits-all solution to logistical challenges, overlooking the importance of contextualising regulations.

Furthermore, participants expressed a desire for flexible and community-oriented regulation such as operational hours. The social representation of drones as potential disruptors highlights the importance of developing policies that consider local preferences and routines. Implementing community-oriented regulations could improve drone integration by

ensuring operations are aligned with community expectations. Participants emphasised the need to introduce drone licensing and ensure drones are identifiable and used responsibly. The media, on the other hand, tends to celebrate the developments in the drone industry without sufficiently addressing the complexities of compliance and regulation. This reflects a broader tendency in media coverage to foreground innovation while minimising societal risks or regulatory complexity (see for example Racine et al. 2010; van Atteveldt et al. 2014, cited in Jelinski et al. 2021). Although news media headlines have reported on UK drone laws, they have largely presented these regulations uncritically, focusing solely on introducing new rules without further scrutiny.

The discussion on combining drones with traditional delivery methods highlights participants' pragmatic approach to integrating drones with existing systems. This hybrid model represents a balanced view of drones as complementary rather than wholly disruptive, contrasting with media narratives that often depict drones as a complete replacement for traditional delivery methods. Such co-existence of multiple perspectives illustrates the dialogic nature of social representations (see for example Marková et al., 2007), where new meanings emerge not in isolation but through contrast and comparison with established systems. Participants' views highlight the potential for hybrid models integrating drones with conventional delivery systems, suggesting this as a consideration for future logistics planning and policy discussions. Participants expressed various safety concerns related to delivery drones, including the risk of crashes, battery failure and the impact of drone size and weight. These concerns reflect a social representation of drones as potentially dangerous, especially in populated areas. Media narratives, however, have focused on the novelty of drones, downplaying or oversimplifying these safety risks. Concerns about the impact of drones on wildlife and domestic pets, particularly on bird populations and potential harm to animals, reflect a social representation of drones as a threat to natural environments. The portrayal of drones in the media was also depicted as causing animal distress.

Participants questioned the reliability of drone operations under adverse weather conditions. Media portrayal of drones does not fully capture the complexities involved and has portrayed drones as innovative solutions capable of reaching remote areas. Still, participants recognised the limitations imposed by environmental factors like wind, rain and extreme temperatures. This social representation of drones as weather-sensitive technology contrasts with the often-idealised media portrayal, emphasising the need for realistic expectations and adaptive delivery systems that can operate effectively under varying conditions. Participants expressed scepticism about the cost-effectiveness of drone deliveries, particularly for small or

low-value items. This contrasts with media narratives highlighting drones as cost-saving, efficient alternatives to traditional delivery methods. Participants' concerns about the potential for increased costs being passed on to consumers suggest a social representation of drones as potentially expensive and not necessarily more efficient. This highlights the need for regulatory oversight to ensure that drone delivery services remain economically accessible and competitive. Policies could include cost regulations to protect consumers from excessive fees and support for developing scalable and economically viable delivery models that offer clear benefits over traditional methods. These findings contribute to existing research by showing how shared representations of drones as expensive or unreliable emerge from situated, dialogical exchanges, rather than from individual attitudes alone (see for example Jovchelovitch 2007; Sherry-Brennan et al. 2010; Batel and Devin-Wright 2015).

The social representations expressed by participants provide a nuanced perspective on the perceived benefits and drawbacks of delivery drones, challenging the often one-dimensional portrayals in the media. Consistent with Moscovici (1984) notion of conventionalisation, participants anchored drones to existing ideas, to make sense of their purpose and risks. These anchoring processes were socially negotiated, aligning with Marková et al.'s (2007) emphasis on the relational nature of representational building. Participants' framing of drones as intrusive or unequal also echoes Olausson's (2011) work on how technologies are embedded within broader cultural and moral landscapes. Importantly, this study goes beyond earlier applications of SRT by using a game-based focus group format to support real time co-construction of meaning. This enabled participants to not only articulate their views but actively engage with others' perspectives, illustrating the dynamic and performative nature of representations. As drone technology evolves, policy must reflect these negotiated understanding, not only by disseminating facts, but engaging in open dialogue shaped by context, values and collective sense-making.

## 12.5 The Application of Serious Game Methodology in Transport Planning

Serious games serve multiple purposes in focus group studies, making them valuable tools for exploring complex topics like delivery drones. The Game of (Delivery) Drones was designed to immerse participants in hypothetical drone delivery scenarios. Choices related to risk, routing, and energy management facilitated in-depth discussions and knowledge co-

creation. As highlighted by Chen and Janicki (2020) and Bayeck (2020) the value of serious games lies in their capacity to contextualise abstract information and encourage experiential learning. This board game methodology provided a structured yet flexible platform for participants to engage with complex issues, enhancing the typical focus group format by integrating visual and interactive elements.

A primary objective of incorporating serious games into focus groups is to stimulate in-depth discussions between participants and analyse how knowledge is co-constructed among them. Traditional focus groups are known for generating rich, process-oriented data that reveals how participants collaboratively make sense of the topic at hand (Marková et al., 2007). As discussed by Bayeck (2020), games can extend this by inviting exploratory play and social interaction. The inclusion of a serious game added a visual and imagination-stimulating component, broadening the analysis beyond participant interactions. This captured how participants interacted with one another and engaged with the game as a tool, influencing their understanding of delivery drones. The game board, tailored to reflect participants' local environments, allowed intuitive navigation and decision-making, making the discussions more grounded and relevant to real-world contexts. Furthermore, the game demonstrated that it was able to facilitate knowledge co-creation,

The board game's design required participants to be in proximity, promoting direct interaction and dialogue. Participants engaged in collaborative discussions, sharing information, collectively reasoning, and negotiating meaning. The game's components, such as Comment Cards and Flight Update Cards, prompted participants to speak about their personal drone experiences, fostering mutual trust and shared understanding. This environment of mutual interaction and equal exchanges enabled the development of shared knowledge, which emerged from analysing interactions and relationship dynamics within the group. These findings suggest that the game encouraged knowledge co-creation within the socialisation stage of knowledge co-creation, as conceptualised by Nonaka and Takeuchi (1995).

In the externalisation stage, participants were observed verbalising their thought processes and strategic decisions during gameplay, facilitating externalisation of tacit knowledge. This dynamic reflects discussion on knowledge sharing and expressive interaction in participatory methods (see for example Ragothama et al. 2022; Tsai et al. 2021; Periera et al. 2012). By sharing personal insights and experiences, they transformed unspoken, intuitive knowledge into explicit information that contributed to knowledge co-creation. The game

effectively encouraged participants to articulate their assumptions and concerns about drone operations, leading to deeper dialogue and reflection. This interplay between tacit and explicit knowledge enriched the group's understanding of delivery drones, making complex concepts more accessible and understandable.

Participants integrated their diverse experiences and knowledge during the combination stage to form a cohesive understanding of delivery drones. They synthesised information about operational parameters such as safety, payload, and weather conditions by building on each other's ideas. This collaborative process led to a collective perspective, as participants combined individual insights to view the challenges and opportunities associated with drone deliveries comprehensively. The game mechanics facilitated this synthesis by providing structured opportunities for participants to discuss and refine their ideas, reinforcing the co-construction of shared knowledge.

The internalisation stage involved participants reflecting on the insights gained from the game and integrating new knowledge into their thinking. Many participants showed a shift in perspective, demonstrating a deeper understanding of the complexities of drone logistics. This was evident as they applied learned concepts to real-world scenarios and continued reflecting on drone use's implications beyond the focus group setting. The game, combined with structured discussions, effectively supported the internalisation of new knowledge, leading to more informed and considered opinions on delivery drones.

Another key benefit of integrating serious games into focus group research is the opportunity to evaluate and refine the game itself. The focus group setting allowed for immediate feedback on the game's features, highlighting areas where participants experienced challenges or confusion. This iterative feedback loop is invaluable for improving the game design to suit different target audiences and settings. As noted by Olejniczak et al. (2020), incorporating structured reflection into gameplay enhances engagement by catering to varied user preferences. In this study, for example, the use of mission cards and flight update cards provided structured entry points for discussion, while the localised game board made the gameplay more relatable. Participants' reactions to these elements offered insights into enhancing the game's engagement potential, ensuring it remains an effective tool for exploring the implications of delivery drones across diverse contexts.

The integration of serious gaming into focus groups also aligns with principles of experiential learning, emphasising the 'importance of direct experience and reflective observation' (Kiili 2006, p.17). In the Game of (Delivery) Drones, participants were allowed to

explore options and make decisions within the game and were encouraged to share their thoughts and reflections with others. This setup facilitated a dynamic exchange of ideas, where participants could debate different strategies and refine their understanding of drone operations. The structured debriefing sessions after each round of gameplay, where participants discussed their decisions and the outcomes, were particularly effective in reinforcing learning and fostering critical thinking. This combination of gameplay and reflective discussion supported deeper engagement and more nuanced topic exploration.

Focus groups are often seen as arenas for the co-construction of socially shared knowledge, where participants collaboratively foster arguments, narratives, and new ways of thinking (Wibeck et al. 2007; Marková et al. 2007). The game-based methodology further enriched this process by providing structured yet open-ended scenarios that prompted participants to articulate, negotiate, and reconcile their views. The inclusion of interactive elements such as comment cards and flight update cards encouraged participants to contextualise their decisions and critically evaluate the implications of drone deliveries. When participants disagreed with each other's choices or the game content, these moments of tension became opportunities for deeper discussion and the co-creation of knowledge. Through these interactions, participants collectively built a more comprehensive understanding of the challenges and opportunities associated with delivery drones.

Using serious games in focus groups offers a novel approach to engaging the public and experts in discussions on technology, communication, and policy. Games can help bridge the gap between abstract policy concepts and everyday experiences by simulating real-world scenarios and encouraging active participation, making complex issues more accessible and understandable. The insights gained from the Game of (Delivery) Drones can inform future policy development by highlighting public concerns, preferences, and misconceptions about drone technology. Moreover, this methodology can be adapted to explore other emerging technologies, providing a versatile tool for public engagement and policy research. Overall, applying a board game methodology in focus groups proved to be an effective means of exploring public perceptions and knowledge co-creation around delivery drones. By integrating interactive and experiential elements into the focus group format, the study generated rich data that extends beyond traditional discussions. This approach facilitated a deeper understanding of the complexities involved in drone logistics and offered valuable insights into communicating and engaging with the public on technological issues. The findings highlight the potential of serious games to serve as tools for both research and practice in technology communication and adoption studies.

## 12.6 Games for Research: Guidance for Future Game

### Designers

In response to the growing interest in using serious games to explore public perspectives on emerging technologies, this study offers several practical insights for researchers and designers aiming to develop games for similar purposes. While this research focused on delivery drones, many of the lessons learned are transferable to other contexts where public attitudes, social values, or contested futures are under investigation.

One key priority in the game's development was designing for deliberation. Rather than relying on competition or point scoring, the game mechanics were structured around decision-making and trade-offs to prompt reflection and group negotiation. Tangible components such as energy tokens, risk meter and the card decks (mission, comment cards) helped participants concretely engage with complex issues.

Grounding these scenarios in real-world complexities, drawn from literature, media analysis, made the gameplay feel relevant and credible. Designers should aim to create scenarios that are speculative yet resonant, encouraging participants to connect the game to their experiences. The iterative development process was also critical in refining both the mechanics and framing of the game. Playtesting helped uncover moments of confusion, gaps in engagement and opportunities to better align the game with its intended research goals.

Another key consideration is the balance between structure and flexibility. While the game provided a clear format, space was also provided for organic conversation, tangents and unexpected insights. This duality proved valuable in surfacing participants' underlying values and assumptions. Designers should also recognise that games for research must serve both engagement and data collection purposes. Emotional investment, enjoyment and immersion can significantly enhance the richness of insights gathered. The role of the facilitator is central to guiding discussions while allowing participants to take ownership of their gameplay experiences.

Ultimately, this study demonstrates that serious games can offer more than just an alternative data collection tool, they can function as participatory methods that encourage dialogue, uncover tensions and reveal collective values. When carefully designed and ethically



deployed, games can support more inclusive conversations around emerging technologies and inform policy in a way that is grounded in public understanding and lived experiences.

## 12.7 Research Contributions

This research makes several significant contributions to technology communication, public perception, and the study of emerging technologies. Through an innovative methodological approach, the application of SRT and an in-depth analysis of stakeholder views, this study advances the understanding of how people make sense of delivery drones. These contributions span methodological advancements, theoretical insights and practical implications for stakeholder engagement.

This study introduces a game-based focus group methodology as an innovative tool for exploring stakeholder deliberations on emerging technologies. By embedding realistic drone scenarios into gameplay, participants were encouraged to actively engage, reflect and negotiate their views in a structured yet flexible environment. Unlike traditional focus groups, which rely on verbal discussions, this approach provided an experiential dimension that allowed participants to simulate decision-making processes, consider trade-offs and critically assess drone deployment in various settings. This novel approach offers a replicable framework for researchers and practitioners seeking to capture deeper public perspectives on complex or abstract technologies. The approach also demonstrated the value of participatory methods in technology discourse, highlighting how stakeholder engagement can go beyond passive consultation and encourage knowledge co-creation. This contribution extends beyond delivery drones, offering a versatile model for studying other emerging technologies where public attitudes are still forming.

A key theoretical contribution of this research is the application of Social Representation Theory (SRT) to examine how an emerging and uncertain technology is contextualized, negotiated, and socially constructed. The study reveals how participants anchored delivery drones within familiar societal frameworks, such as existing transport systems, environmental concerns, and risk management strategies. This process of anchoring and objectification demonstrates how abstract technologies are made tangible through media narratives, personal experiences, and collective discourse.

The study provides new insights into how social representations evolve in response to conflicting media narratives. For instance, drones are framed as both technological innovations and potential threats. It also highlights how place-specific concerns shape social

representations, with urban and rural participants framing drones differently based on their perceived impact on local infrastructure, privacy, and security. By applying SRT to a technological context, this research advances a theoretical understanding of how public perceptions of innovation are not static but shaped through continuous social interactions.

The research offers insights into how the public perceives future transport scenarios, uncovering a spectrum of attitudes ranging from curiosity and optimism to scepticism and concern. It identifies key factors shaping these perceptions, such as impact on communities and related concerns. These findings contribute to understanding the public's expectations and fears regarding an emerging transport technology. The study provides a detailed map of the social representations and concerns that the population has about delivery drones, which is essential for developing informed and responsive policy and regulatory frameworks.

A key contribution of this research is its emphasis on the need for place-specific regulations. The study highlights the unique challenges of integrating delivery drones in diverse environments, such as urban and rural settings, where regulatory needs may vary significantly. It highlights the importance of adaptable and context-sensitive regulatory frameworks addressing safety and equity concerns. This contribution is particularly valuable for policymakers, as it provides a nuanced perspective on how regulations can be tailored to different contexts to ensure delivery drones safe and equitable integration. The research provides practical recommendations for policymakers and advocates for clear safety standards, privacy protections, and infrastructure development to support drone operations. It offers a roadmap for creating regulations that are responsive to public concerns while promoting the responsible integration of delivery drones. These practical insights are valuable for policymakers seeking to balance innovation with public safety and social acceptance, ensuring that regulatory frameworks are both effective and inclusive.

To the best of the researcher's knowledge, the influence of media narratives on public perceptions of drones has not been extensively studied. The significant role of media in shaping these perceptions, particularly through sensationalised coverage of security incidents and technological failures, can heighten public fears and scepticism, potentially hindering the adoption of drone technology. This finding contributes to the field of science and technology communication by demonstrating the impact of media narratives on public attitudes. Understanding these representations is critical for technology communication and public engagement stakeholders.

To conclude, this thesis makes significant contributions across multiple domains, advancing both theoretical and practical knowledge on delivery drones. The study lays the groundwork for more informed and effective development and regulation of emerging technologies by integrating innovative methodologies, exploring public perceptions, and providing actionable insights for policymakers

## 12.8 Limitations and Recommendations for Future Research

While this study provides insights into stakeholder views of delivery drones and the potential for serious games to facilitate knowledge co-creation, several limitations must be acknowledged to contextualise the findings and fully guide future research.

This study faced several limitations that may have influenced its findings. Firstly, the use of some closed questions in the board game posed a risk of limiting participants' discussions on drone-related issues, potentially constraining deeper engagement or exploration of broader concerns. Secondly, important questions regarding the game's effectiveness arose, particularly where participants perceived that their decisions related to risk and energy did not have significant penalties. This may have impacted their engagement and the game's ability to reflect real-world consequences, suggesting the need for adjustments to ensure these factors feel consequential and engaging. Lastly, a lack of diversity in flight update cards led to occasional participant boredom, which may have reduced overall interest and engagement during gameplay.

Several recommendations are proposed to address these limitations and further enhance this study. Future research could explore more approaches in focus groups by challenging stakeholder perspectives, such as questioning optimistic claims like "drones will save lives." This method could encourage deeper discussions and more critical engagement with diverse viewpoints. Creating a new board game for each location proved to be a significant challenge, and future research could investigate whether simplifying the customisation process would affect participant engagement and the overall outcomes. While the study assumes that localised game elements are important, further research could evaluate how much this localisation matters.

Additionally, while the study aimed to encourage inclusive dialogue, certain limitations on participant representations should be acknowledged. The game format was highly visual and relied on reading, movement of pieces and tokens. As such, it was not designed to

accommodate individuals with visual impairments or other disabilities, which may have excluded important voices from the conversation. Future research should explore accessible game formats such as tactile components or audio-based alternatives, to ensure broader participation. Similarly, while the game has the potential to appeal to younger audiences, engaging them meaningfully may require adaptation of both content and delivery format.

Another consideration relates to group dynamics during gameplay. As with many participatory methods, certain individuals were more vocal than others, which may have led to some perspectives being overshadowed. While facilitators were present to guide discussion, future iterations could incorporate structured turn-taking or reflection cards to help balance participation and ensure a wider range of views are heard.

Moreover, playing the game in locations where drone trials are currently underway or have previously taken place could provide participants with a more tangible connection to real-world applications, helping to ground their discussions in practical experiences and local relevance. Additionally, future studies could integrate virtual reality (VR) headsets to show participants drone operations in their local areas before gameplay. This immersive approach might give participants more informed views, fostering deeper discussions about drones' potential impacts and risks. By addressing these limitations and exploring these recommendations, future research can further refine the use of interactive tools like board games to effectively engage stakeholders and the public in meaningful conversations about drone technology.

This study analysed media narratives exclusively through headlines. Future research could investigate the full content of these news reports to gain a more comprehensive understanding of how public opinions are shaped. Additionally, examining the accuracy of these reports could help provide more reliable information and address public misconceptions about delivery drones.

Overall, while this study significantly contributes to understanding public perceptions of delivery drones and the use of serious games in research, future research can build upon these findings in several areas. By addressing these limitations and expanding the scope of inquiry, researchers can provide more comprehensive and actionable insights to guide the development and integration of drone technology in society.

## References

- Aalmoes, R., Bruijn, B.D. and Sieben, N., 2023, May. The influence of contextual non-auditory factors on drone sound perception. In *INTER-NOISE and NOISE-CON Congress and Conference Proceedings* (Vol. 266, No. 2, pp. 773-779). Institute of Noise Control Engineering.
- Aasgaard, T., 2005. Song creations by children with cancer—process and meaning. In D. Aldridge (Ed.), *Case study designs in music therapy*. 67–96. London, UK: Jessica Kingsley.
- Abu-Rumman, A., 2021. Effective Knowledge Sharing: A Guide to the Key Enablers and Inhibitors. In *Handbook of Research on Organizational Culture Strategies for Effective Knowledge Management and Performance* (pp. 133-156): IGI Global. DOI: 10.4018/978-1-7998-7422-5.ch008
- Absattar, A., Mambetova, M. and Zhubay, O., 2022. The potential of emotive language to influence the understanding of textual information in media coverage. *Humanities and Social Sciences Communications*, 9(1), pp.1-7.
- Adam, B., Van Loon, J. and Beck, U., 2000. The risk society and beyond: critical issues for social theory.
- Agar, N., 2019. *How to be human in the digital economy*. MIT Press.
- Ajzen, I., 1991. The Theory of Planned Behavior, *Organizational Behavior, and Human Decision Processes*. 50, p.179-211
- Ajzen, I., 2002. Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior 1. *Journal of applied social psychology*, 32(4), pp.665-683.
- Akhtar, M., de la Chevrotière, C., Tanzeeba, S., Tang, T. and Grover, P., 2020. A serious gaming tool: Bow River Sim for communicating integrated water resources management. *Journal of Hydroinformatics*, 22 (3), 491-509
- Akkerman, S. and Bruining, T., 2016. Multilevel boundary crossing in a professional development school partnership. *Journal of the Learning Sciences*, 25(2), pp.240-284.
- Alavi, M. and Leidner, D.E., 2001. Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS quarterly*, pp.107-136.

Alhakami, A.S. and Slovic, P., 1994. A psychological study of the inverse relationship between perceived risk and perceived benefit. *Risk analysis*, 14(6), pp.1085-109

Al-Wathinani, A.M., Alhallaf, M.A., Borowska-Stefańska, M., Wiśniewski, S., Sultan, M.A.S., Samman, O.Y., Alobaid, A.M., Althunayyan, S.M. and Goniewicz, K., 2023, May. Elevating healthcare: Rapid literature review on drone applications for streamlining disaster management and prehospital care in Saudi Arabia. In *Healthcare* (Vol. 11, No. 11, p. 1575). MDPI.

Al-Zou'bi, R., 2021. The impact of media and information literacy on acquiring the critical thinking skill by the educational faculty's students. *Thinking Skills and Creativity*, 39, p.100782.

Alavi, M. and Leidner, D.E., 2001. Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS quarterly*, pp.107-136.

Alenezi, M. (2023). Digital Learning and Digital Institution in Higher Education. *Education Sciences*, 13(1). <https://doi.org/10.3390/educsci13010088>

Allery, L., 2014. Make use of educational games. *Education for Primary Care*, 25 (1), 65-66.

Allum N, Sibley E, Sturgis P, Stoneman P (2014) Religious beliefs, knowledge about science and attitudes towards medical genetics. *Public Understanding of Science* 23(7): 833–849.

Almås, H. and Giæver, F., 2024. The emergence of collaboration in serious games: An exploratory study. *International Journal of Serious Games*, 11(3), pp.89-108.

Alvesson, M., & Sköldberg, K., 2009. *Reflexive methodology: New vistas for qualitative research* (2nd ed.). Thousand Oaks, CA: Sage.

Amazon., 2016. "Amazon prime air's first customer delivery", available at: <https://www.youtube.com/watch?v=vNySOrl2Ny8&t=69s>

Amazon., 2025. Amazon announces first UK drone delivery location. Available at: <https://www.aboutamazon.com/news/transportation/amazon-first-drone-delivery-uk-prime-air-location>

Amelung, N., Granja, R., & Machado, H., 2020. Communicating forensic genetics: 'enthusiastic' publics and the management of expectations. *Exploring Science*

Communication: A Science and Technology Studies Approach, 209-226.

<https://doi.org/10.4135/9781529721256.n11>

Ampatzidou, C., 2018. Reinventing the rules: emergent gameplay for civic learning., 187-203. [https://doi.org/10.1007/978-981-13-2694-3\\_10](https://doi.org/10.1007/978-981-13-2694-3_10)

Ampatzidou, C., Gugerell, K., Constantinescu, T., Devisch, O., Jauschneg, M. and Berger, M., 2018. All Work and No Play? Facilitating Serious Games and Gamified Applications in Participatory Urban Planning and Governance. *Urban Planning*, 3 (1), 34-46.

Ampatzidou, C., Vervoort, J., Flittner, Z. F. v., & Vaajakallio, K., 2022. New insights, new rules: what shapes the iterative design of an urban planning game?. *Urban Planning*, 7(2). <https://doi.org/10.17645/up.v7i2.5112>

Ampatzidou, C. and Gugerell, K., 2023. Mapping game mechanics for learning in a serious game for the energy transition. In *Research Anthology on Game Design, Development, Usage, and Social Impact* (pp. 482-506). IGI Global.

Anania, E. C., Rice, S., Walters, N. W., Pierce, M., Winter, S. R. and Milner, M. N., 2018. 'The effects of positive and negative information on consumers' willingness to ride in a driverless vehicle'. *Transport Policy* 72, pp. 218–224. <https://doi.org/10.1016/j.tranpol.2018.04.002>.

Anbaroğlu, B., 2017. Parcel delivery in an urban environment using unmanned aerial systems: A vision paper. *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, 4, pp.73-79.

Anbaroğlu, B., 2019. Drones in healthcare: An extended discussion on humanitarian logistics. In *Unmanned aerial vehicles in civilian logistics and supply chain management* (pp. 86-114). IGI Global.

Andrew, B., 2013. Political journalism represented by headline news: Canadian public and commercial media compared. *Canadian Journal of Political Science*, 46(2), pp.455-478.

Ansari, K.I., Shendge, A., Pakhrani, K. and Singh, R., 2023. Design and development of an auto-inflatable airbag as the failsafe system of unmanned aerial vehicle. *Materials Today: Proceedings*, 77, pp.983-990.

- Antonucci, T. C., Ajrouch, K. J., & Manalel, J. A., 2017. Social relations and technology: Continuity, context, and change. *Innovation in Aging*, 1(3), igx029.
- Aronovitch, H., 2007. The political importance of analogical argument. *Political Studies*, 45(1), pp.78-92.
- Aubert, A., Bauer, R. and Lienert, J., 2018. A review of water-related serious games to specify use in environmental Multi-Criteria Decision Analysis. *Environmental Modelling & Software*, 105, 64-78.
- Avery, J. M., 2009. Videomalaise or virtuous circle?: The influence of the news media on political trust. *The international journal of press/politics*, 410- 431.
- Aubert, A., Medema, W., and Wals, A., 2019. Towards a Framework for Designing and Assessing Game-Based Approaches for Sustainable Water Governance. *Water*. 11(4), 869. <https://doi.org/10.3390/w11040869>
- Aydin, B., 2019. Public acceptance of drones: Knowledge, attitudes, and practice. *Technology in society*, 59, p.101180.
- Bada, S. O., & Olusegun, S., 2015. Constructivism learning theory: A paradigm for teaching and learning. *Journal of Research and Method in education*. 5(6), 66-70.
- Bagozzi, R.P., 2007. The legacy of the technology acceptance model and a proposal for a paradigm shift. *Journal of the association for information systems*, 8(4), p.3.
- Baishya, A.K., 2022. Through a Drone Darkly: Drone Media as Pandemic Witnessing. *BioScope: South Asian Screen Studies*, 13(1), pp.24-32.
- Bajde, D., Woermann, N., Bruun, M.H., Gahrn-Andersen, R., Sommer, J.K., Nøjgaard, M., Christensen, S.H., Kirschner, H., Jensen, R.H.S. and Bucher, J.H., 2017. Public reactions to drone use in residential and public areas.
- Baker, B.H., Graham, T., Kaminsky, S., 1994 How to Identify, Expose and Correct Liberal Media Bias. Media Research Center, Alexandria
- Baran, S. J., & Davis, D. K., 2000. Mass Communication Theory: Foundations, Ferment, and Future (2nd ed.). Belmont: Wadsworth.



Baranowski, T., Baranowski, J., Thompson, D., & Buday, R. (2011). Behavioral science in video games for children's diet and physical activity change: key research needs. *Journal of Diabetes Science and Technology*, 5(2), 229-233.

<https://doi.org/10.1177/193229681100500204>

Barbara, J., 2017. Measuring User Experience in Multiplayer Board Games. *Games and Culture*, 12 (7-8), 623-649.

Barben, D., Fisher, E., Selin, C. and Guston, D.H., 2008. 38 anticipatory governance of nanotechnology: foresight, engagement, and integration. In *The handbook of science and technology studies* (pp. 979-1000). Cambridge, Massachusetts: MIT Press.

Bargh, J., 2017. *Before you know it: The unconscious reasons we do what we do*. Simon and Schuster.

Barnaud, C. and Van Paassen, A., 2013. Equity, power games, and legitimacy: dilemmas of participatory natural resource management. *Ecology and Society*, 18(2).

Batel, S. and Devine-Wright, P., 2015. Towards a better understanding of people's responses to renewable energy technologies: Insights from Social Representations Theory. *Public Understanding of Science*, 24(3), pp.311-325.

Bauer, M.W. and Gaskell, G., 1999. Towards a paradigm for research on social representations. *Journal for the theory of social behaviour*, 29(2), pp.163-186.

Bauer, M.W. and Gaskell, G., 2002. Biotechnology-the making of a global controversy.

Bauer, M. W., 2009. The evolution of Public Understanding of Science — discourse and comparative evidence. *Science, Technology and Society* 14 (2), 221–240.

doi:[10.1177/097172180901400202](https://doi.org/10.1177/097172180901400202)

Bayeck, R., 2020. Examining Board Gameplay and Learning: A Multidisciplinary Review of Recent Research. *Simulation & Gaming*, 51 (4), 411-431.

Bayeck, R. Y., 2023. Understanding computational thinking in the gameplay of the africansongboard game. *British Journal of Educational Technology*, 55(1), 259-276.

<https://doi.org/10.1111/bjet.13353>

- Bearth, A. and Siegrist, M., 2016. Are risk or benefit perceptions more important for public acceptance of innovative food technologies: A meta-analysis. *Trends in Food Science & Technology*, 49, pp.14-23.
- Beauchamp, P., 2015. Commercial drones: The future of retail and entertainment. [Blog] inguard. Retrieved from <https://www.inguard.com/blog/commercial-drones-the-future-of-retail-and-entertainment>
- Becerra-Fernandez, I., Sabherwal, R., 2001. 'Organizational Knowledge Management: A Contingency Perspective', *Journal of Management Information Systems*, 18(1), pp. 23–55. doi: 10.1080/07421222.2001.11045676
- Beck, U., 1992. Risk society: Towards a new modernity. *Sage google schola*, 2, pp.53-74.
- Bedwell, W. L., Pavlas, D., Heyne, K., Lazzara, E. H., & Salas, E., 2012. Toward a taxonomy linking game attributes to learning. *Simulation & Gaming*, 43(6), 729-760. <https://doi.org/10.1177/1046878112439444>
- Beiker, S. A., 2015. 'Implementierung eines selbstfahrenden und individuell abrufbaren Personentransportsystems'. In: *Autonomes Fahren. Technische, rechtliche und gesellschaftliche Aspekte*. Ed. by M. Maurer, J. C. Gerdes, B. Lenz and H. Winner. Berlin, Heidelberg, Germany: Springer Vieweg, pp. 287–307. [https://doi.org/10.1007/978-3-662-45854-9\\_14](https://doi.org/10.1007/978-3-662-45854-9_14).
- Beltrami, D., 2020. A board game design process: A game is a system. Available at: <https://uxdesign.cc/a-board-game-design-process-a-game-is-a-system-5469dfa4536>
- Ben Amara, B., Mhiri Sellami, H. and Ben Said, L., 2024. An approach for serious game design and development based on iterative evaluation. *Journal of Software: Evolution and Process*, 36(10), p.e2680.
- Berland, M. and Lee, V., 2011. Collaborative Strategic Board Games as a Site for Distributed Computational Thinking. *International Journal of Game-Based Learning*, 1 (2), 65-81.
- Bernauw, K., 2016. Drones: the emerging era of unmanned civil aviation. *Zbornik PFZ*, 66, p.223.
- Bernhardt, D., Krasa, S., Polborn, M., 2008. Political polarization and the electoral effects of media bias. *J. Public Econ*. 92(5), 1092–1104

- Besley, J. C. and Shanahan, J., 2005. 'Media attention and exposure in relation to support for agricultural biotechnology'. *Science Communication* 26 (4), pp. 347–367. <https://doi.org/10.1177/1075547005275443>
- Besley, T., Prat, A., 2006. Handcuffs for the grabbing hand? Media capture and government accountability. *Am. Econ. Rev.* 96(3), 720–736 <https://doi.org/10.1257/aer.96.3.720>
- Bigl, B., 2019. Stop the Frack! Exploring the Media's Portrayal of the Social Representation of an Anti-Fracking Protest at the Baltic Sea. *Environmental Communication*, 14 (2), 271-286.
- Bless, H., Fiedler, K. and F. Struck (2004) *Social Cognition. How Individuals Construct Social Reality*. Hove: Psychology, cop.
- Bloise, N., Primatesta, S., Antonini, R., Fici, G.P., Gaspardone, M., Guglieri, G., and Rizzo, A. 2019. A survey of unmanned aircraft system technologies to enable safe operations in urban areas. Presented at 2019 International Conference on Unmanned Aircraft Systems (ICUAS). Atlanta, GA, USA.
- Blom, J.N. and Hansen, K.R., 2015. Click bait: Forward-reference as lure in online news headlines. *Journal of pragmatics*, 76, 87-100. <https://doi.org/10.1016/j.pragma.2014.11.010>
- Board Game Geek, 2022. *Board game mechanics*. [online] Board Game Geek. Available at: <https://boardgamegeek.com/browse/boardgamemechanic>
- Boczkowski, P.J., 2004. The processes of adopting multimedia and interactivity in three online newsrooms. *J. Commun.* 54, 197–213
- Bode, C., Lindemann, E., & Wagner, S. M., 2011. Driving trucks and driving sales? the impact of delivery personnel on customer purchase behaviour. *Journal of Business Logistics*, 32(1), 99-114. <https://doi.org/10.1111/j.2158-1592.2011.01009.x>
- Bogue, R., 2018. What are the prospects for robots in the construction industry?. *Industrial Robot: An International Journal*, 45 (1), 1-6.
- Boomgaarden, H. G., & Vliegenthart, R., 2007. Explaining the rise of anti- immigrant parties:..*Electoral studies* , 400-417.

Bolsen, T. and Shapiro, M.A., 2018. The US news media, polarization on climate change, and pathways to effective communication. *Environmental Communication*, 12(2), pp.149-163.

Bonfanti, M.E., 2017. Let's go for New or Emerging Security Technologies!... What About Their Impact on Individuals and the Society?. *Democrazia e Sicurezza-Democracy*, 7(2), pp.37-85.

Boselli, C., Danis, J., McQueen, S., Breger, A., Jiang, T., Looze, D. and Ni, D., 2017. Geo-fencing to secure airport perimeter against sUAS. *International Journal of Intelligent Unmanned Systems*, 5(4), pp.102-116.

Boucher, P., 2014. Civil Drones in Society. *JRC Science and Policy Reports*, p.9.

Boucher, P., 2016. You Wouldn't have Your Granny Using Them: Drawing Boundaries Between Acceptable and Unacceptable Applications of Civil Drones. *Science and Engineering Ethics*, 22 (5), 1391-1418

Bousquet, F., Lifran, R., Tidball, M., Thoyer, S. and Antona, M., 2001. Agent-based modelling, game theory and natural resource management issues. *Journal of Artificial Societies and Social Simulation*, 4(2), p.0.

Boyd, A.D., Liu, Y., Stephens, J.C., Wilson, E.J., Pollak, M., Peterson, T.R., Einsiedel, E. and Meadowcroft, J., 2013. Controversy in technology innovation: Contrasting media and expert risk perceptions of the alleged leakage at the Weyburn carbon dioxide storage demonstration project. *International Journal of Greenhouse Gas Control*, 14, pp.259-269.

Bracken-Roche, C., 2016. Domestic drones: the politics of verticality and the surveillance industrial complex. *Geographica Helvetica*, 71(3), pp.167-172.

Brandmeyer, A., Swedlow, N., Hertensteiner, M., & Crum, P., 2021. Benefits of immersive spatial audio on athlete reaction times in e-sports.. <https://doi.org/10.31219/osf.io/dwyr5>

Brar, S., Rabbat, R., Raithatha, V., Runcie, G., & Yu, A. (2015). Drone for deliveries (pp. 4–17). [online] Sutardja Center for Entrepreneurship & Technology.

Braun, S., Friedewald, M. and Valkenburg, G., 2015. Civilizing drones—military discourses going civil?. *Science & Technology Studies*, 28(2), pp.73-87.

Braun, V. and Clarke, V., 2006. Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), pp.77-101.

Braun, V. and Clarke, V., 2012. *Thematic analysis*. American Psychological Association.

Braun, V. and Clarke, V., 2019. Reflecting on reflexive thematic analysis. *Qualitative research in sport, exercise and health*, 11(4), pp.589-597.

Braun, V., Clarke, V., Hayfield, N. and Terry, G., 2024. Thematic Analysis, 238–248.

Bravo, R.Z.B., Leiras, A. and Cyrino Oliveira, F.L., 2019. The use of UAVs in humanitarian relief: An application of POMDP-based methodology for finding victims. *Production and Operations Management*, 28(2), pp.421-440.

Brell, T., Philipsen, R. and Ziefle, M., 2019. sCARY! Risk perceptions in autonomous driving: The influence of experience on perceived benefits and barriers. *Risk analysis*, 39(2), pp.342-357.

Bremer, B., & Bürgisser, R. (2023). Public opinion on welfare state recalibration in times of austerity: Evidence from survey experiments. *Political Science Research and Methods*, 11(1), 34–52. <https://doi.org/10.1017/psrm.2021.78>

Bridge, D., 2014. You Sunk My Constitution: Using a Popular Off-the-Shelf Board Game to Simulate Political Concepts. *Journal of Political Science Education*, 10 (2), 186-203.

Broadbent, G.H., Wiedmann, T.O., Metternicht, G.I., 2021. Electric Vehicle Uptake: Understanding the Print Media's Role in Changing Attitudes and Perceptions. *World Electric Vehicle Journal*. 12(4):174. <https://doi.org/10.3390/wevj12040174>

Brossard, D. and Nisbet, M. C., 2007. 'Deference to scientific authority among a low information public: understanding U.S. opinion on agricultural biotechnology'. *International Journal of Public Opinion Research* 19 (1), pp. 24–52. <https://doi.org/10.1093/ijpor/edl003>

Brossard, D. and Lewenstein, B.V., 2009. A critical appraisal of models of public understanding of science: Using practice to inform theory. In *Communicating science* (pp. 25-53). Routledge.

- Brossard D, Scheufele DA, Kim E, Lewenstein BV., 2009. Religiosity as a perceptual filter: Examining processes of opinion formation about nanotechnology. *Public Understanding of Science* 18(5): 546–558.
- Brown P., 2012. Nothing but the truth. Are the media as bad at communicating science as scientists fear? *EMBO Rep.* 13(11), 964-7. [10.1038/embor.2012.147](https://doi.org/10.1038/embor.2012.147)
- Brown, T., & Wyatt, J., 2010. Design thinking for social innovation. *Stanford Social Innovation Review*, 8(1), 30–35.
- Brox, E., Hirche, J., Evertsen, G., Yliräisänen-Seppänen, P., & Bomark, P. (2012). User centric social diabetes game design for children.. <https://doi.org/10.1145/2393132.2393196>
- Brüggemann, M. and Engesser, S., 2017. Beyond false balance: How interpretive journalism shapes media coverage of climate change. *Global Environmental Change*, 42, pp.58-67.
- Bruscia, K., 2005. Research topics and questions in music therapy. In B. L. Wheeler (Ed.), *Music therapy research* (2nd ed.; pp. 81–93). Gilsum, NH: Barcelona.
- Bryman, A., 2016. *Social research methods*. Oxford University Press.
- Bucher, H.J., Schumacher, P. 2006. The relevance of attention for selecting news content. An eye-tracking study on attention patterns in the reception of print and online media. *Communications* 31, 347 (2006)
- Buckingham, D., 2015. Defining digital literacy-What do young people need to know about digital media?. *Nordic journal of digital literacy*, 10(Jubileumsnummer), pp.21-35.
- Bulger, M. and Davison, P., 2018. The promises, challenges, and futures of media literacy. *Journal of Media Literacy Education*, 10(1), pp.1-21.
- Bunz, M., Braghieri, M., 2021. The AI doctor will see you now: assessing the framing of AI in news coverage. *AI Soc.* <https://doi.org/10.1007/s00146-021-01145-9>
- Burns W. J., Slovic P., Kasperson R. E., Kasperson J. E., Renn O., Emani S., 1993. Incorporating structural models into research on the social amplification of risk: Implications for theory construction and decision making. *Risk Analysis*, 13, 611-623
- Burrell, G. and Morgan, G., 2016. *Sociological Paradigms and Organisational Analysis*. Abingdon: Routledge (originally published by Heinemann 1979)

CAA, 2021. Where You Can Fly Drones! UK Civil Aviation Authority 2021. Available online: <https://register-drones.caa.co.uk/drone-code/where-you-can-fly>

CAA, 2024a. Flying drones and model aircraft! UK Civil Aviation Authority 2024. Available online: <https://register-drones.caa.co.uk/>

CAA, 2024b. Registering to use a drone or model aircraft! UK Civil Aviation Authority 2024. Available online: <https://register-drones.caa.co.uk/individual>

CAA, 2024c. New trials set to help unlock drone deliveries and inspections in the UK. Available online: <https://www.caa.co.uk/newsroom/news/new-trials-set-to-help-unlock-drone-deliveries-and-inspections-in-the-uk/>

Calo, M.R., 2011. The drone as a privacy catalyst. *Stan. L. Rev. Online*, 64, p.29.

Callaghan, M., McCusker, K., Losada, J., Harkin, J., & Wilson, S., 2012. Circuit warz, the games; collaborative and competitive game-based learning in virtual worlds. 2012 9th International Conference on Remote Engineering and Virtual Instrumentation (REV). <https://doi.org/10.1109/rev.2012.6293095>

Calleja, G., 2022. *Unboxed: Board game experience and design*. MIT Press.

Carlile, P.R., 2002. A pragmatic view of knowledge and boundaries: Boundary objects in new product development. *Organization science*, 13(4), pp.442-455.

Carmichael, J.T. and Brulle, R.J., 2017. Elite cues, media coverage, and public concern: an integrated path analysis of public opinion on climate change, 2001–2013. *Environmental Politics*, 26(2), pp.232-252.

Carmichael, J.T., Brulle, R.J. and Huxster, J.K., 2017. The great divide: Understanding the role of media and other drivers of the partisan divide in public concern over climate change in the USA, 2001–2014. *Climatic change*, 141, pp.599-612.

Carson, D., Gilmore, A., Perry, C. and Gronhaug, K., 2001. *Qualitative Marketing Research*, Sage Publications, London

Carvalho, A., 2010. Media(ted)discourses and climate change: a focus on political subjectivity and (dis)engagement. *WIREs Climate Change*, 1 (2), 172-179.

Catenaccio, P., 2023. A Model for Understanding and Assessing Semi-Fake Scientific News Reporting. In *The Routledge Handbook of Discourse and Disinformation*. 64-78. Routledge.

Chaib, M. and Orfali, B., 2000. *Social representations and communicative processes*. Jönköping University Press..

Chaiken, S. and Stangor, C., 1987. Attitudes and attitude change. *Annual review of psychology*.

Chambers, R., 2006. Participatory mapping and geographic information systems: Whose map? Who is empowered and who disempowered? Who gains and who loses?. *The electronic journal of information systems in developing countries*, 25(1), pp.1-11.

Chan, A., 2007. Guiding Public Opinion through Social Agenda-Setting: China's media policy since the 1990s. *Journal of Contemporary China* 16(53), November , 547–559.

Chan, H.C. and Teo, H.H., 2007. Evaluating the boundary conditions of the technology acceptance model: An exploratory investigation. *ACM Transactions on Computer-Human Interaction (TOCHI)*, 14(2), pp.9-es.

Chang, S.H., 2009. *The influence of media frames on the public's perception of biofuels*. Iowa State University.

Chang, V., Chundury, P. and Chetty, M., 2017. Spiders in the Sky. *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*.

Chao, J., Kao, H., & Chu, F., 2023. Development and evaluation of diet- and health-themed board game products for the elderly. *Sensors and Materials*, 35(5), 1539.  
<https://doi.org/10.18494/sam4050>

Chen, G.Y., 2016. Reforming the current regulatory framework for commercial drones: retaining American businesses' competitive advantage in the global economy. *Nw. J. Int'l L. & Bus.*, 37, p.513.

Chen, Y. and Janicki, S., 2020. A cognitive-based board game with augmented reality for older adults: development and usability study. *Jmir Serious Games*, 8(4), e22007.  
<https://doi.org/10.2196/22007>



- Cheng, P., Yeh, T., Chao, Y., Lin, J. and Chang, C., 2020. Design Ideas for an Issue-Situation-Based Board Game Involving Multirole Scenarios. *Sustainability*, 12 (5), 2139.
- Cherney, M., 2019. Some Want Delivery Drones to Buzz Off. Would Stricter Rules Change Their Minds? Wall Street Journal.
- Cheung, K. L., Stevens, E., Evers, S. M. A. A., & Hiligsmann, M., 2018. Serious gaming as a method for changing stakeholders' perspectives on integrated care. *Journal of Integrated Care*, 26(1), 54-64. <https://doi.org/10.1108/jica-10-2017-0035>
- Choi, M.C., and Hwang, H.Y., 2022. A Exploratory Analysis on the Concept and Issue of 'Regulatory Void': Focusing on the Drone Sector. *Journal of Safety and Crisis Management*, 12(8), pp.9-15.
- Chong D., Druckman J. N., 2007. Framing theory. *Annual Review of Political Science*, 10, 103-126.
- Chorney, A. I., 2012. Taking the game out of gamification. *Dalhousie Journal of Interdisciplinary Management*, 8(1). <https://doi.org/10.5931/djim.v8i1.242>
- Chowanda, A., Dennis, V., Dharmawan, V., & Ramli, J. D., 2023. Player's affective states as meta ai design on augmented reality games. *JOIV : International Journal on Informatics Visualization*, 7(2), 561. <https://doi.org/10.30630/joiv.7.2.1022>
- Chowdhury, D., Sarkar, M., & Haider, M. Z. A (2017). Cyber-Vigilance System for Anti-Terrorist Drives Based on an Unmanned Aerial Vehicular Networking Signal Jammer for Specific Territorial Security, *Advances in Science, Technology and Engineering Systems Journal*, 3(3), 43-50.
- Christidou, V., Dimopoulos, K. and Koulaidis, V., 2004. Constructing social representations of science and technology: the role of metaphors in the press and the popular scientific magazines. *Public Understanding of Science*, 13 (4), 347-362.
- Chung, C.J., Nam, Y. and Stefanone, M.A., 2012. Exploring online news credibility: The relative influence of traditional and technological factors. *Journal of computer-mediated communication*, 17(2), pp.171-186.
- Chuttur, M., 2009. Overview of the technology acceptance model: Origins, developments and future directions.

Clarke, R. and Moses, L.B. (2014) The regulation of civilian drones' impacts on public safety. *Computer Law & Security Review* 30(3): 263–285.

Cleland, J.A., 2017. The qualitative orientation in medical education research. *Korean Journal of medical education*, 29(2), p.61.

Clothier, R., Greer, D., Greer, D. and Mehta, A., 2015. Risk Perception and the Public Acceptance of Drones. *Risk Analysis*, 35 (6), 1167-1183.

Coeckelbergh, M., 2013. Drones, information technology, and distance: mapping the moral epistemology of remote fighting. *Ethics and information technology*, 15, pp.87-98.

Cohen, B., 1963. *The press and foreign policy*. Princeton, NJ

Cohn, A., Fehr, E. and Maréchal, M.A., 2014. Business culture and dishonesty in the banking industry. *Nature*, 516(7529), pp.86-89.

Cokyasar, T., 2021. Delivery drone route planning over a battery swapping network. *Procedia Computer Science*, 184, pp.10-16.

Conboy, M., 2007. *The language of the news*. London: Routledge.

Conner, M. and Armitage, C.J., 1998. Extending the theory of planned behavior: A review and avenues for further research. *Journal of applied social psychology*, 28(15), pp.1429-1464.

Connor, M., & Siegrist, M., 2010. Factors Influencing People's Acceptance of Gene Technology: The Role of Knowledge, Health Expectations, Naturalness, and Social Trust. *Science Communication*, 32(4), 514-538. <https://doi.org/10.1177/1075547009358919>

Consalvo, M., Busch, T., & Jong, C. (2016). Playing a better me: how players rehearse their ethos via moral choices. *Games and Culture*, 14(3), 216-235. <https://doi.org/10.1177/1555412016677449>

Constantino, T. E., 2008. Constructivism. In L. Given (Ed.), *The Sage Encyclopedia of qualitative research* (pp. 116–120) [electronic resource]. Thousand Oaks, CA: Sage.

Corti, K., 2006. *Gamesbased Learning; a serious business application* [online]. PIXELearning Limited. Available from:

<https://www.cs.auckland.ac.nz/courses/compsci777s2c/lectures/lan/serious%20games%20business%20applications.pdf> [Accessed 20 May 2022].

Costikyan, G., 2013. *Uncertainty in Games, Playful Thinking*. Cambridge, MA: MIT Press.

Crookall, D., 2010. Serious games, debriefing, and simulation/gaming as a discipline. *Simulation & gaming*, 41(6), pp.898-920.

Crotty, M. J., 1998. *The foundations of social research: Meaning and perspective in the research process*. Thousand Oaks, CA: Sage.

Cui, D., & Wu, F., 2021. The influence of media use on public perceptions of artificial intelligence in China: Evidence from an online survey. *Information Development*, 37(1), 45-57. <https://doi.org/10.1177/0266666919893411>

Culver, K.B., 2014. From battlefield to newsroom: Ethical implications of drone technology in journalism. *Journal of mass media ethics*, 29(1), pp.52-64.

D'Angelo, P., Kuypers, J.A., 2010. *Doing News Framing Analysis: Empirical and Theoretical Perspectives*. Routledge, Abingdon

Daanen, P., 2009. Conscious and non-conscious representation in social representations theory: Social representations from the phenomenological point of view. *Culture & Psychology*, 15(3), pp.372-385.

Daneva, M., 2014. How practitioners approach gameplay requirements? an exploration into the context of massive multiplayer online role-playing games.. <https://doi.org/10.1109/re.2014.6912242>

Davenport, T. H., and L. Prusak. 1997. *Working knowledge: how organizations manage what they know*. Harvard Business School Press, Boston, Massachusetts, USA.

Davis, F.D., 1986. *A technology acceptance model for empirically testing new end-user information systems: theory and results*. Ph.D. dissertation, MIT Sloan School of Management, Cambridge, MA.

Davis, F.D., 1989. Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, pp.319-340.

- Decety, J. and Yoder, K.J., 2016. Empathy and motivation for justice: Cognitive empathy and concern, but not emotional empathy, predict sensitivity to injustice for others. *Social neuroscience*, 11(1), pp.1-14.
- De Vreese, C.H., 2005. News framing: theory and typology. *Inf. Des. J. Doc. Des.* 13(1), 51–62 (2005)
- de Vreese C. H., Boomgaarden H. G., Semetko H. A., 2011. (In)direct framing effects: The effects of news media framing on public support for Turkish membership in the European Union. *Communication Research*, 38, 179-205
- Delaney, J., 2022. Minecraft and playful public participation in urban design. *Urban Planning*, 7(2). <https://doi.org/10.17645/up.v7i2.5229>
- Del-Real, C. and Díaz-Fernández, A., 2021. Lifeguards in the sky: Examining the public acceptance of beach-rescue drones. *Technology in Society*, 64, 101502.
- Dempster, G., Sutherland, G., & Keogh, L., 2022. Scientific research in news media: a case study of misrepresentation, sensationalism and harmful recommendations. *Journal of Science Communication*, 21(01), 06. <https://doi.org/10.22323/2.21010206>
- Denisova, A., Nordin, A. and Cairns, P., 2016. The Convergence of Player Experience Questionnaires. *Proceedings of the 2016 Annual Symposium on Computer-Human Interaction in Play*.
- Denzin, N.K., 1998. The new ethnography. *Journal of Contemporary Ethnography*, 27(3), pp.405-415.
- Denzin, N. K., & Lincoln, Y. S., 2003. *The landscape of qualitative research* (2nd ed.). Thousand Oaks, CA: Sage.
- Denzin, N. K., & Lincoln, Y. S., 2005. *The Sage Handbook of Qualitative Research* (3rd ed.). Thousand Oaks, CA: Sage.
- Desurvire, H. and El-Nasr, M.S., 2013. Methods for game user research: studying player behavior to enhance game design. *IEEE computer graphics and applications*, 33(4), pp.82-87.

Develotte, C and Rechniewski, E., 2001. Discourse analysis of newspaper headlines : a methodological framework for research into national representations. *The Web Journal of French Media Studies*, 4, 1-12.

Devine-Wright, P. and Devine-Wright, H., 2006. Social representations of intermittency and the shaping of public support for wind energy in the UK. *International journal of global energy issues*, 25(3-4), pp.243-256.

Devisch, O., Poplin, A. and Sofronie, S., 2016. The gamification of civic participation: Two experiments in improving the skills of citizens to reflect collectively on spatial issues. *Journal of Urban Technology*, 23(2), pp.81-102.

Díaz-Furlong, H. and Cosio, A., 2013. An approach to level design using procedural content generation and difficulty curves.. <https://doi.org/10.1109/cig.2013.6633640>

Dickinson, J.E. and Dickinson, J.A., 2006. Local transport and social representations: Challenging the assumptions for sustainable tourism. *Journal of sustainable tourism*, 14(2), pp.192-208.

Diehl, N. and Diehl, C., 2018. 'Autonomes Fahren im Diskurs — Semantische Netzwerke und diskursive Regelmäßigkeiten'. In: Kommunikation und Technik. Ausgewählte neue Ansätze im Rahmen einer interdisziplinären Betrachtung. Ed. by F. U.Siems and M.-C. Papen. Wiesbaden, Germany: Springer VS, pp. 325–338. [https://doi.org/10.1007/978-3-658-21537-8\\_18](https://doi.org/10.1007/978-3-658-21537-8_18).

Dieleman, H. and Huisingh, D., 2006. Games by which to learn and teach about sustainable development: exploring the relevance of games and experiential learning for sustainability. *Journal of Cleaner Production*, 14 (9-11), 837-847.

Dietz, T., 2013. Bringing values and deliberation to science communication. *Proceedings of the National Academy of Sciences* 110 (Supplement 3), 14081–14087. doi:[10.1073/pnas.1212740110](https://doi.org/10.1073/pnas.1212740110)

Donk A., Metag J., Kohring M., Marcinkowski F., 2012. Framing emerging technologies: Risk perceptions of nanotechnology in the German press. *Science Communication*, 34, 5-29.

Downie, G.A., Mullan, B.A., Boyes, M.E. and McEvoy, P.M., 2021. The effect of psychological distress on self-care intention and behaviour in young adults with type 1 diabetes. *Journal of Health Psychology*, 26(4), pp.543-555.

- Drapkin, A., 2021. Tech's Biggest Winners and Losers of 2021. *Tech.co*. Available at: <https://tech.co/news/tech-biggest-winners-losers-2021>
- Druehl, C., Carrillo, J. and Hsuan, J., 2018. *Technological innovations: Impacts on supply chains* (pp. 259-281). Springer International Publishing.
- Drucker, P., 2012. *Management challenges for the 21st century*. Routledge.
- Druckman J. N., 2001. On the limits of framing effects: Who can frame? *Journal of Politics*, 63, 1041-1066.
- Druckman, J.N., Parkin, M., 2005. The impact of media bias: how editorial slant affects voters. *J. Polit.* 67(4), 1030–1049
- Dubljević, V., Saigle, V. and Racine, E., 2014. The rising tide of tDCS in the media and academic literature. *Neuron*, 82(4), pp.731-736.
- Duffy, C., 2019. Google agrees to pay \$13 million in Street View privacy case, 2019. CNN Business, July 25, 2019. Retrieved from: <https://edition.cnn.com/2019/07/22/tech/google-street-view-privacy-lawsuit-settlement/index.html#:~:text=Google%20has%20agreed%20to%20pay,through%20its%20Street%20View%20project>.
- Duke, R.D., 1995. Gaming: An emergent discipline. *Simulation & gaming*, 26(4), pp.426-439.
- Duncan, M. and Culver, K. B., 2020. Technologies, ethics and journalism's relationship with the public. *Media and Communication*, 8(3), 101-111.  
<https://doi.org/10.17645/mac.v8i3.3039>
- Durant, J. (1999). Participatory technology assessment and the democratic model of the public understanding of science. *Science and Public Policy* 26(5), 313–319.  
doi:[10.3152/147154399781782329](https://doi.org/10.3152/147154399781782329)
- Eagly, A.H. and Chaiken, S., 2007. The advantages of an inclusive definition of attitude. *Social cognition*, 25(5), pp.582-602.
- Eberle, S., 2014. The Elements of Play: Toward a Philosophy of Play, *American Journal of Play* 6, no. 2.

- Ecker, U. K. H., Lewandowsky, S., Cook, J., Schmid, P., Fazio, L. K., Brashier, N., ... Amazeen, M. A., 2022. The psychological drivers of misinformation belief and its resistance to correction. *Nature Reviews Psychology* 1 (1), 13–29. doi:[10.1038/s44159-021-00006-y](https://doi.org/10.1038/s44159-021-00006-y)
- Eißfeldt, H., Vogelpohl, V., Stolz, M., Papenfuß, A., Biella, M., Belz, J. and Kügler, D., 2020. The acceptance of civil drones in Germany. *CEAS Aeronautical journal*, 11(3), pp.665-676.
- Eißfeldt, H. and Biella, M., 2022. The public acceptance of drones—Challenges for advanced aerial mobility (AAM). *Transportation Research Procedia*, 66, pp.80-88.
- Eisend, M., 2006. Source credibility dimensions in marketing communication—A generalized solution. *Journal of Empirical Generalisations in Marketing Science*, 10(2).
- Elliott, L., Ream, G. L., McGinsky, E., & Dunlap, E., 2012. The contribution of game genre and other use patterns to problem video game play among adult video gamers. *International Journal of Mental Health and Addiction*, 10(6), 948-969. <https://doi.org/10.1007/s11469-012-9391-4>
- Enemark, C., 2013. *Armed drones and the ethics of war: military virtue in a post-heroic age*. Routledge.
- Engasser, F. and Saunders, T., 2018. *How to use games to involve the public in decisions about research and innovation policy* [online]. Nesta. Available from: <https://www.nesta.org.uk/blog/how-use-games-involve-public-decisions-about-research-and-innovation-policy/> [Accessed 24 May 2022].
- Enticknap-Seppänen, K., 2017. Goofy Guide Game: affordances and constraints for engagement and oral communication in English. *CALL in a climate of change: Adapting to turbulent global conditions—short papers from EUROCALL*, pp.105-109.
- Entman, R.M., 1993. Framing: toward clarification of a fractured paradigm. *J. Commun.* 43(4), 51–58
- Entman, R., 2003. Presentation given at the “American Media and Wartime Challenges” Conference (March 21-March 22, 2003,) Chapel Hill, North Carolina.
- Entman, R.M., 2007. Framing bias: media in the distribution of power. *J. Commun.* 57(1), 163–173

Entman R. M., Matthes J., Pellicano L., 2009. Nature, sources, and effects of news framing. In Wahl-Jorgensen K., Hanitzsch T. (Eds.), *The handbook of journalism studies* (pp. 175-190). New York, NY: Routledge.

European RPAS Steering Group (ERSG), 2013. *Roadmap for the integration of civil Remotely-Piloted Aircraft Systems into the European Aviation System*. Available online: <https://publicintelligence.net/eu-rpa-roadmap/>

Fadhilah, N., 2024. The Influence of Mass Media on Public Perception of Criminal Cases: A Qualitative Approach. *Journal of Strafvordering Indonesian*, 1(2), pp.1-5.

Fährnrich, B., Weitkamp, E. & Kupper, J. F., 2023. Exploring ‘quality’ in science communication online: expert thoughts on how to assess and promote science communication quality in digital media contexts. *Public Understanding of Science* 32 (5), 605–621. doi:[10.1177/09636625221148054](https://doi.org/10.1177/09636625221148054)

Farber, H.B., 2014. Eyes in the sky: Constitutional and regulatory approaches to domestic drone deployment. *Syracuse L. Rev.*, 64, p.1.

Farnese, M.L., Barbieri, B., Chirumbolo, A. and Patriotta, G., 2019. Managing knowledge in organizations: A Nonaka’s SECI model operationalization. *Frontiers in psychology*, 10, p.506330.

Farkas, T., Wiseman, S., Cairns, P. and Fiebrink, R., 2020. A Grounded Analysis of Player-Described Board Game Immersion. *Proceedings of the Annual Symposium on Computer-Human Interaction in Play*.

Fast, E., Horvitz, E., 2017. Long-term trends in the public perception of artificial intelligence. AAAI Press, Stanford, pp 963–969

Feldman, L., Hart, P.S. and Milosevic, T., 2017. Polarizing news? Representations of threat and efficacy in leading US newspapers’ coverage of climate change. *Public Understanding of Science*, 26(4), pp.481-497.

Fathurrohman, M., Nindiasari, H., & Rahayu, I., 2022. A conventional and digital mathematical board game design and development for use by students in learning arithmetic. *Journal on Mathematics Education*, 13(4), 631-660.  
<https://doi.org/10.22342/jme.v13i4.pp631-660>



Fatta, H., Maksom, Z. and Zakaria, M., 2019. Game-based Learning and Gamification: Searching for Definitions. *International journal of simulation: systems, science & technology*

Fazio, R.H., 2007. Attitudes as object–evaluation associations of varying strength. *Social cognition*, 25(5), pp.603-637.

Feindt, P.H. and Poortvliet, P.M., 2020. Consumer reactions to unfamiliar technologies: mental and social formation of perceptions and attitudes toward nano and GM products. *Journal of Risk Research*, 23(4), pp.475-489.

Felt, U., 2015. Keeping technologies out: Sociotechnical imaginaries and the formation of Austria's technopolitical identity. *Dreamscapes of modernity: Sociotechnical imaginaries and the fabrication of power*, pp.103-125.

Feng, C., Luo, Y., & Krueger, F., 2014. Neural signatures of fairness-related normative decision making in the ultimatum game: a coordinate-based meta-analysis. *Human Brain Mapping*, 36(2), 591-602. <https://doi.org/10.1002/hbm.22649>

Ferrara, J., 2012. *Playful design: Creating game experiences in everyday interfaces*. Rosenfeld Media.

Fields, B., 2006. "School discipline coverage in Australian newspapers: impact on public perceptions, educational decisions and policy." *International Conference of the Australian Association for Research in Education (AARE 2005): Creative Dissent: Constructive Solutions*. Sydney, Australia 27 Nov - 01 Dec 2005 Melbourne, Australia. Accessed from: <https://core.ac.uk/download/pdf/11039769.pdf>

Figliozi, M.A., 2020. Carbon emissions reductions in last mile and grocery deliveries utilizing air and ground autonomous vehicles. *Transportation Research Part D: Transport and Environment*, 85, p.102443.

Finn, R.L. and Wright, D., 2012. Unmanned aircraft systems: Surveillance, ethics and privacy in civil applications. *Computer Law & Security Review*, 28(2), pp.184-194.

Finn, R.L. and Wright, D., 2016. Privacy, data protection and ethics for civil drone practice: A survey of industry, regulators and civil society organisations. *Computer Law & Security Review*, 32(4), pp.577-586.

Finucane, M.L., Alhakami, A., Slovic, P. and Johnson, S.M., 2000. The affect heuristic in judgments of risks and benefits. *Journal of behavioral decision making*, 13(1), pp.1-17.

Fischer, P., Jonas, E., Frey, D., & Schulz-Hardt, S., 2005. Selective exposure to information: The impact of information limits. *European Journal of Social Psychology*, 35, 469–492.

Fischhoff, B. and Bar-Hillel, M., 1984. Diagnosticity and the base-rate effect. *Memory & Cognition*, 12(4), pp.402-410.

Fischhoff, B., Slovic, P., Lichtenstein, S., Read, S. and Combs, B., 1978. How safe is safe enough? A psychometric study of attitudes towards technological risks and benefits. *Policy sciences*, 9, pp.127-152.

Fishhoff, B., 2013. The sciences of science communication. *Proceedings of the National Academy of Sciences*, 110. <http://dx.doi.org/10.1073/pnas.1213273110>

Fjællingsdal, K. and Klöckner, C., 2020. Green across the board: board games as tools for dialogue and simplified environmental communication. *Simulation & Gaming*, 51(5), 632-652. <https://doi.org/10.1177/1046878120925133>

Fleischer, T. and Schippl, J., 2018. 'Automated driving — blessing or curse for a sustainable mobility?' *TATuP — Zeitschrift für Technikfolgenabschätzung in Theorie Und Praxis* 27 (2), pp. 11–15. <https://doi.org/10.14512/tatup.27.2.11>.

Foina, A.G., Krainer, C. and Sengupta, R., 2015, June. An unmanned aerial traffic management solution for cities using an air parcel model. In *2015 International Conference on Unmanned Aircraft Systems (ICUAS)* (pp. 1295-1300). IEEE.

Foreman, K., Arteaga, C. and Collins, A., 2016. The role of media framing in crime reports: How different types of news frames and racial identity affect viewers' perceptions of race. *Pepperdine Journal of Communication Research*, 4(1), p.12.

Foucault, M., 1977. Discipline and punish: The birth of the prison. *London: Allen Lane*.

Freese, M., Lukosch, H., Wegener, J., & König, A., 2020. Serious games as research instruments – Do's and don'ts from a cross-case-analysis in transportation. *European Journal of Transport and Infrastructure Research*, 20(4), 103–126. <https://doi.org/10.18757/ejtir.2020.20.4.4205>

- Freeman, P.K. and Freeland, R.S., 2016. Media framing the reception of unmanned aerial vehicles in the United States of America. *Technology in Society*, 44, pp.23-29.
- Freudenburg W. R., Coleman C. L., Gonzales J., Helgeland C., 1996. Media coverage of hazard events: Analyzing the assumptions. *Risk Analysis*, 16, 31-42.
- Fu, Q. K., & Hwang, G. J., 2018. Trends in mobile technology-supported collaborative learning: A systematic review of journal publications from 2007 to 2016. *Computers & Education*, 119, 129–143.
- Funabashi, A. M. M., Aranha, R. V., Silva, T. D., Monteiro, C. B. d. M., Silva, W. S., & Nunes, F. L. S., 2018. A serious game for virtual rehabilitation: evaluation with patients and physiotherapists. *Journal on Interactive Systems*, 9(2). <https://doi.org/10.5753/jis.2018.698>
- Gächter, S., Johnson, E.J. and Herrmann, A., 2022. Individual-level loss aversion in riskless and risky choices. *Theory and Decision*, 92(3), pp.599-624.
- Galván-Pérez, L., Ouariachi, T., Pozo-Llorente, M. and Gutiérrez-Pérez, J., 2018. Outstanding Videogames on Water: A Quality Assessment Review Based on Evidence of Narrative, Gameplay and Educational Criteria. *Water*, 10 (10), 1404.
- Gandziarowska-Ziołocka, J. and Stasiak, D., 2019. Simulation and Gaming for Policy Advice. *Handbuch Politikberatung*, pp.563-582.
- Garritzmann, J. L., Neimanns, E., & Busemeyer, M. R. (2023). Public opinion towards welfare state reform: The role of political trust and government satisfaction. *European Journal of Political Research*, 62(1), 197–220. <https://doi.org/10.1111/1475-6765.12501>
- Gee, J.P., 2006. Are video games good for learning?. *Nordic Journal of Digital Literacy*, 1(3), pp.172-183.
- Genov, A., 2005. Iterative usability testing as continuous feedback: A control systems perspective. *Journal of Usability Studies*, 1(1), pp.18-27.
- Gentzkow, M., Shapiro, J.M., 2006. Media bias and reputation. *J. Polit. Econ.* 114(2), 280–316. <https://doi.org/10.1086/499414>
- Gentzkow, M., Shapiro, J.M., 2010. What drives media slant? Evidence from US daily newspapers. *Econometrica* 78(1), 35–71

Gentzkow, M., Glaeser, E.L., Goldin, C., 2006. The rise of the fourth estate How newspapers became informative and why it mattered. In: Glaeser, E.L., Goldin, C. (eds.) *Corruption and Reform: Lessons from America's Economic History*, pp. 187–230. University of Chicago Press, Chicago

Gerber, A.S., Karlan, D., Bergan, D., 2009. Does the media matter? A field experiment measuring the effect of newspapers on voting behavior and political opinions. *Am. Econ. J. Appl. Econ.* 1(2), 35–52 (2009)

Geurts, J.L., Duke, R.D. and Vermeulen, P.A., 2007. Policy gaming for strategy and change. *Long Range Planning*, 40(6), pp.535-558.

Ghoman, S. K., Patel, S., Cutumisu, M., Hauff, P. v., Jeffery, T., Brown, M., ... & Schmölzer, G. M., 2019. Serious games, a game changer in teaching neonatal resuscitation? a review. *Archives of Disease in Childhood - Fetal and Neonatal Edition*, 105(1), 98-107.  
<https://doi.org/10.1136/archdischild-2019-317011>

Gilens, M., Hertzman, C., 2000. Corporate ownership and news bias: newspaper coverage of the 1996 Telecommunications Act. *J. Polit.* 62(02), 369–386

Gillmore, M. R., Archibald, M. E., Morrison, D. M., Wilsdon, A., Wells, E. A., Hoppe, M. J., ... & Murowchick, E., 2002. Teen sexual behavior: applicability of the theory of reasoned action. *Journal of Marriage and Family*, 64(4), 885-897. <https://doi.org/10.1111/j.1741-3737.2002.00885.x>

Gianfelice, M., Aboshosha, H. and Ghazal, T., 2022. Real-time wind predictions for safe drone flights in Toronto. *Results in Engineering*, 15, p.100534.

Glick, T.B., Figliozzi, M.A. and Unnikrishnan, A., 2022. Case study of drone delivery reliability for time-sensitive medical supplies with stochastic demand and meteorological conditions. *Transportation Research Record*, 2676(1), pp.242-255.

Glisby, M. and Holden, N., 2003. Contextual constraints in knowledge management theory: the cultural embeddedness of nonaka's knowledge-creating company. *Knowledge and Process Management*, 10(1), 29-36. <https://doi.org/10.1002/kpm.158>

Goodchild, A. and Toy, J., 2018. Delivery by drone: An evaluation of unmanned aerial vehicle technology in reducing CO2 emissions in the delivery service industry. *Transportation Research Part D: Transport and Environment*, 61, pp.58-67.

Golan, G.J. and Kiouisis, S.K., 2010. Religion, media credibility, and support for democracy in the Arab world. *Journal of Media and Religion*, 9(2), pp.84-98.

Gomes, M., Carvalho, C. and Rocha, A., 2021. Serious games as social innovation tools. *Product Management & Development*, 19 (2), e20210013.

Gourlay, S. (2006). Conceptualizing knowledge creation: a critique of nonaka's theory. *Journal of Management Studies*, 43(7), 1415-1436. <https://doi.org/10.1111/j.1467-6486.2006.00637.x>

Graham, H., Bell, S., 2020. The representation of future generations in newspaper coverage of climate change: a study of the UK press. *Children and Society*.  
<https://doi.org/10.1111/chso.12411>

Greene, J., 2010. Knowledge accumulation: Three views on the nature and role of knowledge in social science. In W. Luttrell (Ed.), *Qualitative educational research: Readings in reflexive methodology and transformative practice* (pp. 63–77). New York, NY: Routledge.

Greenhalgh, S., Koehler, M. and Boltz, L., 2019. The fun of its parts: Design and player reception of educational board games. *Contemporary Issues in Technology and Teacher Education*, 19 (3), 469-497.

Grefenstette, G., Qu, Y., Shanahan, J., Evans, D., 2004. Coupling niche browsers and affect analysis for an opinion mining application. In: Proceedings of 12th International Conference on Rech. d'Information Assistee par Ordinateur (2004)

Groff, T., Chilcote, J., Kasdin, N., Galvin, M., Loomis, C., Carr, M., Brandt, T., Knapp, G., Limbach, M., Guyon, O., Jovanovic, N., McElwain, M., Takato, N. and Hayashi, M., 2016. Laboratory testing and performance verification of the CHARIS integral field spectrograph. *SPIE Proceedings*

Gröhn, P., Kasu, D., Swiac, M. and Zafar, A., 2017. Organizing the Organization: Recommendation of development for explicit and tacit knowledge sharing at a University Library in North America.

Groseclose, T., Milyo, J., 2005. A measure of media bias. *Q. J. Econ.* 120, 1191–1237.

Grote, M., Pilko, A., Scanlan, J., Cherrett, T., Dickinson, J., Smith, A., Oakey, A. and Marsden, G., 2022. Sharing airspace with uncrewed aerial vehicles (UAVs): Views of the general aviation (GA) community. *Journal of Air Transport Management*, 102, p.102218.

Grote, M., Oakey, A., Pilko, A., Smith, A. and Cherrett, T., 2023. Drones: The Scope for Integration into Multi-modal Urban Logistics Services. In *The Routledge Handbook of Urban Logistics* (pp. 72-90). Routledge.

Grote, M., Oakey, A., Pilko, A., Krol, J., Blakesley, A., Cherrett, T., Scanlan, J., Anvari, B., Martinez-Sykora, A. 2024. The effects of costs on drone uptake in multi-modal logistics systems within a healthcare setting. *Transport Economics and Management*, 2, Pages 58-75. Doi: 10.1016/j.team.2024.03.001

Guba, E. G., & Lincoln, Y. S., 1994. Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 105–117). Thousand Oaks, CA: Sage.

Guckelsberger, C., Salge, C., Gow, J., & Cairns, P., 2017. Predicting player experience without the player.. Proceedings of the Annual Symposium on Computer-Human Interaction in Play. <https://doi.org/10.1145/3116595.3116631>

Guillén-Nieto, V. and Aleson-Carbonell, M., 2012. Serious games and learning effectiveness: The case of It's a Deal!. *Computers & Education*, 58(1), pp.435-448.

Gupta, A.K. and Govindarajan, V., 2000. Knowledge flows within multinational corporations. *Strategic management journal*, 21(4), pp.473-496.

Haan, R. and Voort, M., 2018. On evaluating social learning outcomes of serious games to collaboratively address sustainability problems: a literature review. *Sustainability*, 10(12), 4529. <https://doi.org/10.3390/su10124529>

Habermas, J., 1984. *The theory of communicative action: Reason and the rationalization of society. Vol. 1*. Boston: Beacon Press.

Hale, S., Wakeling, S., Blain, J., Pardhan, A., Mondoux, S., & Chan, T., 2020. Side effects may include fun: pre- and post-market surveillance of the gridlocked serious game. *Simulation & Gaming*, 51(3), 365-377. <https://doi.org/10.1177/1046878120904125>

Halkier, B., 2017. Practice theoretically inspired focus groups: Socially recognizable performativity. *A New Era in Focus Group Research: Challenges, Innovation and Practice*, 389-410.

Hamborg, F., Donnay, K. and Gipp, B., 2019. Automated identification of media bias in news articles: an interdisciplinary literature review. *International Journal on Digital Libraries*, 20(4), pp.391-415.

Ham, M., Jeger, M. and Frajman Ivković, A., 2015. The role of subjective norms in forming the intention to purchase green food. *Economic research-Ekonomska istraživanja*, 28(1), pp.738-748.

Hameed, Z.S.M, Nordin, R., Ismail, A., Zulkifley, M.A., Sham, A.S.H., Sabudin, R.Z.A.R., Zailani, M.A.H., Saiboon, I.M., Mahdy, Z.A., 2023. Acceptance of medical drone technology and its determinant factors among public and healthcare personnel in a Malaysian urban environment: knowledge, attitude, and perception. *Frontiers in Public Health*, 11, p.1199234.

Hanandini, D., 2024. Social Transformation in Modern Society: A Literature Review on the Role of Technology in Social Interaction. *Jurnal Ilmiah Ekotrans & Erudisi*, 4(1), pp.82-95.

Hansen, M.T. and Nohria, N. and Tierney, T. (1999), "What's your strategy for managing knowledge?", *Harvard Business Review*, pp. 106-116.

Hansen, A., 2016. The changing uses of accuracy in science communication. *Public Understanding of Science* 25 (7), 760–774. doi:[10.1177/0963662516636303](https://doi.org/10.1177/0963662516636303)

Happer, C. and Philo, G., 2013. The role of the media in the construction of public belief and social change. *Journal of social and political psychology*, 1(1), pp.321-336.

Hassandoust, F., Kazerouni, M. F., & Perumal, V., 2012. Socio-behavioural factors in virtual knowledge sharing. *International Journal of Knowledge-Based Organizations*, 2(2), 40-53. <https://doi.org/10.4018/ijkbo.2012040103>

Hautopp, H. (2023). Facilitating an educational board game jam: analysing different game design strategies. *European Conference on Games Based Learning*, 17(1), 242-250. <https://doi.org/10.34190/ecgbl.17.1.1759>

He, Y., Tran, C., Jiang, J., Burghardt, K., Ferrara, E., Zheleva, E., ... & Lerman, K. (2021). Heterogeneous effects of software patches in a multiplayer online battle arena game.. <https://doi.org/10.1145/3472538.3472550>

Hedlund, G., 1994. A model of knowledge management and the N-form corporation. *Strategic management journal*, 15(S2), pp.73-90.

Hern, A., 2014. DHL launches first commercial drone 'parcelcopter' delivery service. *The Guardian*. Available at: <https://www.theguardian.com/technology/2014/sep/25/german-dhl-launches-first-commercial-drone-delivery-service#:~:text=But%20now%2C%20German%20delivery%20firm,research%20project%20in%20December%202013>

Herron, K., Smith, H. and Silva, C., 2014. US Public Perspectives on Privacy, Security, and Unmanned Aircraft Systems. *Technical Report University of Oklahoma, Norman*.

Hinds, P.J. and Pfeffer, J., 2001. Why organizations don't know what they know": Cognitive and motivational factors affecting the transfer of expertise (pp. 3-26). Stanford: Graduate School of Business, Stanford University.

Ho, S.S., Scheufele, D.A. and Corley, E.A., 2013. Factors influencing public risk–benefit considerations of nanotechnology: Assessing the effects of mass media, interpersonal communication, and elaborative processing. *Public Understanding of Science*, 22(5), 606-623. [10.1177/0963662511417936](https://doi.org/10.1177/0963662511417936)

Hoagland, A. and Kipping, S., 2024. Challenges in promoting health equity and reducing disparities in access across new and established technologies. *Canadian Journal of Cardiology*.

Hoffman, L.H., 2007. Public opinion in context: a multilevel model of media effects on perceptions of public opinion and political behaviour. Doctoral dissertation. Graduate School of Ohio State University. Retrieved from Electronic Theses and Dissertation database.

Höjjer, B., 2010. Emotional anchoring and objectification in the media reporting on climate change. *Public understanding of science*, 19(6), pp.717-731.

Höjjer, B., 2011. Social Representations Theory. *Nordicom Review*, 32 (2), 3-16.



Holland, R.W., Verplanken, B. and Van Knippenberg, A., 2002. On the nature of attitude–behavior relations: The strong guide, the weak follow. *European journal of social psychology*, 32(6), pp.869-876.

Holsapple, C.W. and Singh, M., 2003. The knowledge chain model: activities for competitiveness. *Handbook on Knowledge Management: Knowledge Directions*, pp.215-251.

Horn, M., Weintrop, D., Beheshti, E. and Olson, I., 2012. Spinners, dice, and pawns: Using board games to prepare learners for agent-based modeling activities. *Environmental Science*.

Hornig S., 1993. Reading risk: Public response to print media accounts of technological risk. *Public Understanding of Science*, 2, 95-109.

Hortacsu, N. and Ertürk, E.M., 2003. Women and Ideology: Representations of Women in Religious and Secular Turkish Media 1. *Journal of Applied Social Psychology*, 33(10), pp.2017-2039.

Hildebrand, J.M. and Soderro, S., 2021. Pandemic drones: promises and perils. *Transfers*, 11(1), pp.148-158.

Hirling, O. and Holzapfel, F., 2017. ORCUS risk assessment tool for operations of light UAS above Germany. *International Journal of Intelligent Unmanned Systems*, 5(1), pp.2-17.

Hubbart, J. A., 2023. Harmonizing science and society: a change management approach to align scientific endeavours with societal needs. *Sustainability*, 15(21), 15233.

<https://doi.org/10.3390/su152115233>

Hur, S.H. and Won, M., 2024. CO2 emissions and delivery time of last-mile drone delivery using trucks. *IET Intelligent Transport Systems*, 18(1), pp.101-113.

Iacovides, I. and Cox, A. L., 2015. Moving beyond fun. Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems.

<https://doi.org/10.1145/2702123.2702204>

Iansiti, M., 1993. Real-world R&D: jumping the product generation gap. *Harvard Business Review*, 71(3), 138-147.

IATA., 2018. Flying is by Far the Safest Form of Transport. Accessed from:  
<https://www.iata.org/en/iata-repository/publications/economic-reports/flying-is-by-far-the-safest-form-of-transport/>

İnal, Y. and Wake, J. D., 2022. An old game, new experience: exploring the effect of players' personal gameplay history on game experience. *Universal Access in the Information Society*, 22(3), 757-769. <https://doi.org/10.1007/s10209-022-00872-0>

International Transport Forum, 2021. *Ready for Take-Off? Integrating Drones into the Transport System*. Available at: <https://www.itf-oecd.org/integrating-drones-transport-system>

Jansiti, M. (1993), "Real-world R&D: jumping the product generation gap", *Harvard Business Review*, Vol. 71 No. 3, pp. 138-147.

Ivanova, A. and Jocelin-Almendras, J.A., 2022. Representations of (Im) migrants in Chilean local press headlines: A case study of El Austral Temuco. *Journal of International Migration and Integration*, 23(1), 227-242. <https://doi.org/10.1007/s12134-021-00832-2>

Jakubik, M., 2011. Becoming to know: Essays on extended epistemology of knowledge creation. Svenska handelshögskolan.

Jannah, I. and Kholid, M.N., 2020. Ethics theory and theory of reasoned action in e-book piracy: An empirical study of accounting students. *International Journal of Research in Business and Social Science* (2147-4478), 9(3), pp.114-122.

Jansen, P.H., 2015. *The ethics of domestic drones: An ethical evaluation of the use of surveillance-capable unmanned aerial systems in civil contexts* (Master's thesis, University of Twente).

Jaspal, R., Nerlich, B., & Koteyko, N., 2012. Contesting science by appealing to its norms. *Science Communication*, 35(3), 383-410. <https://doi.org/10.1177/1075547012459274>

Jazairy, A., Persson, E., Brho, M., von Haartman, R. and Hilletoft, P., 2024. Drones in last-mile delivery: a systematic literature review from a logistics management perspective. *The International Journal of Logistics Management*.

Jean, S.; Gilbert, L.; Medema, W.; Keijser, X.; Mayer, I.; Inam, A.; Adamowski, J., 2018a. Serious Games as Planning Support Systems: Learning from Playing Maritime Spatial Planning Challenge 2050. *Water*. 10, 1786. <https://doi.org/10.3390/w10121786>

Jean, S., Medema, W., Adamowski, J., Chew, C., Delaney, P. and Wals, A., 2018b. Serious games as a catalyst for boundary crossing, collaboration and knowledge co-creation in a watershed governance context. *Journal of environmental management*, 223, pp.1010-1022.

Jeffres, L.W., Neuendorf, K. and Atkin, D.J., 2012. Acquiring knowledge from the media in the Internet age. *Communication Quarterly*, 60(1), pp.59-79.

<https://doi.org/10.1080/01463373.2012.641835>

Jelinski, L., Etzrodt, K. and Engesser, S., 2021. Undifferentiated optimism and scandalized accidents: the media coverage of autonomous driving in Germany. *Journal of Science Communication*, 20(4), p.A02.

Jensen, O.B., 2016. New 'Foucaultian Boomerangs': Drones and Urban Surveillance. *Surveillance and Society*, 14(1), pp.20-33.

Jeong, S.H., Cho, H. and Hwang, Y., 2012. Media literacy interventions: A meta-analytic review. *Journal of communication*, 62(3), pp.454-472.

Jeong, H.Y., Song, B.D. and Lee, S., 2019. Truck-drone hybrid delivery routing: Payload-energy dependency and No-Fly zones. *International Journal of Production Economics*, 214, pp.220-233.

Jessen, S., Mirković, J., & Ruland, C. M., 2018. Creating gameful design in mhealth: a participatory co-design approach. *JMIR mHealth and uHealth*, 6(12), e11579.

<https://doi.org/10.2196/11579>

Jiggins, J., van Slobbe, E. and Röling, N., 2007. The organisation of social learning in response to perceptions of crisis in the water sector of The Netherlands. *Environmental Science & Policy*, 10 (6), 526-536.

Joffe, H., 2002. Representations of health risks: What social psychology can offer health promotion. *Health education journal*, 61(2), pp.153-165.

Johannessen, J.A. and Olsen, B. and Olaisen, J., 1999. "Aspects of innovation theory based on knowledge management", *International Journal of Information Management*, Vol. 19, pp. 121-139.

Johannessen, K.A., Wear, N.K.S., Toska, K., Hansbø, M., Berg, J.P. and Fosse, E., 2021. Pathologic blood samples tolerate exposure to vibration and high turbulence in simulated

drone flights, but plasma samples should be centrifuged after flight. *IEEE Journal of Translational Engineering in Health and Medicine*, 9, pp.1-10.

Johnson, T. J., & Fahmy, S., 2009. See no evil, hear no evil, judge as evil? Examining whether Al-Jazeera English-language website users transfer credibility to its satellite network. In G. Golan, T. J. Johnson, & W. Wanta (Eds.), *International communication in a global age* (pp. 241–260). Philadelphia, PA: Routledge/Lawrence Erlbaum.

Jordan, B. and Henderson, A., 1995. Interaction analysis: Foundations and practice. *The journal of the learning sciences*, 4(1), pp.39-103.

Jovchelovitch, S., 2007. *Knowledge in context: Representations, community and culture*. Routledge.

Jungmann, M. and Cox, R., 2017. Undesirable consequences and social contexts of technology use: a micro-analysis of embodied user interaction. *Interacting with Computers*, 29(4), pp.481-493.

Kafai, Y., Burke, Q., & Mote, C., 2012. What makes competitions fun to participate?.. <https://doi.org/10.1145/2307096.2307146>

Kahneman, D.; Tversky, A., 1979. Prospect Theory: An Analysis of Decision under Risk. *Econometrica*. 47, 263–292.

Kahneman, D., Tversky, A., 1984. Choices, values, and frames. *Am. Psychol.* **39**(4), 341.

Kahneman, D., 2011. Thinking, fast and slow. *Farrar, Straus and Giroux*.

Kam, C.D. and Zechmeister, E.J., 2013. Name recognition and candidate support. *American Journal of Political Science*, 57(4), pp.971-986.

Kang, H., Hahn, M., Fortin, D.R., Hyun, Y.J. and Eom, Y., 2006. Effects of perceived behavioral control on the consumer usage intention of e-coupons. *Psychology & Marketing*, 23(10), pp.841-864.

Kasperson R. E., Kasperson J. X., 1996. The social amplification and attenuation of risk. *The Annals of the American Academy of Political and Social Science*, 545, 95-105.

Kasperson R. E., Renn O., Slovic P., Brown H. S., Emel J., Goble R., Ratick S., 1988. The social amplification of risk: A conceptual framework. *Risk Analysis*, 8, 177-187.

Kasperson J. X., Kasperson R. E., Pidgeon N., Slovic P., 2003. The social amplification of risk: Assessing fifteen years of research and theory. In Pidgeon N., Kasperson R. E., Slovic P. (Eds.), *The social amplification of risk*(pp. 13-46). Cambridge, UK: Cambridge University Press.

Kasurinen, J. and Smolander, K., 2017. Defining an iterative iso/iec 29110 deployment package for game developers. *International Journal of Information Technologies and Systems Approach*, 10(1), 107-125.

Katual, D., Drevin, L. and Goede, R., 2023. GAME-BASED LEARNING TO IMPROVE CRITICAL THINKING AND KNOWLEDGE SHARING: LITERATURE REVIEW. *Journal of the International Society for the Systems Sciences*, 67.

Kaur, K. and Rampersad, G., 2018. 'Trust in driverless cars: investigating key factors influencing the adoption of driverless cars'. *Journal of Engineering and Technology Management* 48, pp. 87–96. <https://doi.org/10.1016/j.jengtecman.2018.04.006>

Ke, F., Xie, K., & Xie, Y., 2015. Game-based learning engagement: a theory- and data-driven exploration. *British Journal of Educational Technology*, 47(6), 1183-1201. <https://doi.org/10.1111/bjet.12314>

Keijser, X., Ripken, M., Mayer, I., Warmelink, H., Abspoel, L., Fairgrieve, R. and Paris, C., 2018. Stakeholder engagement in maritime spatial planning: The efficacy of a serious game approach. *Water*, 10(6), p.724.

Kellermann, R. and Fischer, L., 2020. Drones for parcel and passenger transport: A qualitative exploration of public acceptance.

Kellermann, R., Biehle, T. and Mostofi, H., 2023. Modelling public attitude towards drone delivery in Germany. *European Transport Research Review*, 15(1), p.38.

Kempton, W., 1997. How the Public Views Climate Change. *Environment: Science and Policy for Sustainable Development*, 39 (9), 12-21

Khaled, R., Abeeel, V. V., Mechelen, M. V., & Vasalou, A., 2014. Participatory design for serious game design. *Proceedings of the First ACM SIGCHI Annual Symposium on Computer-Human Interaction in Play*. <https://doi.org/10.1145/2658537.2659018>

Khaled, R., 2018. 'Questions Over Answers: Reflective Game Design', in Media, P. D. of D. (ed.) *Playful Disruption of Digital Media*. Singapore: Springer, pp. 3–27. doi: 10.1007/978-981-10-1891-6\_1

Khan, R., Tausif, S. and Javed Malik, A., 2019. Consumer acceptance of delivery drones in urban areas. *International Journal of Consumer Studies*, 43(1), pp.87-101.

Khankeh H, Ranjbar M, Khorasani-Zavareh D, Zargham-Boroujeni A, Johansson E., 2015. Challenges in conducting qualitative research in health: A conceptual paper. *Iran J Nurs Midwifery Res*. 20(6), 635-41. Doi: <https://doi.org/10.4103%2F1735-9066.170010>

Khoury, M., Gibson, M., Savic, D., Chen, A., Vamvakeridou-Lyroudia, L., Langford, H., and Wigley, S., 2018. A Serious Game Designed to Explore and Understand the Complexities of Flood Mitigation in Urban-Rural Catchments. *Water*, 10(12), 1885.

Khrais, L. T., & Gabbori, D., 2023. The effects of social media digital channels on marketing and expanding the industry of e-commerce within digital world. *Original Research*, 11(5), 64–75.

Kiili, K., 2006. Towards a participatory multimedia learning model. *Education and Information Technologies*, 11, pp.21-32.

Kim, B., 2015. Game mechanics, dynamics, and aesthetics. *Library technology reports*, 51(2), pp.17-19.

Kim, S.J., Lim, G.J., Cho, J. and Côté, M.J., 2017. Drone-aided healthcare services for patients with chronic diseases in rural areas. *Journal of Intelligent & Robotic Systems*, 88, pp.163-180

Kirby DA., 2008. Cinematic Science. *Handbook of Public Communication of Science And Technology*. New York: Routledge, pp. 41–56

Kitzinger, J., 1994. The methodology of focus groups: the importance of interaction between research participants. *Sociology of health & illness*, 16(1), pp.103-121.

Klauser, F. and Pedrozo, S., 2017. Big data from the sky: popular perceptions of private drones in Switzerland. *Geographica Helvetica*, 72 (2), 231-239.

Koh, C.H., Low, K.H., Li, L., Zhao, Y., Deng, C., Tan, S.K., Chen, Y., Yeap, B.C. and Li, X., 2018. Weight threshold estimation of falling UAVs (Unmanned Aerial Vehicles) based on impact energy. *Transportation Research Part C: Emerging Technologies*, 93, pp.228-255.

Kolb, D. 1984 . *Experiential learning: Experience as the source of learning and development* , New Jersey : Prentice-Hall .

Kopsel, V., Walsh, C., Leyshon, C., 2017. Landscape narratives in practice: implications for climate change adaptation. *The Geographical Journal*, 83(2), 175–186.

Kosonen, E., 2015. Mixed Mode Communication for Knowledge Co-creation in Networked Organisation. MSc Thesis, Aalto University, Finland. Accessed from:  
[https://aaltodoc.aalto.fi/bitstream/123456789/15576/1/master\\_Kosonen\\_Elina\\_2015.pdf](https://aaltodoc.aalto.fi/bitstream/123456789/15576/1/master_Kosonen_Elina_2015.pdf)

Koster, R., 2004. *Theory of Fun for Game Design*. Boston: O'Reilly Media.

Kövecses, Z. (2005) *Metaphor in Culture: Universality and Variation*. Cambridge: Cambridge University Press.

Kraker, J. d., Offermans, A., & Wal, M. v. d., 2021. Game-based social learning for socially sustainable water management. *Sustainability*, 13(9), 4646.  
<https://doi.org/10.3390/su13094646>

Krath, J., Schürmann, L. and Von Korfflesch, H.F., 2021. Revealing the theoretical basis of gamification: A systematic review and analysis of theory in research on gamification, serious games and game-based learning. *Computers in Human Behavior*, 125, p.106963.

Krishnaveni, R. and Sujatha, R., 2012. Communities of practice: An influencing factor for effective knowledge transfer in organizations. *IUP Journal of Knowledge Management*, 10(1).

Kumar, R., Singh, J., Yadav, P., Semwal, N., Yadav, S., Bhorey, A. and Dhawan, H., 2023. Parachute deployment system for safe recovery of a drone. *Materials Today: Proceedings*.

Kurniati, E., Kamila, I. N., Rudianto, R., & Eliyawati, C., 2017. Playing and traditional games in learning model based on culture of national character and play. Proceedings of the 3rd International Conference on Early Childhood Education (ICECE 2016).  
<https://doi.org/10.2991/icece-16.2017.32>

Ladd, J.M., 2010. The role of media distrust in partisan voting. *Political Behavior*, 32, pp.567-585.

Laja, U. L., Azaini, A. M. A., & Adis, A. A. (2018). Evaluating south korean based mobile role playing games with playability heuristic evaluation. *International Journal of Engineering & Technology*, 7(3.18), 1.

Lakoff, G. and M. Johnson., 2008. *Metaphors We Live By*. Chicago: Chicago University Press.

Lamb, R., 2024. Serious Games. In *Oxford Research Encyclopedia of Communication*.

Lameras, P., Arnab, S., Dunwell, I., Stewart, C., Clarke, S., & Petridis, P., 2016. Essential features of serious games design in higher education: linking learning attributes to game mechanics. *British Journal of Educational Technology*, 48(4), 972-994.

<https://doi.org/10.1111/bjet.12467>

Langdridge, D., Sheeran, P., & Connolly, K. (2007). Analyzing additional variables in the theory of reasoned action. *Journal of Applied Social Psychology*, 37(8), 1884-1913.

<https://doi.org/10.1111/j.1559-1816.2007.00242.x>

Largent M. A., 2012. *Vaccine: The debate in modern America*. Baltimore, MD: Johns Hopkins University Press.

Leaning, M., 2017. *Media and information literacy: An integrated approach for the 21st century*. Chandos Publishing.

Lee, H. and Choi, B., 2003. Knowledge management enablers, processes, and organizational performance: An integrative view and empirical examination. *Journal of management information systems*, 20(1), pp.179-228.

Lee, C.J., Scheufele, D.A. and Lewenstein, B.V., 2005. Public attitudes toward emerging technologies: Examining the interactive effects of cognitions and affect on public attitudes toward nanotechnology. *Science communication*, 27(2), pp.240-267.

Lee, C.J. and Scheufele, D.A., 2006. The influence of knowledge and deference toward scientific authority: A media effects model for public attitudes toward nanotechnology. *Journalism & Mass Communication Quarterly*, 83(4), pp.819-834.



- Lee, H., Parsons, D., Kwon, G., Kim, J., Petrova, K., Jeong, E., & Ryu, H., 2016. Cooperation begins: Encouraging critical thinking skills through cooperative reciprocity using a mobile learning game. 97, 97-115. <https://doi.org/10.1016/j.compedu.2016.03.006>
- Legrís, P., Ingham, J. and Collerette, P., 2003. Why do people use information technology? A critical review of the technology acceptance model. *Information & management*, 40(3), pp.191-204.
- Lenz, B. and Fraedrich, E. (2015a). 'Gesellschaftliche und individuelle Akzeptanz des autonomen Fahrens'. In: *Autonomes Fahren. Technische, rechtliche und gesellschaftliche Aspekte*. Ed. by M. Maurer, J. C. Gerdes, B. Lenz and H. Winner. Berlin, Heidelberg, Germany: Springer Vieweg, pp. 639–660. [https://doi.org/10.1007/978-3-662-45854-9\\_29](https://doi.org/10.1007/978-3-662-45854-9_29).
- Lenz, B. and Fraedrich, E. ,2015b.'Vom(Mit)Fahren:autonomesFahrenundAutonutzung'.In: *Autonomes Fahren. Technische, rechtliche und gesellschaftliche Aspekte*. Ed. by M. Maurer, J. C. Gerdes, B. Lenz and H. Winner. Berlin, Heidelberg, Germany: Springer Vieweg, pp. 687–708. [https://doi.org/10.1007/978-3-662-45854-9\\_31](https://doi.org/10.1007/978-3-662-45854-9_31).
- Leong, M.K. and Koay, K.Y., 2023. Towards a unified model of consumers' intentions to use drone food delivery services. *International Journal of Hospitality Management*, 113, p.103539.
- Lerner, E., Streicher, B., Sachs, R., Raue, M. and Frey, D., 2015. The effect of construal level on risk-taking. *European Journal of Social Psychology*, 45(1), pp.99-109.
- Levin, I.P., Schneider, S.L. and Gaeth, G.J., 1998. All frames are not created equal: A typology and critical analysis of framing effects. *Organizational behavior and human decision processes*, 76(2), pp.149-188.
- Li, H., 2023. Identifying the science and art of interactive experiences. *Advances in Economics, Management and Political Sciences*, 58(1), 96-101. <https://doi.org/10.54254/2754-1169/58/20230831>
- Liao, C.H., 2023. Exploring the Influence of Public Perception of Mass Media Usage and Attitudes towards Mass Media News on Altruistic Behavior. *Behavioral Sciences*, 13(8), p.621.

- Li, C. and Li, Y., 2023. Factors influencing public risk perception of emerging technologies: a meta-analysis. *Sustainability*, 15(5), p.3939.
- Li, X., Lee, G.J.X. and Yuen, K.F., 2024. Consumer acceptance of urban drone delivery: The role of perceived anthropomorphic characteristics. *Cities*, 148, p.104867.
- Lidynia, C., Philipsen, R. and Ziefle, M., 2016. Droning on About Drones—Acceptance of and Perceived Barriers to Drones in Civil Usage Contexts. *Advances in Intelligent Systems and Computing*, 499, 317-329.
- Lim, S.F.W., Jin, X. and Srail, J.S., 2018. “Consumer-driven e-commerce: a literature review, design framework, and research agenda on last-mile logistics models”, *International Journal of Physical Distribution and Logistics Management*, Vol. 48 No. 3, pp. 308-332, doi: 10.1108/ijpdlm-02-2017-0081
- Lin, H.F., 2007. Knowledge sharing and firm innovation capability: an empirical study. *International Journal of manpower*, 28(3/4), pp.315-332.
- Lin, L., 2019. The design of UAV collision avoidance system based on ADS-B IN. *Paper Asia*, 2, pp. 141–144.
- Lin, C.H., Shih, H.Y. and Sher, P.J., 2007. Integrating technology readiness into technology acceptance: The TRAM model. *Psychology & Marketing*, 24(7), pp.641-657.
- Litosseliti, L., 2003. Using focus groups in research. A&C Black.
- Liu, S., Huang, J.C. and Brown, G.L., 1998. Information and risk perception: A dynamic adjustment process. *Risk analysis*, 18(6), pp.689-699.
- Liu, Y., Liu, Z., Shi, J., Wu, G. and Chen, C., 2019. Optimization of base location and patrol routes for unmanned aerial vehicles in border intelligence, surveillance, and reconnaissance. *Journal of Advanced Transportation*, 2019(1), p.9063232.
- Liu, W., Li, W., Zhou, Q., Die, Q. and Yang, Y., 2022. “The optimization of the ‘UAV-vehicle’ joint delivery route considering mountainous cities”, *PLoS One*, Vol. 17 No. 3, e0265518, doi: 10.1371/journal.pone.0265518.

Lloyd-Walker, B. M., Mills, A. J., & Walker, D. H., 201. Enabling construction innovation: the role of a no-blame culture as a collaboration behavioural driver in project alliances. 32(3), 229-245. DOI: 10.1080/01446193.2014.892629

Lohn, A.J., 2017. *What's the buzz? The city-scale impacts of drone delivery* (No. RR-1718-RC).

Lu, X., Liu, X., Li, Y., Zhang, Y. and Zuo, H., 2020. Simulations of airborne collisions between drones and an aircraft windshield. *Aerospace Science and Technology*, 98, p.105713.

Luce, R.D. and Weber, E.U., 1986. An axiomatic theory of conjoint, expected risk. *Journal of mathematical psychology*, 30(2), pp.188-205.

Luppigini R. and So A. 2016. A technoethical review of commercial drone use in the context of governance, ethics, and privacy. *Technol. Soc.* 46,109–119

Lupton D (2013) Risk, 2nd edn. Routledge, London

Lyon, D., 2007. Surveillance studies: An overview.

MacGregor, B., 1997. Live, Direct, and Biased?: Making Television News in the Satellite Age. Arnold, London.

Mackay, R., 2013. *Using games as an educational tool provides opportunities for deeper learning, panelists at Stanford event say* [online]. Stanford News. Available from: <https://news.stanford.edu/2013/03/01/games-education-tool-030113/> [Accessed 20 May 2022].

Macklin, C. and Sharp, J., 2016. *Games, Design and Play: A detailed approach to iterative game design*. Addison-Wesley Professional.

Macnaghten, P. and Chilvers, J., 2014. The future of science governance: Publics, policies, practices. *Environment and Planning C: Government and Policy*, 32(3), pp.530-548.

Macnaghten, P., Kearnes, M. and Davies, S., 2015. Anticipating public responses to emerging technologies: a narrative approach. *Journal of Environmental Policy and Planning*.

Mahatmi, N., 2021. Perancangan board game kolaboratif. studi kasus: legenda gunung tondoyan. *Ultimart: Jurnal Komunikasi Visual*, 14(1), 43-55.

<https://doi.org/10.31937/ultimart.v14i1.1975>

Maher, B., 2023. BBC annual report 2023: World Service global reach declines 12% amid cuts. *Press Gazette*. Accessed from: <https://pressgazette.co.uk/publishers/broadcast/bbc-annual-report-2022-2023-world-service-reach-declines/>

Mahyuddin, N., Sofiya, R., Agusniati, A., Nurani, Y. and Novaliendry, D., 2024. Development of Board Game Media on Air Theme for Children Aged 5-6 Years. *International Journal of Interactive Mobile Technologies*, 18(8).

Malaby, T., 2007. "Beyond Play: A New Approach to Games, Games and Culture 2(2).

Malveaux, C., Hall, S. and Price, R., 2014. Using Drones in Agriculture: Unmanned Aerial Systems for Agricultural Remote Sensing Applications. *2014 ASABE Annual International Meeting*.

Marczewski, A., 2013. *Gamification: a simple introduction*. Andrzej Marczewski.

Marini, D.; Medema, W.; Adamowski, J.; Veissière, S.P.L.; Mayer, I.; Wals, A.E.J., 2018. Socio-Psychological Perspectives on the Potential for Serious Games to Promote Transcendental Values in IWRM Decision-Making. *Water*. 10, 1097.  
<https://doi.org/10.3390/w10081097>

Marková, I. 2003 *Dialogicality and Social Representations*. The Dynamics of Mind. Cambridge, UK: Cambridge University Press

Marková, I., Linell, P., Grossen, M. and Salazar Orvig, A., 2007. *Dialogue in focus groups: Exploring socially shared knowledge*. Equinox publishing.

Markowitz, D.M., Levine, T.R., Serota, K.B. and Moore, A.D., 2023. Cross-checking journalistic fact-checkers: The role of sampling and scaling in interpreting false and misleading statements. *Plos one*, 18(7), p.e0289004.

Manna, 2024. *Drone delivery made simple*. Available from:  
<https://www.manna.aero/#OrderAnything>

Marris, E., 2013. Drones in science: Fly, and bring me data. *Nature*, 498 (7453), 156-158.

- Marshall, B., Easdown, C., Day, H., Camilleri, E., Roelcke, P., 2022. *Technology Tracker: Wave 9*. Available from: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1139418/transport-and-transport-technology-public-attitudes-tracker-wave-9-report.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1139418/transport-and-transport-technology-public-attitudes-tracker-wave-9-report.pdf)
- Martins, B.O., Lavallée, C. and Silkoset, A., 2021. Drone Use for COVID-19 Related Problems: Techno-solutionism and its Societal Implications. *Global Policy*, 12(5), pp.603-612.
- Matthes J., 2008. Media frames and public opinion: Exploring the boundaries of framing effects in a two-wave panel study. *Studies in Communication Sciences*, 8(2), 101-128.
- Maxwell, J.A., 2008. Designing a qualitative study (Vol. 2, pp. 214-253). The SAGE handbook of applied social research methods.
- Mayer, I., 2009. The Gaming of Policy and the Politics of Gaming: A Review. *Simulation & Gaming*, 40(6), 825-862. <https://doi.org/10.1177/1046878109346456>
- McCombs, M.E. and Shaw, D.L., 1972. The agenda-setting function of mass media. *Public opinion quarterly*, 36(2), pp.176-187
- McGonigal, J., 2011. *Reality Is Broken, Why Games Make Us Better and How They Can Change the World*. New York: The Penguin Press.
- McHughen, A., 2007. Public perceptions of biotechnology. *Biotechnology Journal: Healthcare Nutrition Technology*, 2(9), pp.1105-1111.
- McLeod, F., Cherrett, T., Oakey, A., Theobald, K., Waters, T., Grote, M., Armstrong, J., Denny, J. and Murray, A., 2024. Investigating the Crash Protection Performance of a Medical Carrier Bag for Drone Transport. *Logistics*, 8(1), p.31.
- Medema, W., Adamowski, J., Orr, C., Furber, A., Wals, A. and Milot, N., 2017. Building a foundation for knowledge co-creation in collaborative water governance: Dimensions of stakeholder networks facilitated through bridging organizations. *Water*, 9(1), p.60. <https://doi.org/10.3390/w9010060>
- Medema, W., Chew, C., Adamowski, J., Mayer, I. and Wals, A., 2020. Understanding Game-based Approaches for Improving Sustainable Water Governance. *Water*.

Melero, J., and Hernández-Leo, D., 2017. Design and Implementation of Location-Based Learning Games: Four Case Studies with “QuesTInSitu: The Game, *IEEE Transactions on Emerging Topics in Computing*, vol. 5, no. 1, pp. 84-94. doi: 10.1109/TETC.2016.2615861.

Metz, A., 2021. Why delivery drones are struggling to take off—even with DHL and Amazon on board. *Tech Radar*. Available at: <https://www.techradar.com/news/why-delivery-drones-are-struggling-to-take-off-even-with-dhl-and-amazon-on-board>

Metzger, M., 2009. The study of media effects in the era of internet communications. In R. Nabi & M. Oliver (Eds.), *The SAGE handbook of media processes and effects*. 561–575 Sage.

Metzger, M.J., Flanagin, A.J. and Medders, R.B., 2010. Social and heuristic approaches to credibility evaluation online. *Journal of communication*, 60(3), pp.413-439.

Melo, S., Silva, F., Abbasi, M., Ahani, P. and Macedo, J., 2023. Public acceptance of the use of drones in city logistics: A citizen-centric perspective. *Sustainability*, 15(3), p.2621.

Menda, J., Hing, J.T., Ayaz, H., Shewokis, P.A., Izzetoglu, K., Onaral, B. and Oh, P., 2011. Optical brain imaging to enhance UAV operator training, evaluation, and interface development. *Journal of intelligent & robotic systems*, 61, pp.423-443.

Merkert, R. and Bushell, J., 2020. Revolution or epidemic? A systematic literature review on the effective control of airborne drones.

Metzger, E.C., Lubin, L., Patten, R.T. and Whyte, J., 2016. Applied gamification: Creating reward systems for organizational professional development. *Foundation of Digital Badges and Micro-Credentials: Demonstrating and Recognizing Knowledge and Competencies*, pp.457-466.

Mezirow, J., 1991. Transformative dimensions of adult learning. San Francisco, CA: Jossey-Bass

Michael, M., 1998. Between citizen and consumer: multiplying the meanings of the public understanding of science. *Public Understanding of Science*, 7(4), p.313.  
<https://doi.org/10.1088/0963-6625/7/4/004>

- Miles, M.B., 1994. Qualitative data analysis: An expanded sourcebook. *Thousand Oaks*.
- Miller, J.D., 1983. Scientific literacy: A conceptual and empirical review. *Daedalus* 112(2): 29–48.
- Miller, J.M. and Krosnick, J.A., 2000. News media impact on the ingredients of presidential evaluations: Politically knowledgeable citizens are guided by a trusted source. *American Journal of Political Science*, pp.301-315.
- Minishi-Majanja, M.K. and Kiplang'at, J., 2005. The diffusion of innovations theory as a theoretical framework in library and information science research. *South African journal of libraries and information science*, 71(3), pp.211-224.
- Molina, M., Campos, S., 2018. Ethics and Civil Drones: European policies and proposals for the industry. Springer Nature.
- Morgan, D. L., 1996. *Focus groups as qualitative research*. Vol. 16. Sage publications, 1996.
- Morgan, M.G., 2002. *Risk communication: A mental models approach*. Cambridge University Press.
- Morgan, D., 2012. Focus groups and social interaction. In J. Gubrium, J. Holstein, A. Marvasti, & K. McKinney (Eds.), *The Sage handbook of interview research: The complexity of the craft* ( 2nd ed., pp. 161–176). Thousand Oaks: SAGE.
- Morren, M. and Grinstein, A., 2021. The cross-cultural challenges of integrating personal norms into the Theory of Planned Behavior: A meta-analytic structural equation modeling (MASEM) approach. *Journal of Environmental Psychology*, 75, p.101593.
- Mossberger, K., Tolbert, C.J., McNeal, R.S., 2007. Digital Citizenship: The Internet, Society, and Participation. MIT Press, Cambridge
- Moscovici, S., 1963. Attitudes and Opinions. *Annual Review of Psychology*, 14 (1), 231-260.
- Moscovici, S., 1981. On social representations. *Social cognition: Perspectives on everyday understanding*, 8(12), pp.181-209.
- Moscovici, S. 1984 'The Phenomenon of Social Representations', pp. 3-69 in R.M. Farr and S. Moscovici (eds) *Social Representations*. Cambridge, UK: Cambridge University Press

Moscovici, S. and Marková, I., 1998. Presenting social representations: A conversation. *Culture & psychology*, 4(3), pp.371-410.

Moscovici, S. 2000 *Social Representations. Explorations in Social Psychology*. Cambridge, UK: Polity Press.

Moscovici, S. 2007 *Psychoanalysis. Its Image and Its Public*. Oxford: Blackwell Publishing (first published 1961)

Mostafavi, F., Nasirian, M., Zeinali, M., Ardalan, G., Mohebpour, F., Daniali, S.S., Pirzadeh, A. and Kelishadi, R., 2021. Evaluating community-based programs in promoting traffic behaviors and safe road crossing behaviors in youth: an application on theory of planned behavior. *International journal of preventive medicine*, 12.

Mou Y, Lin, C.A., 2014. Communicating food safety via the social media: The role of knowledge and emotions on risk perception and prevention. *Science Communication* 36(5): 593–616.

Mutz, D.C. and Young, L., 2011. Communication and public opinion: Plus ça change?. *Public opinion quarterly*, 75(5), pp.1018-1044.

Nadeem, T., Dickinson, J.E., Smith, A., King, K., Cherret, T., Oakey, A., Grote, M. and Pilko, A., 2024. Game of (delivery) drones: A serious game exploring transport futures involving logistics drones with stakeholders. *Journal of Transport & Health*, 38, p.101881.

Nadolny, L., Alaswad, Z., Culver, D., & Wang, W., 2017. Designing with game-based learning: game mechanics from middle school to higher education. *Simulation & Gaming*, 48(6), 814-831. <https://doi.org/10.1177/1046878117736893>

Nassi, B., Shabtai, A., Masuoka, R. and Elovici, Y., 2019. SoK-security and privacy in the age of drones: threats, challenges, solution mechanisms, and scientific gaps. *arXiv preprint arXiv:1903.05155*.

National Union of Journalists, 2020. *BBC stats and facts*. [online] National Union of Journalists. Available at: <https://www.nuj.org.uk/resource-report/bbc-stats-facts.html>



Nejatian, M., Nejati, M., Zarei, M.H. and Soltani, S., 2013. Critical enablers for knowledge creation process: Synthesizing the literature. *Global Business and Management Research*, 5(2-3), pp.105-119.

Nelson T. E., Oxley Z. M., Clawson R. A., 1997. Toward a psychology of framing effects. *Political Behavior*, 19, 221-246.

Nentwich, M., & Horváth, D. M. (2018). The vision of delivery drones: Call for a technology assessment perspective. *Journal for Technology Assessment in Theory and Practice*, 27(2), 46-52. <https://doi.org/10.14512/tatup.27.2.46>

Newman, N., Levy, D.A.L., and Nielsen, R.K., 2015. "Reuters Institute Digital News Report 2015," Available SSRN 2619576.

Newman, N., Fletcher, R., Robertson, C.T., Ross Arguedas, A., and Nielsen, R.K., 2024. *Reuters Institute Digital News Report 2024*. [online] Available at: [https://reutersinstitute.politics.ox.ac.uk/sites/default/files/2024-06/RISJ\\_DNR\\_2024\\_Digital\\_v10%20lr.pdf](https://reutersinstitute.politics.ox.ac.uk/sites/default/files/2024-06/RISJ_DNR_2024_Digital_v10%20lr.pdf)

Nguyen, D. and Hekman, E., 2024. The news framing of artificial intelligence: a critical exploration of how media discourses make sense of automation. *AI & society*, 39(2), pp.437-451.

NHS, 2023. NHS to scale up drone delivery programme of critical medical supplies using Apian and Zipline. Available from: <https://www.northumbria.nhs.uk/media-centre/news-and-blogs/news-stories/nhs-scale-drone-delivery-programme-critical-medical-supplies-using-apian-and-zipline>

NHS, 2024. Drones successfully fly blood packs in longest ever 'beyond visual line of sight' flights in UK first. Available from: <https://www.nhsbt.nhs.uk/news/drones-successfully-fly-blood-packs-in-longest-ever-beyond-visual-line-of-sight-flights-in-uk-first/>

Nicholas, J., Mills, B., Hansen, S., Bright, S., Boyd, H., Brook, L., ... & Hopper, L., 2022. Developing an alcohol and other drug serious game for adolescents: considerations for improving student engagement. *Australian and New Zealand Journal of Public Health*, 46(5), 682-688. <https://doi.org/10.1111/1753-6405.13287>

Nielsen, R.K., Schulz, A., Fletcher, R., Robertson, C.T., 2023. The BBC is under scrutiny. Here's what research tells about its role in the UK. *Reuters Institute for the Study of*

*Journalism, University of Oxford*. Accessed from:

<https://reutersinstitute.politics.ox.ac.uk/news/bbc-under-scrutiny-heres-what-research-tells-about-its-role-uk>

Nikitina, V., 2021. Behavioral modelling of subjects in legal cases-games with imperfect rationality. *SHS Web of Conferences*, 118, 01011.

<https://doi.org/10.1051/shsconf/202111801011>

Nilsson, N., Nordahl, R. and Serafin, S., 2016. Immersion Revisited: A review of existing definitions of immersion and their relation to different theories of presence. *Human Technology*, 12 (2), 108-134.

Nisbet, M. C., Brossard, D. and Kroepsch, A., 2003. 'Framing science: the stem cell controversy in an age of press/politics'. *The International Journal of Press/Politics* 8 (2), pp. 36–70. <https://doi.org/10.1177/1081180X02251047>.

Nisbet, M.C., 2009. Communicating climate change: Why frames matter for public engagement. *Environment: Science and policy for sustainable development*, 51(2), pp.12-23.

Nisbet, M.C. and Scheufele, D.A., 2009. What's next for science communication? Promising directions and lingering distractions. *American journal of botany*, 96(10), pp.1767-1778.

Nisbet, E. C., & Myers, T. A., 2011. Anti-American sentiment as a media effect? Arab media, political identity and public opinion in the Middle East. *Communication Research*, 38(5), 684–709.

Nisbet, E.C., Saldaña Villa, M.C., Johnson, T.J., Golan, G. and Day, A., 2017. Credibility gaps and public opinion in a competitive media environment: The case of Arab satellite TV news in Lebanon.

Nisingizwe, M.P., Ndishimye, P., Swaibu, K., Nshimiyimana, L., Karame, P., Dushimiyimana, V., Musabyimana, J.P., Musanabaganwa, C., Nsanzimana, S. and Law, M.R., 2022. Effect of unmanned aerial vehicle (drone) delivery on blood product delivery time and wastage in Rwanda: a retrospective, cross-sectional study and time series analysis. *The Lancet Global Health*, 10(4), pp.e564-e569.

Nonaka, I., 1994. A dynamic theory of organizational knowledge creation. *Organization science*, 5(1), pp.14-37.

- Nonaka, I.; Takeuchi, H., 1995. *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*; Oxford University Press: Oxford, UK.
- Nonaka, L., Takeuchi, H. and Umemoto, K., 1996. A theory of organizational knowledge creation. *International journal of technology Management*, 11(7-8), pp.833-845.
- Nonaka, I. and Takeuchi, H., 2007. The knowledge-creating company. *Harvard business review*, 85(7/8), p.162.
- Nonaka, I. and Von Krogh, G., 2009. Perspective—Tacit knowledge and knowledge conversion: Controversy and advancement in organizational knowledge creation theory. *Organization science*, 20(3), pp.635-652.
- Oakey, A., Waters, T., Zhu, W., Royall, P.G., Cherrett, T., Courtney, P., Majoe, D. and Jelev, N., 2021. Quantifying the effects of vibration on medicines in transit caused by fixed-wing and multi-copter drones. *Drones*, 5(1), p.22.
- Pavone, V., Degli-Esposti, S., Santiago, E., 2015. D 2.4—Key factors affecting public acceptance and acceptability of SOSTs. *SURPRISE*. Available online at <http://surprise-project.eu>.
- Oakey, A., Grote, M., Smith, A., Cherrett, T., Pilko, A., Dickinson, J., AitBihiOuali, L. 2022. Integrating drones into NHS patient diagnostic logistics systems: Flight or fantasy? *PLOS ONE* 17(12): <https://doi.org/10.1371/journal.pone.0264669>
- Oakey, A., Smith, A., 2023. Written evidence submitted by Andy Oakey, Dr Angela Smith and Dr Matt Grote (STO0019). Available at: <https://committees.parliament.uk/writtenevidence/123332/pdf/>
- Ocal, A. and Crowston, K., 2024. Framing and feelings on social media: the futures of work and intelligent machines. *Information Technology & People*.
- Oelke, D., Geißelmann, B., Keim, D.A., 2012. Visual analysis of explicit opinion and news bias in german soccer articles. EuroVis Workshop on Visual Analytics, EuroVA 2012, Vienna, Austria, June 4–5 June 2012. <https://doi.org/10.2312/PE/EuroVAST/EuroVA12/049-053>
- Ofcom., 2023. News consumption in the UK: 2023. Accessed from: <https://www.ofcom.org.uk/siteassets/resources/documents/research-and-data/tv-radio-and->

[on-demand-research/tv-research/news/news-consumption-2023/news-consumption-in-the-uk-2023/?v=329963](https://on-demand-research.tv-research/news/news-consumption-2023/news-consumption-in-the-uk-2023/?v=329963)

Olausson, U., 2011. "We're the Ones to Blame": Citizens' Representations of Climate Change and the Role of the Media. *Environmental Communication*, 5 (3), 281-299.

Olausson, U., 2019. Meat as a matter of fact(s): the role of science in everyday representations of livestock production on social media. *Journal of Science Communication*, 18 (06), A01.

Olbertz-Siitonen, M., Piirainen-Marsh, A., & Siitonen, M., 2021. Constructing co-presence through shared vr gameplay. *Journal Für Medienlinguistik*, 4(2), 85-122.  
<https://doi.org/10.21248/jfml.2021.31>

Olejniczak, K., Newcomer, K. and Meijer, S., 2020. Advancing Evaluation Practice With Serious Games. *American Journal of Evaluation*, 41 (3), 339-366.

O'Neill, S. and Nicholson-Cole, S., 2009. "Fear won't do it" promoting positive engagement with climate change through visual and iconic representations. *Science communication*, 30(3), pp.355-379.

Oren, T.G. and Petro, P. eds., 2004. *Global currents: media and technology now*. Rutgers University Press.

Orr, M., Thrush, R. L., & Plaut, D. C., 2013. The theory of reasoned action as parallel constraint satisfaction: towards a dynamic computational model of health behavior. *PLoS ONE*, 8(5), e62490. <https://doi.org/10.1371/journal.pone.0062490>

Otmakhova, J., Khanehzar, S. and Frermann, L., 2024, August. Media Framing: A Typology and Survey of Computational Approaches Across Disciplines. In *Proceedings of the 62nd Annual Meeting of the Association for Computational Linguistics (Volume 1: Long Papers)* (pp. 15407-15428).

Ouchchy, L., Coin, A. and Dubljević, V., 2020. AI in the headlines: the portrayal of the ethical issues of artificial intelligence in the media. *AI & SOCIETY*, 35, pp.927-936.

Pan, Y., Opgenhaffen, M. and Van Gorp, B., 2019. Negotiating climate change: A frame analysis of COP21 in British, American, and Chinese news media. *Public Understanding of Science*, 28(5), pp.519-533.

Paranthaman, P.K. and Cooper, S., 2019, October. ARAPID: towards integrating crowdsourced playtesting into the game development environment. In *Proceedings of the Annual Symposium on Computer-Human Interaction in Play* (pp. 121-133).

Park, H.S., 2000. Relationships among attitudes and subjective norms: Testing the theory of reasoned action across cultures. *Communication studies*, 51(2), pp.162-175.

Pascale, C., 2011. *Cartographies of knowledge: Exploring qualitative epistemologies*. Thousand Oaks, CA: Sage.

Pasher, E., Ronen, T., 2011. The complete guide to knowledge management: A strategic plan to leverage your company's intellectual capital: John Wiley and Sons

Passalacqua, M., Morin, R., Sénécal, S., Nacke, L. E., & Léger, P., 2020. Demystifying the first-time experience of mobile games: the presence of a tutorial has a positive impact on non-expert players' flow and continuous-use intentions. *Multimodal Technologies and Interaction*, 4(3), 41. <https://doi.org/10.3390/mti4030041>

Patriotta, G., 2004. On studying organizational knowledge. *Knowledge Management Research & Practice*, 2(1), pp.3-12.

Paul, R., Elder, L., 2004. The Thinker's Guide for Conscientious Citizens on how to Detect Media Bias & Propaganda in National and World News. Foundation Critical Thinking

Patro, R. K., Chandra, S., & Patro, J. P., 2024. Drone Integration in Last-Mile Delivery Operations. *International Journal of Supply Chain and Logistics*, 8(2), 109–122. <https://doi.org/10.47941/ijscsl.2286>

Patton, M.Q., 2002. Two decades of developments in qualitative inquiry: A personal, experiential perspective. *Qualitative social work*, 1(3), pp.261-283.

Pavone, V., Degli-Esposti, S., Santiago, E., 2015. D 2.4—Key factors affecting public acceptance and acceptability of SOSTs. *SURPRISE*. Available online at <http://surprise-project.eu>.

Pedrozo, S. and Klauser, F., 2022. Between formality and informality: A critical study of the integration of drones within the Neuchâtel police force 1 2. *Information Polity*, 27(2), pp.247-258.

- Peppler, K., Danish, J., & Phelps, D., 2013. Collaborative gaming. *Simulation & Gaming*, 44(5), 683-705. <https://doi.org/10.1177/1046878113501462>
- Pereira, A., Prada, R. and Paiva, A., 2012. Socially Present Board Game Opponents. *Lecture Notes in Computer Science*, 101-116.
- Peterson, T.R., Stephens, J.C. and Wilson, E.J., 2015. Public perception of and engagement with emerging low-carbon energy technologies: A literature review. *MRS Energy & Sustainability*, 2, p.E11.
- Peterson, E. and Allamong, M.B., 2022. The influence of unknown media on public opinion: Evidence from local and foreign news sources. *American Political Science Review*, 116(2), pp.719-733.
- Petrovskaya, E. and Zendle, D., 2021. Predatory monetisation? a categorisation of unfair, misleading and aggressive monetisation techniques in digital games from the player perspective. *Journal of Business Ethics*, 181(4), 1065-1081. <https://doi.org/10.1007/s10551-021-04970-6>
- Petrovskaya, E. and Zendle, D., 2022. “these people had taken advantage of me”: a grounded theory of problematic consequences of player interaction with mobile games perceived as “designed to drive spending”. *Human Behavior and Emerging Technologies*, 2022, 1-14. <https://doi.org/10.1155/2022/1260174>
- Petty R. E. and Cacioppo, J.T., 1986. Communication and persuasion: Central and peripheral routes to attitude change.
- Peyer, R.D., 2015. Drones are banned from Royal Parks amid 'fears over impact on wildlife and visitor safety.' *The Standard*. Available at: <https://www.standard.co.uk/news/london/drones-banned-from-royal-parks-amid-fears-over-impact-on-wildlife-and-visitor-safety-10095538.html>
- Pidgeon N. F., Kasperson R. E., Slovic P. (Eds.), 2003. *The social amplification of risk*. Cambridge, UK: Cambridge University Press.
- Pillai, G.M., Suresh, A., Gupta, E., Ganapathy, V. and Patra, A., 2024. Privadome: Delivery Drones and Citizen Privacy. *Proceedings on Privacy Enhancing Technologies*.

Pilko, A., Sóbester, A., Scanlan, J.P. and Ferraro, M., 2023. Spatiotemporal ground risk mapping for uncrewed aircraft systems operations. *Journal of Aerospace Information Systems*, 20(3), pp.126-139.

Pilt, E. and Himma-Kadakas, M., 2023. Training researchers and planning science communication and dissemination activities: testing the QUEST model in practice and theory. *Journal of Science Communication*, 22(6), p.A04.

Pisor, A.C., Gervais, M.M., Purzycki, B.G. and Ross, C.T., 2020. Preferences and constraints: the value of economic games for studying human behaviour. *Royal Society open science*, 7(6), p.192090. <https://doi.org/10.1098/rsos.192090>

Pissarra Esteves, J., 2016. *Sociology of Communication*. Lisbon: Fundação Calouste Gulbenkian.

Plass, J. L., Mayer, R. E., & Homer, B. D., 2020. Handbook of game-based learning: MIT Press.

Plioutsias A., Karanikas N., and Chatzimihailidou M.M. 2018. Hazard analysis and safety requirements for small drone operations: To what extent do popular drones embed safety? *Risk Anal.* 38(3): 562–584.

Polanyi, M., 1966. The logic of tacit inference. *Philosophy*, 41(155), pp.1-18.

Polanyi, M. 1983. Tacit dimension. Peter Smith Publisher Inc., Gloucester, Massachusetts, USA.

Poljak, M. and Šterbenc, A.J.C.M., 2020. Use of drones in clinical microbiology and infectious diseases: current status, challenges and barriers. *Clinical Microbiology and Infection*, 26(4), pp.425-430.

Pope, M., 2016. Reporting beyond the pale: UK news discourse on drones in Pakistan. *Critical Studies on Terrorism*, 10(1), 138-161. <https://doi.org/10.1080/17539153.2016.1178486>

Pope, L., 2021. Board Games as Educational Tools Leading to Climate Change Action: A Literature Review. *Journal of Sustainability Education*, 25.

Poplin, A., 2012. Playful public participation in urban planning: A case study for online serious games. *Computers, environment and urban systems*, 36(3), pp.195-206.

Potter, W.J., 2010. The state of media literacy. *Journal of broadcasting & electronic media*, 54(4), pp.675-696.

Priest, S.H., 1995. Information equity, public understanding of science, and the biotechnology debate. *Journal of Communication*, 45(1), pp.39-54.

<https://doi.org/10.1111/j.1460-2466.1995.tb00713.x>

Proulx, J.-N., Romero, M., & Arnab, S., 2017. Learning mechanics and game mechanics under the perspective of self-determination theory to foster motivation in digital game-based learning. 48(1), 81-97. <https://doi.org/10.1177/1046878116674399>

Psaltis, C., 2012. Culture and social representations: A continuing dialogue in search for heterogeneity in social developmental psychology. *Culture & Psychology*, 18(3), pp.375-390.

Putra, K.N., Triuwono, I. and Purwanti, L., 2018. Fraud procurement of goods and services a perspective of the Theory of Planned Behavior. *Jurnal Akuntansi*, 22(3), pp.385-404.

PWC, 2022. *Skies without limits: The potential to take the UK's economy to new heights*. Available at: <https://www.pwc.co.uk/intelligent-digital/drones/skies-without-limits-2022.pdf>

Racine, E., Waldman, S., Rosenberg, J. and Illes, J. (2010). 'Contemporary neuroscience in the media'. *Social Science & Medicine* 71 (4), pp. 725–733.  
<https://doi.org/10.1016/j.socscimed.2010.05.017>.

Radecki, C.M. and Jaccard, J., 1995. Perceptions of knowledge, actual knowledge, and information search behavior. *Journal of experimental social psychology*, 31(2), pp.107-138.

Raghothama, J., Hauge, J., & Meijer, S., 2022. Curating player experience through simulations in city games. *Urban Planning*, 7(2). <https://doi.org/10.17645/up.v7i2.5031>

Rahman, B.H., 2014. Conditional influence of media: Media credibility and opinion formation. *J. Pol. Stud.*, 21, p.299.

Ramadan, Z.B., Farah, M.F. and Mrad, M., 2017. An adapted TPB approach to consumers' acceptance of service-delivery drones. *Technology Analysis & Strategic Management*, 29(7), pp.817-828.



- Rao, B., Gopi, A. and Maione, R., 2016. The societal impact of commercial drones. *Technology in Society*, 45, 83-90.
- Rathore, B., Gupta, R., Biswas, B., Srivastava, A. and Gupta, S. (2022), "*Identification and analysis of adoption barriers of disruptive technologies in the logistics industry*", The International Journal of Logistics Management, Vol. 33No. 5, pp. 136-169, doi: 10.1108/ijlm-07-2021-0352.
- Rathlev, F., Meyer, B. and Juerss, S., 2012. *Innovative technologies for aerial survey of gas pipes*.
- Raue, M., Streicher, B., Lerner, E. and Frey, D., 2015. How far does it feel? Construal level and decisions under risk. *Journal of Applied Research in Memory and Cognition*, 4(3), pp.256-264.
- Rayner, S., 2004. "The novelty trap: Why does institutional learning about new technologies seem so difficult?", *Industry and Higher Education*, Vol. 18, No. 6, pp. 349-355.
- Reddy, L.B. and DeLaurentis, D., 2016. Opinion survey to reduce uncertainty in public and stakeholder perception of unmanned aircraft. *Transportation Research Record*, 2600(1), pp.80-93.
- Reed, M.S., 2008. Stakeholder participation for environmental management: a literature review. *Biological conservation*, 141(10), pp.2417-2431.
- Reese, S.D., 2001. Framing public life: Perspectives on media and our understanding of the social world. *Lawrence Erlbaum*.
- Reese S. D., 2007. The framing project: A bridging model for media research revisited. *Journal of Communication*, 57, 148-154.
- Reincke, C. M., Bredenoord, A. L. & van Mil, M. H. W. (2020). From deficit to dialogue in science communication. *EMBO reports* 21 (9), e51278. doi:[10.15252/embr.202051278](https://doi.org/10.15252/embr.202051278)
- Renn O., Burns W. J., Kasperson J. X., Kasperson R. E., Slovic P., 1992. The social amplification of risk: Theoretical foundations and empirical applications. *Journal of Social Issues*, 48, 137-160.

Renn, O., Burns, W.J., Kasperson, J.X., Kasperson, R.E. and Slovic, P., 1992. The social amplification of risk: Theoretical foundations and empirical applications. *Journal of social issues*, 48(4), pp.137-160.

Renn, O., 2004. Perception of risks. *Toxicology letters*, 149(1-3), pp.405-413.

Renn, O. and Benighaus, C., 2013. Perception of technological risk: insights from research and lessons for risk communication and management. *Journal of Risk Research*, 16(3-4), pp.293-313.

Resnik, D.B. & Elliott, K.C., 2019. Using Drones to Study Human Beings: Ethical and Regulatory Issues. *Science and Engineering Ethics* 25 (3):707-718.

Richards, D., 2018. The role of the media in the public perception of Unmanned Aerial Vehicles. In *2018 Aviation Technology, Integration, and Operations Conference* (p. 3514).

Robbennottl, J. K., & Studebaker, C. A., 2003. News Media Reporting on Civil Litigation and Its Influence on Civil Justice Decision Making. *Law and Human Behavior*, Vol. 27, No. 1, 5-27

Rodari, P., 2008. The frontiers of dialogue. *Journal of Science Communication*, 7(1), p.C01.

Rodela, R., Ligtenberg, A. and Bosma, R., 2019. Conceptualizing Serious Games as a Learning-Based Intervention in the Context of Natural Resources and Environmental Governance. *Water*, 11 (2), 245.

Rodrigues, T.A., Patrikar, J., Oliveira, N.L., Matthews, H.S., Scherer, S. and Samaras, C., 2022. Drone flight data reveal energy and greenhouse gas emissions savings for very small package delivery. *Patterns*, 3(8).

Rogers, EM. 1983. Diffusion of innovations. (3 rd. ed.) New York: Free Press

Rogers, E.M. and Scott, K.L., 1997. The diffusion of innovations model and outreach from the National Network of Libraries of Medicine to Native American communities. *Retrieved March, 22*, p.2006.

Rogers, M., 2010. Technology and the baby boomers. *World Future Review*, 2(3), pp.54-59.

Rogerson, M., Gibbs, M. and Smith, W., 2016. "I Love All the Bits". *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*.

- Roma, A., 2017. Drones and popularisation of space. *Space Policy*, 41, pp.65-67.
- Roslyng, M.M. and Eskjær, M.F., 2017. Mediatised risk culture: News coverage of risk technologies. *Health, risk & society*, 19(3-4), pp.112-129.
- Roux, D.J., Rogers, K.H., Biggs, H.C., Ashton, P.J. and Sergeant, A., 2006. Bridging the science–management divide: moving from unidirectional knowledge transfer to knowledge interfacing and sharing. *Ecology and society*, 11(1).
- Rowe, G., & Frewer, L. J. (2000). Public participation methods: A framework for evaluation. *Science, Technology, & Human Values*, 25(1), 3–29. <https://doi.org/10.1177/016224390002500101>
- Royal Society (2018) Portrayals and perceptions of AI and why they matter. <https://royalsociety.org/-/media/policy/projects/ai-narratives/AI-narratives-workshop-findings.pdf>
- Russel, D., 1997. Rethinking Genre in School and Society. *Written Communication*, 14 (4), 504-554
- Rygshaug, M., Holtan Sørensen, K. and Næss, R., 2011. Making sense of global warming: Norwegians appropriating knowledge of anthropogenic climate change. *Public Understanding of Science*, 20(6), pp.778-795.
- Sakiyama, M., Miethe, T.D., Lieberman, J.D., Heen, M.S. and Tuttle, O., 2017. Big hover or big brother? Public attitudes about drone usage in domestic policing activities. *Security Journal*, 30, pp.1027-1044.
- Salmon, P.M., King, B.J., Elstak, I., McLean, S. and Read, G.J., 2024. Tomorrow's demons: a scoping review of the risks associated with emerging technologies. *Ergonomics*, pp.1-17.
- Samarasinghe, D., Barlow, M., Lakshika, E., Lynar, T., Moustafa, N., Townsend, T., ... & Turnbull, B., 2021. A data driven review of board game design and interactions of their mechanics. *IEEE Access*, 9, 114051-114069. <https://doi.org/10.1109/access.2021.3103198>
- Sandler, R., 2013. GM food and nanotechnology. In *In pursuit of nanoethics* (pp. 39-57). Dordrecht: Springer Netherlands.

Santos, Í., Carvalho, L.M. and Portugal e Melo, B., 2022. The media's role in shaping the public opinion on education: A thematic and frame analysis of externalisation to world situations in the Portuguese media. *Research in Comparative and International Education*, 17(1), 29-50. <https://doi.org/10.1177/17454999211057753>

Santos, A., 2023. Board Games as Part of Effective Game-Based Learning Strategies. In: Spector, J.M., Lockee, B.B., Childress, M.D. (eds) *Learning, Design, and Technology*. Springer, Cham. [https://doi.org/10.1007/978-3-319-17461-7\\_142](https://doi.org/10.1007/978-3-319-17461-7_142)

Sarathchandra, D., & McCright, A. M., 2017. The Effects of Media Coverage of Scientific Retractions on Risk Perceptions. *Sage Open*, 7(2). <https://doi.org/10.1177/2158244017709324>

Saunders, M.N.K., Lewis, P., Thornhill, A., Bristow, A., 2019. Chapter 4: Understanding research philosophy and approaches to theory development. *Research Methods for Business Students*. Edition:8. Pearson Education.

Savolainen, R., 2017. Information sharing and knowledge sharing as communicative activities. 22 (3).

Scheufele, D.A., 2000. Agenda-setting, priming, and framing revisited: another look at cognitive effects of political communication. *Mass Commun. Soc.* 3(2–3), 297–316

Scheufele, D. A. and Lewenstein, B. V., 2005. 'The public and nanotechnology: how citizens make sense of emerging technologies'. *Journal of Nanoparticle Research* 7 (6), pp. 659–667. <https://doi.org/10.1007/s11051-005-7526-2>

Schlag, B. (2016). 'Automatisiertes Fahren im Straßenverkehr — Offene Fragen aus Sicht der Psychologie'. *Zeitschrift für Verkehrssicherheit* 62 (2), pp. 94–98.

Schmierbach, M., Tan, R. and Sherrick, B., 2024. Difficulty and Challenge in Video Games. In *Oxford Research Encyclopedia of Communication*.

Scholz, R.W. and Siegrist, M., 2010. Low risks, high public concern? The cases of persistent organic pollutants (POPs), heavy metals, and nanotech particles. *Human and Ecological Risk Assessment*, 16(1), pp.185-198.

Schwarz, N., 2007. Attitude construction: Evaluation in context. *Social cognition*, 25(5), pp.638-656.

Schwarz-Plaschg, C., 2018. The power of analogies for imagining and governing emerging technologies. *NanoEthics*, 12(2), pp.139-153.

Schwarzer, R., 2008. Modeling health behavior change: How to predict and modify the adoption and maintenance of health behaviors. *Applied psychology*, 57(1), pp.1-29.

Schlinkheider, J., Ramarao, P., Tully, T., Banga, V., & Deokar, V. (2014).

Commercial drones are coming sooner than you think? [online]  
UC Berkeley. Retrieved from <https://ikhlaqsidhu.files.wordpress.com/2015/01/commercial-drones-white-paper-1.pdf>

Schwandt, T. A., 2003. Three epistemological stances for qualitative inquiry: Interpretivism, hermeneutics, and social constructionism. In N. Denzin & Y. Lincoln (Eds.), *The landscape of qualitative research* (pp. 292–331). Thousand Oaks, CA: Sage.

Seppelt, B., Reimer, B., Russo, L., Mehler, B., Fisher, J. and Friedman, D., 2019, June. Consumer confusion with levels of vehicle automation. In *Driving Assessment Conference* (Vol. 10, No. 2019). University of Iowa.

Sezen, T.I., 2024. Analog prototyping for digital game design. In *Encyclopedia of Computer Graphics and Games* (pp. 102-104). Cham: Springer International Publishing.

Shariff, A., Bonnefon, J.F. and Rahwan, I., 2021. How safe is safe enough? Psychological mechanisms underlying extreme safety demands for self-driving cars. *Transportation research part C: emerging technologies*, 126, p.103069.

Shao, A., Feng, Y., & Liu, L., 2012. The mediating effect of organisational culture and knowledge sharing on transformational leadership and enterprise resource planning systems success: An empirical study in China. 28(6), 2400-2413.

Shaw, G., 2020. The UK media coverage of China's handling of the coronavirus outbreak. *Global Media and China*, 6(1), 40-61. <https://doi.org/10.1177/2059436420980072>

Sheets, P., Rowling, C. M., & Jones, T. M., 2015. The view from above (and below): a comparison of American, British, and Arab news coverage of US drones. *Media, War & Conflict*, 8(3), 289-311. <https://doi.org/10.1177/1750635215593973>

Sherry-Brennan, F., Devine-Wright, H. and Devine-Wright, P., 2010. Public understanding of hydrogen energy: A theoretical approach. *Energy Policy*, 38(10), pp.5311-5319.

- Sicart, M., 2009. *The ethics of computer games*. Cambridge, MA: MIT Press
- Siegel, S., Dors, S., Brants, L., Schuy, K. and Rau, H., 2018. Understanding health care avoidance and initial help-seeking behavior in German veterans: a theory of planned behavior. *Psychology Research and Behavior Management*, pp.243-248.
- Siegrist, M., Keller, C. and Cousin, M.E., 2006. Implicit attitudes toward nuclear power and mobile phone base stations: Support for the affect heuristic. *Risk Analysis*, 26(4), pp.1021-1029.
- Simoni, M. D., Kockelman, K. M., Gurumurthy, K. M. and Bischoff, J., 2019. 'Congestion pricing in a world of self-driving vehicles: an analysis of different strategies in alternative future scenarios'. *Transportation Research Part C: Emerging Technologies* 98, pp. 167–185. <https://doi.org/10.1016/j.trc.2018.11.002>.
- Simis, M.J., Madden, H., Cacciatore, M.A. and Yeo, S.K., 2016. The lure of rationality: Why does the deficit model persist in science communication?. *Public understanding of science*, 25(4), pp.400-414.
- Singh, I., 2017. NASA develops technology to help drones crash-land safely during emergencies. Accessed from: <https://geoawesome.com/nasa-develops-technology-help-drones-crash-land-safely-emergencies/>
- Singleton, R., Winskell, K., Nkambule-Vilakati, S. and Sabben, G., 2018. Young Africans' social representations of rape in their HIV-related creative narratives, 2005–2014: Rape myths and alternative narratives. *Social Science & Medicine*, 198, 112-120.
- Sjoraida, D.F., Guna, B.W.K., Nungraha, A.R., Pasaribu, D. and Djafri, N., 2024. Public Opinion Formation in the Digital Age: A Review of Literature. *Indonesia Journal of Engineering and Education Technology (IJEET)*, 2(2), pp.290-297. <http://dx.doi.org/10.61991/ijeet.v2i2.52>
- Skirpan, M.W., Yeh, T. and Fiesler, C., 2018, April. What's at Stake: Characterizing Risk Perceptions of Emerging Technologies. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems* (pp. 1-12).
- Slovic, P., 1992. Perception of risk: Reflections on the psychometric paradigm.

Smith, M., 2017. How left or right-wing are the UK's newspapers? *YouGov UK*. Accessed from: <https://yougov.co.uk/politics/articles/17715-how-left-or-right-wing-are-uks-newspapers>

Smith, N.W. and H. Joffe., 2009. 'Climate Change in the British Press: The Role of the Visual', *Journal of Risk Research* 12(5): 647-663.

Smith, A., Dickinson, J.E., Marsden, G., Cherrett, T., Oakey, A., Grote, M. 2022a. Public acceptance of the use of drones for logistics: The state of play and moving towards more informed debate. *Technology in Society*, 68.

Smith, A., Marsden, G., Dickinson, J., 2022b. Shaping the role of drones in UK logistics. In: Oldbury, K. and Isaksson, K., eds. *Experimentation for sustainable transport? Risks, strengths, and governance implications*.

Smith, A., Dickinson, J.E., Nadeem, T., Snow, B., Permana, R., Cherrett, T. and Drummond, J., 2024. Supporting inclusive debate on Advanced Air Mobility: An evaluation. *Transportation Research Part D: Transport and Environment*, 136, p.104471.

Sniehotta, F., 2009. An experimental test of the theory of planned behavior. *Applied Psychology: Health and Well-Being*, 1(2), pp.257-270.

Snippe, M.H., Peters, G.J.Y. and Kok, G., 2021. The operationalization of self-identity in reasoned action models: A systematic review of self-identity operationalizations in three decades of research. *Health Psychology and Behavioral Medicine*, 9(1), pp.48-69.

Snowden, D., 2002. Narrative patterns: uses of story in the third age of knowledge management. *Journal of Information & Knowledge Management*, 1(01), pp.1-6.

Stephan H. R., 2015. *Cultural politics and the transatlantic divide over GMOs*. New York, NY: Palgrave Macmillan.

Solberg, M., & Kirchhoff, R., 2024. Media Representations of Healthcare Robotics in Norway 2000-2020: A Topic Modeling Approach. *Social Science Computer Review*, 42(3), 636-660. <https://doi.org/10.1177/08944393231212251>

Sousa, M., 2021. Serious board games: modding existing games for collaborative ideation processes. *International Journal of Serious Games*, 8(2), pp.129-146.

Sousa, M., Antunes, A.P., Pinto, N. and Zagalo, N., 2022. Serious games in spatial planning: strengths, limitations and support frameworks. *International Journal of Serious Games*, 9(2), pp.115-133. <http://dx.doi.org/10.17083/ijsg.v9i2.510>

Sousa, M., 2023. The novelty of collaboration: high school students learning and enjoyment perceptions when playing cooperative modern board games. *European Conference on Games Based Learning*, 17(1), 632-642. <https://doi.org/10.34190/ecgbl.17.1.1461>

Squire, K. and Jenkins, H., 2003. Harnessing the power of games in education. *Insight*, 3(1), pp.5-33.

Squire, K., 2011. *Video games and learning: Teaching and participatory culture in the digital age*. New York, NY: Teachers College Press.

Stephan H. R., 2015. *Cultural politics and the transatlantic divide over GMOs*. New York, NY: Palgrave Macmillan.

Stilgoe, J., Cohen, T. 2021. Rejecting acceptance: learning from public dialogue on self-driving vehicles. *Science and Public Policy*. 48, 849–859. DOI: <https://doi.org/10.1093/scipol/scab060>

Stockwell, E. S., 2006. *The relationship between newspaper credibility and reader attitude toward Korea and Korean*. Retrieved December Tuesday, 2010, from <http://adt.lib.rmit.edu.au/adt/uploads/approved/adt-VIT20070125.160936/public/02whole.pdf>

Stolaroff, J.K., Samaras, C., O'Neill, E.R., Lubers, A., Mitchell, A.S. and Ceperley, D., 2018. Energy use and life cycle greenhouse gas emissions of drones for commercial package delivery. *Nature communications*, 9(1), p.409.

Stroud, N. J., 2008. Media use and political predispositions: Revisiting the concept of selective exposure. *Political Behavior*, 30, 341–366.

Stroud, N. J., 2011. *Niche news: The politics of news choice*. New York, NY: Oxford University Press

Sudhindra, S., Ganesh, L.S. and Arshinder, K., 2017. Knowledge transfer: an information theory perspective. *Knowledge Management Research & Practice*, 15(3), pp.400-412.



- Sun, D. and Zhang, L., 2024. The Social Contagion of Risk Perceptions of Emerging Technologies through Evolutionary Game in Networks. *Systems*, 12(10), p.411.
- Sunstein, C.R., 2002. The law of group polarization. *J. Polit. Philos.* 10(2), 175–195
- Susi, T., Johannesson, M. and Backlund, P., 2007. *Serious Games : An Overview*.
- Sutrisno, S., 2023. Changes in Media Consumption Patterns and their Implications for People's Cultural Identity. *Technology and Society Perspectives (TACIT)*, 1(1), 18–25. <https://doi.org/10.61100/tacit.v1i1.31>
- Svatý, Z., Nouzovský, L., Mičunek, T. and Frydrýn, M., 2022. Evaluation of the drone-human collision consequences. *Heliyon*, 8(11).
- Sznajder, H. T. S., 2016. A comparative study of keywords in English-language corporate press releases from European companies: insights into discursive practices. *Discourse and Interaction*, 9(1), 49. <https://doi.org/10.5817/di2016-1-49>
- Taborda, A., 2017. Privacy & drone surveillance: the illusive remedy. *Canadian Journal of Law and Technology*, 15(2).
- Taddicken, M., Reif, A., Brandhorst, J., Schuster, J., Diestelhorst, M. and Hauk, L., 2020. 'Wirtschaftlicher Nutzen statt gesellschaftlicher Debatte? Eine quantitative Framing-Analyse der Medienberichterstattung zum autonomen Fahren'. *M&K Medien & Kommunikationswissenschaft* 68 (4), pp. 406–427. <https://doi.org/10.5771/1615-634X-2020-4-406>.
- Taiwo, R., 2007. Language, Ideology and Power Relations in Nigerian Newspaper Headlines, *Linguistics, Political Science*, 4(1), 218-245
- Tatar, M., Khrapunenko, M., Henahan, R. K., & Asser, A., 2023. Engaging citizens in the bioeconomy: insights from the co-creation and co-design in the development of the serious bioeconomy game “mission biohero”. *Sustainability*, 15(18), 13364. <https://doi.org/10.3390/su151813364>
- Teo, T. and Jarupunphol, P., 2015. Dhammic Technology Acceptance Model (DTAM) Extending the TAM Using a Condition of Attachment in Buddhism. *Journal of Educational Computing Research*, 52(1), pp.136-151.

- Terlouw, G., Kuipers, D., Veer, J. v. ', Prins, J. T., & Pierie, J. E. N., 2021. The development of an escape room–based serious game to trigger social interaction and communication between high-functioning children with autism and their peers: iterative design approach. *JMIR Serious Games*, 9(1), e19765. <https://doi.org/10.2196/19765>
- Terzioglu, M. and Rodrigues, V., 2023. Winning at more than a game! a storytelling board game concept to raise awareness about refugees' language barriers. *Connectivity and Creativity in Times of Conflict*. <https://doi.org/10.26530/9789401496476-089>
- Thomas, T. H., Sivakumar, V., Babichenko, D., Grieve, V. L. B., & Klem, M. L., 2020. Mapping behavioral health serious game interventions for adults with chronic illness: scoping review. *JMIR Serious Games*, 8(3), e18687. <https://doi.org/10.2196/18687>
- Thévin, L., Rodier, N., Oriola, B., Hachet, M., Jouffrais, C., & Brock, A., 2021. Inclusive adaptation of existing board games for gamers with and without visual impairments using a spatial augmented reality framework for touch detection and audio feedback. *Proceedings of the ACM on Human-Computer Interaction*, 5(ISS), 1-33. <https://doi.org/10.1145/3488550>
- Tondorf, D. and Hounsell, M., 2022. Constructs and outcomes of fun in digital serious games: the state of the art. *Journal on Interactive Systems*, 13(1), 386-399. <https://doi.org/10.5753/jis.2022.2605>
- Toolan M., 2016. Peter Black, Christopher Stevens, class and inequality in the Daily Mail. *Discourse & Society*, 27(6), 642–660. <https://doi.org/10.1177/0957926516664655>
- Tran, T.H. and Nguyen, D.D., 2022. Management and regulation of drone operation in urban environment: A case study. *Social Sciences*, 11(10), p.474.
- Trench, B., 2008. Towards an analytical framework of science communication models. In D. Cheng, M. Claessens, T. Gascoigne, J. Metcalfe, B. Schiele & S. Shi (Eds.), *Communicating science in social contexts* (pp. 119–135). doi:[10.1007/978-1-4020-8598-7\\_7](https://doi.org/10.1007/978-1-4020-8598-7_7)
- Tsai, J., Liu, S., Chang, C. and Chen, S., 2021. Using a Board Game to Teach about Sustainable Development. *Sustainability*, 13 (9), 4942.
- Tsfati, Y., 2014. Public and elite perceptions of news media in politics. *The Oxford Handbook of Political Communication*.

Tsfati, Y. and Cappella, J.N., 2003. Do people watch what they do not trust? Exploring the association between news media skepticism and exposure. *Communication research*, 30(5), pp.504-529.

Turney, J., 1998. *To know science is to love it? Observations from public understanding of science research*. London. Available at: <http://www.communicatingastronomy.org/repository/guides/toknowscience.pdf>

Ueda, S., Nakashima, R. and Kumada, T., 2021. Influence of levels of automation on the sense of agency during continuous action. *Scientific reports*, 11(1), p.2436.

UK Research and Innovation (UKRI) 2021. *Future Flight Vision and Roadmap August 2021*. Available at: <https://www.ukri.org/wp-content/uploads/2021/08/UKRI-130821-FutureFlightVisionRoadmap.pdf>

Vahlo, J., Kaakinen, J. K., Holm, S. K., & Koponen, A., 2017. Digital game dynamics preferences and player types. *Journal of Computer-Mediated Communication*, 22(2), 88-103. <https://doi.org/10.1111/jcc4.12181>

van Atteveldt, N. M., van Aalderen-Smeets, S. I., Jacobi, C. and Ruigrok, N., 2014. 'Media reporting of neuroscience depends on timing, topic and newspaper type'. *PLoS ONE* 9 (8), e104780. <https://doi.org/10.1371/journal.pone.0104780>.

van Witsen, A. and Takahashi, B. (2018). 'Knowledge-based journalism in science and environmental reporting: opportunities and obstacles'. *Environmental Communication* 12 (6), pp. 717–730. <https://doi.org/10.1080/17524032.2018.1455723>

Van Bilsen, A., Bekebrede, G. and Mayer, I., 2010. Understanding Complex Adaptive Systems by Playing Games. *Informatics in Education*, 9(1), pp.1-18.

Van der Wal, M.M., De Kraker, J., Kroeze, C., Kirschner, P.A. and Valkering, P., 2016. Can computer models be used for social learning? A serious game in water management. *Environmental modelling & software*, 75, pp.119-132.

Van Dijk, T., 1988. *News as Discourse*. Routledge:New York (208)

Vat, K.H., 2003, June. Toward an actionable framework of knowledge synthesis in the pursuit of learning organization. In *Proceedings of 2003 Informing Science and Information Technology Education Conference* (pp. 1085-1100).

- Vattapparamban, E., Guvenc, I., Yurekli, A., Akkaya, K. and Uluagac, S., 2016. Drones for smart cities: Issues in cybersecurity, privacy, and public safety. *2016 International Wireless Communications and Mobile Computing Conference (IWCMC)*.
- Vavra, P., van Baar, J. and Sanfey, A., 2017. The neural basis of fairness. *Interdisciplinary perspectives on fairness, equity, and justice*, pp.9-31.
- Venkatesh, V., 2000. Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Information systems research*, 11(4), pp.342-365.
- Venkatesh, V. and Davis, F.D., 2000. A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management science*, 46(2), pp.186-204.
- Venkatesh, V., Morris, M.G., Davis, G.B. and Davis, F.D., 2003. User acceptance of information technology: Toward a unified view. *MIS quarterly*, pp.425-478.
- Venkatesh, V. and Bala, H., 2008. Technology acceptance model 3 and a research agenda on interventions. *Decision sciences*, 39(2), pp.273-315.
- Venkatesh, V., Thong, J.Y. and Xu, X., 2012. Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS quarterly*, pp.157-178.
- Verheggen, T. and Baerveldt, C., 2007. We don't share! The social representation approach, enactivism and the ground for an intrinsically social psychology. *Culture & Psychology*, 13(1), pp.5-27.
- Vita-Barrull, N., March-Llanes, J., Guzmán, N., Estrada-Plana, V., Mayoral, M., Moya-Higueras, J. and Conectar Jugando Experts Committe, 2022. The cognitive processes behind commercialized board games for intervening in mental health and education: a Committee of Experts. *Games for Health Journal*, 11(6), pp.414-424.  
<https://doi.org/10.1089/g4h.2022.0109>
- Voelklein, C. and Howarth, C., 2005. A review of controversies about social representations theory: A British debate. *Culture & psychology*, 11(4), pp.431-454.

Volz, V., Rudolph, G., & Naujoks, B. (2016). Demonstrating the feasibility of automatic game balancing. Proceedings of the Genetic and Evolutionary Computation Conference 2016.

<https://doi.org/10.1145/2908812.2908913>

Von Schomberg, R., 2010. Understanding public debate on nanotechnologies.

Vygotsky, L.S., 1978. *Mind in Society*. Cambridge: Harvard University Press

Wagner, W. and N. Hayes., 2005. *Everyday Discourse and Common Sense. The Theory of Social Representation*. Hampshire: Palgrave Macmillan.

Wagner, W., 2007. Vernacular science knowledge: Its role in everyday life communication. *Public Understanding of Science*, 16(1), pp.7-22.

Wagner, W., 2016. Embodied social representation. *Journal for the Theory of Social Behaviour*, 47(1), 25-31. <https://doi.org/10.1111/jtsb.12113>

Wake, P., 2019. *Token Gestures: Towards a Theory of Immersion in Analog Games* [online]. *Analog Game Studies Journal* VI, III. Available from: <http://analoggamestudies.org/2019/09/token-gestures-towards-a-theory-of-immersion-in-analog-games/> [Accessed 24 May 2022].

Walther, J., PytlikZillig, L., Detweiler, C. and Houston, A., 2019. How people make sense of drones used for atmospheric science (and other purposes): Hopes, concerns, and recommendations. *Journal of Unmanned Vehicle Systems*, 7(3), pp.219-234.

Wang, N., 2020. Killing two birds with one stone? A case study of development use of drones. *2020 IEEE International Symposium on Technology and Society (ISTAS)*.

<https://doi.org/10.1109/istas50296.2020.9462187>

Wang, Y., Yu, L. and Yu, Z., 2022. An extended CCTalk technology acceptance model in EFL education. *Education and Information Technologies*, 27(5), pp.6621-6640.

Wanta, W. and Hu, Y.W., 1994. The effects of credibility, reliance, and exposure on media agenda-setting: A path analysis model. *Journalism Quarterly*, 71(1), pp.90-98.

Warren, C., McGraw, A. P., & Boven, L. V., 2010. Values and preferences: defining preference construction. *WIREs Cognitive Science*, 2(2), 193-205.

<https://doi.org/10.1002/wcs.98>

Watkins, S., Burry, J., Mohamed, A., Marino, M., Prudden, S., Fisher, A., Kloet, N., Jakobi, T. and Clothier, R., 2020. Ten questions concerning the use of drones in urban environments. *Building and Environment*, 167, 106458.

<https://doi.org/10.1016/j.buildenv.2019.106458>

Watson, A., 2022. Leading online news brands accessed UK 2021 [online]. Statista.

Available from: <https://www.statista.com/statistics/262514/leading-online-news-brands-accessed-in-the-uk>

Wegerif, R., 2011. Towards a dialogic theory of how children learn to think. *Thinking skills and creativity*, 6(3), pp.179-190.

Wenger, E., 1998. Communities of practice: Learning as a social system. *Systems thinker*, 9(5), pp.2-3.

Wenger, E., R. McDermott, and W. Snyder., 2002. Cultivating communities of practice: a guide to managing knowledge. Boston Business School Press, Boston, Massachusetts, USA.

West, J.P. and Bowman, J.S., 2016. The domestic use of drones: An ethical analysis of surveillance issues. *Public Administration Review*, 76(4), pp.649-659.

Whitley, R., 1984. The Scientific Status of Management Research as a Practically-Oriented Social Science. *Journal of Management Studies*, 21, 369-

390. <http://dx.doi.org/10.1111/j.1467-6486.1984.tb00234.x>

Wibeck V., Öberg G., Abrandt-Dahlgren M., 2007. Learning in focus groups: An analytical dimension for enhancing focus group research. *Qualitative Research*, 7(2), 249–

262. <https://doi.org/10.1177/1468794107076023>

Wibeck, V. and Neset, T., 2020. Focus groups and serious gaming in climate change communication research—a methodological review. *WIREs Climate Change*, 11(5).

<https://doi.org/10.1002/wcc.664>

Willcocks, L., 2020. Robo-Apocalypse cancelled? Reframing the automation and future of work debate. *Journal of Information Technology*, 35(4), pp.286-302.

Wilson, J. & Wilson, S., 2001. *Mass media, mass culture: An introduction (5th ed.)* Boston, MA: McGraw-Hill.

Wilson, D., Jenkins, J., Twyman, N., Jensen, M., Valacich, J., Dunbar, N., ... & Nunamaker, J., 2016. Serious games: an evaluation framework and case study..

<https://doi.org/10.1109/hicss.2016.85>

Witmer, B. and Singer, M., 1998. Measuring Presence in Virtual Environments: A Presence Questionnaire. *Presence: Teleoperators and Virtual Environments*, 7 (3), 225-240.

Woods, S., 2012. *Eurogames*. Jefferson, N.C.: McFarland & Co.

Wu, H.L. and Volker, D.L., 2009. The use of theory in qualitative approaches to research: application in end-of-life studies. *Journal of advanced nursing*, 65(12), 2719-2732.

Wu, J. S., & Lee, J. J., 2015. Climate change games as tools for education and engagement. *Nature Climate Change*, 5(1), 413–418.

<https://doi.org/10.1038/NCLIMATE2566>

Yang, Y.T. C., & Chang, C.H., 2013. Empowering students through digital game authorship: Enhancing concentration, critical thinking, and academic achievement. 68, 334-344. <https://doi.org/10.1016/j.compedu.2013.05.023>

Yang, Z.J., Kahlor, L. and Li, H., 2014. A United States-China comparison of risk information-seeking intentions. *Communication Research*, 41(7), 935-960.

<https://doi.org/10.1177/0093650213479795>

Yang, M., Yu, Y., Bandara, A.K. and Nuseibeh, B., 2014. Adaptive sharing for online social networks: A trade-off between privacy risk and social benefit. In *2014 IEEE 13th International Conference on Trust, Security and Privacy in Computing and Communications* (pp. 45-52). IEEE.

Yee, N., 2006. Motivations for Play in Online Games. *CyberPsychology & Behavior*, 9 (6), 772-775.

Yin, R.K., 2018. Case study research and applications.

Yoo, E.E. and Buzinde, C.N., 2012. Gazing upon the kingdom: An audience reception analysis of a televised travelogue. *Annals of Tourism Research*, 39(1), pp.221-24

Yoo, W., Yub, E. and Jungb, J., 2018. Drone delivery: Factors affecting the public's attitude and intention to adopt. *Telematics and Informatics*, 35 (6), 1687-1700.

Yuan, X., Song, T.H. and Kim, S.Y., 2011. Cultural influences on consumer values, needs and consumer loyalty behavior: East Asian culture versus Eastern European culture. *African Journal of Business Management*, 5(30), p.12184.

Zahra, S., and G. George. 2002. Absorptive capacity: a review, reconceptualisation, and extension. *Academy of Management Review* 27 (2):185–203.

Zailani, M.A.H., Sabudin, R.Z.A.R., Rahman, R.A., Saiboon, I.M., Ismail, A., Mahdy, Z.A., 2020 Drone for medical products transportation in maternal healthcare: A systematic review and framework for future research. *Medicine* 99(36):p e21967

Zhang, Z., 2023. Drone-YOLO: an efficient neural network method for target detection in drone images. *Drones*, 7(8), p.526.

Zhang, L., 2021. Emerging Technology Risks and Adaptive Governance. *J. Shanghai. Adm. Inst.* 22, 13–27

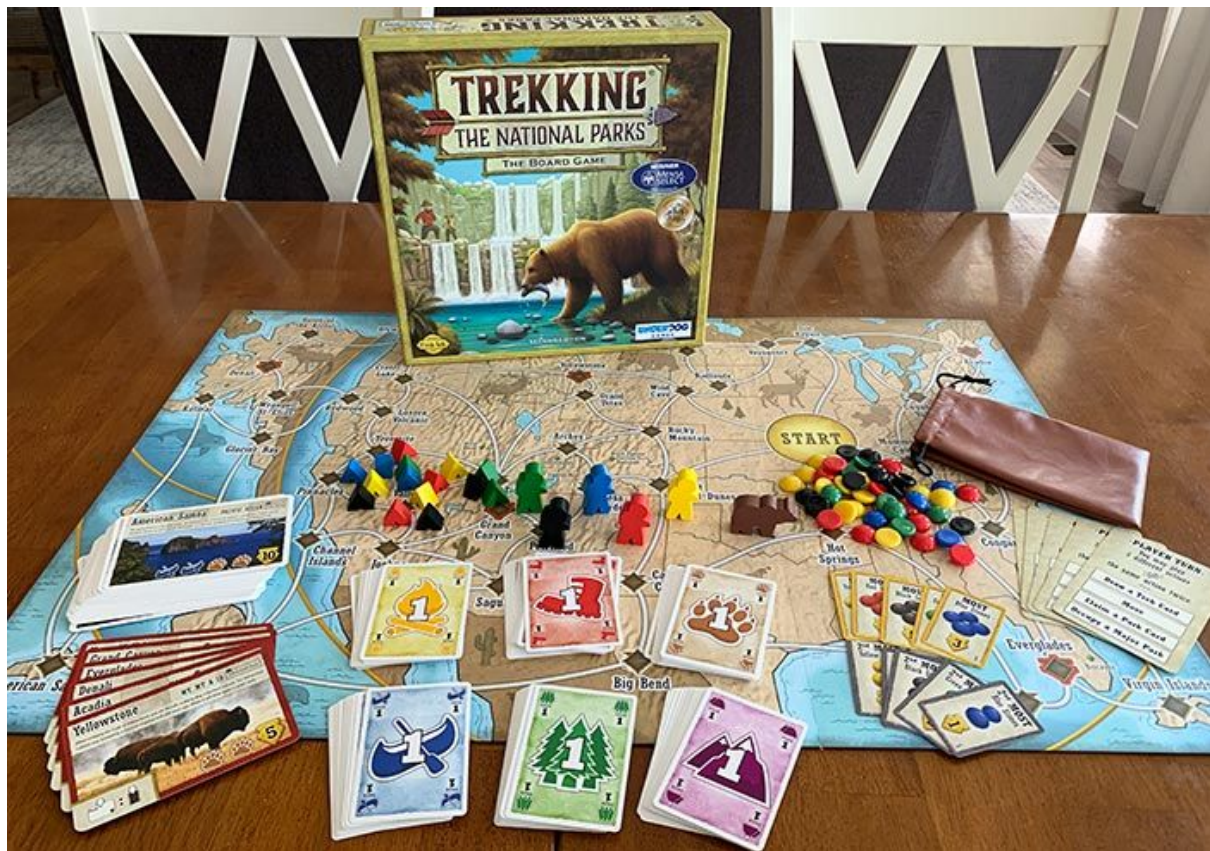
Zhang, M., 2023. Older people's attitudes towards emerging technologies: A systematic literature review. *Public Understanding of Science*, 32(8), pp.948-968.

Zheng, Z., Liu, Y., & Zhang, X., 2016. The more obstacle information sharing, the more effective real-time path planning? *Knowledge-Based Systems*, 114, 36-46.

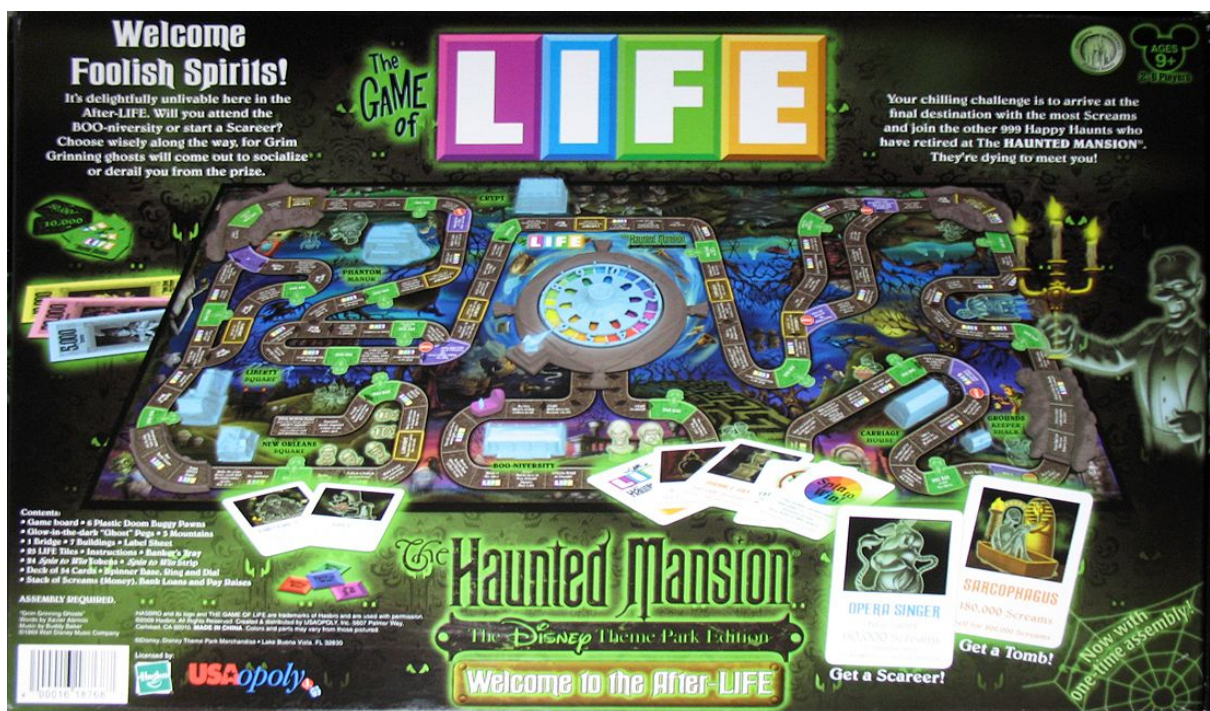
Zwickle, A., Farber, H.B. and Hamm, J.A., 2019. Comparing public concern and support for drone regulation to the current legal framework. *Behavioral Sciences & the Law*, 37(1), pp.109-124.



## Appendix 1: Trekking the National Parks



## Appendix 2: Game of Life





## Appendix 3: Ticket to Ride



## Appendix 4: Positive Flight Update Cards

| Theme              | Description                                                                                                                                                                                                                                                                                                                            |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Good route         | <ul style="list-style-type: none"> <li>Well done! Gain 5 energy points and move one step</li> <li>Move one step and adjust risk slider accordingly.</li> <li>Well done! Adjust your risk slider by -1 and move one step.</li> </ul>                                                                                                    |
| Safe route         | <ul style="list-style-type: none"> <li>Gain 5 energy points and adjust risk slider by -1.</li> <li>Gain 5 energy points and adjust risk slider by -2.</li> </ul>                                                                                                                                                                       |
| Good altitude      | <ul style="list-style-type: none"> <li>Well done flying at the correct altitude. No complaints received. Adjust risk slider by -2.</li> </ul>                                                                                                                                                                                          |
| No complaints      | <ul style="list-style-type: none"> <li>Your flight has been at the correct altitude. Adjust risk slider by -3.</li> <li>Your flight has been at the correct altitude. Adjust risk slider by -2.</li> <li>You have been flying at the correct altitude. No noise or intrusion complaints received. Adjust risk slider by -2.</li> </ul> |
| You made the news! | Assistant dog learns to collect drone package for owner.                                                                                                                                                                                                                                                                               |

|                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Good news!                  | <ul style="list-style-type: none"> <li>• Tourists are now visiting to see the drones!</li> <li>• Your new noise mitigating rotors mean that complaints are down 25%. Gain 5 energy points.</li> <li>• Your drone has received approval to carry new types of cargo. Gain 5 energy points.</li> <li>• Your drone has received approval to carry new types of cargo. Adjust risk slider by -2.</li> <li>• Your drone has received approval to carry new types of cargo. Adjust risk slider by -1.</li> </ul> |
| Night flight                | <ul style="list-style-type: none"> <li>• You have been making the delivery at night and flying at the correct altitude, no complaints were received. Move one step and reduce risk by -2.</li> <li>• You have been making the delivery at night and flying at the correct altitude, no complaints were received. Move one step and reduce risk by -1.</li> </ul>                                                                                                                                           |
| Sunny condition             | Good weather means a good flight. Reduce risk by -1.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Efficient payload capacity  | <ul style="list-style-type: none"> <li>• Your parcel is much lighter than your drone's payload limit. Gain 5 energy points.</li> <li>• Your parcel is much lighter than your drone's payload limit. Reduce risk by -1.</li> <li>• Your parcel is much lighter than your drone's payload limit. Reduce risk by -2.</li> </ul>                                                                                                                                                                               |
| New safety feature approved | <ul style="list-style-type: none"> <li>• New safety feature approved! Move your risk slider by -2.</li> <li>• New safety feature approved! Move your risk slider by -1.</li> </ul>                                                                                                                                                                                                                                                                                                                         |
| Pop up festival!            | A pop up festival has been set up. Place a token on the board for 1 turn. No player can fly over this area whilst it is active.                                                                                                                                                                                                                                                                                                                                                                            |

## Appendix 5: Negative Flight Update Cards

| Themes                 | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Disruption to animals! | <ul style="list-style-type: none"> <li>Your drone has disturbed birds. Move back one space, adjust your risk slider and lose 5 energy points accordingly. Change route on next turn.</li> <li>Your drone is disturbing livestock. Adjust risk slider by +1.</li> <li>You must avoid migratory flocks of geese. Change route on next turn.</li> <li>You're flying too low and disturbing animals. Move 1 step back and lose 5 energy points.</li> <li>You're flying too low and disturbing animals!</li> <li>Lots of complaints as you set the dogs barking!</li> </ul> |
| Local Event            | <ul style="list-style-type: none"> <li>Red arrows are performing for the Bournemouth Air Festival. All drones must be grounded.</li> <li>Fireworks ahead. Change route on next turn.</li> <li>Bournemouth air festival stopped due to drone flying.</li> </ul>                                                                                                                                                                                                                                                                                                         |
| Storms encountered     | <ul style="list-style-type: none"> <li>You have encountered thunderstorms. Move back and ground drone to the nearest landing site. Adjust your risk slider and lose energy points accordingly.</li> <li>Bournemouth air festival stopped due to drone flying.</li> </ul>                                                                                                                                                                                                                                                                                               |
| Complaints received    | <ul style="list-style-type: none"> <li>Intrusion complaints received. Lose 10 energy points and fly higher!</li> <li>You have been flying too low. Lots of noise and intrusion complaints generated. Lose 5 energy points and fly higher!</li> <li>Intrusion complaints received. Increase risk by +1.</li> </ul>                                                                                                                                                                                                                                                      |
| Heavy payload          | <ul style="list-style-type: none"> <li>Lose 5 energy points for carrying a heavy parcel.</li> <li>The cargo you are carrying has been re-classified as 'dangerous goods' and needs to be put into a crash proof container. Divert backwards to nearest landing site.</li> </ul>                                                                                                                                                                                                                                                                                        |
| Unhappy locals         | <ul style="list-style-type: none"> <li>Locals have complained about noise. Move back 1 space and change route next turn.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                    |

|                                        |                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                        | <ul style="list-style-type: none"> <li>• Tourism takes a hit as holidaymakers find drones irritating.</li> <li>• Locals are concerned about their privacy. Lose 5 energy points as you need to fly higher.</li> <li>• Your flight was disruptive and somebody tweeted about you. Miss the next turn.</li> <li>• Complaints about noise have been received. Fly higher and lose 5 energy points.</li> </ul> |
| No fly zone                            | Your drone has been grounded. Skip the next turn.                                                                                                                                                                                                                                                                                                                                                          |
| Bad press coverage                     | <ul style="list-style-type: none"> <li>• Your flight has been too disruptive and you made the news! Lose 5 energy points.</li> <li>• Your flight has been too disruptive and you made the news! Adjust risk slider by +1.</li> <li>• Your flight has been too disruptive. Lots of people tweeted about you! Miss the next turn.</li> </ul>                                                                 |
| Too many drones                        | <ul style="list-style-type: none"> <li>• The route you have chosen already has too many drones in the sky. Move backwards to the nearest landing site to ground drone. Adjust risk slider and lose energy points accordingly.</li> </ul>                                                                                                                                                                   |
| Low altitude flight!                   | <ul style="list-style-type: none"> <li>• You have been reported for infringing airspace restrictions without permission. Lose 5 energy points and increase your risk by +1.</li> <li>• You are flying too low and likely to hit a building. Lose 5 energy points and fly higher!</li> </ul>                                                                                                                |
| Divert route!                          | <ul style="list-style-type: none"> <li>• Your drone needs to divert its route and clear airspace for an approaching helicopter. Move back one step and change route on next turn. Adjust risk slider and lose energy points accordingly.</li> </ul>                                                                                                                                                        |
| Operating outside approved permissions | <ul style="list-style-type: none"> <li>• Somebody made a serious complaint about your drone. Miss the next turn.</li> </ul>                                                                                                                                                                                                                                                                                |
| Territorial birds encountered          | <ul style="list-style-type: none"> <li>• Your drone has encountered some territorial birds. Use 10 energy points and move one step ahead.</li> <li>• You have disrupted birds during low-tide feeding. Move back 1 space and lose 5 energy points.</li> </ul>                                                                                                                                              |
| Helimed approaching                    | <ul style="list-style-type: none"> <li>• Clear airspace as the helimed approaches. Move back and ground</li> </ul>                                                                                                                                                                                                                                                                                         |

|                  |                                                                                                                                                                                                                                 |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                  | drone to the nearest landing site. Adjust your risk slider and lose energy points accordingly.                                                                                                                                  |
| Divert route     | <ul style="list-style-type: none"> <li>Police are conducting surveillance in your area. Move back 1 space and take an alternative route.</li> </ul>                                                                             |
| Recharge         | <ul style="list-style-type: none"> <li>Your drone has been grounded due to technical fault, skip a turn while you wait for a replacement.</li> </ul>                                                                            |
| Unhappy tourists | <ul style="list-style-type: none"> <li>You have generated noise and intrusion complaints. Lose 5 energy points, fly higher and go back 1 step.</li> <li>Tourism takes a hit as holidaymakers find drones irritating.</li> </ul> |
| Strong winds     | <ul style="list-style-type: none"> <li>Looks like you have encountered strong winds. Skip the next turn and lose 5 energy points.</li> </ul>                                                                                    |

# Appendix 6: Pre-Game Survey

Ref & Version: v1  
Ethics ID:45823  
Date:11/10/2022



## Are drones the future of delivery?

**What are your thoughts about delivery drones?**

**Please state your gender:**

---

**What is your age group? (tick one)**

- ☐ 18-24
- ☐ 25-34
- ☐ 35-44
- ☐ 45-54
- ☐ 55-64
- ☐ 65-74
- ☐ 75-84

**What is the highest level of education you have completed? (tick one)**

- ☐ A-Level or equivalent
- ☐ Higher National Diploma or equivalent
- ☐ O-Level/CSE/GCSE
- ☐ Post-graduate qualification
- ☐ University degree or equivalent
- ☐ Other (please specify): \_\_\_\_\_

## Appendix 7: Demographic Data

| Age                                                                              | Gender | Education                             | Occupation/field of employment |
|----------------------------------------------------------------------------------|--------|---------------------------------------|--------------------------------|
| <b>Public Group #1:</b> Recruited by research team member, Bournemouth v1 played |        |                                       |                                |
| 55-64                                                                            | Female | University degree or equivalent       | -                              |
| 55-64                                                                            | Female | O-Level/CSE/GCSE                      | -                              |
| 55-64                                                                            | Female | Higher National Diploma or equivalent | -                              |
| 55-64                                                                            | Female | A-Level or equivalent                 | -                              |
| <b>Public Group #2:</b> Recruited by research team member, Bournemouth v1 played |        |                                       |                                |
| 65-74                                                                            | Male   | O-Level/CSE/GCSE                      | -                              |
| 65-74                                                                            | Male   | Postgraduate qualification            | -                              |
| 75-84                                                                            | Male   | University degree or equivalent       | -                              |
| 65-74                                                                            | Female | A-Level or equivalent                 | -                              |
| 65-74                                                                            | Female | Postgraduate qualification            | -                              |
| 75-84                                                                            | Female | O-Level/CSE/GCSE                      | -                              |
| <b>Public Group #3:</b> Recruited by research team member, Bournemouth v1 played |        |                                       |                                |
| 65-74                                                                            | Female | Postgraduate qualification            | -                              |
| 75-84                                                                            | Female | A-Level or equivalent                 | -                              |
| 65-74                                                                            | Female | A-Level or equivalent                 | -                              |
| 65-74                                                                            | Female | No qualification                      | -                              |
| 75-84                                                                            | Female | University degree or equivalent       | -                              |
| <b>Public Group #4:</b> Recruited by research team member, Bournemouth v1 played |        |                                       |                                |
| 18-24                                                                            | Female | Undergrad                             | -                              |
| 18-24                                                                            | Female | Undergrad                             | -                              |
| 35-44                                                                            | Female | Post-grad qualification               | -                              |
| 18-24                                                                            | Female | A-level or equivalent                 | -                              |
| 18-24                                                                            | Male   | A-level or equivalent                 | -                              |
| 18-24                                                                            | Male   | A-level or equivalent                 | -                              |
| 18-24                                                                            | Female | A-level or equivalent                 | -                              |
| <b>Public Group #5:</b> Recruited by email, Solent game played                   |        |                                       |                                |
| 55-64                                                                            | Female | Other: PhD                            | -                              |
| 35-44                                                                            | Female | Higher National Diploma or Equivalent | -                              |
| 25-34                                                                            | Female | Postgraduate qualification            | -                              |
| 55-64                                                                            | Male   | A Level                               | -                              |
| 45-54                                                                            | Female | University degree of equivalent       | -                              |
| <b>Public Group #6:</b> Recruited by email, Bournemouth v2 played                |        |                                       |                                |
| 55-64                                                                            | Female | University degree of equivalent       | -                              |
| 25-34                                                                            | Male   | Post-graduate qualification           | -                              |
| 35-44                                                                            | Female | Post-graduate qualification: PhD      | -                              |
| 25-34                                                                            | Male   | Post-graduate qualification           | -                              |
| <b>Public Group #7:</b> Recruited by research team member, Bournemouth v2 played |        |                                       |                                |



|                                                                                       |        |                                                        |                                                                                             |
|---------------------------------------------------------------------------------------|--------|--------------------------------------------------------|---------------------------------------------------------------------------------------------|
| 18-24                                                                                 | Male   | A-level or equivalent                                  | -                                                                                           |
| 25-34                                                                                 | Male   | A-level or equivalent                                  | -                                                                                           |
| 75-84                                                                                 | Male   | Youth & Community worker,<br>City & Guild 8 (Building) | -                                                                                           |
| 18-24                                                                                 | Female | University degree or<br>equivalent                     | -                                                                                           |
| 45-54                                                                                 | Female | A-level or equivalent                                  | -                                                                                           |
| 45-54                                                                                 | Female | NVQ 1,2,3                                              | -                                                                                           |
| <b>Stakeholder Group #1:</b> Recruited by research team member, Solent game played    |        |                                                        |                                                                                             |
| 25-34                                                                                 | Female | University degree or<br>equivalent                     | Civil Servant                                                                               |
| 25-34                                                                                 | Male   | Post-graduate qualification                            | Transport Policy and<br>Strategy                                                            |
| 45-54                                                                                 | Male   | Post-graduate qualification                            | Transport Policy and<br>Strategy (Aviation)                                                 |
| 45-54                                                                                 | Male   | University degree or<br>equivalent                     | Innovation- EVRI                                                                            |
| <b>Stakeholder Group #2:</b> Recruited by research team member, Solent game played    |        |                                                        |                                                                                             |
| 25-34                                                                                 | Female | Other: PhD                                             | Senior Future<br>Mobility Developer -<br>Behaviour Change<br>Transport for West<br>Midlands |
| 55-64                                                                                 | Male   | Higher National Diploma or<br>equivalent               | Head of profession,<br>future mobility -<br>consultant                                      |
| 18-24                                                                                 | Male   | University degree or<br>equivalent                     | Medical UAS - flight<br>operations manager                                                  |
| 18-24                                                                                 | Male   | Post-graduate qualification                            | Transport Planner                                                                           |
| 25-34                                                                                 | Male   | Post-graduate qualification                            | Transport Policy<br>Officer                                                                 |
| 65-74                                                                                 | Male   | Post-graduate qualification                            | Transport Innovation<br>Manager - Local<br>Government                                       |
| <b>Stakeholder Group #3:</b> Recruited by research team member, Solent game played    |        |                                                        |                                                                                             |
| 25-34                                                                                 | Female | University degree or<br>equivalent                     | Local Government<br>Programme Support<br>Officer                                            |
| 45-54                                                                                 | Male   | University degree or<br>equivalent                     | Head of New User<br>Engagement-NATS<br>Aviation Industry                                    |
| 25-34                                                                                 | Male   | Post-graduate qualification                            | Civil Servant                                                                               |
| 35-44                                                                                 | Female | University degree or<br>equivalent                     | Project manager                                                                             |
| 45-54                                                                                 | Male   | A-Level or equivalent                                  | Police BVLOS<br>Project Lead                                                                |
| 35-44                                                                                 | Male   | University degree or<br>equivalent                     | Drone Service<br>Supplier                                                                   |
| <b>Stakeholder Group #4:</b> Recruited by research team member, Bournemouth v2 played |        |                                                        |                                                                                             |

|       |        |                                                                   |                                                         |
|-------|--------|-------------------------------------------------------------------|---------------------------------------------------------|
| 18-24 | Male   | University degree or equivalent                                   | Assistant Ecologist at Dorset Council                   |
| 25-34 | Male   | University degree or equivalent                                   | Environment Agency-Fisheries                            |
| 55-64 | Female | Other: Professional membership of Landscape Institute (Chartered) | Landscape officer at New Forest National Park Authority |
| 35-44 | Male   | University degree or equivalent                                   | Rural Estate Management                                 |
| 45-54 | Male   | Postgraduate qualification                                        | Air Quality Mitigation Officer                          |
| 55-64 | Male   | University degree or equivalent                                   | Council Ecologist                                       |

## Appendix 8: Ethics Checklist

| About Your Checklist |                     |
|----------------------|---------------------|
| Ethics ID            | 45823               |
| Date Created         | 03/10/2022 11:28:26 |
| Status               | Approved            |
| Date Approved        | 14/10/2022 09:10:20 |
| Risk                 | High                |

| Researcher Details                                          |                                                            |
|-------------------------------------------------------------|------------------------------------------------------------|
| Name                                                        | Taalia Nadeem                                              |
| Faculty                                                     | BU Business School                                         |
| Status                                                      | Postgraduate Research (MRes, MPhil, PhD, DProf, EngD, EdD) |
| Course                                                      | Postgraduate Research - BUBS                               |
| Have you received funding to support this research project? | Yes                                                        |
| Is this external funding?                                   | Yes                                                        |
| RED ID                                                      | 11731                                                      |
| Please provide the External Funding Body                    | EPSRC                                                      |
| Is this internal funding?                                   | No                                                         |

| Project Details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Shaping future transport – delivery drones |
| Start Date of Project                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 20/09/2021                                 |
| End Date of Project                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 20/06/2025                                 |
| Proposed Start Date of Data Collection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 02/11/2022                                 |
| Original Supervisor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Janet Dickinson                            |
| Approver                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Research Ethics Panel                      |
| Summary - no more than 600 words (including detail on background methodology, sample, outcomes, etc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                            |
| <p>The use of drones in logistics is evolving and the public is challenged to understand their implications and there is a need for them to be involved in the process of drone adoption. Most existing research focuses on the acceptance and lacks depth on understanding public perceptions. As part of the E-drone project, this research aims to facilitate the public's understanding of drones in logistics and provide opportunities for them to give more informed views that may feed into future policies. This will be achieved using a board game to engage the public, providing them a space to share ideas and reflect on experiences during game play.</p> |                                            |

As part of the ESRC Festival of Social Science, a workshop will be held on 2nd November, 2022 at the Little Pickle Deli, a local café in Boscombe. It will involve a 90-minute gameplay session where participants will explore how delivery drones might operate in their local area. The board game is based on real world scenarios involving delivery drones followed by a discussion with the researchers about transport futures. Participants will be able to explore key decisions about where delivery drones will fly using real-world choices currently being debated by policymakers and researchers. This will include choices related to risk, energy and other operational parameters. Participants will take on the role of a drone pilot and will be challenged to make deliveries to understand where delivery drones may fit into our future. The board game has been designed to deal with, engage and acquaint the public with the benefits and drawbacks of using drone deliveries.

The workshop will be conducted in three phases: introduction, gameplay and debriefing. During the introduction, participants will be made aware of the game rules and discussion will be prompted by the board game during game play. The debriefing session will allow participants time to reflect on their gaming experience and have a discussion with the researchers. This will be a pilot test of the game with the public, and will be subsequently developed.

### Filter Question: Does your study involve Human Participants?

| Participants                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Describe the number of participants and specify any inclusion/exclusion criteria to be used                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |    |
| <p>The research intends to include members of the public (anyone over the age of 18), to understand their views on delivery drones. No prior skills or knowledge about drones are required to play the game.</p> <p>The workshop will be held in three slots during the day, each slot involving 8 participants (total of 24 participants). The game is not restricted or limited to a certain number of participants therefore if the numbers increase, more people can be facilitated to play. The game is playable with even a minimum of two participants.</p> |    |
| Do your participants include minors (under 16)?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | No |
| Are your participants considered adults who are competent to give consent but considered vulnerable?                                                                                                                                                                                                                                                                                                                                                                                                                                                               | No |
| Is a Disclosure and Barring Service (DBS) check required for the research activity?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | No |

| Recruitment                                                                                                                                                                                                                                                                                                                                                                           |    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Please provide details on intended recruitment methods, include copies of any advertisements.                                                                                                                                                                                                                                                                                         |    |
| <p>Participants will be sent a link to an Eventbrite page (<a href="https://www.eventbrite.co.uk/e/are-drones-the-future-of-delivery-registration-429060951857">https://www.eventbrite.co.uk/e/are-drones-the-future-of-delivery-registration-429060951857</a>), by which they will be able to sign up.</p> <p>Some participants will also be directly recruited using a leaflet.</p> |    |
| Do you need a Gatekeeper to access your participants?                                                                                                                                                                                                                                                                                                                                 | No |

| Data Collection Activity                                                                                                                                                                                                                                                                  |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Will the research involve questionnaire/online survey? If yes, don't forget to attach a copy of the questionnaire/survey or sample of questions.                                                                                                                                          | No  |
| Will the research involve interviews? If Yes, don't forget to attach a copy of the interview questions or sample of questions                                                                                                                                                             | No  |
| Will the research involve a focus group? If yes, don't forget to attach a copy of the focus group questions or sample of questions.                                                                                                                                                       | Yes |
| Please provide details e.g. where will the focus group take place. Will you be leading the focus group or someone else?                                                                                                                                                                   |     |
| <p>The workshop is being held at a local cafe (Little Pickle Deli), where they will be playing a board game and their views will be recorded (audio) as part of the data collection activity. Participants will also be engaging in a discussion with the researchers post game play.</p> |     |

|                                                                                                                                                                                         |     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Will the research involve the collection of audio recordings?                                                                                                                           | Yes |
| Will your research involve the collection of photographic materials?                                                                                                                    | No  |
| Will your research involve the collection of video materials/film?                                                                                                                      | No  |
| Will any audio recordings (or non-anonymised transcript), photographs, video recordings or film be used in any outputs or otherwise made publicly available?                            | No  |
| Will the study involve discussions of sensitive topics (e.g. sexual activity, drug use, criminal activity)?                                                                             | No  |
| Will any drugs, placebos or other substances (e.g. food substances, vitamins) be administered to the participants?                                                                      | No  |
| Will the study involve invasive, intrusive or potential harmful procedures of any kind?                                                                                                 | No  |
| Could your research induce psychological stress or anxiety, cause harm or have negative consequences for the participants or researchers (beyond the risks encountered in normal life)? | No  |
| Will your research involve prolonged or repetitive testing?                                                                                                                             | No  |
| What are the potential adverse consequences for research participants and how will you minimise them?                                                                                   |     |

| Consent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Describe the process that you will be using to obtain valid consent for participation in the research activities. If consent is not to be obtained explain why.                                                                                                                                                                                                                                                                                                                                                                                                 |    |
| <p>A participant information sheet and participant agreement form will be provided prior to data collection and signing up for the event.</p> <p>Participants will be able to read the participant information sheet and the agreement form online using Eventbrite, and will be consenting upon sign up and confirm both of these during the registration process on Eventbrite. Participants that are being recruited using a leaflet will be provided with a copy of participant information sheet and participant agreement form prior to the activity.</p> |    |
| Do your participants include adults who lack/may lack capacity to give consent (at any point in the study)?                                                                                                                                                                                                                                                                                                                                                                                                                                                     | No |
| Will it be necessary for participants to take part in your study without their knowledge and consent?                                                                                                                                                                                                                                                                                                                                                                                                                                                           | No |

| Participant Withdrawal                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| At what point and how will it be possible for participants to exercise their rights to withdraw from the study?                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <p>Participants can withdraw any time without giving a reason and decline to answer any particular question(s). Participants are also free to leave the workshop at any point, or decide not to attend. Participants will be able to cancel their online registration if they no longer want to participate.</p> <p>If a participant decides to withdraw after the workshop, data collected prior to their withdrawal will continue to be used noting that all data will be anonymised. Once data has been transcribed, all recordings will be destroyed.</p> |
| If a participant withdraws from the study, what will be done with their data?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <p>If a participant decides to withdraw from the workshop, we will not collect any further information from them. Data that had already been collected prior to their withdrawal will continue to be used noting that all data will be anonymised. Once data has been transcribed, all recordings will be destroyed.</p>                                                                                                                                                                                                                                      |

| Participant Compensation                                                                      |    |
|-----------------------------------------------------------------------------------------------|----|
| Will participants receive financial compensation (or course credits) for their participation? | No |

|                                                                                                                    |     |
|--------------------------------------------------------------------------------------------------------------------|-----|
| <b>Will financial or other inducements (other than reasonable expenses) be offered to participants?</b>            | Yes |
| <b>Please provide details</b>                                                                                      |     |
| Participants will be provided with a £10 voucher to buy food or drink from the cafe the workshop is being held at. |     |

| Research Data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| <b>Will identifiable personal information be collected, i.e. at an individualised level in a form that identifies or could enable identification of the participant?</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Yes |
| <b>Please give details of the types of information to be collected, e.g. personal characteristics, education, work role, opinions or experiences</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |
| Demographic data will be collected at the beginning of the activity i.e., age, gender and education. The game involves sparking discussion between participants on their views around use of drones in logistics, and audio will be recorded during the activity. Anonymity will be maintained during the study. If in the recording participants refer to each other by names, they will be anonymised using pseudonyms or will be transcribed as 'Participant 1; Participant 2; and so on.' Audio is recorded for the purpose of transcription only and will be destroyed following transcription. The audio files and the participant agreement forms will also be kept separately so information is not identifiable. Data will also be stored on a BU password protected device after event. |     |
| <b>Will the personal data collected include any special category data, or any information about actual or alleged criminal activity or criminal convictions which are not already in the public domain?</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | No  |
| <b>Will the information be anonymised/de-identified at any stage during the study?</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Yes |
| <b>Will research outputs include any identifiable personal information i.e. data at an individualised level in a form which identifies or could enable identification of the individual?</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | No  |

| Storage, Access and Disposal of Research Data                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>During the study, what data relating to the participants will be stored and where?</b>                                                                             | Demographic data (age, gender and education) will be collected. No further information about the participant will be collected or stored. Audio will also be recorded during the game play to record participant views and opinions involving logistic drones. Audio recordings will initially be stored on recording devices and transferred to a password protected BU computer as soon as possible. Contact details will also be stored separately on a password protected BU computer. |
| <b>How long will the data relating to participants be stored?</b>                                                                                                     | Data from the recordings will be deleted once it has been transcribed. Transcription will take place within three months of the data collection date.                                                                                                                                                                                                                                                                                                                                      |
| <b>During the study, who will have access to the data relating to participants?</b>                                                                                   | Researchers at Bournemouth University and University of Southampton                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>After the study has finished, what data relating to participants will be stored and where? Please indicate whether data will be retained in identifiable form.</b> | No personal data will be stored after the study has finished.                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>After the study has finished, how long will data relating to participants be stored?</b>                                                                           | No personal data will be stored after the study has finished.                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>After the study has finished, who will have access to the data relating to participants?</b>                                                                       | No personal data will be stored after the study has finished.                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Will any identifiable participant data be transferred outside of the European Economic Area (EEA)?</b>                                                             | No                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

|                                                                                                                                                 |                                                                                                                      |
|-------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| <b>How and when will the data relating to participants be deleted/destroyed?</b>                                                                | The recordings will be deleted after transcription along with other information that was collected during the study. |
| <b>Once your project completes, will your dataset be added to an appropriate research data repository such as BORDaR, BU's Data Repository?</b> | Yes                                                                                                                  |

| Dissemination Plans                                                                                                                                                                                                                                                                    |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| <b>How do you intend to report and disseminate the results of the study?</b>                                                                                                                                                                                                           |     |
| Peer reviewed journals, Internal Report, Conference presentation                                                                                                                                                                                                                       |     |
| <b>Will you inform participants of the results?</b>                                                                                                                                                                                                                                    | Yes |
| <b>If Yes or No, please give details of how you will inform participants or justify if not doing so</b>                                                                                                                                                                                |     |
| <p>If the participant is interested, they can be emailed a short summary of the key findings.</p> <p>The summary will also be posted on BU research blog, the project website (<a href="http://e-drone.org">e-drone.org</a>), and the research Facebook page for the participants.</p> |     |

| Final Review                                                                                                  |    |
|---------------------------------------------------------------------------------------------------------------|----|
| <b>Are there any other ethical considerations relating to your project which have not been covered above?</b> | No |

| Risk Assessment                                            |     |
|------------------------------------------------------------|-----|
| <b>Have you undertaken an appropriate Risk Assessment?</b> | Yes |

| Attached documents                                                   |  |
|----------------------------------------------------------------------|--|
| Participant Agreement form.docx - attached on 13/10/2022 18:09:43    |  |
| Participant Information Sheet.docx - attached on 13/10/2022 18:09:47 |  |
| Game play and decks.docx - attached on 13/10/2022 18:11:45           |  |
| Leaflet .docx - attached on 13/10/2022 18:12:01                      |  |
| Eventbrite screenshot.pdf - attached on 13/10/2022 18:38:21          |  |

| Approved Amendments   |                                                                                                                                                                                                                                                                                                         |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Message</b>        | I want to apply for an amendment to the ethics as the game mechanics (as previously stated in the ethics form) have changed, and additional game workshops will be held that involve stakeholders such as land owners, or groups interested in planning will be involved other than the general public. |
| <b>Date Submitted</b> | 30/10/2023 10:06                                                                                                                                                                                                                                                                                        |
| <b>Comment</b>        | Reviewed and approved by Chair's Action (SW)                                                                                                                                                                                                                                                            |
| <b>Date Approved</b>  | 31/10/2023 14:59                                                                                                                                                                                                                                                                                        |
| <b>Approved By</b>    | Suzy Wignall                                                                                                                                                                                                                                                                                            |

## Appendix 9: Participant Information Sheet



**Bournemouth  
University**

### **Sheet**

### **Participant Information**

#### **The title of the research project**

Game of (Delivery) Drones

#### **Invitation to take part**

You are being invited to take part in a research project. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether you wish to take part.

#### **Who is organising/funding the research?**

This research is part of a Bournemouth University research project funded by the Engineering and Physical Sciences Research Council.

#### **What is the purpose of the project?**

The research aims to facilitate the public's and other stakeholders' understanding of drones in logistics and provide opportunities for them to give more informed views that may feed into future policies. The research would contribute to a deeper understanding of the knowledge and interaction with drones in logistics, as current research lacks understanding.

#### **Why have I been invited?**

The research intends to include members of the public (anyone over the age of 18), or key stakeholders, such as expert in planning and policy to take part so we can understand their views on delivery drones. No prior skills or knowledge about drones are required to play the game.



### **Do I have to take part?**

It is up to you to decide whether or not to take part. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a participant agreement form. We want you to understand what participation involves, before you make a decision on whether to participate.

If you or any family member have an on-going relationship with BU or the research team, e.g. as a member of staff, as student or other service user, your decision on whether to take part (or continue to take part) will not affect this relationship in any way.

### **Can I change my mind about taking part?**

Yes, you can stop participating in study activities at any time and without giving a reason.

### **If I change my mind, what happens to my information?**

After you decide to withdraw from the study, we will not collect any further information from or about you. The information collected will be anonymised for the purpose of this study.

As regards to the information we have already collected before this point, your rights to access, change or move that information are limited. This is because we need to manage your information in specific ways in order for the research to be reliable and accurate. Further explanation about this is in the Personal Information section below.

### **What would taking part involve?**

The 90 minute workshop will involve playing a board game on drones and how they may operate in your local area. This would involve choices related to drones involving risk, energy and other operational parameters. You will take on the role of a drone pilot and will be challenged to make deliveries in the 90-minute interactive game session. Discussion and cooperation between players are also key components. You will also be answering some questions while playing the game and a discussion session with the researchers about transport futures involving delivery drones.

### **What are the advantages and possible disadvantages or risks of taking part?**

Whilst there are no immediate benefits to you participating in the project, it is hoped that this work will inform policies around future drone use.

### **What type of information will be sought from me and why is the collection of this information relevant for achieving the research project's objectives?**

Participants' views will be recorded during the activity using gameplay to understand their thoughts and reflections. The participants can learn more about the implications of delivery drones and will be able to directly interact with realistic scenarios to provide more informed views. These views will be anonymised in the audio transcripts for the purpose of the study.

### **Will I be recorded, and how will the recorded media be used?**

The workshop will be recorded. The audio recordings of your activities made during this research will only be used for transcription for illustration in conference presentations and lectures. No other use will be made of them without your written permission, and no one outside the project will be allowed access to the original recordings.

### **How will my information be managed?**

Bournemouth University (BU) is the organisation with overall responsibility for this study and the Data Controller of your personal information, which means that we are responsible for looking after your information and using it appropriately. Research is a task that we perform in the public interest, as part of our core function as a university.

Undertaking this research study involves collecting and/or generating information about you. We manage research data strictly in accordance with:

- Ethical requirements; and
- Current data protection laws. These control use of information about identifiable individuals, but do not apply to anonymous research data: "anonymous" means that we have either removed or not collected any pieces of data or links to other data which identify a specific person as the subject or source of a research result.

BU's [Research Participant Privacy Notice](#) sets out more information about how we fulfil our responsibilities as a data controller and about your rights as an individual under the data protection legislation. We ask you to read this Notice so that you can fully understand the basis on which we will process your personal information.

Research data will be used only for the purposes of the study or related uses identified in the Privacy Notice or this Information Sheet. To safeguard your rights in relation to your personal information, we will use the minimum personally-identifiable information possible and control access to that data as described below.

#### **Publication**

You will not be able to be identified in any external reports or publications about the research without your specific consent. Otherwise, your information will only be included in these materials in an anonymous form, i.e., you will not be identifiable.

#### **Security and access controls**

BU will hold the information we collect about you in hard copy in a secure location and on a BU password protected secure network where held electronically.

Personal information which has not been anonymised will be accessed and used only by appropriate, authorised individuals and when this is necessary for the purposes of the research or another purpose identified in the Privacy Notice. This may include giving access to BU staff or others responsible for monitoring and/or audit of the study, who need to ensure that the research is complying with applicable regulations.

#### Sharing your personal information with third parties

As well as BU staff and the BU students working on the project, we may also need to share personal information in non-anonymised form with research partners at the University of Southampton.

#### Further use of your information

The information collected about you may be used in an anonymous form to support other research projects in the future and access to it in this form will not be restricted. It will not be possible for you to be identified from this data. To enable this use, anonymised data will be added to BU's online Research Data Repository: this is a central location where data is stored, which is accessible to the public.

#### Keeping your information if you withdraw from the study

If you withdraw from active participation in the study we will keep information which we have already collected from or about you, if this has on-going relevance or value to the study. As explained above, your legal rights to access, change, delete or move this information are limited as we need to manage your information in specific ways in order for the research to be reliable and accurate. However if you have concerns about how this will affect you personally, you can raise these with the research team when you withdraw from the study.

You can find out more about your rights in relation to your data and how to raise queries or complaints in our Privacy Notice.

#### Retention of research data

**Project governance documentation**, including copies of signed **participant agreements**: we keep this documentation for a long period after completion of the research, so that we have records of how we conducted the research and who took part. The only personal information in this documentation will be your name and signature, and we will not be able to link this to any anonymised research results.

#### Research results:

As described above, during the course of the study we will anonymise the information we have collected about you as an individual. This means that we will

not hold your personal information in identifiable form after we have completed the research activities.

You can find more specific information about retention periods for personal information in our Privacy Notice.

We keep anonymised research data indefinitely, so that it can be used for other research as described above.

### **Contact for further information**

If you have any questions or would like further information, please contact:

Taalia Nadeem ([nadeemt@bournemouth.ac.uk](mailto:nadeemt@bournemouth.ac.uk))

Professor Janet Dickinson ([JDickinson@bournemouth.ac.uk](mailto:JDickinson@bournemouth.ac.uk))

In case of complaints

Any concerns about the study should be directed to Professor Lee Miles (Deputy Dean) Bournemouth University Business School by email to [researchgovernance@bournemouth.ac.uk](mailto:researchgovernance@bournemouth.ac.uk).

### **Finally**

If you decide to take part, you will be given a copy of the information sheet and a signed participant agreement form to keep.

Thank you for considering taking part in this research project.

# Appendix 10: Participant Agreement Form

Ref & Version: v2  
Ethics ID number: 45823  
Date: 31/10/2023



## Participant Agreement Form

Full title of project: Game of (Delivery) Drones  
Name, position and contact details of researcher: Taalia Nadeem  
(nadeemt@bournemouth.ac.uk)

To be completed prior to data collection activity

### Agreement to participate in the study

You should only agree to participate in the study if you agree with all of the statements in this table and accept that participating will involve the listed activities.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| I have read and understood the Participant Information Sheet (PIS1) and have been given access to the BU Research Participant <a href="https://www1.bournemouth.ac.uk/about/governance/access-information/data-protection-privacy">Privacy Notice</a> which sets out how we collect and use personal information ( <a href="https://www1.bournemouth.ac.uk/about/governance/access-information/data-protection-privacy">https://www1.bournemouth.ac.uk/about/governance/access-information/data-protection-privacy</a> ). |
| I have had an opportunity to ask questions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| I understand that my participation is voluntary. I can stop participating in research activities at any time without giving a reason and I am free to decline to answer any particular question(s).                                                                                                                                                                                                                                                                                                                       |
| I understand that taking part in the research will include the following activity/activities as part of the research:                                                                                                                                                                                                                                                                                                                                                                                                     |
| <ul style="list-style-type: none"><li>• being audio recorded during the project</li><li>• my words may be quoted in publications, reports, web pages and other research outputs without using my real name.</li></ul>                                                                                                                                                                                                                                                                                                     |
| I understand that, if I withdraw from the study, I will also be able to withdraw my data from further use in the study <b>except</b> where my data has been anonymised (as I cannot be identified) or it will be harmful to the project to have my data removed.                                                                                                                                                                                                                                                          |
| I understand that my data may be included in an anonymised form within a dataset to be archived at BU's Online Research Data Repository.                                                                                                                                                                                                                                                                                                                                                                                  |
| I understand that my data may be used in an anonymised form by the research team to support other research projects in the future, including future publications, reports or presentations.                                                                                                                                                                                                                                                                                                                               |

|                                                                         |                             |
|-------------------------------------------------------------------------|-----------------------------|
|                                                                         | <b>Initial box to agree</b> |
| <b>I consent to take part in the project on the basis set out above</b> |                             |

**I confirm my agreement to take part in the project on the basis set out above.**

\_\_\_\_\_  
 Name of participant  
 (BLOCK CAPITALS)      Date  
 (dd/mm/yyyy)

\_\_\_\_\_  
 Name of researcher  
 (BLOCK CAPITALS)      Date  
 (dd/mm/yyyy)

## Appendix 11: Responses from Survey

### Public Group #1

- Participant: Open minded
- Participant: I'm ambivalent
- Participant: I worry about there being no interaction/ Can be isolating for those who don't see many people. Good for those with busy lifestyles
- Participant: Bring them on

### Public Group #2

- Participant: Until no not really thought about them. However feel they could be most useful to free up roads, congestion, emissions
- Participant: Very wary as to how + who shall operate them
- Participant: If they add to speed and efficiency that's fine
- Participant: Very positive - especially if it means the end of the white van brigade. Not holding my breath for their implementation due to technical difficulties
- Participant: Flight control needed- I do not want a Melton Mowberry colliding with my Tarka Masala (like Tikka Masala, but Tarka is just a little other). Flight path regulation needed. I have seen a photograph of a delivery drone resting on a high-voltage power line. Legal protection against attacks and hijacking (archery or fireworks or other drones). Insurance required to cater cost of damages in event of accidents.
- Participant: If operated responsibly I think it is a great idea. It has been used successfully in sending medicines from the mainland to St. Mary's Hospital IOW.

### Public Group #3

- Participant: Could be useful

- Participant: A necessary next step into the future but I worry about the safety aspects of possible collisions, rules for operators etc
- Participant: Strong feelings, know little about them
- Participant: A very good idea, especially when we had lockdowns but how much can they carry?
- Participant: Concern about sabotage of drones. Think they would be useful for remote or island communities

#### **Public Group #4**

- Participant: Useful, time efficient and greenhouse-friendly however it does reduce jobs for delivery drivers
- Participant: They can be noisy. They can reduce congestion. They can help save unnecessary (illegible)
- Participant: I believe they have been useful with delivery companies to produce a mass amount of deliveries in a short period of time, however could be chaotic if too many are produced
- Participant: I feel like they could be highly useful to increase industrial efficiency. Despite this, there are inherent dangers both physically (fear of them crashing/causing harm) and economically (forcing people into redundancy)
- Participant: I don't really know much about delivery drones but I think they would be very good especially for food delivery as it would make the food get places quicker
- Participant: We have little decision in the fact that delivery drones are the future of large corporations, however their safety through using airspace is one which needs to be carefully managed

#### **Public Group #5**

- Participant: Really supportive of them from an environmental and efficiency angle
- Participant: Interesting idea as it might help with traffic congestion. Is it a B2B or B2C for implementation? Concerns would be around safety and regulation (licenses)
- Participant: I think there is a place for them but I worry about them droppin off from the sky and hitting people
- Participant: Great scope but equally limitations on possible cargo
- Participant: Not opposed

#### **Public Group #6**

- Participant: I think, along with other new technologies it is to be embraced and used for delivering those things that might be difficult to deliver before today. I'm thinking in times of emergency, natural disasters etc.
- Participant: It will surely help people, but they will have to adapt. For example, we are not used to crowds on the sky or noises.
- Participant: I'm not sure if we actually need them beyond very specific circumstances like emergencies (under which drones might not be very effective). I understand it's important to do research on this but I'm not entirely sure I'd welcome them being used regularly and for delivering things of little importance. Also, there is a whole range of social issues in that another part of life gets automated which kind of makes people more and more 'lazy' (and I'm not talking about physically not doing things but more like less cognitive stimulation – like not needing to plan their everyday activities e.g. shopping as everything just can be ordered and then delivered by a drone, or social contacts – some people may rely on going out to do shopping or whatever as their opportunity to basically have some social activity, etc.).

### **Public Group #7**

- Participant: Not given it much thought. Worried about jobs for people, unemployment? But open to more consistent and efficient delivery.
- Participant: Could be good. Could be the future
- Participant: I have never really thought about it, but sounds like a good idea
- Participant: To be honest, I haven't really considered it. Just a worrying concept again doing away with people
- Participant: Could be a good idea if it works

### **Stakeholder Group #1:**

- Participant: It is important to consider them; their implications, the threats and opportunities and what we can do to mitigate and take advantage of these. It is important to consider extremes and uncertainties so we are prepared for different eventualities i.e., rapid acceleration and roll out the tech vs something else appearing and getting rid out the need for them. I am sceptical of how fast they will develop/ if they are better than other solutions, but still think we need to plan and explore how they could shape our future
- Participant: Could bring benefits but probably not a cure-all. Will need serious restrictions and may be of more use in some areas than others. If brought into urban or rural landscapes must be part of broader strategy.
- Participant: Potential merits but also substantial challenges

### **Stakeholder Group #2:**

- Participant: Neutral/sceptical. Not sure about the financial viability of the use cases, not sure about their social benefits. There may be some but I don't think the public has been engaged much.
- Participant: Potential, but needs to be use case/commercial case driven, not tech looking for application. High value, time sensitive use cases seem (at present) plausible)
- Participant: Delivery drones has the potential of reducing carbon emissions from delivery vans if properly implemented.

### **Stakeholder Group #3**

- Participant: Lower carbon emissions? Scary + Futuristic if they fly around the streets e.g., pizza delivery. Good in medical + emergency use cases
- Participant: They represent an important part of the solution associated with decarbonising aviation and displacing other forms of polluting transportation whilst also presenting time-saving ways to deliver critical goods and services
- Participant: They have the potential to make significant benefits to the economy, industry and the consumer, but significant challenges exist to making them safe, scalable and acceptable
- Participant: Very positive and much-needed service
- Participant: They're great. Commercialisation of the technology and scaling up of operations to form a business-as-usual service remain challenges

### **Stakeholder Group #4**

- Participant: I think they are interesting but have some safety concerns
- Participant: Can see things moving in this direction but lots of concerns about its practicality



- Participant: Useful and direct, sustainable energy use. Potentially noisy in protected landscapes (e.g., National Parks)
- Participant: A good thing for the future. Positive generally
- Participant: Not thought out how it will impact wildlife and the response of birds to drones

## Appendix 12: Game Instructions

### Game objective:

Keeping in mind route, risk and energy— make an efficient drone delivery.

The board illustrates locations around the Solent. Areas are marked according to risk. Drone take-off and landing sites are also marked on the board.



low risk



medium risk



high risk



Take-off/  
landing sites



Players start with a total of 100 energy (20 tokens) each round. 5 energy points will be lost each turn and placed in an 'energy consumption' pile to be counted at the end.

Each player will get a risk scale to be displayed in front of them.



Depending on the colour of the hexagon the player lands on each turn, the risk slider will be adjusted accordingly.

**Move slider by +2 boxes if player lands on a red hexagon.**

**Move slider by +1 box if player lands on an orange hexagon**

**Do not move slider if player lands on a green hexagon.**

Do not land in any of the hexagons next to another player, you will be penalised by +4 risk.

Each player will pick a mission card from the deck and read it out to their fellow players.

Depending on the mission, players will locate their take-off and landing sites on the board and place their round counters. Drone pieces will be placed on the take-off site.

Each player is required to pick a card from the flight update deck each turn and act accordingly and place them in front of them. Do not place them back in the deck.

Landing on a hexagon marked by a speech bubble means players pick up a comment card and read it to fellow players. All players must comment.

Leaderboard must be maintained each round.