Understanding Near-Future Technology: An Exploration of Participatory Speculative Design for Policymaking in Shaping Connected Places

Thesis is submitted for the degree of Doctor of Philosophy in Design by

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Declaration

This thesis has not been submitted to support an application for another degree at this or any other university. It is the result of my own work and includes nothing that is the outcome of work done in collaboration except where expressly indicated. Many of the ideas in this thesis were the product of discussions with my supervisors, Prof Rachel Cooper OBE, Dr Naomi Jacobs, and Dr Marianna Cavada.

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Abstract

The fourth industrial revolution (4IR) has significantly impacted our everyday lives through digital technology. The 4IR enables us to be digitally connected with everyday objects almost everywhere. In particular, the emerging concept of connected places describes the vision of public spaces digitally connected to enhance the quality of residents' lives based on data-driven decision-making processes. However, policymakers face challenges in understanding the needs and values in a place and implementing the initiatives of connected places with understanding.

Meanwhile, design has evolved over the past century from contributing to offering form or functionality to embracing broader perspectives such as systems thinking. Indeed, critical design and speculative design have emerged to think beyond industrial needs and commercial returns and explore future possibilities of technology and design offers via alternative scenarios to prompt stakeholder discussions. Nevertheless, conventional speculative design has been criticised for demonstrating limited views created by privileged and highly educated groups. Critics claim speculative design should embrace more engagement with the public, especially regarding technology implementations. It links to the need to thoroughly reflect on the potential impacts before its implementation, as it could have a broad influence and cause unexpected consequences. To tackle this challenge in speculative design, participatory speculative design (PSD) has emerged to involve individuals with lived experience but not necessarily with specialised expertise.

This doctoral research employed PSD approaches to explore how people without expertise in design and technology can participate in designing the future of connected places. It also aimed to discuss with local policymakers how and where they can reflect and use those insights from the public generated from PSD activities. This research methodology included contextual pilot studies and primary research. In the contextual pilot studies, the researcher actively engaged in three pilot research projects relevant to this study: local policy, speculative design, the Internet of Things (IoTs) in public spaces and place-based policymaking. Meanwhile, the primary research was designed in three stages. In Stage 1, two speculative prototyping workshops were conducted involving university students from design and architecture. In Stage 2, the researcher exhibited six prototypes created in the previous stage at two public exhibitions. Finally, in Stage 3, a workshop was organised inviting local policymakers to demonstrate PSD activities, reflect on their current policymaking practices and discuss potential areas and values of PSD.

The study's findings led to nine critical topics for discussion regarding the value of collective and collaborative efforts in speculative design. The topics include (1) rationales behind employing collectiveness in crafting speculative design, (2) values of speculation for places, (3) participants' contributions to PSD, (4) trainability of participants, (5) multiple roles of PSD planners, (6) scope

of participants, (7) diverse engagement approaches, (8) incorporating place-based approach in PSD, and (9) relevance of PSD in policymaking.

Preface

Interestingly, my PhD research topic closely relates to my previous experiences before starting the PhD journey. I started my master's degree in *Design Management* at Lancaster University in 2014. This experience broadened my perspectives on various design research and methodologies. The new areas I encountered ranged from design thinking to human-centred design, participatory design, co-design, service design, and design fiction. After exploring design-related areas, I conducted my major research project as a part of my master's, titled *Utilising Co-Designing Techniques to Enhanced Place Identity through Design.*

After finishing my master's degree, I started working in 2016 as a technology and marketing analyst for a newly established organisation called iCono UDD. This organisation is a technology transfer office (TTO) at *Universidad del Desarrollo* (UDD) in Chile. As this organisation was relatively new and small, I played multiple roles, including reviewing technologies developed by university researchers, conducting market research to identify potential market opportunities, participating in discussions to devise intellectual property (IP) protection strategies, and analysing different countries' policies concerning national technology transfer strategies. When I met with researchers who brought new ideas or inventions, most believed in their innovative solutions; they argued that they would benefit people and society rather than comprehensively consider both positive and negative outcomes.

Moreover, the starting points of these inventions are driven by the researchers' motivations, interests, or research grant opportunities without thorough consideration or examination of their creations. In particular, there needs to be a broader reflection on the potential impact, including how they could influence people. This personal observation within the organisation cast doubt on the approach and process of technology development. I started questioning: *What about the involvement of* ***people*** *in this process right from the inception of technology invention or even before?* Eventually, this curiosity led me to start a new journey as a design researcher at Lancaster University.

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Section 1. Introduction and Overview

1. Introduction

'Then tell us, what kind of thing is an elephant?'
The blind people who had been shown the elephant's head said, 'Your Majesty, an elephant is like a pot.'
Those who had been shown the ear said, 'An elephant is like a winnowing fan.'

The Buddhist's parable (translated by Sujato, 2023)

The most well-known story from the Buddhist scriptures is probably the Blind Men and the Elephant. This narrative describes the experiences of individuals with visual disabilities who have never encountered an elephant but are asked to explain its appearance based on the part of an elephant they touched. Those who touched its head compared it to a pot, while those who touched its ear compared it to a fan. Those who had an opportunity to experience its tusk perceived it to be like a ploughshare, while those who experienced its trunk thought it was like a plough-pole. Detailed descriptions were shared for each different body part of the elephant at the end of the story (Sujato, 2023). This story teaches us that individuals are different from each other due to their various subjectiveness, such as backgrounds, disciplines, cultures, religions, and races (a physical condition in this story); consequently, they tend to argue, acknowledge, or deny alternative interpretations regarding the "*elephant*." Nevertheless, achieving a comprehensive understanding of the elephant, a *never-seen animal*, would be challenging due to the limited perspectives that we have as human beings. Therefore, to overcome this elephant challenge, there should be space for individuals who have experienced it to come together to share their experiences, listen to others, imagine, and build a comprehensive image of the elephant collectively.

Nowadays, advanced technology is growing rapidly and becoming more complicated and unfamiliar, like *an unseen elephant*. It is close to becoming applied in our lives, as is so-called near-future technology. Understanding its complexity is challenging without specialised knowledge and expertise. Furthermore, anticipating its potential positive and negative impact on our daily lives is almost impossible. Certain individuals may benefit from it, while others may be disadvantaged. By drawing insights from the lessons of Buddha, we acknowledge the importance of establishing a communal area where we can meet and reflect with others. In this space, we can engage in imagination and speculation regarding the appearance of this hyper-complicate technological elephant while also listening to others' opinions and drawing our own experiences.

Throughout history, we have experienced numerous elephants, including industrial revolutions; we now encounter the Fourth Industrial Revolution (4IR), which has positively and negatively affected our daily lives. In this revolution, digital technology has perversely and rapidly changed physical spaces by adding invisible digital layers. The concept of connected places envisions a future in which physical public spaces are interconnected digitally by integrating the influence of Artificial Intelligence (AI), sensors, the Internet of Things (IoT), autonomous vehicles and drones. This concept is similar to the concept of smart cities, but connected places include a broader range of places than urban spaces. Based on data-driven decision-making, the vision of connected places promises a better quality of living for residents of a place. Nonetheless, connected places or smart city initiatives are frequently presented without consideration of the pre-existing values and needs of the people in place. Moreover, policymakers have encountered *"wicked problems"* from implementing connected technology in public spaces.

In the meantime, the discipline of design evolved throughout the Industrial Revolution, transferring its focus from visuals and forms to systems later. In particular, critical and speculative designs have emerged, criticising the role of design in influencing industrial profits. They examine a range of possible scenarios, including utopian and dystopian futures, to stimulate dialogues regarding technology implementation. However, speculative design has been criticised for inadequately incorporating diverse perspectives, which needs to be revised to address the challenges caused by the 4IR and its key technological drivers. Therefore, this study examines how a collective *we,* comprising individuals who will be affected by the *unseen elephant* (representing complex digital technology), can collectively imagine and comprehend this phenomenon to formulate better policies that navigate its intricacies. In other words, the study investigates ways of involving non-design or non-technology experts in speculating and designing the future of interconnected public spaces by using participatory speculative design for policymaking.

1.1. PhD topic

Saunders, Lewis and Thornhill (2009) state that a research question is helpful as a 'starting point' to shape research and leads to multiplying several detailed research questions at the end of the process. As mentioned above, in this study, the main research question is:

- *How can non-design or non-technology experts participate in speculating and designing the future of digitally connected public spaces?*

This main research question gives rise to the sub-research questions as listed following:

- *How can speculative design processes be utilised to involve members of the public?*
- *How can collective insights into place and technology be used to inform policymakers?*

The detailed sub-research questions lead to defining research objectives. Research objectives are the explicit sentences describing research purposes written by researchers (Saunders, Lewis and Thornhill, 2009). In this study, the research objectives are:

- To understand the future impact of the 4IR and the connected place
- To explore existing participatory speculative methods in policymaking with a focus on place
- To develop participatory speculative design (PSD) methods to enable diverse community groups to engage in speculation
- To create prototypes of speculative future scenarios for public spaces
- To examine the opportunities and challenges of the PSD methods
- To offer insights and recommendations for place-based PSD in the policymaking context

1.2. Overview of the thesis

This thesis investigates how individuals without the expertise of design or relevant technology can engage in speculation and design concerning the future of interconnected public spaces. Based on this aim, this thesis comprises five sections, including twelve chapters. An overview of this thesis is presented in **Figure 1**.

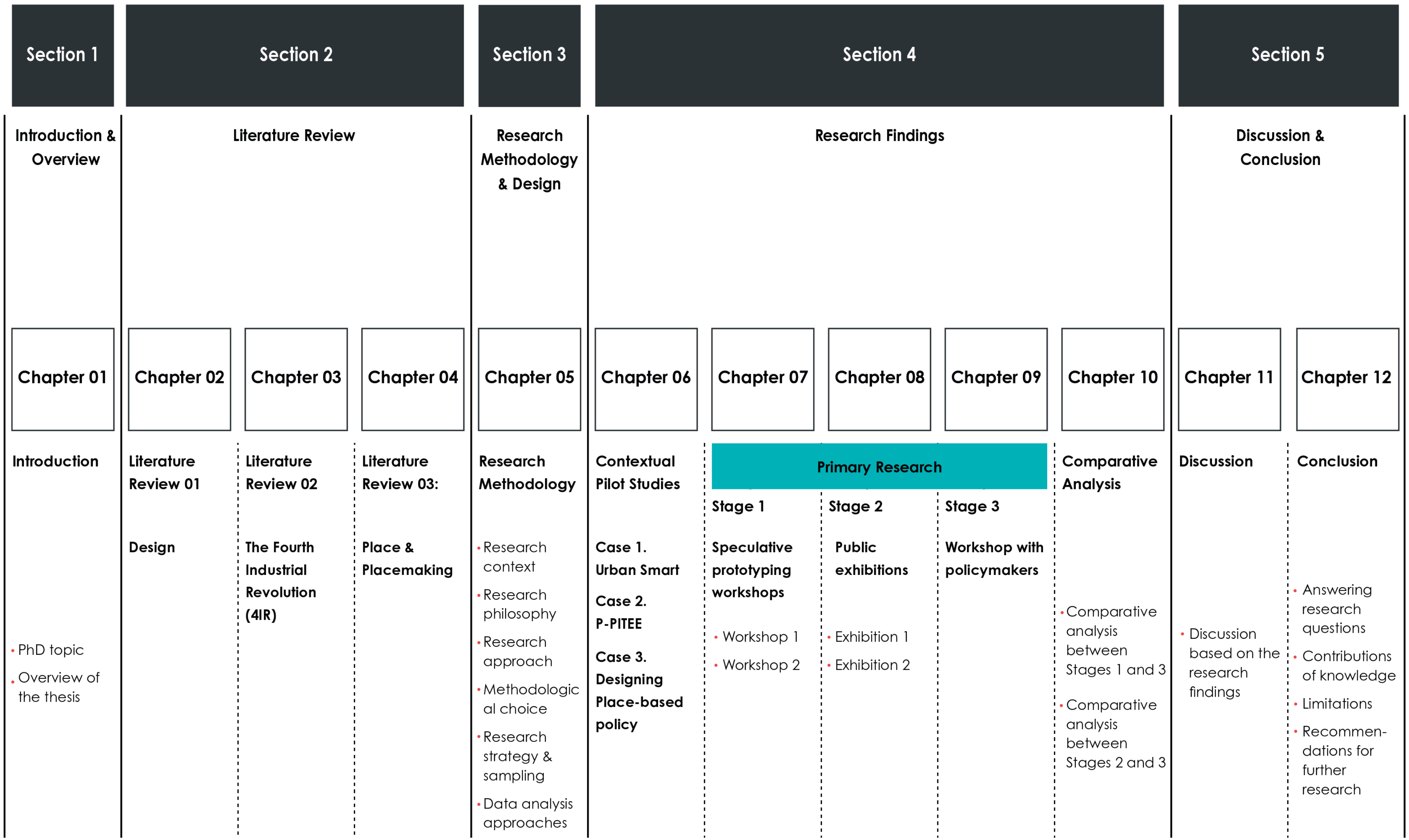

Figure 1. *The overview of the thesis*

First, **Section 1** includes **Chapter 1**, which introduces this thesis. It presents the PhD topic and the overview of this thesis. **Section 2** is the literature review, presented in **Chapters 2** to **4**, and builds an understanding of the research context and theoretical framework of design, the 4IR, and place. The first part of the literature review in **Chapter 2** explores design and relevant practices, enabling the researcher to build a theoretical foundation in participatory speculative design (PSD), an approach this research adopted. Second, the literature review in **Chapter 3** focuses on the Industrial Revolutions and 4IR as the research context, specifically the changes caused by the revolutions and the potential impact in places and societies by 4IR. Lastly, focusing on the 4IR impact on places, the literature review in **Chapter 4** explores the definition of place and placemaking, which is an approach to involve various stakeholders in designing a place.

In **Section 3**, **Chapter 5** provides an overview of the research methodology employed in this study. It starts with the research context, which provided opportunities for the researcher to be involved in several pilot projects and research activities, which contributed to constructing this doctoral research. Then, the chapter offers research philosophy and approaches which influenced the following: methodological choices, research and sampling design, data collection, and analysis.

Section 4 presents research findings based on the contextual pilot studies and the primary research in **Chapters 6** and **9**. In **Chapter 6**, the contextual pilot studies are based on the researcher's involvement in the different projects as a research associate or a visualiser. This research is funded by the *Beyond Imagination* project, which provided strategic research opportunities involving a research cluster, *populations and policy*. This involvement in the research cluster offered opportunities to work with research projects related to local policies, IoTs in public spaces and place-based policymaking. Thus, these chapters describe each project's overview, research method and process, findings and outputs, and insights. The description will justify how each project helped the researcher understand and influence the research design.

The primary research consists of three stages of data collection. **Chapters 7** and **9** explain the process and the analysis of each stage. **Chapter 7** demonstrates Stage 1 of the data collection, two speculative prototyping workshops with two different groups of students at Lancaster University. Stage 2 is described in **Chapter 8**, which is about public exhibitions in two different locations to exhibit prototypes produced in Stage 1 and collect the public's reviews. Lastly, in Stage 3, presented in **Chapter 9**, a workshop was conducted inviting local policymakers to explore some of the methods used in the previous stages and discuss the potential areas where design can be employed in policymaking. **Chapter 10** presents a comparative analysis as some exercises utilising the same methods were conducted across different stages.

Last, **Section 5** includes discussions in **Chapter 11** and the conclusion of this study in **Chapter 12**. In the discussion, the researcher reflected on the research findings and developed nine topics about employing PSD within the context of connected places. Then, the final chapter provides the conclusion of this study, addressing the research question, summarising and reflecting on the research and highlighting recommendations for further research.

Section 2. Literature Review

As described in the introduction, this research explores how individuals, not necessarily with design and technological knowledge, can be involved in speculating the futures of connected places. In response to this aim, the researcher investigated the works of the existing literature as the starting point with the scope of design and place and placemaking. This exploration will offer the backgrounds and contexts of this doctoral research and an in-depth understanding of the subject. Thus, the second section consists of three literature review chapters from **Chapters 2** to **4**. Then, at the end of **Chapter 4**, the researcher will state the research gaps identified from the review and the research aim (**Figure 2**).

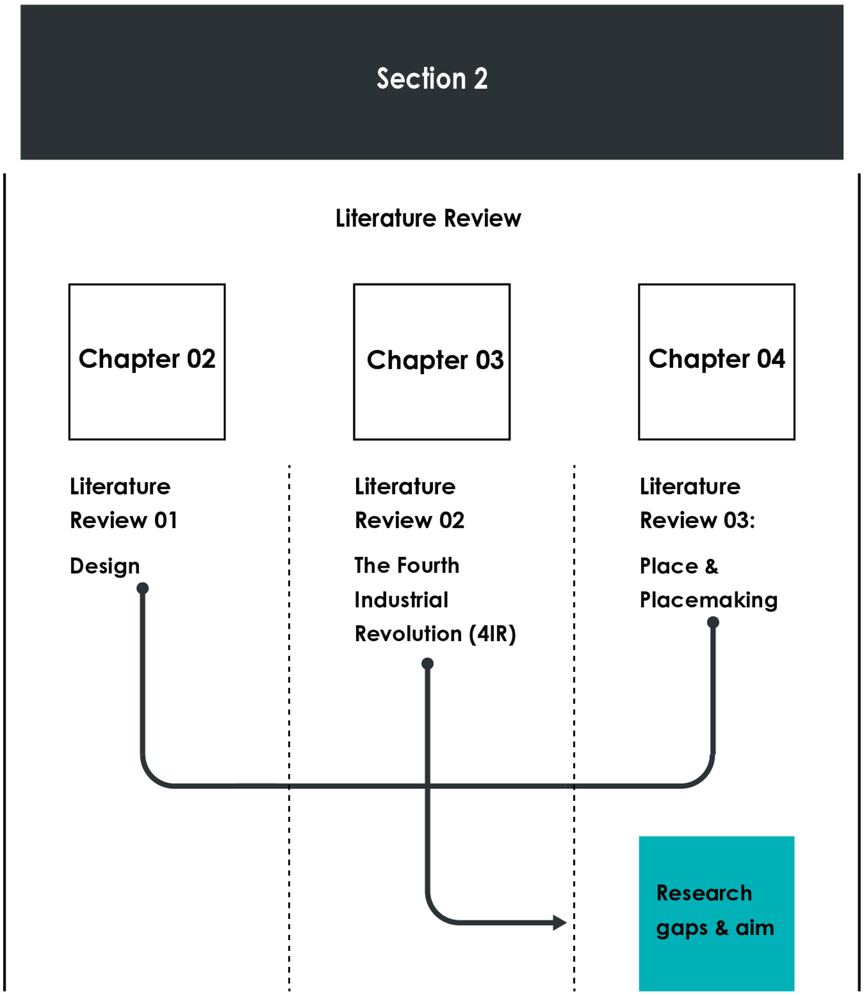

Figure 2. *The overview of Section 2*

2. Design

This first part of the literature review aims to understand what design is and how design has evolved through history to respond to social challenges and movements. The design transition is also linked to the history of the Industrial Revolution, which will be explored in the next chapter.

Understanding this flow between design and historical events will guide the future directions of design research. Moreover, the researcher designed her research based on this review, justifying the new design approach, speculative design with participatory settings (defined as participatory speculative design later). Therefore, the chapter will explore the different definitions, attributes, types and methodologies and practices design, focusing on participatory and collaborative design, critical and speculative design and other relevant areas.

2.1. Definitions of Design

This part will present different definitions of design to describe what design means and the diverse meanings behind the term. However, Brown and Chandrasekaran (2014) explain that design is difficult to define because of its nature as a highly complicated activity that deals with a wide range of phenomena. In addition, Cooper and Press (1995) state that the definitions of design have changed and are affected by various perspectives, such as social and cultural aspects. They provide an example of a specific product representing that time's social value and aspirations. Despite this challenge, exploring diverse definitions of design is a starting point of this review to understand design, its backgrounds, and the future direction of design research. While design is defined, shaped, and empathised by various perspectives, there is a continuous need to employ and merge some design theories and practices as a creative approach to deal with social demands or challenges caused by technology implementation.

"Everybody designs who devises courses of action aimed at changing existing situations into preferred ones."

(Simon, 1996)

"Design is the transformation of surrounding into environments for human experience."

(Buchanan, 2019b)

According to Simon's quotes (1996), design is the fundamental nature of human beings and some activities that every individual can do. In the second quote, Buchanan (2019b) describes human actions and design as causing certain changes and transformations of pre-existing conditions aiming for a better experience. The term, preferred ones, suggests a persistent need and desire for design changes and transitions among a specific group of people and individuals. Based on these definitions, a designer can be described as the primary player in this action, designing artefacts or situations following the required needs (Simon, 1996). Other works of literature describe design as the action of imagination and creation. According to Bleecker (2009), design enables people to imagine and create things. The materialising form expresses imagination by making, crafting, and prototyping the object. A designed object, including physical products, services, places, infrastructures and policies, links imagination or conceptual development and materialisation (Zamenopoulos and Alexiou, 2018).

2.2. Attributes of design

The previous part presented a range of design definitions. The definitions of design have changed over time and have been influenced by social and cultural elements. Regardless of the changes, the core element of design is a human activity creating changes from the conditions already in place. Also, there are definitions related to the action of materialisation and imagination. Now, this part provides an in-depth discussion of the specific attributes of design, such as problem-solving, creative action, and process.

2.2.1. Design as problem-solving

Problem-solving is a cognitive activity that most people learn how to solve problems in their daily and in their professional lives (Jonassen, 2000). In the design context, solving a problem is a distinctive design attribute. This attribute also aligns with the above definitions that design causes the transformation of situations and environments towards the preferred from the pre-existing. Design can convert challenges into opportunities, change or influence human behaviours, and add unique and creative values to routines or processes. According to Best (2010), design is described both as a problem-defining and a problem-solving process. Similarly, Buchanan (1992) categorises a design process into two stages: problem definition and problem solution. The first stage of defining problems is to analyse all the aspects and elements of the problem sequentially and to identify the requirements of possible design solutions. The second stage is to combine sequentially and balance different elements, and finally, to come up with a solution, which can be a final plan of production or service.

Designers often face more complex problems with ambiguous and unique natures, such as *wicked problems* (Jones, 2014; Ryan, 2014). The term *wicked problems* was first used by Horst Rittel and Melvin Webber, urban planners, in 1973. This concept refers to complex problems in the social and organisational setting. These problems are often too complex to tackle by the traditional linear processes or methods (Rittel and Webber, 1973). Also, Middleton (2005) claims that *wicked problems* might be challenging to define where the starting or finishing points of design are, unlike the traditional occasions where designers tend to have a clear picture of problems. This ambiguity of the problems challenges designers to approach the problem by combining existing experiences, knowledge, and creative strategies (Middleton, 2005). In addition, other elements cause *wicked problems, such as* social and organisational environments. Cooper and Press (1995) state that the complexity of the design problem has increased because of technological changes and its cultural use. They argue that as technology becomes more sophisticated and widely accessible, the design landscape faces challenges from the industrial culture's intricacy. However, O'Grady (2012) argues that a design problem can be a design opportunity. For instance, when defining problems, a new niche market can be found by identifying the needs of individuals or groups. For this reason, designers and innovators are often described as problem-solvers (O'Grady, 2012).

2.2.2. Design as creative action

Creativity is an essential cause of action in design. Buchanan (2001) describes creativity as a natural talent of human beings that can be developed and improved through education. In design education, creativity and creative action have been emphasised. Cooper and Press (1995) observe that design students are asked to be inspired by various aspects, to experiment with ideas, to come up with solutions, and to take the risk of failure. Creativity is combining different skills and applying them. As mentioned above, design problems tend to be complex and designing is an activity that solves complex problems that require creative solutions (Middleton, 2005). This means that design solutions arrived at creative thinking. Creative thinking includes creating ideas, dealing with ambiguity, using intuition and imagination, and finding meaningful connections and combinations (Sullivan and Schuh, 2015). In addition, Middleton (2005) states that visual mental images, which are the essential elements of design, offer an influential description supporting creative solutions. At this point, this attribute links to the first attribute of design, problem-solving, as the aim of design involves delivering creative solutions to complex problems. It reveals the second attribute of design as a creative action that uses creative thinking to generate ideas, handle ambiguity, find connections, and use imagination to accomplish the aim.

2.2.3. Design as process

The third attribute of design is an iterative process. First, Murray (2012) claims a design process combines framing and reframing. Framing is an activity in which designers define design problems within existing things such as traditions, practices, and even stereotypes in a social context. Based on the framing process, designers can reframe common values and activities (Murray, 2012). The stage of reframing may lead to design innovation. Second, the design process defined by Sanders and Stappers (2008) provides an overview of the design process in general (**Figure 3**). To some extent, this process embraces the design process demonstrated by Murray (2012). They expand the process, including the front end of design, described as the *fuzzy* pre-design stage. This *fuzzy* stage includes various activities of inspiration and exploration of *open-ended questions*. It also explores the context of the surrounding issues, gains an understanding of users, and looks for new technology opportunities. After the *fuzzy* front end, the traditional design processes will be followed by ideas and concepts, prototypes and then deliverables or design solutions, which can be a product, a service or a building (Sanders and Stappers, 2008).

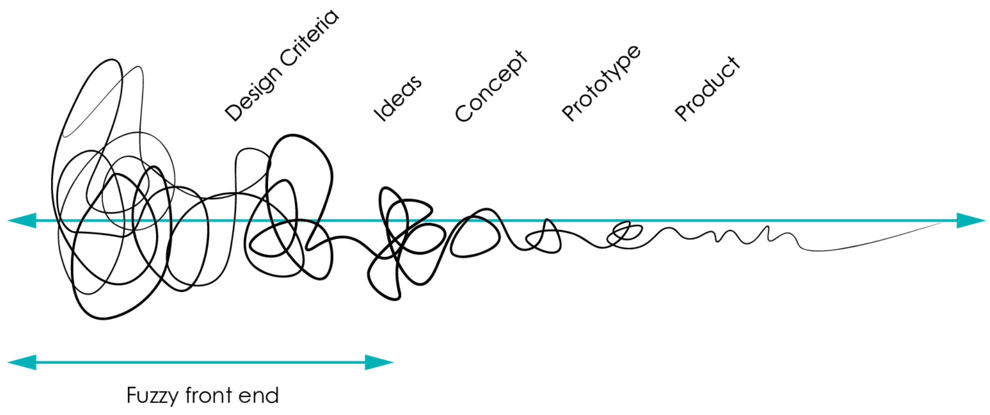

Figure 3. *The front end of the design process (Sanders and Stappers, 2008)*

Another design process is the double diamond model, which offers a refined design process. This model became popular and has been a widely recognised design process, and it was introduced by the British Design Council in 2005. The model graphically demonstrates the divergence-convergence process (**Figure 4**). It describes the design process as divided into four phases: Discover, Define, Develop and Deliver.

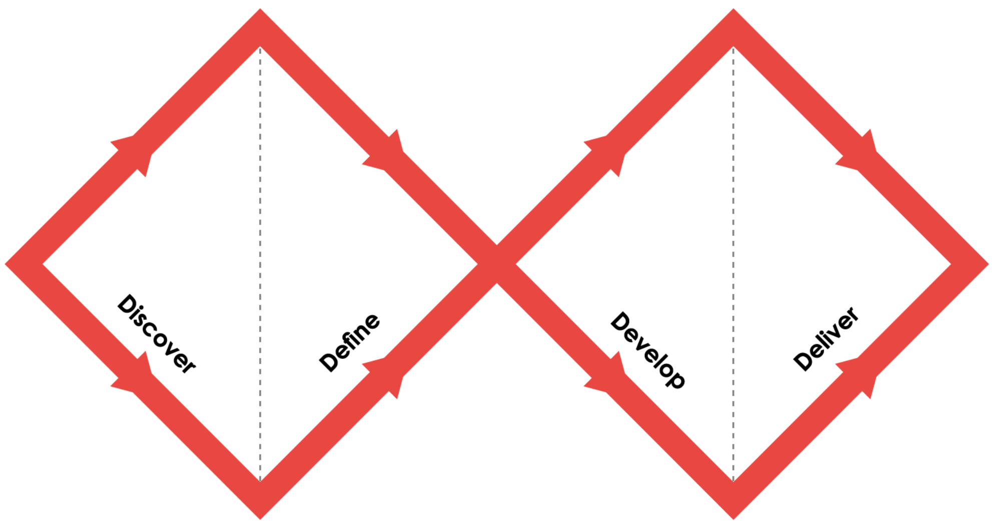

Figure 4. *The Design Council's Double Diamond (Design Council, 2014)*

According to the Design Council (2015), **Discover** is the first phase of the process which involves exploring related issues and challengesc. This stage helps people understand the contexts of the problems. The next stage of the process, **Define**, collects the insights and makes sense of the findings. At the end of the first diamond, this process enables people to identify specific challenges based on the findings. The beginning of the second diamond, **Develop** is the third phase to produce multiple solutions. At this stage, stakeholders related to the design problem are invited to gather a wide range of insights and to design solutions collaboratively. The last phase of the diamond, **Deliver**, provides a single solution among potential solutions ideally. This solution can be developed by testing and prototyping on small scale (Design Council, 2015; Ball, 2019).

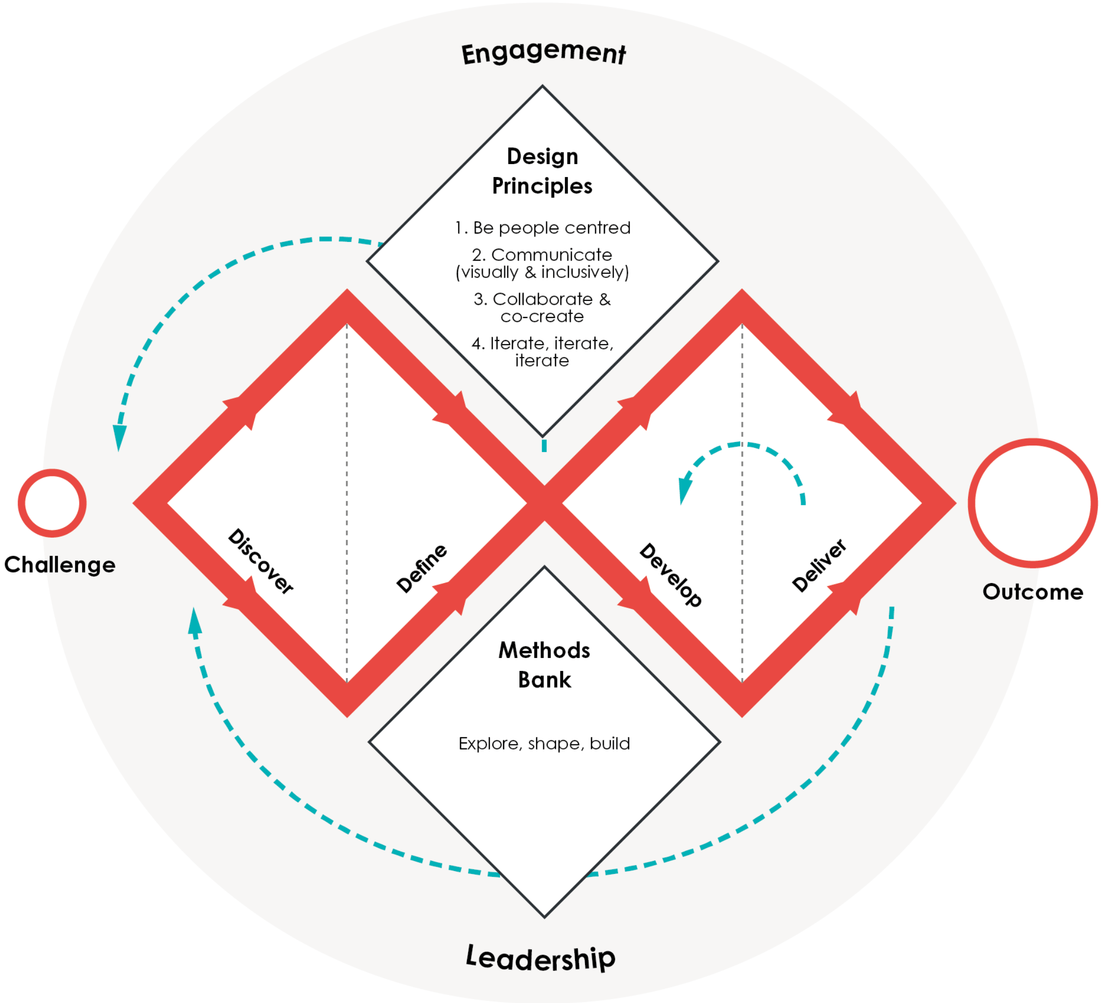

Figure 5. *The framework for innovation (Design Council, 2019)*

Subsequently, the Design Council presented an updated version of Double Diamond with extended areas (Design Council, 2019) (**Figure 5**). Design principles and design methods are added in these areas that designers and non-designers should adopt. The framework introduces four **design principles** for problem-solvers to adapt and work effectively:

1. Be people-centred: This principle requires the attention of users of products or services. It is significant to understand their needs, desires and aspirations.
2. Communication (Visually and Inclusivity): Visual and inclusive communications are required to create a holistic view of understandings and ideas during the design process

3. Collaborate & Co-create: The culture of collaboration and co-creation is vital to creating an environment where individuals can work with others and employ their practical knowledge.
4. Iterate, iterate, and iterate: A design process requires continuous iterations (presented in the blue dashed lines on the diagram). This iterative process allows people to define problems early, reduce risks and create innovative solutions.

The Design Council has presented a set of design methods for tackling challenges and developing innovative solutions. They also created a method bank and categorised these methods into three areas: exploration, refinement, and implementation:

1. Exploration: This is a category for methods when method bank users need to examine challenges and opportunities or the needs of their targeted users.
2. Refinement: This category includes methods that help in further development, such as turning ideas into prototypes or design concepts.
3. Implementation: The methods in this category enable the method bank users to develop the solutions using various sources, ideas, and experties.

Moreover, they highlight that building a strong culture in this framework is important. The ideal culture is collaborating with other organisations and empowering individuals to be part of the solution, as they acknowledge that nowadays, solving problems requires more than one idea. Therefore, it is essential to adopt effective processes and principles in an organisation and foster a culture that connects with other stakeholders. This insight leads to two elements, leadership and engagement, presented in the grey area on the top and the bottom. First, leadership is essential to drive innovation, foster individual skills and capabilities and encourage learning and experimentation within a team. Second, engagement is essential in collaborating with other stakeholders, such as citizens and partners, who contribute with different perspectives. Establishing connections with them leads to generating more innovative ideas (Design Council, 2019).

To summarise, these models of design processes explored above feature common factors. First, design is an interactive process. This feature was shown in the *fuzzy front-end* model and the extended version of the double diamond as one of the design principles. This integration allows designers to explore and experiment with different concepts and ideas. This process is often found chaotic, as illustrated in the *fuzzy front-end*. Even though it is a confusing process, it will allow individuals involved in this process to define a problem at the early stage, minimise risks and develop innovative solutions. Second, the design process has divergent and convergent phases described in the double diamond and similar in the framing and reframing model. The divergent phase is defined as discover and develop stages in the double diamond. In those stages, designers can explore the context, experiment and test, which results in the convergent phase.

This phase includes define and deliver stages in the diamond, linked to framing and reframing stages. The convergent phase is to identify the problem or frame the challenge and offer innovative solutions based on outputs from the divergent phase.

2.3. Types of design

The previous part describes design attributes as problem-solving, creative action and process. The part will present different types of design that have evolved throughout time and are related to design professions. Buchanan (1992) suggests a model, **four orders of design** (**Figure 6**), which presents the change of design scopes and roles from the traditional concept of visual symbols and artefacts to interactions, systems, and environments. Each order of design is essential in establishing design professions, from graphic and industrial design to interaction and environmental design.

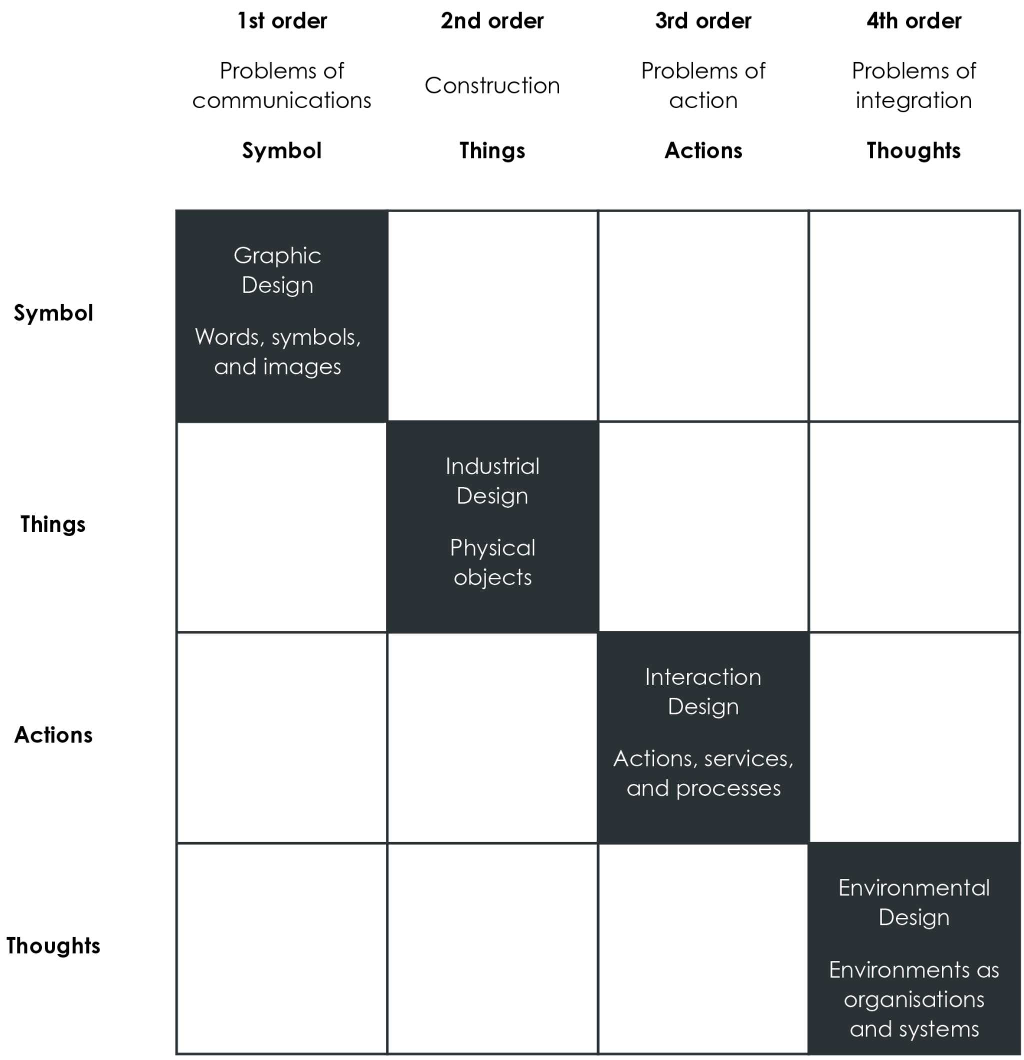

Figure 6. *Four orders of design (Buchanan, 2001, 2019a)*

He highlights how each order represents flexible *placements* of the nature of design or design concepts rather than fixed definitions. The four orders of design might be considered the traditional definition of design from the twentieth century. However, it provides an understanding of how the focus of design principles and professionals has shifted through historical timelines and technological developments and how the complexity of design problems has grown. Recognising the growing complexities for designers, Jones and VanPatter (2009) expand design domains into four stages, Design 1.0 to Design 4.0, from simple to complex;

- Design 1.0 Artefacts and Communications (design as making): In this domain of design, design is considered a making activity to deal with simple design problems that are low in complexity.
- Design 2.0 Products and Services (design as integrating): At this level, the design integrates and results in value creation and innovation. For example, service design and user experience design focus on this domain to offer new values to their users.
- Design 3.0 Organisational Transformation: Design 3.0 incoporates with problems more intiricate than the previous levels. These problems requires cahanges at oragnisational level such as strucutures, strategies and practices.
- Design 4.0 Social Transformation: In this domain, the most complex problems are in areas such as policymaking and social systems.

Jones (2014) states that each stage requires different design skills, practices, methods, and collaboration skills to deal with increasing complexities. He presents a systemic design approach as a fusion of two principles between design and systems theory to apply design practice to higher levels of complexity like Design 3.0 and 4.0. Buchanan (2019b) also describes how systemic design combines systems thinking and design thinking, placed in the fourth order of design (**Figure** 7).

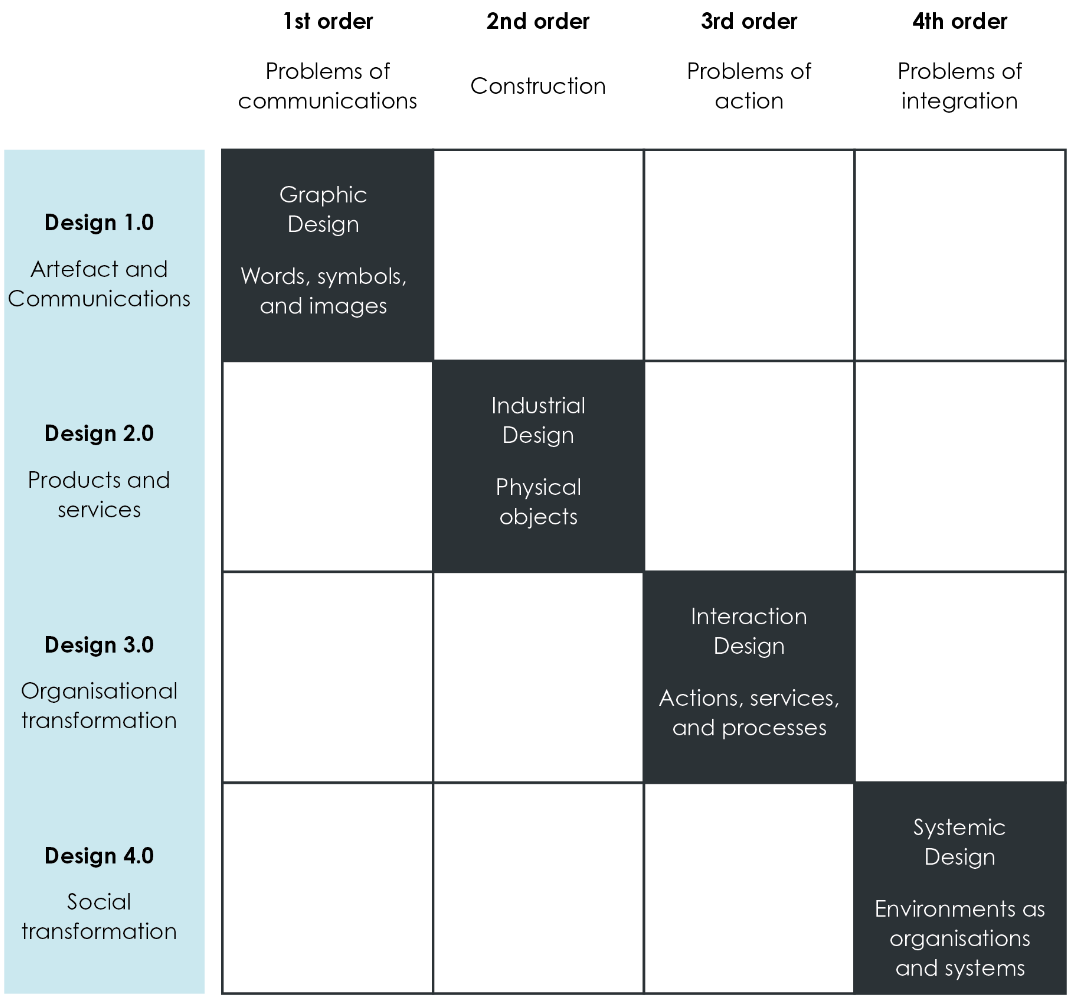

Figure 7. *Four order of design and design domains (1.0 to 4.0)*

The following part will analyse and reflect on the literature on different design types, considering different complexity levels. This part will explore other professions of design, graphic design, industrial design and interaction design, based on Buchanan's understanding of design. However, the last part reviews systemic design instead of environmental design (which represents the fourth order of design) to focus on the context of complex social systems beyond ecological issues. The reason is that the research context focuses more on social transitions and problems caused by digital technology than environmental issues.

2.3.1. Graphic design

There are no clear definitions of graphic design, as graphic designers have been engaged in various specialities, disciplines, and clients (Vit and Gomez Palacio, 2014). However, it seems evident that the first order of design, design as visual communication or symbols, has evolved throughout centuries and contributed to graphic design professions. Graphic design has oriented from visual symbols and communications in words to expressions of human beings. From cave wall drawings at Lascaux, cuneiform writing in Mesopotamia, Chinese calligraphy, and Egyptian hieroglyphs to modern expressions of human beings, the desire for expression through drawing and writing has been found a part of human heritage (Poulin, 2012).

The main purposes of early graphic design or visual communications included aesthetic ritual and functionality. Later, the invention of the printing press in the mid-15th century opened a new graphic design phase, which allowed a more comprehensive range of people to access knowledge and communicate through graphic materials, such as books. However, the nature of visualisation was dramatically changed through the Industrial Revolution. Meggs and Purvis (2016) state that technology and factory systems, such as the industrial printing press, contributed to mass production and established mass communication systems. These new industrial mechanisms reduced costs and increased accessibility of graphic communications. Concurrently, the role of graphic design took on added significance in promoting and marketing industrial outputs (Meggs and Purvis, 2016).

Graphic design still plays a significant role in commercial and industrial sectors as a communication channel for companies, such as corporate identity and branding through typography, images, and colour (Vit and Gomez Palacio, 2014). It enables designers to deliver specific messages or information in an aesthetic form or style to targeted customers and establish a brand image. Furthermore, from the Information Age and digitalisation (which will be further discussed in **Part 3.2** of **Chapter 3**), the profession of graphic design and related industries has integrated digital media and platforms (Buchanan, 2001). Contemporary graphic design has become digitalised. For instance, graphic designers can be found to create digitalised graphics and design applications for mobile phones, such as motion graphic design, user experience design (UX design), and user interface design (UI design).

2.3.2. Industrial design

The second order of design is about a physical artefact. According to Buchanan (2001), industrial design (also referred to as product design) has evolved with a concern for tangible and material things, mainly a product. The focus of the second order of design is on commercial and industrial sectors, boosting production and consumption (Simonsen and Robertson, 2012), which is in common with the first order of design, graphic design. Fuad-Luke (2013) critically analyses the historical position of design, in particular industrial design, which has mainly offered limited service in production and consumption. The role of design has shifted through industrial movements in general, and the relationship between design and technological development has remained so throughout history. He summarises the shifts of industrial design in three phases from 1750 to 1990 to examine the moment the First Industrial Revolution took place (which will be further discussed in **Part 3.2** of **Chapter 3**).

In the first era, between 1750-1850, design contributed to agricultural equipment and the early stage of industrial manufacturing. At the beginning of the First Industrial Revolution, industrial design emerged. This revolution allowed human beings to mass produce things at a low cost. This historical event influenced design processes and led to a rapid evolution of design theory and practice that separated design from making (Fuad-Luke, 2013) . The second phase, from 1851 to 1918, began with the world's first trade fair, the Great Exhibition in London (Kaiser, 2005). This event reflected the European production and consumption boom, supported by the colonies harnessing raw materials and labour. During the second phase, industrial design still played a role in manufacturing to minimise costs and maximise profits. However, it was challenging for industrial designers to meet the specific needs of customers, juggling different aspects of products such as aesthetics, functionality, and marketability as their products could be applied to a broader audience (King, 2016). The First World War from 1914 to 1918 changed the global order when the economy and society were unstable, triggering the third phase of industrial design (Fuad-Luke, 2013). The third phase of industrial design from 1918 to 1990 influenced diverse design movements and groups which commenced against the mainstream, considering social needs and values, such as Bauhaus and Futurism. In parallel, in the early 1970s, designers' roles expanded by engaging with broader issues and needs. They started solving problems and interacting with wider stakeholders through the participatory process (Cross, 1993). Today, people are still surrounded by industrial design. Industrial designers may produce physical objects at a smaller scale than complex systems or environments. However, these objects designed by industrial designers still shape people's everyday lives, including behaviours. Moreover, industrial design plays a significant role in the feasibility of technology in the market. It introduces new technologies to markets by spotting opportunities for businesses to meet customers' needs (King, 2016).

2.3.3. Interaction design

Over the centuries, designers have juggled two fundamental questions: how to create attractive visual symbols and how to shape tangible artefacts. However, contemporary concerns now extend beyond creating symbols and objects solely for individual experiences and actions. Nowadays, only symbols and objects are no longer suitable for creating value or enhancing human interaction. Thus, the design field has moved to interaction design, which considers intangible but valuable interactions. Buchanan (2001) describes interaction design as focusing on facilitating connections among other people through the designed mediating elements. As described by Buchanan, these elements are more than just tangible object but also includes intangible services or experiences. This notion of the design outputs broadens the definition of what can be designed beyond the visible artefact.

Norman (2016) points out that interaction design concerns how humans interact with technology. It aims to reinforce the users' understanding of activities that can be done, current events, and recent occasions, as well as to ensure a positive experience of those interactions. It is a combined area of design, psychology, art, and emotion. In particular, Norman claims that designers must understand technology and psychology as design shows an interplay of both. Likewise, interaction design is more dominant in digital platforms linked to UX and UI design and service design (Buchanan, 2019). This concept leads to a new type of question: how can human beings interact with other human beings via computers or other digital artefacts? (Kaptelinin and Nardi, 2007) narrow down that interaction design is understanding all kinds of human involvement utilising digital technology.

2.3.4. Systemic design

Contemporary designers have to deal with more complex problems that embed uniqueness and ambiguity, such as *wicked problems* in complex environments (Jones, 2014; Ryan, 2014). Barbero and Bicocca (2017) state that complexity is accompanied by a systemic concept like a complex web of connecting people, organisations, and countries. For this reason, any problem in a complex system is unlikely to be solved in isolated environments. The fourth order of design (similar to Design 4.0) is the design of complex environments and systems. Buchanan (2019b) introduces systemic design as placed in the fourth order of design, the design of complex environments and systems. According to Jones (2014), the scope of systemic design is broader than service and experience design in terms of social complexity and integration. Systemic design is often described as a combination of systems thinking and design thinking. While systems thinking is a holistic approach to understanding the context within a system on a larger scale (Jones, 2014), design thinking is a design methodology that moves the focus from designing an artefact to a general process (Ryan, 2014). In other words, systemic design aims to understand complicated systems by applying systems thinking and identifying and designing connections through design thinking. However, the position of design in systemic design is broader than design thinking. Systemic design converges systemic thinking and methods to direct human-centred design for complex or multi-systems and multi-stakeholder service systems (Jones, 2014).

Previous studies have highlighted systemic design in social transformation. Examples of systemic design range from sustainable and social innovation to local and national policymaking. For instance, systemic design has been applied to food processes and culture to reduce waste and increase sustainable development by mapping complex food systems, involving local family businesses and building a strongly connected community (Barbero and Tamborrini, 2015). In another case, the *RETRACE* project, led by *Politecnico di Torino*, demonstrates the potential in policymaking. Through a systemic design approach, including creativities and creating connection and participation, the project outcomes are presented to holistically diagnose regional and national policies, encourage participation among stakeholders and partners, and enhance the ownership of the policymaking process (Barbero and Bicocca, 2017).

2.4. Design practices

The previous part outlined various design professions based on the model proposed by Buchanan (1992), known as the four orders of design, and Design 1.0 to 0.4 by Jones and VanPatter (2009). This part explores design methodologies and practices relevant to this study, which enables the researcher to build a theoretical foundation to investigate the involvement of the public in designing future imaginary public spaces. The discussion begins with human-centred design, followed by participatory design, co-design, service design, design for policy, critical design, speculative design, and participatory speculative design (PSD). Each subpart defines the practice, its principles, and challenges. Additionally, within the critical design and speculative design parts, the researcher examines criticism surrounding current practices and explores participatory speculative design (PSD) as a suggestion to address these challenges, shaping this study's central focus.

2.4.1. Human-centred design

As mentioned previously, technology's rapid growth and implementation intensify everyday life's complexity and push design practices to progress. According to Sanders and Stappers (2008), the relationship between new technologies and human experiences has become entangled. In this context, human-centred design first appeared in technology-related fields such as ergonomics, computer science, and artificial intelligence (Giacomin, 2014). Moreover, the Industrial Revolutions facilitated industries to utilise design mostly in manufacturing or technology-driven design (Sanders and Stappers, 2008). These technologies focused on predefined functions and feature approaches, and the designed intentions did not often match the needs of the end-users of products, services, and systems (Giacomin, 2014). Recognising this limited interaction with the users, companies have changed their attention towards human perspectives, considering emotions and experiences (Boy, 2011; Sanders and Stappers, 2008).

Human-centred design is responding and learning from human perspectives in order to develop and design products, services and systems based on users' needs and preferences (Steen, 2011). However, Giacomin (2014) points out that the early attempt at human-centred was focused on designing for users but it still had limited views towards user involvement by optimising user's needs into fixed plans to design products or services. Norman and Verganti (2014) claim that the human-centred design aims to achieve radiation innovation by adding new meanings to products and services. Later, Norman (2016) states that it is a design process to prioritise to human needs and behaviours and achieve innovation. Giacomin's model (**Figure 8**) shows a pyramid, on the bottom of which are questions associated with relatively scientific factors, such as human physical conditions, emotions, and cognitions. It represents a process of answering these questions in a sequence, helping to discover new meanings. The process of questioning starts with complex issues and interactions and then moves on to concepts like sociological considerations. By understanding a broader context of surrounding elements, this model is useful to understand people's minds deeply and their everyday lives (Giacomin, 2014).

Figure 8. *The human-centred design pyramid (Giacomin, 2014)*

It is challenging to answer these questions, which require multiple perspectives. This challenge highlights the requirement to adopt a multidisciplinary approach and systems thinking in design (van der Bijl-Brouwer and Dorst, 2017). Moreover, these considerations have contributed to expanding the human-centred design approach. As Sanders and Stappers (2008) landscape diagram demonstrates (**Figure 9**), there are diverse design methodologies and practices in the context of human-centred design. They can be categorised by user as subject and user as partner (left to right), and led by design and led by research (top to bottom).

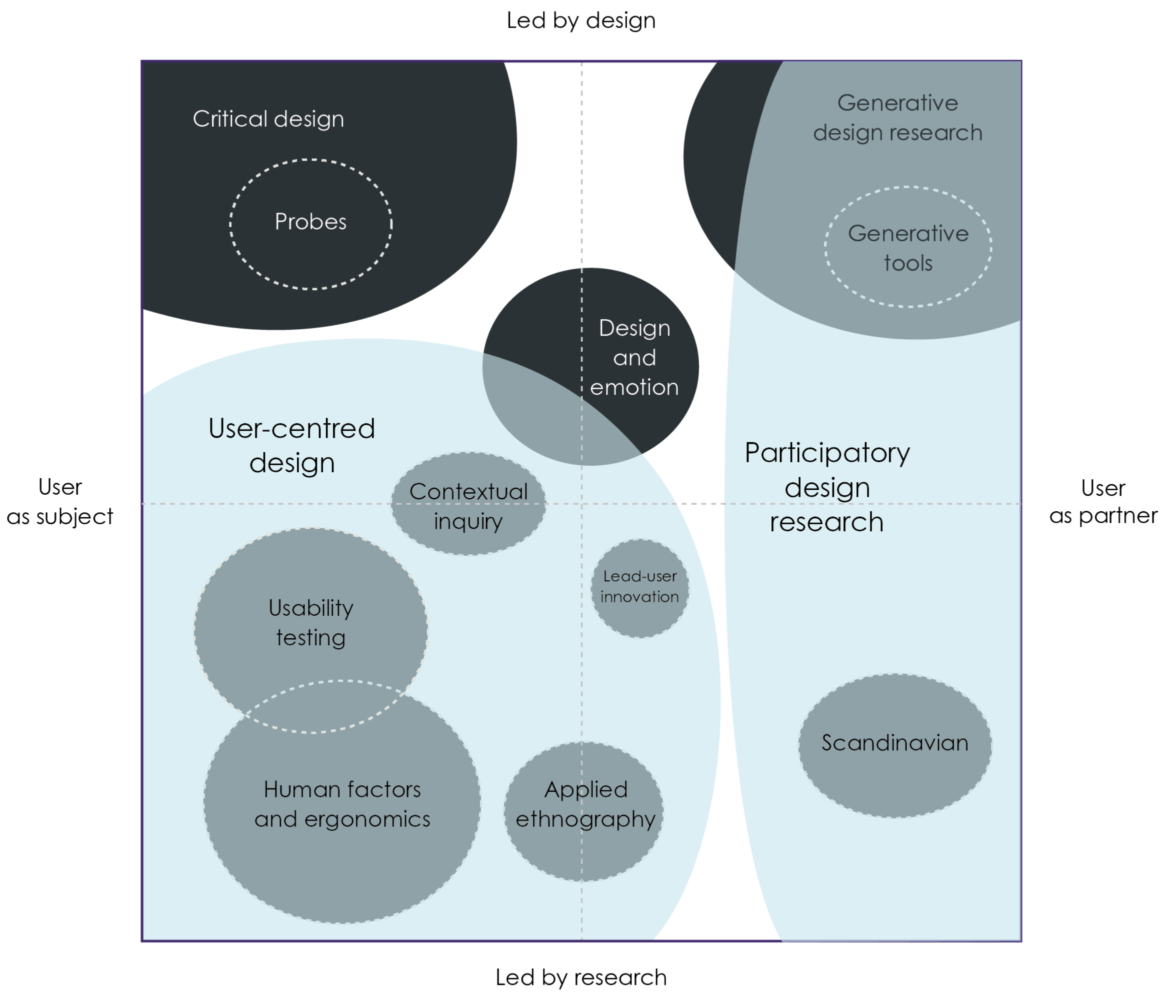

Figure 9. *The current landscape of the human-centred design research (Sanders and Stappers, 2008)*

The following subparts will examine human-centred design research relevant to this PhD research, including participatory design collaborative design, service design, service design, critical design, including speculative design and design for policy.

2.4.2. Participatory design

"Participatory Design is about the direct involvement of people in the co-design of the technologies they use."

(Simonsen and Robertson, 2012)

Participatory design has emerged from the need for public participation in political decision-making. The first attempt at participatory design was made in Scandinavia in the early 1970s. It reflected social and political changes which required civil participation in decision-making from the 1960s to the 70s. Some designers responded to those needs for collaborative actions in social, political, technological, and economic challenges. In the early 1970s, computer-based technologies were considered new and unusual in Scandinavian countries. The *UTOPIA* project was a cooperation between researchers and workers of organisations and partners, such as the Nordic Graphic Workers' Union (NGU), Center for Working Life (Arbetslivscentrum, ALC), the Royal Institute of Technology in Sweden, and Aarhus University in Denmark (Sundblad, 2011). The main objective was to allow workers as end users to be involved in all design and development processes in the computerised workplace (Bodker and Pekkola, 2010). Sundblad (2011) states that the project had a significant impact on design research and methods, highlighting the importance of user involvement in all stages of the design process. The UTOPIA approach proved the potential of user participation in designing information technology. The involvement helped the designers to understand their requirements, including the workplace, organisational forms, and skills.

Greenbaum and Loi (2012) argue that participatory design can be done *by*, *for*, and *with* people. People here refer to those using designed objects or systems or even being exposed to situations. They state the principles of participatory design below, which this study attempts to reflect on through the research.

- Equalising power relations: participatory design involves various voices from individuals who may not be considered or have less power within the power structure of an organisation or community.
- Situation-based actions: participatory design involves direct engagements from people in real-life contexts, such as workplaces, homes, or public spaces. This principle aims to understand human interactions with other factors, such as technologies, within the context of actual situations rather than depend on abstract concepts.
- Mutual learning: involving diverse participants creates mutual learning spaces. In these spaces, they can learn from each other, who are the experts in their context, understand different perspectives and agree with common ground during the process.
- Tools and techniques: tools and techniques are necessities of participatory design that help participants express their thoughts, needs and visions in certain situations.
- Alternative visions about technology: participatory design enables participants and designers to consider alternative visions of technology. The multiple visions can be projected in different settings, such as workplaces, homes, and public spaces.
- Democratic practices: participatory design promotes democratic practices, leading to equitable models representing different views towards specific issues (Greenbaum and Kensing, 2012).

Participatory design approaches have been widely recognised as practical in various design fields. For instance, information and communication technology involve users in the design process and apply iterative design methods, such as prototyping (Robertson and Simonsen, 2012). However, there are challenges to be spotted when conducting participatory design projects. Robertson and

Simonsen (2012) argue that it is challenging to maintain the duration of the participatory design process until a new product or service is developed. Despite the challenge, sustaining the process is essential to building a mutual learning space and fully allowing participants to reflect on the process and its outputs. Another challenge Dalsgaard (2012) pointed out is applying the participatory design approach on a large scale, especially in public sectors. This challenge requires setting appropriate conditions and visions for participatory design, such as managing stakeholders effectively, developing proper methods for participation and utilising a wide range of knowledge (Dalsgaard, 2012).

2.4.3. Collaborative design

In literature, collaborative design (co-design) has its roots in human-centred design and Scandinavian participatory design (Steen, 2013; Sanders and Stappers, 2008). One of the characteristics of co-design is the multiple roles of human agents and a wide range of involvement in design processes. Sanders and Stappers (2008) argue that human-centred design and user-centred design focus on human beings as the vital factor to consider for products, services and systems; however, they are still limited to view human beings as passive objects to observe or study. Co-design has acknowledged this limitation and allowed users to be part of design processes rather than remain as a passive audience. Thus, in the realm of co-design, people play multiple roles, including users, researchers, and designers (Sanders and Stappers, 2008).

> *"At a most fundamental level, co-design is a practice where people collaborate or connect their knowledge, skills and resources in order to carry out a design task."*
>
> *(Zamenopoulos and Alexiou, 2018)*

Zamenopoulos and Alexiou (2018) contend that the prefix 'co' encompasses more than 'collaborative.' They suggest other meanings to consider, such as 'cooperative, collective or connective' engagements in design. With this broader definition of co-design, the related activities include working collaboratively, cooperating to generate synergies, creating collective creativity, and connecting people across sectors. In other words, co-design activities enable people to develop new insights by gathering their expertise. As a result of the activities, the expected benefits would be to improve idea generation processes for product or service development, better decision-making, cooperation and creativity, and users' or consumers' satisfaction and loyalty (Steen, 2013). In particular, Bason (2016) emphasises the potential use of co-design in policymaking. He highlights the importance of collaboration and cooperation across departments and levels of governance. The co-design approaches can boost joint efforts with the government to create effective policies and support the implementation of policies with materialising visions (Bason, 2016). The co-design concept has emerged in various areas, not only in public sectors but also in product design and social science. It can facilitate engagement from citizens and empower them (Evans and Terrey, 2016).

Evans and Terrey (2016) define three phases of co-design process: first, exploring and understanding; second, prototyping; and third, assessing and expanding co-design interventions. In the first phase, it is essential to establish a shared account of issues and problems within the group. This phase requires synthesising reliable evidence and collecting various perspectives from different citizens about the matter. The next step is prototyping via key players' collective and collaborative efforts. The development of suitable research methods also accompanies it to facilitate feedback rapidly. For instance, Blomkamp (2018) describes an initiative by the Australian Centre for Social Innovation to improve Australian private rental accommodation for the senior population. They created prototypes with paper to demonstrate several policy options. The prototyping process helped the centre to materialise the invisible interactions in complicated public systems, present alternative scenarios, and gain feedback from the stakeholders (Blomkamp, 2018). Finally, the last phase concentrates on the evaluation process, analysing collaborative options and pilot interventions. Randomised controlled trials or other evaluation methods are used in this stage (Evans and Terrey, 2016).

2.4.4. Service design

Service design focuses on human centred service innovation utilising creativity and iterative process. This approach includes ideas and tools from various disciplines not only design but also service marketing and business management. It also employs design methods to drive transitions and foster innovations (Sangiorgi and Prendiville, 2017; Stickdorn and Schneider, 2012).

In the literature, the fundamental principles of service design are highlighted:

- User-centred: The customer's perspectives and experiences are essential in developing services.
- Co-creative: The involvement of stakeholders is crucial in a service design process.
- Sequencing: A service is a series of interconnected action points.
- Evidencing: Visualisation of invisible services is useful for considering invisible and physical components and elements.
- Holistic: In service design, it is significant to consider all relevant aspects including service environments (Saco and Goncalves, 2008; Stickdorn and Schneider, 2012).
- Systematic and iterative: Service design is a systematic and iterative process that includes user-centred, team-based, interdisciplinary approaches and methods (Saco and Goncalves, 2008).

This study influenced and employed several tools and methods from service design, such as stakeholder maps, prototyping, *what-if* questions, design scenarios and building storyboards (Stickdorn and Schneider, 2012).

2.4.5. Critical design

How and when critical design started is still difficult to define. A considerable amount of literature describes that in the late 1990s, the term *critical design* was coined by Dunne and Raby at the Royal College of Art (RCA) in London. However, critical design practices were not completely new then (Dunne and Raby, 2013). Malpass (2017) argues that some elements of contemporary critical design can be found in the Italian design movement in the late 1950s. The movement, such as radical design, anti-design, and conceptual design, was oriented to form the practices of critical design and started by questioning conventional industrial design practices. It started criticising the mainstream of design, industrial design, and the dark side of technological development by imagining the future. It has been described as Italian critical design that shifted a designer's role from serving industrial and commercial areas to engaging broader sectors. Moving away from commercial gains, the Italian designers criticised capitalism and consumerism prevalent at that time. They started to design objects of furniture and lighting, enabling people to have new experiences differing from traditional concepts. These predecessors contributed diversely to developing critical design practices and forming contemporary critical design practices (Malpass, 2017).

According to Malpass (2013), critical design focuses on exploring when design objects and practices imply current social, cultural, and ethical contexts. It is based on critical social theory, and the critical designers analyse ongoing cultural factors and provide a critique of existing things. He analyses that the critiques were often presented as scenarios or objects, such as hypothetical products, to probe the diverse impact of future changes. Many critical design projects cover various issues and are more scathing than speculative design. This way of communication tends to be demanding for audiences to interpret, as the objects described cannot exist in the real world due to cultural or social taboos and restraints. Even though the fictive objects are often presented in familiar forms, they eventually make the user uncomfortable between the real and fictional worlds.

2.4.6. Speculative design

While critical design focuses on the present implications of design objects and practices, speculative design explores the potential future implications of applied science and technology. Its narrative and scenarios may be unfamiliar to the public because it deals with new technologies. Their forms include scenarios, images, and films (Malpass, 2013). Dunne and Raby criticise how many technology companies try to predict or forecast new trends by narrowing the future down. They believe it is meaningless because traditional future predictions have been inaccurate and one-dimensional. It is significant to consider the new way of understanding the present and future, simply what people want and do not want. The new way of future speculation they suggested is often delivered as scenarios or started with a *what-if* question, which helps users broaden their minds for debate and discussion. In speculative design practices, a taxonomy of futures is employed to demonstrate an expanded spectrum of different futures: probable, plausible, possible and preferable (**Figure 10**). This diagram was first introduced by Hancock and Bezold (1994) and then made more widely known by Voros (2003).

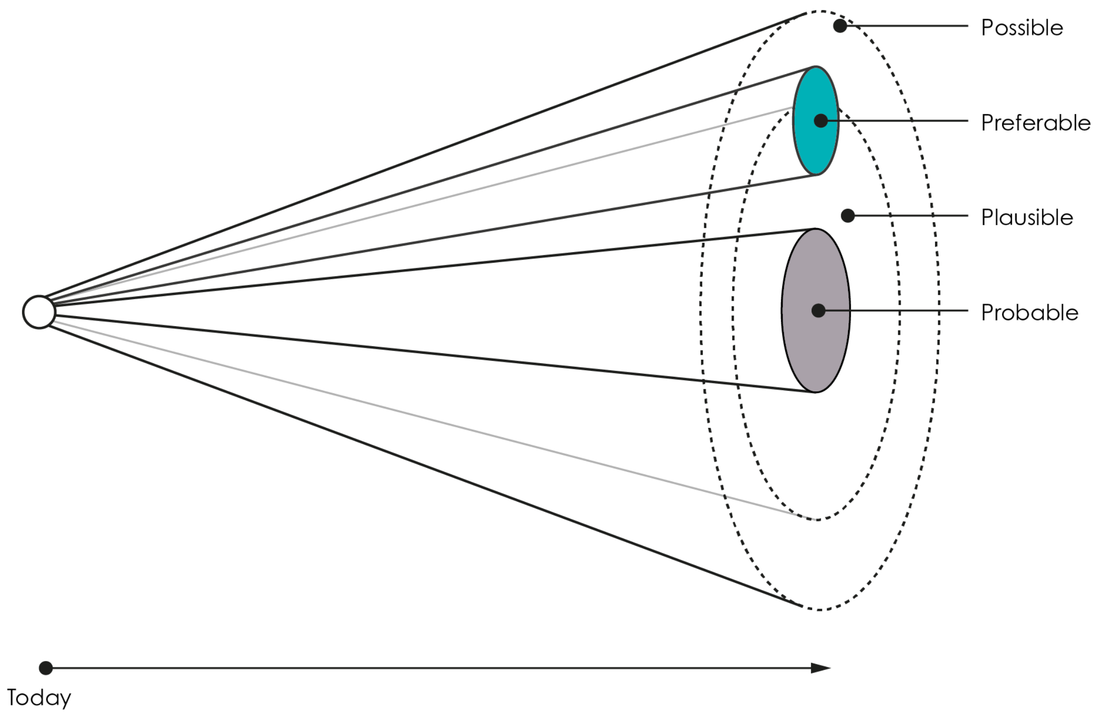

Figure 10. *Futures cone adapted from Hancok and Bezold (1994)*

- **Probable future**: Most designers have traditionally concentrated in this space. This area of the future assumes 'what is likely to happen' if there is no unexpected event such as war, financial crisis, or natural disaster.
- **Plausible future**: Plausible future is space that has been explored by companies since the 1970s to develop modelling about future global situations. It is about "what could happen" and exploring alternative futures. It helps organisations and companies be prepared and survive political, economic, and global trends.
- **Possible future**: This is an expanded space compared to any other future, including all extreme possible scenarios.
- **Preferable future**: The final area overlaps between the plausible and probable. It includes ambiguity because the meaning of preferable does not present who prefers and

who benefits. In current practice, it is decided by the government and industry, even though individuals in society will be most affected by their decisions.

There are some criticisms about initial Voros's cone due to (1) inflexible categorisation of probable, plausible, and possible futures, (2) exclusion of the outer realm of the cone, considering ridiculous or preposterous scenarios, (3) relying on probabilistic forecasting, and (4) linear future representation (Selkirk, Selin and Felt, 2018; Voros, 2017; Miller, 2011). To some extent, the inflexible categorisation has been addressed by adding more divisions or divisions in the cone (Gall, Vallet and Yannou, 2022). However, the linear representation is challenging to address (Smith and Ashby, 2020). Also, the fundamental assumption of this model is the linear progression of time, which means time moves in one direction. Although other alternative views suggest that times move circularly or multi-directional, there is no better visualisation of time than the futures cone, so the cone's limitations are acknowledged (Smith and Ashby, 2020; Gall, Vallet and Yannou, 2022).

Furthermore, an adaptation of the cone in speculative design casts doubts on what is desirable and preferable in the future. Coulton, Burnett, and Gradinar (2016) argue that it is significant for speculative designers to prioritise ongoing exploration of what is desirable instead of making it the only focus of the design process. Dunne and Raby claim that a preferable future should be collectively defined for groups of people *"from companies to cities and to societies."* The preferable future represents that designers should work with experts, such as ethicists and scientists, to create futures that trigger discussions reflecting what people want. They also believe that by speculating more diversely and looking into alternatives with a different group of experts, the future can be more shapable, although it cannot be predicted. Design can help present factors to be probable for preferable futures. At the same time, even unpreferable futures may follow the elements found in the early stage and their impact can be minimised.

Several speculative design methods include prototyping artefacts and building scenarios that offer people experiential understanding. Prototyping is one of the essential methods in speculative design as it materialised abstract ideas regarding technologies into tangible models. For instance, Schuijer, Broerse and Kupper (2021) employed a situated speculative prototyping approach in their project. This approach enables the public to contextualise emerging technologies, particularly nanotechnology, in their research context. They argue that prototyping is useful to rationalise complexity and uncertainty from technological futures by linking them to the social and cultural contexts of the public. According to Burdick (2015), prototypes lead to a wider range of engagements with the public as they envision new technologies' potential.

Nowadays, policymakers have increasingly recognised the role of speculative design in public engagement. Kolehmainen (2016) claims an opportunity to apply speculative design in policymaking and public engagement to understand the complicated realities of sociotechnological systems. She also argues that by using a lens of speculative design, policymakers can detect the consequences of their actions. At the same time, the public can articulate their desires and fears for the future. From this aspect, speculative design approaches might help policymakers tackle challenges and even *wicked problems* related to technology.

2.4.6.1. Design fictions

In 2005, Bruce Sterling, a science fiction writer from the United States, first used the term design fiction. Mitrović (2015) argues that design fiction is one of the genres in speculative design practices. Design fiction helps people question the current world's values, functions, metabolisms, and expectations by creating imaginary worlds (Mitrović, 2015). However, Coulton and Lindley (2017) state that speculative design and design fiction differ in their approaches to envisioning imaginary worlds. Speculative design focuses on making art-like artefacts representing characteristics from an alternative world. In contrast, design fiction employs multiple media, including objects, to present the world as coherent. Moreover, design fiction is inspired by science fiction. Bleecker (2009) points out that even though both fields are like cousins, the distinctive difference between design fiction and science fiction is that *"making more sense"* than science fiction. Design fiction plays the role of a bridge between intangible ideas and tangible demonstrations and also between scientific trues and speculative fiction.

Design fiction provokes the actions of individuals to imagine alternative futures. It indicates that incorporating storytelling, technology and design allows individuals to envision futures and expands possibilities. This combination includes conceptual descriptions of non-pre-existing prototypes and explorations of previously not-tested studies (Blythe, 2014). Design fictions can present interesting design concepts in diverse forms, including short films and exhibitions, to audiences such as targeted stakeholder or to the general public. While design fiction includes various methods and outputs, the ultimate aim of design fiction is to maintain consistency in presenting a fictional world (world building) (Coulton and Lindley, 2017).

2.4.6.2. Criticisms of critical and speculative design practices

In literature, speculative design is helpful in visualising elements of preferable futures. For instance, creating design fictions, scenarios, or prototypes of future technologies allows people to experience artefacts and reflect on their positive and negative impacts on ordinary lives. However, there are criticisms within the context of early speculative design approaches. First, Michael (2012) states that the early approaches did not focus on the urgent controversy in technology and science. Instead, the focus was on creating abstract artefacts with complexity that challenged the public. This criticism reveals the importance of design fiction creators' or speculative designers' interests and intentions. In addition, there is a gap between speculative design practices and the practicality of public involvement in speculative design processes. The second critique is that there needs to be a systemic process to record public opinion during and after provocation. Gatehouse (2020) points out that the outcomes of speculation are not visible and are evasive to capture. Michael (2012) argues they are not systemically measured and analysed for further steps after public exhibitions and engagement activities. Even though there are several research projects involving stakeholders or experts (Kerridge, 2015; Farias, 2020; Dawson, 2010), the issue of needing more record and analysis systems has yet to be fully explored.

Moreover, even though expert involvement has increased, speculative design practices have been criticised for a lack of diversity in ethnicity and social classes (Tonkinwise, 2014). Most participations or creations of speculative design are done by speculative designers and practitioners mostly affiliated with privileged, educated groups. This approach is perceived as a top-down approach and is questioned in its practicality to tackle *wicked problems*. This critique is connected to the question of *how* to increase diversity and address social issues that marginalised communities might have in speculative design and prototyping (DiSalvo, 2022).

Coulton and Lindley (2017) argue that the future cone is not suitable as a framework for speculative design and design fiction. They point out that reading the intention behind speculative provocations requires considering the future and the past as well. Various views of the past and future are linked and constructed to an individual's perception of reality. When building worlds of design fiction, a common way to perceive is from the present to plausible futures. However, the model that Coulton and Lindley (2017) suggest is to consider the multiple versions of the past. The diagram (**Figure 11**) has added a cone to the future cone, which is like a reverse version of the future cone. World-building intends to facilitate meaningful discussions and explorations within the realm of design fiction (Auger, 2013; Blythe and Encinas, 2016).

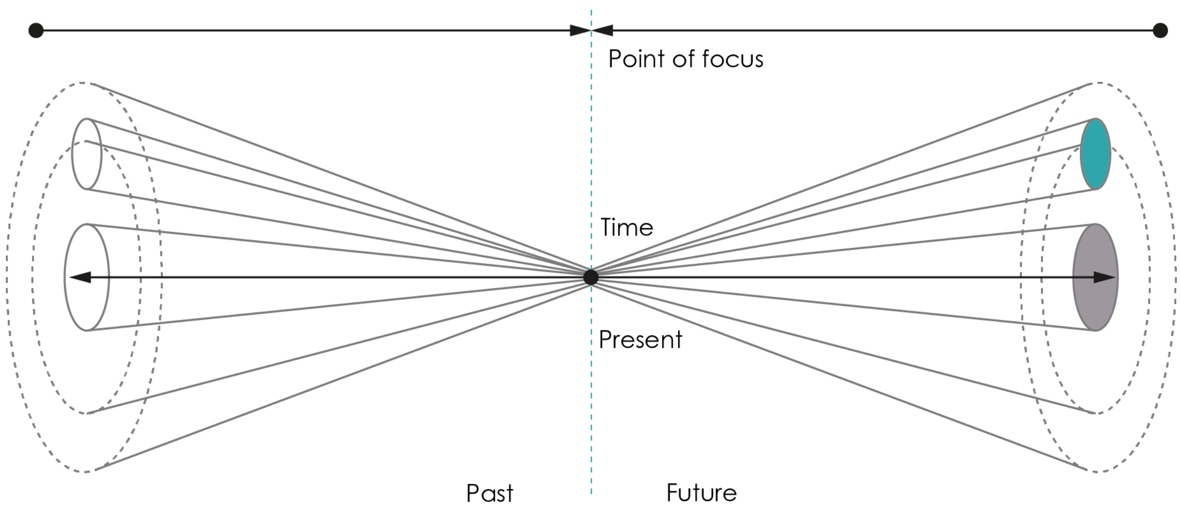

Figure 11. *A hermeneutic model of the future (Coulton and Lindley, 2017)*

Moving to contemporary perspectives, Hanna (2019) states that the new generation of speculative design practitioners focuses on inclusive, distributing power and proactive approaches to engage with social issues. This approach is constructively reflected in the criticism of the previous generations (Hanna, 2019). In particular, Ward (2021) argues that increasing inclusivity in speculative design is essential in the field of design education for students to learn how to create more holistic and equitable futures. He highlights design education should apply the following criteria for student projects to foster inclusivity:

1. Participation and engagement: A design educator should encourage interactions among individuals to understand their considerations and desires regarding the current situation.
2. Authorship and benefactors: It is important to ensure the equal distribution of authorship and benefits of speculative design.
3. Inclusion and exclusion: During speculative design activities, individuals need to embrace other's experiences beyond their own.
4. Maintenance and social infrastructure: It should be reflected on 'who' presents alternative futures.
5. Feedback and reflection: the speculative design creators should be open-minded to collect various input from others (Ward, 2021).

2.4.7. Design for policy

Bason (2016) and Kimbell and Vesnić-Alujević (2020) argue that governments have increased attention to design approaches to develop public policies and services. In particular, Mazé (2021) emphasises that design has been applied within hierarchical governmental systems and policymaking processes. Bason (2016) states that design is a tool to innovate public services. For instance, design helps suggest a cost-efficient model for the public sector. Durose *et al.* (2023) also highlight that design has been recognised as an activity to solve problems and envision alternative scenarios for policymaking.

Bason (2016) acknowledges the key contributions of design for policy: First, design is useful for understanding problems from the public side, and it offers proper research tools, including rapid prototyping, systems thinking, and observation. These tools can help policymakers to understand the related causes and interconnectedness of problems. Second, design offers a collaborative nature in hierarchical systems. For instance, design allows policymakers, stakeholders, external partners, and end-users to design policy options collaboratively. In public sectors, product and service design methods help service providers understand user experiences (*i.e.*, citizens in the policymaking context) and eventually innovate the services (Mulgan, 2014). Third, design provides opportunities for physical and emotional human interactions by materialising. Bason (2016) argues that design practices help develop user experiences in services and products, which are the channel of human interactions.

However, although there is growing attention to employing design methods and practices, design for policy is still in the early stage of establishment (Kimbell *et al.*, 2022). Applying design methods in policymaking is still challenging due to its complex nature. The nature of policymaking systems is complicated, and their outputs are often unpredictable due to the dynamic interactions between policymakers and local environments (Cairney, 2015). These systems are not linear but include iterative and continuous actions (Kraft and Furlong, 2019). Nonetheless, some models (**Table 1**) aim to reflect on essential aspects of policymaking.

Stage of the Process	Definition
Agenda Setting	This stage is to define problems and structure the policy agenda.
Policy formulation	Policy formulation sets policy aims and strategies to accomplish the goals.
Policy legitimation	This stage requires proper political support, and policymakers officially execute policies at this stage.
Policy implementation	Institutional resources are needed in this stage to initiate policies within a bureaucratic system.
Policy evaluation	This stage focuses on the evaluation of how effective policies are including their achievements and limitations.
Policy changes	This stage helps policymakers adjust their policy goals and approaches based on the outputs from the previous experiences.

Table 1. *Stages of the policymaking process (adapted from Kraft and Furlong, 2019)*

Villa Alvarez, Auricchio and Mortati (2022) and Vaz-Canosa and Prendeville (2019) have utilised these models to examine design practicality in policymaking. These studies employ a similar approach to analyse how Public Sector Innovation units (PSI units) utilise design methods in their processes. Interestingly, the findings from the studies discover that design methods are generally used in policymaking processes in the field that do not require legal decision-making. This field involves policy legitimation, evaluation, and changes. Both studies show that design methods are applied in policymaking processes mainly in the primary stages, such as agenda setting and policy formulation. At these stages, design is used in the realm of policymaking to envision future scenarios, understand existing problems, collect information for policymakers and involve stakeholders and the public in policymaking (Vaz-Canosa and Prendeville, 2019; Villa Alvarez, Auricchio and Mortati, 2022).

2.4.8. Participatory speculative design (PSD)

Participatory speculative design (PSD) combines participatory and speculative design. It is alternatively referred to as participatory speculation, although this study emphasises the actual act of designing. Thus, this study has preferably adopted the term PSD rather than participatory speculation. Gerber (2018) states that PSD employs speculative design practices to foster critical thinking and create provocations towards emerging technology while it embraces participatory approaches to engage with those who will be affected mainly by technology. Also, PSD reshapes the role of designers as input is needed from participants. Farias, Bendor and Van Eekelen (2022) argue that a designer's influence on final design outputs may decrease by involving non-designers in design processes. The PSD concept justifies why the exclusive authority of designers should be opened in speculative design. Speculation of futures as an action anticipates alternative scenarios and has emancipatory effects. The nature of speculative design can be political, depending on the intention it contains. Therefore, involving a broader range of stakeholders in speculation is significant for projecting multiple future views. In particular, communities should be involved in the process as they are the most affected by the potential scenarios in their daily lives (Farias, Bendor and Van Eekelen, 2022).

PSD is still in the early stage of practice, while increased attempts at speculative design with participatory approaches have been made. This attempt is seen to draw collective effect, creativity, and expertise from individuals (Tsekleves *et al.*, 2017). Kerridge (2015) states that the benefit of engaging the public is that it has an increasing impact beyond academia in the early stage of speculative design. Heidingsfelder *et al.* (2015) describe another advantage: the public can create prototypes and materialise physical artefacts beyond verbal discussion. This engagement can lead to a broader reflection, including ethics. With these benefits, speculative design and design fiction have been acknowledged in literature to provoke discussions around future technology among policymakers and local communities. Tsekleves *et al.* (2017) experimented with how speculative design could be utilised with participatory design settings in the context of policymaking in Global South coteries. The project used this combination to define local challenges and foster a safe space for inclusive discussions. Rüller *et al.* (2022) explored how developing design fiction with communities collaboratively. Based on the study, they argued that the co-development of design fiction could provoke further steps to co-design technological solutions that reflect local needs. Forlano and Mathew (2014) employed design fiction with collaborative practice and storytelling methods to involve communities.

As explored above, combining speculative design and participatory or collaborative approaches becomes a trend. Farias, Bendor and Van Eekelen (2022) suggest eight categories of different participation in speculative design related to four levels*: spectatorship, reflection, inspiration, generative reflection, shared creativity, shared authorship, initiative,* and *ownership* (**Figure 12**). The four levels are non-participation, involvement, collaboration, and leadership. These categories indicate how much influence non-designers can have in each process, ranging from the four levels.

Sallow → **Deep**

Level of engagement	Non-participation	Involvement		Collaboration			Leadership	
Category of participation	Spectatorship	Reflection	Inspiration	Generative reflection	Shared creativity	Shared authorship	Initiative	Ownership
Description of participation	Non-designers view or interact with the finished speculative design.	Non-designers discuss the finished speculative design with designers after viewing or interacting with them.	Non-designers inspire designers before the speculative design process begins.	Non-designers respond to speculative designs during the design process and their comments and feedback on the design.	Non-designers brainstorm with the designers before and/or during the design process.	Non-designers produce speculative designs alongside the designers.	Non-designers initiate the speculative design process and have the opportunity to influence its direction.	Non-designers maintain ownership over the process by shaping goals, procedures, outcomes, and dissemination.

Figure 12. *Levels of engagement and categories of participation from deep to shallow (Farias, Bendor and Van Eekelen, 2022)*

However, as discussed earlier, PSD is still a new emerging area, so a limited amount of existing literature exists. Especially in the context of policymaking, there are several challenges to overcome. For instance, adaptation of PSD is challenging in different contexts of culture and geography. In addition, public participation in the speculative design process might not lead to desirable and relevant policies or discussions (Forlano and Mathew, 2014; DiSalvo, 2022; Rüller *et al.*, 2022).

2.5. Summary of Chapter 2

This chapter explored the in-depth literature review, trying to understand the attributes, types, and practise of design. In exploring the various definitions suggested by the scholars, it was emphasised in this literature review that design is a process evolving through history by different cultural, historical, and social focuses. As Simon and Buchanan defined, design transforms by shaping surroundings into preferred ones. In particular, Simon highlights that this study focuses on the fact that design is an action that everybody, as a human being, can do. Other definitions also reveal that design results in artefacts or situations reflected in the needs of human beings. Moreover, design embraces imagination to reach preferred situations and materialisation. The results of designs can be physical products, services, places, infrastructure, and policies. The design outcomes vary from intended interactions with the product to surrounding contexts, such as further engagement discussions and reflections from the public.

This chapter also looked into three attributes of design. The first attribute is problem-solving. Design enables people to identify and solve problems by exploring various aspects and potential solutions. Designers often encounter *wicked problems* embedded in ambiguity, making defining the problems' starting or finishing points challenging. However, through the design process, there is the potential to turn the issues into a new opportunity as a journey of defining and solving problems. Second, design includes creative action to utilise creative thinking, which is the capacity to mix different skills and use them. This attribute is connected to the first attribute, problem-solving, to deal with ambiguous problems, ideate solutions and utilise imagination. The third attribute is seen as design as a process. There are diverse models of design processes, such as the design process of framing and reframing, the *fuzzy* front end of the design process, and double diamond. These models highlight common design process features: iterative, convergent and divergent processes.

Moreover, this chapter examined the different types of design. First, Buchanan's four orders of design illustrate the evolution of design types through history. The orders include symbols, physical objects, services and processes, and environment as systems. Each order links to design professions, such as graphic design, industrial design, interaction design, and systemic design. Jones and VanPatter propose design domains in four stages, from simple to complex, from Design 1.0 to Design 4.0. They argue that different design skills and practices are needed to tackle increasing complexities in each stage. This research reflected on the four orders of design even though the model is conventional. The rationale is that it illustrates an evolutionary process of design professions reflecting historical events.

Along with the exploration of types of design, this chapter presented various research methodologies and practices highly relevant to this study. The methodologies and practices explored here are human-centred design, participatory design, collaborative design, service design, speculative design, design for policy, and participatory speculative design:

1. Human-centred design is an approach to considering human needs when it comes to developing products and services. In addition, it can result in innovation by providing new values and meanings to users.
2. Participatory design is a methodology to involve users in design process. In particular, this study has adopted the principles of participatory design, which Greenbaum and Loi (2012) suggested. They are to distribute power relations between communities and organisations, consider situations and contexts before actions, lead to mutual learning in the process, develop proper tools and methods, project alternative views to technology, and democratise practices.
3. Co-design has inherited the value of human-centred design and participatory design. It actively involves human agents in design process with multiple roles. The three stages of co-design process are (1) exploration and understanding, (2) prototyping, and (3) assessment and expansion of co-design interventions.

4. Service design is also rooted in human-centred design, which aims service innovation through creativity and an iterative design process. Some of the service design methods and tools are employed in this research.

Importantly, this chapter examined the literature on critical and speculative design, which are highly relevant to this study:

1. Critical design casts doubt on mainstream design practices, supporting capitalism and consumerism. This methodology explores broader social, cultural, and ethical contexts by providing different experiences.
2. Speculative design focuses on alternative future scenarios of technology. For instance, the *what-if* questions and the futures cone method enable us to consider different futures. Prototyping is also a significant method in speculative design, as it materialises abstract concepts of technology and envisions their potential scenarios.
3. Design fiction is an approach to present futures in diverse formats, such as storytelling or short films, which help design fictioneers build a fictional world.

Meanwhile, design for policy is also emerging as governments and policymakers have increased interest in design methods and approaches in policymaking and developing public services. There are benefits of applying design for policy, such as allowing policymakers to understand issues from the position of the public, creating collaborative environments across the sectors and providing opportunities to experience potential products or services through materialisation. Specifically, design is utilised in the early stages of policymaking to present possible policy implementation scenarios, comprehend issues holistically, gather relevant information about policymakers and engage with stakeholders in policymaking.

Responding to criticisms, participatory speculative design (PSD) has emerged. This approach combines speculative and participatory designs by encouraging non-designers and non-experts in speculative design processes. In literature, it is highlighted that engaging the public is vital in the early stages of speculative design because it provides an opportunity to reflect diverse views of individuals in prompts and prototypes. However, PSD is still in the early stages and has faced challenges in adapting to different contexts and leading relevant discussions, especially, in the public sector.

Likewise, this chapter investigated a wide range of existing literature on design, examining attribute types and practices of design. This exploration allowed the researcher to understand design and define the research's relevant design attributes, types, and practices. Based on this chapter's learning, the following chapter will present a literature review of the Fourth Industrial Revolution (4IR) and relevant digital connected technologies, which is the vital context of this research. The next chapter will explore previous industrial revolutions and the 4IR. Key technological drivers, including big data, cloud computing, sensor technology, the Internet of Things (IoTs), fog and edge computing, wearable technology, Artificial Intelligence (AI), advanced robotics, autonomous vehicles, and drones, will be discussed. Then, it will focus on place-based technology implementation, which is relevant to the focus of this study, including the concepts of smart cities and connected places. Lastly, the challenges of the 4IR, the implementations, and the strategies to address those challenges will be discussed.

3. The Fourth Industrial Revolution (4IR)

This chapter will demonstrate the Industrial Revolutions from the first and the fourth, including their historical contexts. The Fourth Industrial Revolution (4IR) is a crucial subject in this research context, which is the ongoing transition of applying digital technology at a large scale and influencing places and people. Thus, this chapter will explore the Industrial Revolutions, including the 4IR and its challenges. Following that, its technological drivers of 4IR will be examined from big data, cloud computing, sensor technology, the Internet of Things (IoTs), fog and edge computing, wearable technology, Artificial Intelligence (AI), advanced robotics, autonomous vehicles, and drones. Then, it will explore the concept of smart city and connected places as place-based technology implementation. Lastly, the chapter will address the challenges caused by the 4IR and connected places and then offer suggestions for potential strategies to respond to these challenges, such as collective intelligence and imagination.

3.1. Industrial revolutions

In historical context, *revolution* is a term that might refer to the American and French revolutions, which were sudden events that successfully and radically changed a human group's political and social system. Griewank (1973, as cited in Hobsbawm, 1986) describes a revolution process as combining three features. The first feature is a violent and unexpected shock process, significantly changing the country's institution and system of law. The second regards social content in the involvement of several groups and triggers resistance movements against the change. Lastly, a revolution causes an intellectual form of an idea or ideology which establishes positive social goals to move forward (Griewank, 1973, as cited in Hobsbawm, 1986). Likewise, history's social and political revolutions are interpreted as the transition and distribution of power from a privileged group to the public.

While the industrial revolutions share the common features of social and political revolutions, such as rapid changes, one of the distinctive features of industrial revolutions is the continuity of adding a new layer to pre-existing layers. Even though the first industrial revolution radically changed the world by introducing new technological inventions, the following industrial revolutions, from the second to the fourth, have been continuously affected and shaped by the previous industrial revolution. For instance, it would have been impossible to open **the Information Age** during the Third Industrial Revolution (**Part 3.2**) without electricity during the Second Industrial Revolution. Furthermore, the current social issues of adapting artificial intelligence or robots in workplaces would never have emerged without computers and the adoption of related digital technologies.

Moreover, exploring the meaning of **industrial** and **industry** is crucial to deeply understanding the Industrial Revolution's definition. According to the definition provided by the Oxford Dictionary (Oxford English Dictionary, 2023), the term industry refers to "*productive work, trade, or manufacture. In later use esp.: manufacturing and production carried out on a commercial basis, typically organized on a large scale, and requiring the investment of capital"* (Oxford English Dictionary, 2023). More (2002) claims that the Industrial Revolution indicates **industrialisation**, which refers to boosting economic activities that lead to high productivity through technological development on a large scale. Before the eighteenth century, the mechanism concept was not incorporated into production on a wide scale. Humans relied on agriculture and the handicraft economy (Xu,David and Kim, 2018). The novel invention of machines and the establishment of facilities later called factories (mechanisation) led to better production and manufacturing processes than in the past and the growth of industrial outputs (high productivity).

New production systems created job opportunities and a new type of accommodation for more and more workers who moved from farm to city (urbanisation). New types of transport infrastructure were also established, such as railways, canals, and road networks (Adams and Mouatt, 2010). Moreover, the city population's growth exploded based on high productivity and increased incomes per person. Glaeser (2011) describes that it led to certain advantages for cities, such as high wages, fast speed of knowledge exchanges, and better connectivity to travel. In contrast, it also caused disadvantages, such as increased inequality, crime, high cost of living and long commuting times (Glaeser, 2011).

3.2. Previous Industrial Revolutions

Period	Transition Period	Energy resource	Main technical achievement	Main developed industries
I.1760-1900	1860-1900	Fossil fuel (Coal)	Steam engine	Textile, steel
II.1900-1960	1940-1960	Oil, Electricity	Internal combustion engine	Metallurgy, Auto, Machine building
III.1960-2000	1980-2000	Nuclear Energy, Natural Gas	Computers, Automation, robots	Auto, chemistry, information industries
IV.2000-	2000-2010	Green Energies	Internet, 3D printer, Genetic Engineering	High tech industries

Table 2. *Main characteristics of industrial revolutions (adapted from PRISECARU, 2016)*

The previous Industrial revolutions created significant social changes and opportunities (Schwab, 2017). Those revolutions are not sudden events but a chain based on the previous revolution (Xu,David and Kim, 2018). Janicke and Jacob (2013) suggest that industrial revolutions have historically had *a preceding phase* in which pre-existing technologies and manufacturing methods did not lead to further improvements while new technologies were developed. In this phase, leading technologies and devices' costs decreased, and labour productivity was steady (Greenwood, 1999).

The first industrial revolution started in Britain in 1784 with the mechanisation of the textile industry. During the early 18th century, cotton production relied entirely on the manual labour of weavers in what was known as the cottage industry—a traditional, small-scale craft business primarily situated in rural areas (Snell, 1984). The introduction of the steam engine and mechanical power resulted in the formation of cotton mills, factories, and the concept of industrialisation. It is characterised by using water and **steam power**, fossil fuel and mechanical power (WEF, 2016b).

The second, between the 1870s and 1940s, they brought a mass production system harnessed by **electric power**. Around 1900, electricity replaced water and steam as the primary energy source in manufacturing processes, leading to increased productivity thanks to electric motors and engines (Greenwood, 1999). Later, electric power also became the foundation of inventions such as radio, television, and computers, which led to the transformation of lifestyles (Greenwood, 1999). For instance, incomes increased while working hours decreased. Social insurance was first introduced, and nutrition and housing conditions were improved (Mokyr, 1988). During the Second Industrial Revolution, macro inventions and micro inventions were introduced in various sectors such as energy, materials, chemicals, and, most notably, manufacturing. Mokyr (1988) describes two significant changes in the second revolution. The first change occurred in organisations' production systems. The most well-known example is Henry Ford's assembly line. The automated system was for his automobile business, allowing him to mass-produce a low-cost complex product. The second change, as a consequence of the first change, was the establishment of technical systems (Mokyr, 1988). Before 1870, railroad and telegraph networks and urban infrastructures such as gas, water supply, and sewage systems had already been developed. However, after 1870, those technological systems were widely used and distributed from limited groups to a wide range of groups. As a result of the first two industrial revolutions, people gained more income than before and moved to cities (Gollin, Jedwab and Vollrath, 2016). However, as the limitation of fossil energy, which was the primary energy resource during the first and second revolutions, was apparent, there were social and political needs for the transformation (Janicke and Jacob, 2013).

The third industrial revolution began in the 1950s, and it was breakthroughs in **electronics, automated production, information technology, and digital technology** (WEF, 2016b).

It also was often called the Digital Revolution as it coincided with the adoption of digital computers and record-saving systems. This revolution is closely associated with the adoption of digital computers and digital record-keeping systems (Sinčić, Katić and Čandrlić, 2019). The Digital Revolution encompasses many developments, including advancements in mass production and digital innovations like computers, mobile phones, and the Internet. These innovations have not only transformed conventional business and production methods but have also had a profound and far-reaching impact on society. The transition from mechanical and analogue electronic technologies to digital electronics has enabled faster and more efficient information exchange, heralding the beginning of the Information Age (Bojanova, 2014). The term describes the contemporary period that surfaced during the mid-20th century. In this era, information has evolved into a precious resource, swiftly, extensively distributed, and easily obtainable, mainly because of the widespread utilisation of computer technology and digital communication systems (Merriam-Webster, n.d.).

Technology and society

Examining the industrial revolutions throughout history reveals a clear relationship between technology and society. MacKenzie and Wajcman (1999) state that technology is essential to everyday life and deeply intertwined with society. They explain that technology influences the material aspects of our surroundings, including our biological and physical environments and how we interact socially (MacKenzie and Wajcman, 1999). Specifically, Antonucci, Ajrouch, and Manalel (2017) argue that social relations, which form the fabric of society, have been influenced by emerging technology in various ways, such as enhancing, decreasing, sustaining, or even avoiding social interaction. This indicates that technology has both positive and negative effects on society. For instance, they suggest that technology can be used to overcome conventional barriers to socialising and sharing information, while it can also dehumanise society and increase negativity (Antonucci, Ajrouch and Manalel, 2017). Given this double-edged nature of technology in society, MacKenzie and Wajcman (1999) propose that society should actively shape technological development through democratic participation.

Technology and politics

Technological development influences not only society but also politics. Susskind (2018) argues that the paradigm of politics has shifted since the twentieth century. Previously, the focus was on the influence of the government on collective social life and the relationship between the market and civil society. However, he points out that in the twenty-first century, political power control depends on powerful digital technologies, such as algorithms, that control information that the public can access. This means that entities controlling these technologies can exert significant influence over society. Consequently, political authorities, including governments, now have more means to control the public (Susskind, 2018). Moreover, (Lindman, Makinen and Kasanen,

2023) claim that Big Tech companies, particularly the 'Big Five'—Google, Apple, Meta, Amazon, and Microsoft—have transformed into political actors rather than merely economic operators in the market. Their power poses potential risks to democratic values and could limit fundamental public rights (Lindman, Makinen and Kasanen, 2023). This transformation has also led to corporate surveillance and monopolistic practices (Birch and Bronson, 2022).

3.3. The Fourth Industrial Revolution (4IR)

After the World Economic Forum (WEF) annual meeting in Davos in 2016, the Fourth Industrial Revolution (4IR), a term that was the theme of the meeting, has been discussed worldwide. The term was initially coined by Klaus Schwab, founder and executive chairman of WEF. His description of its characteristics is widely quoted as *"characterized by a much more ubiquitous and mobile Internet, by smaller and more powerful sensors that have become cheaper, and by artificial intelligence and machine learning"* (Slaughter, 2016). Later, Schwab (2017) describes the 4IR as a significant advancement enabling new capabilities, covering artificial intelligence (AI), robotics, the Internet of things (IoT), autonomous vehicles, 3D printing, biotechnology, and material science. Meanwhile, others argue that this fourth revolution can be described as *"a fusion of technologies,"* which connects physical to cyber systems (HM Government, 2017) in different industrial sectors such as manufacturing, services, and even human activities (PRISECARU, 2016). The new phase in the industrial revolution focuses on digitalisation (**Part 3.2**), interconnectivity (**Parts 3.4.2** and **3.4.3**), automation (**Parts 3.4.6** and **3.4.7**), artificial intelligence (**Part 3.4.5**), and big data (**Part 3.4.1**). Those related technologies are widely implicated in everyday life (Greenfield, 2017).

There are many various terms related to the 4IR. The Fourth Industrial Revolution (Schwab, 2017) has been widely used in the UK, while other terms include Industry 4.0, which was introduced at the Hanover Fair in Germany, and Connected Enterprise in the United States (Morrar and Arman, 2017). The term *Industry 4.0* was introduced by the German Government for their future high-tech strategy in 2020 to increase the competitiveness of German and European Union industrial sectors from other global competitors. It became common in the German-speaking area (Lasi *et al.*, 2014). The previous three Industrial Revolutions are called Industry 1.0 to 3.0 (Yin, Stecke and Li, 2018). The German strategy concept has been widely adopted by European countries, India, China, and other countries. A fundamental principle of Industry 4.0 is related to industry, in particular, manufacturing. Gilchrist (2016) suggests the four main characteristics of Industry 4.0: (1) vertical integration of smart production systems, (2) holistic integration through global value chain networks, (3) through-engineering across the entire value chain, and (4) acceleration of manufacturing.

The concept of the 4IR is linked to the adjectives *smart* and *intelligent* even though nowadays, these terms are popularly used but ambiguous and without clear definitions. According to Goddard, Kemp and Lane (1997), in the context of technology, they describe a wide range of technologies, systems, and materials that originated in the 1980s when researchers in the US explored futuristic systems which integrate powerful computers, sensors, and advanced materials. The systems could monitor operating systems in real-time and respond promptly (Goddard, Kemp and Lane, 1997). In the contemporary era, this description reflects the capabilities of powerful computing systems, including Machine Learning (ML) and AI (Spohrer *et al.*, 2017). These systems or devices embedded in the systems can collect data and process it to conduct intellectual reasoning (Goddard, Kemp and Lane, 1997), which results in efficient performance (Silverio-Fernández, Renukappa and Suresh, 2018).

The shifts and the ripple effects of the 4IR will change how people live. Wadhwa and Salkever (2017) note that *"far, larger, though, is happening far faster."* While the 4IR sounds promising, with optimistic visions ranging from artificial intelligence, ubiquitous computing, and advancing robots to driverless cars, some dystopic pessimists argue that the 4IR will cause more problems, such as technological unemployment, cybercrimes, and inequality. Most studies have acknowledged that the 4IR can be a double-edged sword. Its impact is unprecedented in its scale, speed, and complexity. In the national aspect, according to the UK Industrial Strategy report (HM Government, 2017), the 4IR and its emerging technologies are highlighted as grand challenges that the country must respond to. The technologies and their impact on society, recognised as *wicked problems* (discussed in **Part 2.1.1.1**), have raised concerns for policymakers (Ruysenaar, 2020). Social issues, such as inequality and sustainability, including climate change, have been challenging globally. They became *wicked problems* (**Part 2.2.1**) where it is difficult to point out precise starting or finishing points of the problem (Middleton, 2005; Morrar and Arman, 2017).

While Schwab claims that human beings should build *"a new collective and moral consciousness based on social agreements"* (WEF, 2016a), others suggest applying collective intelligence and creativity to solve wicked problems from the 4IR (How *et al.*, 2019). Morrar and Arman (2017) point out that the approaches should be more inclusive and include a creative platform that enables multidisciplinary experts and creative people, such as engineers, social scientists, and artists, to work together for novel solutions.

3.4. Key technological drivers

There are diverse technologies that drive the 4IR (Schwab, 2013). The following parts present the selection of key technological drivers of the 4IR relevant to this research, starting from big data and cloud computing (**Part 3.4.1**), sensor technology and Internet of Things (IoT) (**Part 3.4.2**), edge and fog technology (**Part 3.4.3**), wearable technology (**Part 0**), Artificial Intelligence (AI) (**Part 3.4.5**), advanced robots (**Part 3.4.6)** and autonomous vehicles and drones (**Part 3.4.7**). The selection is based on the research focus on investigating place-based implementations of digital technology. Therefore, this chapter will not discuss the less relevant areas to the research focus, such as biotechnology and material science, which are included as the 4IR's drivers in the literature (Schwab, 2013, 2017).

3.4.1. Big Data and Cloud computing

Today, people rely on Information and Communication Technologies ICTs to record, transmit and use data on all matters (Floridi, 2015). Also, the ability and devices to store, manage and understand data have been improving than ever before (Schwab, 2017). The concept of 'big' data was first used *"referring larger volumes of scientific data for visualisation"* (O'Leary, 2013). There are various definitions of big data. The most known version is from IBM, highlighting big data characteristics with three 'V' words: **volume**, **variety**, and **velocity**. The volume of data means a large amount of data gathered via new sources. The sources include sensors, IoTs (discussed in **Part 3.4.2**), and connected and wearable devices (**Part 3.4.4**). Furthermore, it can also refer to social media platforms like Twitter and Facebook (Niebel, Rasel and Viete, 2019). Second, variety refers to an enormous amount of data and a wide range of data collected from various devices and web browsers, such as blog posts, images, videos, and audio (O'Leary, 2013). Those different kinds of data enable us to analyse different situations. Last, velocity refers to the speed of generating and processing data.

Bahrami and Singhal (2015) argue that utilising Big Data is significant in various domains, such as the global economy, scientific and social research, education and national security. Implementing data at a large scale offers advantages regarding informing and creating meaningful insights extracted from raw data. Consequently, it contributes to better decision-making processes and knowledge distribution. However, they state that Big Data introduces additional challenges to existing concerns regarding data analysis, visualisation and reliability. This is because Big Data is inherited by its complex relations and the high dimensionality of its data sets (Yang *et al.*, 2017).

Cloud Computing is relevant to the field of Big Data. According to Velte and Elsenpeter (2010), the term originated from the metaphoric representation symbolised as a cloud icon. This metaphor indicates that *everything* is required for the network to operate. In other words, Cloud Computing enables users to connect with other devices remotely (Velte and Elsenpeter, 2010). So, it is a significant technology for Big Data systems to store data, categorise it into data clusters and offer diverse services through a network. Users can save and process considerable amounts of data within the Cloud Computing platforms using cloud-based data clusters (Bahrami and Singhal, 2015).

3.4.2. Sensor technology and Internet of Things (IoT)

In 1965, Gordon Moore, the co-founder of Intel, observed the trend that the number of components on an integrated circuit had doubled every year. He predicted this trend would last at least another decade (Schaller, 1997). Moore's prediction is strongly linked to further improvements in the digital electronic industry, such as reduced microprocessor prices, increased memory capacity, and advancing sensor technology. Because computing power has increased and hardware prices have dropped, it has become financially and technically feasible to allow more people and more things to connect to the Internet (Gilchrist, 2016). Following Moore's law, sensors have also become smaller, cheaper, and smarter in recent years, making related technologies and applications more accessible than before (Gilchrist, 2016). In general, smart sensors can sense, measure, and gather data from the users and environments and send the sensed data back to the user for monitoring. These sensors can be connected within a network when added to wireless interfaces. Wireless sensor networks (WSN) have been widely used in various applications, such as military, health, business, environment, public and industrial tracking, and monitoring (Yick, Mukherjee and Ghosal, 2008).

Various Internet of Things (IoT) applications utilise multiple sensors to establish interconnected environments. These sensors have different purposes, such as proximity, temperature, humidity, chemical, position, motion, pressure and more (Sehrawat and Gill, 2019). Kanehisa *et al.* (2014) characterise sensors as integrating with everyday objects via coding and networking, enabling them to transmit readable and traceable data online. They forecasted that interconnected devices will reach 24 billion by 2020. IoT accelerates the connection of both living and non-living entities, leading to transformative changes (Ghosh, Chakraborty and Law, 2018). Different network media are utilised to establish these connections. Farhan *et al.* (2017) summarise the conceptual perspective of IoT as follows:

Internet of Things = Human + Physical Objects (such as sensors, controllers, devices, storages) + Internet

IoT's primary aim is to improve physical objects' flexibility and convenience. The IoT has experienced a substantial increase in the field of smart devices, offering smart functionalities. The IoT is combined with numerous technologies, not only sensors but also RFID (Radio Frequency Identification) and embedded other forms of computing such as fog computing (**Part 3.4.3**) or cloud computing (Greenfield, 2017; Sehrawat and Gill, 2019). The broad dissemination of IoT has resulted in ubiquitous connectivity and accessibility of intelligent services for individuals. Krishnamurthi *et al.* (2020) present an overview of IoT architecture (**Figure 13**).

The first phase describes the IoT sensor data layer (at the bottom of the diagram), consisting of diverse IoT sensors capable of sensing the physical environment and capturing real-time data from the surroundings. The second phase is the data processing layer, which executes different activities such as removing noise from data, identifying errors and variations, and integrating with existing data. Then, the third layer of data fusion is responsible for managing challenges from using different sensor devices. The combined data from several sources is subsequently delivered to the next phase, data analysis later. This phase (on the top of the diagram) provides meaningful knowledge and improves the accuracy of decision-making processes. Integrating emerging technologies has transformed cloud computing (**Part 3.4.1**), fog computing, and edge computing (**Part 3.4.3**) in the context of IoT sensor data analysis (Krishnamurthi *et al.*, 2020).

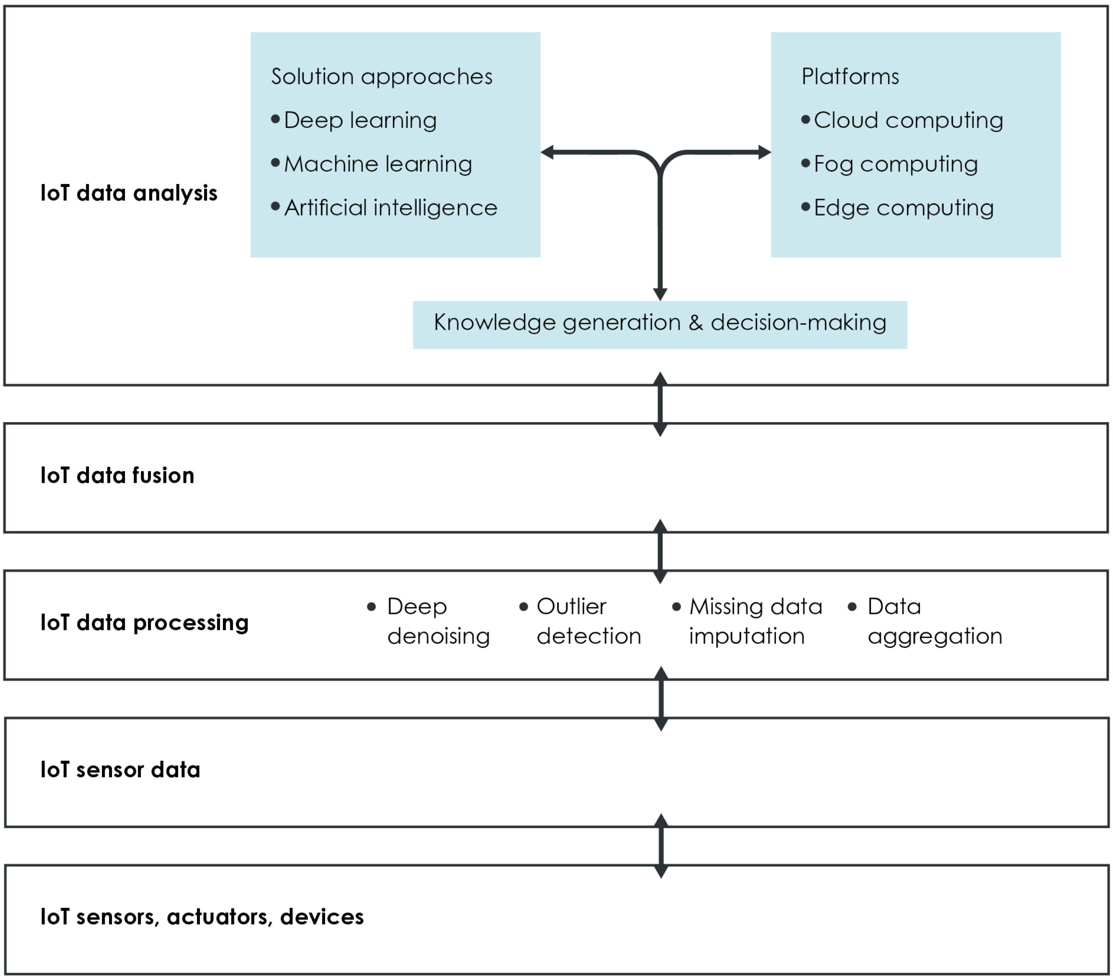

Figure 13. *The overview of architecture for IoT sensor data processing, data fusion, and analysis (Krishnamurthi et al., 2020)*

The growth of IoT applications has led to more sophisticated applications collaborating with humans and things. This symbiotic relationship between humans and IoT devices enables enhanced functionality and performance in various domains (Farhan *et al.*, 2017). Sehrawat and Gill (2019) highlight some applications for utilising IoT sensors in a smarter IoT environment.

The summary of the applications is summarised in **Table 3**. The term smart, used here, means advanced computing systems and devices, such as those integrated with machine learning and AI, as mentioned on pages 40 to 41.

Setting	Application
Smart cities	Applications of smart cities integrate with several areas, including smart parking, structural health monitoring, smart noise handling, smart traffic management, smart waste management, smart lighting, and smart roads.
Smart environment (Smart earth)	Smart earth or smart environment includes monitoring wildfires and air pollution and any early detection of catastrophic events.
Smart water	Smart water refers to IoT sensors detecting water leakages or flooding.
Smart security	Smart security ensures security in the environment. For instance, the smart system can restrict non-authorised people from accessing certain areas.
Smart transport	It is mostly based on the Global Positioning System (GPS), which enables the tracking of items during transportation. Shipping conditions can be improved by implementing vibration level and impact monitoring.
Smart agriculture	Sensors are used in different agricultural contexts with multiple objectives, such as detecting soil moisture levels, measuring climate conditions, automatically watering crops, or applying pesticides.
Smart homes	In the context of smart homes, various sensors allow house residents to control appliances and monitor a house remotely, such as intrusion detection systems and energy and water conservation measures.
Smart health	Individuals incorporate intelligent health systems, which frequently involve wearable technologies, to monitor their biodata in various environments, including hospitals, workplaces, and homes.

Table 3. *IoT applications in connected settings adopted by Sehrawat and Gill (2019) and Farhan et al. (2017)*

The deployment of IoT may lead to colonising everyday life (Greenfield, 2017), besides its technical challenges. The main concerns have been identified as digital divides and digital literacy concerning IoTs (Rasheva-Yordanova, Kostadinova and Toleva-Stoimenova, 2021; Van Deursen and Mossberger, 2018). Rasheva-Yordanova, Kostadinova and Toleva-Stoimenova (2021) claim that utilising IoTs requires specific knowledge and skills of intricate technologies, which could benefit those in possession. They pointed out that this potential benefit of IoTs indicates the possibility that this technology could accelerate pre-existing inequalities in society. In particular, vulnerable populations, including individuals with limited resources and health conditions, may be at risk for abuse within the IoT systems systems (Van Deursen and Mossberger, 2018).

3.4.3. Fog and edge computing

There are several requirements to support increasing Internet deployment, including the IoTs. According to Bonomi *et al.* (2012), the requirements include mobility support, geo-distribution abilities, location awareness and low latency. Fog computing plays an essential role in supporting these requirements. The term fog indicates a cloud-like feature. In computing, it refers to platforms with cloud-like capabilities near the ground, close to the IoT device (Bonomi *et al.*, 2012). Fog computing is an intermediary that facilitates communication between the cloud and IoTs. It expands the potential applications of cloud computing and improves the resource availability of IoT systems (Bellavista *et al.*, 2019).

Edge computing is a physical computing infrastructure between the device and the hyper-scale cloud, which refers to the Internet edge. Escamilla-Ambrosio *et al.* (2018) outline the difference between Internet and IoT edge. The term Internet edge refers to the network infrastructure that establishes and facilitates connectivity to the Internet. This infrastructure serves as a gateway for organisations to more comprehensive cyberspace. On the other hand, the IoT edge includes smart devices, including sensors, actuators, and smart (Escamilla-Ambrosio *et al.*, 2018). The Internet edge facilitates a wide range of applications through data processing capabilities to end users, devices, and data sources. By doing so, the edge computing approach decreases the need for data to be transmitted to the cloud data centre (Ometov *et al.*, 2022).

Both fog and edge computing aim to decentralise IoT systems, reducing costs, improving scalability, and enhancing robustness (Syed *et al.*, 2021). **Table 4** compares fog and edge computing with cloud computing, highlighting their distinct characteristics.

	Cloud computing	Fog computing	Edge computing
Architecture	Centralised	Distributed	Distributed
Latency	High	Varying but higher than Edge	Low
Expected processing time	High	Low	High-medium
Security	Centralised (guaranteed by the Cloud provider)	Mixed (depending on the implementation)	Centralised (guaranteed by the Cellular provider)
Scalability	Average	High	High
Energy consumption	High	Varying but higher than Edge	Low
Storage capacity and computation	High	Varying	Very limited

Table 4. *The comparison among cloud, fog and edge computing (Ometov et al., 2022)*

3.4.4. Wearable technology

In 1999, Billinghurst (1999) described wearable computers as ranging from *"small, wrist-mounted system"* to *"bulky backpack computers."* Smart electric devices are small, so they can be worn on the surface of the human body, where they become the source of biometric data such as blood pressure, step counts, heart rate, and sleeping. Godfrey *et al.* (2018) classify wearables into two main categories. First, primary devices that operate independently and serve as central connectors for other devices or information, such as wrist-worn fitness trackers or smartphones. Second, secondary devices capture specific actions or perform measurements, like a chest-worn heart rate monitor, offloading the data to a primary wearable device for analysis. These categories might encompass smart textiles, materials with physical properties that can measure or respond to stimuli from the user or the surrounding environment.

Dian, Vahidnia and Rahmati (2020) examine the latest research on wearable devices and categorise these applications into four main clusters: health, sports, daily activity, tracking and localisation, and safety. First, the health wearable IoT device aims for remote patient monitoring, treatment, and rehabilitation (Greenfield, 2017; Chawla, 2020). Second, the sports and daily activity cluster focuses on wearables used during sports activities to capture various metrics and improve the performance of users or athletes (Huifeng, Kadry, and Raj, 2020). Additionally, these applications involve gathering data to recognise the daily activities of both humans and animals. Third, the tracking and localisation category primarily involves wearables used to track the location of individuals or animals in real-time. Lastly, the safety cluster comprises wearables that aim to provide a safe environment for users. For example, the wearables can monitor driver fatigue or collect air quality data in mining to safeguard workers and reduce risks while minimising expenses for employers (Dian, Vahidnia and Rahmati, 2020).

3.4.5. Artificial intelligence (AI)

Diverse definitions of Artificial Intelligence (AI) continue to complicate the definition of AI across academic studies. Although diverse definitions exist, the majority of definitions share vital features. Bartoletti (2020) explains its feature by focusing on the term *artificial*, which describes something non-natural produced by humans or even machines. According to Kok *et al.* (2009), AI is a system that mimics human behaviours and thoughts and performs rational behaviours and thoughts. Combining both features, AI is artificially created, a system by humans that behaves and thinks in a way equivalent to humans and makes rational behavioural decisions. Furthermore, beyond invisible programs, AI is often presented as a vehicle or a robot embedded in a system programmed by humans to identify and react to surroundings. It also detects contexts and undertakes actions responding to those caught contexts (Bartoletti, 2020). In a broad context, AI integrates various disciplines and applications ranging from virtual assistants such as Apple's Siri and automated retail stores such as Amazon Go to autonomous vehicles (Wang and Siau, 2019).

AI can be classified according to its different levels of intelligence. Artificial Narrow Intelligence (ANI), Artificial General Intelligence (AGI), and Artificial Super Intelligence (ASI) are the three levels of AI (Reese, 2017; Strelkova, 2017). First, Artificial Narrow Intelligence (ANI) indicates AI specialised to outperform human capabilities within a particular area. For instance, Deep Blue, programmed by IBM, can play chess exceeding human players. However, it lacks any other functionalities. Second, Artificial General Intelligence (AGI) refers to any AI that exceeds human-level intelligence. AGI's capabilities include justifying logically, planning strategically, solving problems, thinking abstractly, learning fast and building knowledge from experience. Third, Artificial superintelligence (ASI) describes a high level of intelligence across almost all domains, such as creativity and social skills. Within this description, ASI exceeds all human capabilities (Strelkova, 2017).

According to Jakhar and Kaur (2020), AI is an umbrella term for any computer program with intelligent behaviour, including machine learning (ML) and deep learning (DL). However, these concepts can be distinguished by their distinct characters (**Figure 14**). AI encompasses a broad range of machine or system capacities to demonstrate intelligence and behaviours like humans. ML is a subset of AI to gain knowledge from data or experience in the past. It can efficiently integrate information by learning from large datasets, which empowers them to perform outstandingly in various tasks, such as facial recognition, translation and more (Reese, 2017). Then, DL is a subset of ML which applies learning strategies that employ multi-layer neural networks for data processing and computations (Sarker, 2021). In other words, DL can examine and analyse data through ML algorithms and artificial neural networks with multiple hidden layers (Ongsulee, 2017).

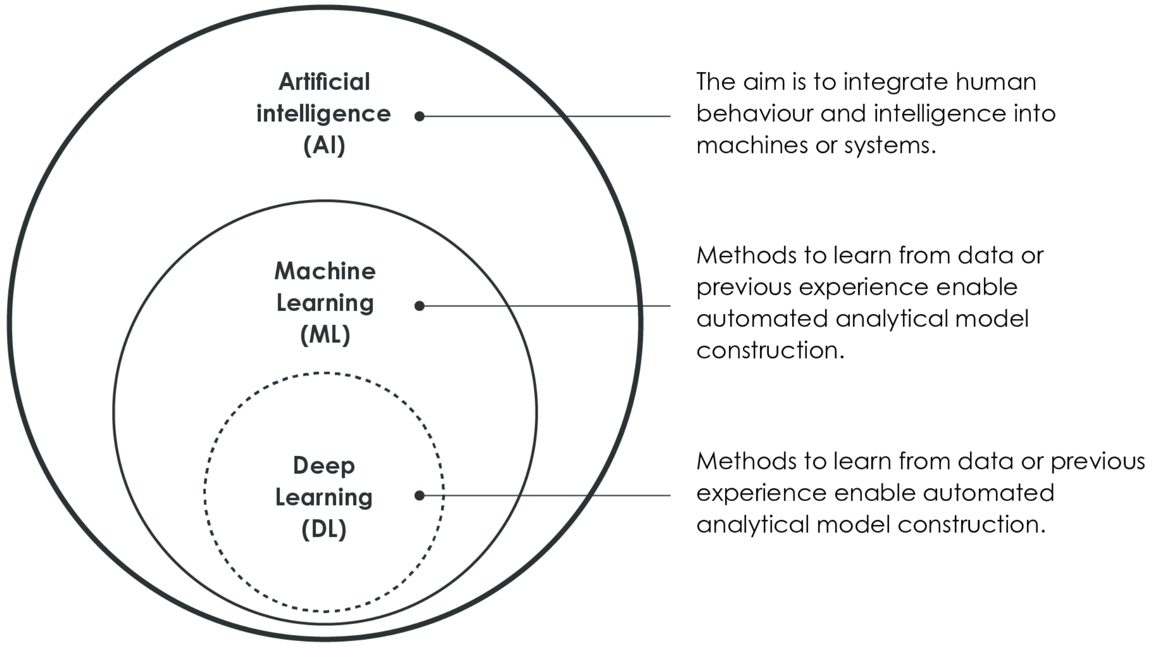

Figure 14. *The relative placement of deep learning (DL) in comparison to machine learning (ML) and artificial intelligence (AI) according to Sarker (2021)*

AI has been applied in numerous industries—including healthcare, education, cybersecurity, the military, residential setting and business—promoting the standardisation of product and service qualities (Nadimpalli, 2017; Wang and Siau, 2019; Greenfield, 2017). Furthermore, the implementation of AI has also increased in risky environments. With its reliability and applicability, AI can perform dangerous and physically demanding tasks instead of humans (Wang and Siau, 2019). In the mining industry, for instance, mining companies utilise both human expertise and AI to achieve optimal outcomes while safeguarding the well-being of employees (Nadimpalli, 2017). In fact, AI is already generating various effects on the job market regarding human labour replacement. Benbya, Davenport and Pachidi (2020) report that it is expected to significantly influence different occupations by automating repetitive and monotonous tasks, potentially rendering specific human skills obsolete. AI technology capable of automating specific job tasks is already being implemented in workplaces. They exemplified applications in law firms to automate tasks like due diligence and contract review, which junior lawyers traditionally handled. Moreover, while AI systems cannot wholly replace human experts, they can augment their work by supporting judgment and decision-making processes. Their study highlights AI systems as valuable tools for professionals rather than complete substitutes (Benbya, Davenport and Pachidi, 2020).

However, despite the benefits of this cutting-edge technology, it has also introduced significant risks for individuals and society. According to Wang and Siau (2019), potential risks regarding AI can be categorised into four layers: (1) data, (2) process, (3) economic impact and (4) social impact (**Figure 15**). Each layer is not separated but interconnected to others, influencing and causing issues.

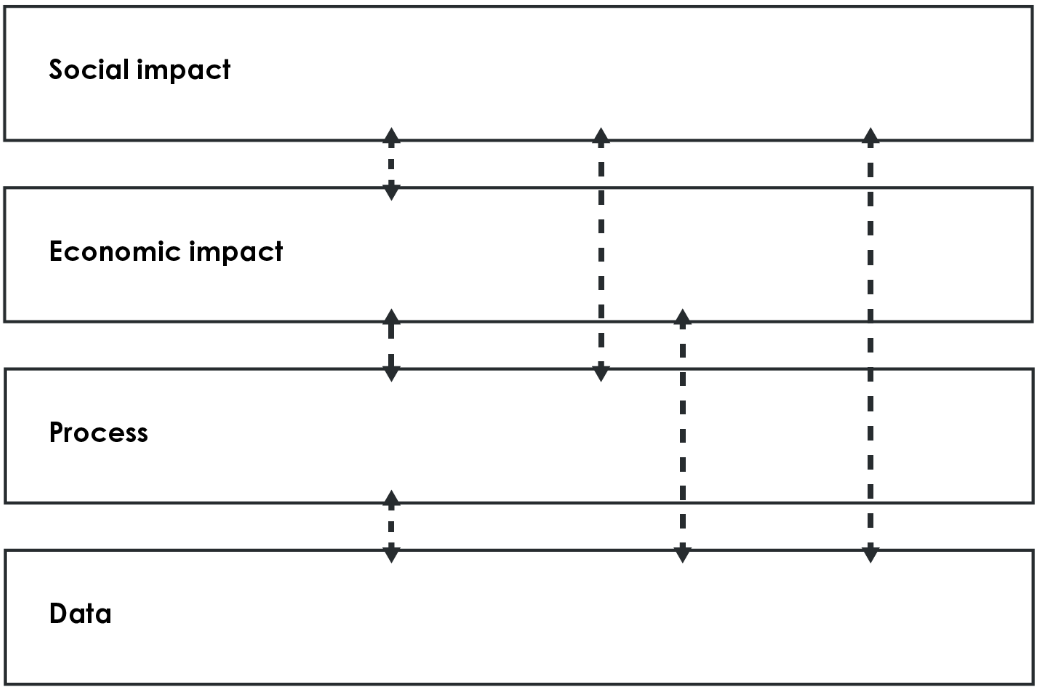

***Figure 15**. Four layers of risks regarding AI systems*

The first layer relates to risks associated with data. Nadimpalli (2017) points out that the effectiveness of AI is dependent on the quality of data. Several issues are resulted when collected data is not accurate or misleading. Wang and Siau (2019) claim a technical constraint of AI bias inherited by human programmers, which will influence how data is handled within the systems. This potential risk of AI can affect individuals directly, violating their privacy and society (Jia and Zhang, 2022). However, there is tension between ensuring users' privacy and enhancing the autonomy of AI systems with the growing need to process large amounts of data (Benbya, Davenport and Pachidi, 2020). The second layer indicates process-related risks. In particular, Wang and Siau (2019) criticise the nature of AI as a *black box*, which is characterised as unpredictable and less transparent. The lack of transparency worsens the difficulty of understanding the decision-making process of AI systems and the reasoning behind the process. In the third layer, there are risks related to the economic impact caused by AI. Zajko (2022) envisions a future in which the *coding elite* strengthens wealth and power even more, accelerating inequalities. The last layer includes risks regarding the social impact of AI, such as human job replacement and displacement (Daugherty and Wilson, 2018). Not only that, but this dimension also highlights the need for legal requirements and regulations and ethical and moral considerations when implementing AI (Wang and Siau, 2019).

3.4.6. Advanced robots

As the 4IR technological driver, robots are a rapidly growing technology industry fundamentally reshaping the employment market and business environment (West, 2018). In the past, people imagined robots as bulky machines built for specific fixed tasks, frequently replacing human labour. However, the most recent generation of robotics has incorporated AI and sensors, enabling them to be smaller and capable of performing complex and adaptable tasks (Daugherty and Wilson, 2018). According to West's book *"The Future of Work: Robots, AI, and Automation"* (2018), implementing robotics is advantageous in various sectors, including construction, manufacturing, personal security, and rescue operations. These advanced robots have the capability to automate tasks that humans previously performed. Robots have especially been adopted in service-related industries. As exemplified in the book, former CKE Restaurants CEO Andrew Puzder states the benefits of automated robots, including punctuality, politeness, no need for vacations, and any risks related discrimination, accidents, and legal disputes (West, 2018).

Even though robots increase productivity and efficiency, they raise concerns regarding replacing human labour (Pol and Reveley, 2017). Initially, robots were employed in blue-collar sectors, such as service, delivery, and manufacturing. The emergence of software programmed to automate administrative tasks has led to integrating robotics into white-collar jobs (West, 2018; Pol and Reveley, 2017). Belk (2021) also raises concerns about implementing robotics in an urban environment, increasing the prevalence of ubiquitous surveillance in online and street environments.

3.4.7. Autonomous vehicles and drones

Over the last thirty years, driverless vehicle technologies have been developed via computing technologies (Paden *et al.*, 2016). Autonomous vehicles refer to various types of vehicles utilising advanced technologies, including diverse terms, such as driverless cars, self-driving cars, robotic vehicles and even drone delivery. The common characteristics of autonomous vehicles often include cameras and sensors to prevent collisions, an AI assistant linked to maps, real-time information and data on streets and surrounding environments (West, 2018). Furthermore, drones are also considered autonomous aerial vehicles that perform without human pilots on board (Zhang and Kamargianni, 2022). According to Smith (2015), drones have diverse applications across industries, including forest monitoring, fire mapping, wildlife surveying, air quality monitoring, mine surveying and agriculture facilitation. These are a few examples of other areas where drones can be applied.

As outlined in the SAE (the Society of Automotive Engineers) standard (**Table 5**), driving automation and classification systems can be categorised into five levels. The five levels range from no automation to full automation. According to this framework, autonomous vehicles are autonomous when they independently carry out all driving tasks in different environments (Faisal *et al.*, 2019).

Level	Name	Definition
Human driver monitors the driving environment		
0	No Automation	The full-time performance by the human driver of all aspects of the dynamic driving task, even when enhanced by warning or intervention systems.
1	Driver Assistance	The driving mode-specific execution by a driver assistance system of either steering or acceleration/deceleration uses information about the driving environment with the expectation that the human driver performs all remaining aspects of the dynamic driving task.
2	Partial Automation	The driving mode-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the human driver performs all remaining aspects of the dynamic driving task.
Automated driving system ("system") monitors the driving environment		
3	Conditional Automation	The driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task with the expectation that the human driver will respond appropriately to a request to intervene.
4	High Automation	The driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task, even if a human driver does not respond appropriately to a request to intervene.
5	Full Automation	The full-time performance by an automated driving system of all aspects of the dynamic driving task under all roadway and environmental conditions that can be managed by a human driver.

Table 5. *SAE International levels of driving automation, according to SAE International (2014)*

Kaur and Rampersad (2018) claim that traditional automobiles are considered unsustainable due to their carbon emission, heavy traffic, and causes of accidents, while autonomous vehicles have been designed with environmental consciousness. Moreover, they are expected to increase the efficiency of transportation systems and reduce traffic-related fatalities resulting from human driver mistakes and negligence (Kyriakidis, Happee and De Winter, 2015).

Despite their benefits, more trust and agreement still need to be built that autonomous vehicles will be beneficial. The first self-driving car fatality in history happened in May 2016. Tesla's car, Model S, collided with a tractor-trailer truck at full speed, and the owner of the vehicle died. This happened because the autopilot failed to distinguish between the white side of the trailer and a lit sky so that the car never slowed down (Greenfield, 2017). In the long term, Wiseman (2022) points out that autonomous vehicles can potentially cause widespread unemployment for professional drivers like taxi and truck drivers in the automotive industry. Also, he argues that there is a risk of cybercrime or cyberterrorism as vehicles become exclusively controlled by computers. Consequently, a new form of car theft involving autonomous vehicles may emerge. Lastly, he highlights that there is already a problem with traffic congestion in many cities and highways. He anticipates introducing autonomous vehicles will exacerbate congestion due to various factors (Wiseman, 2022).

In the case of drones, Zhang and Kamargianni (2022) state that despite the long history of drone technology, how the public will perceive civil drone applications, such as parcel delivery and flying taxis, still needs to be determined. They categorise factors of public acceptance as influenced by application purposes (why), usage contexts (where), and technology-related features (how). The uncertainty and various elements affecting public perceptions indicate a challenge to gaining public acceptance for new technological applications in our everyday lives. Moreover, according to Faisal *et al.* (2019), more responsibility and action are required in policy, legal development, urban planning, and urban management to deal with the potential consequences of autonomous vehicles. Consequently, introducing new technology can take over traditional transportation. Despite the urgent need, there needs to be more clarity in understanding how these emerging capabilities will lead to disruptions and what measures should be undertaken (Faisal *et al.*, 2019).

3.5. Place-based technology implementations

In the previous parts, the key technology drivers of the 4IR, which can be implemented in place-based settings, have been discussed. The emergence of the 4IR has forced individuals to become digitally connected beyond physical barriers. This transition has redefined the concept of place in physical and digital domains. Consequently, hybrid spaces have materialised, allowing individuals to experience a space physically and digitally (De Souza e Silva, 2006). In particular, digital spaces have grown to represent, such as digital twins, which reflect on physical spaces in real-time and effectively encourage innovation and physical operations (Batty, 2018). Within the existing built environment, sensors have been strategically placed and incorporated into a cyber-physical system that autonomously monitors the physical world (NCSC, 2021).

Thus, the following part will examine smart cities and connected places, which are relevant concepts utilises those key drivers for place-based technology implementations. The selection was because, as mentioned above, the researcher is interested in exploring how individuals without design and technology expertise can speculate and design the future of digitally connected public spaces. The researcher's interest directs the literature exploration towards the 4IR technologies implied in physical spaces.

3.5.1. Smart city

According to Kitchin, Lauriault and McArdle (2015), since 2010, smart cities have become popular in the urban context, with cities worldwide aiming to be *smarter*. However, there is no clear agreement regarding what constitutes a smart city. They highlight two perspectives on smart cities. First, smart cities are distinguished by an urban system equipped with *everywhere*, which integrates urban infrastructures, digital devices, and sensors to improve urban management and governance (Greenfield, 2010). Smart cities are often characterised as a digital layer that combines with existing urban environments, establishing a network of interconnected technologies and activities (Hviid Trier and Jenkins, 2020). Kapitonov *et al.* (2019) argue that the proliferation of smart cities results from implementing information and communication technologies (ICT), IoTs, and robots. This integration will enable to manage the city and its surroundings effectively. The second aspect Kitchin, Lauriault and McArdle (2015) discussed is that innovative technology corporations and entrepreneurs propose smart city initiatives. Eventually, implementing the initiatives can encourage more job opportunities and increase the efficiencies and productivity of both governments and corporations (Kitchin, Lauriault and McArdle, 2015).

One example is the platform which Alibaba Group, a Chinese technology company, launched for urban environments in China. The City Brain demonstrates exceptional capabilities, including collecting massive amounts of data from various sources and performing real-time processing and intelligent computing tasks (Zhang *et al.*, 2019). This platform, including vehicle-to-infrastructure and vehicle-to-vehicle communication, improves driver and vehicle safety and public safety (Piccinini *et al.*, 2016). Alibaba stated that the platform had succeeded in 2017 and provided advantageous outcomes, such as a decline of 9.2% in peak hour congestion rates and a 15.3% increase in average travel velocities (Caprotti and Liu, 2022). However, there is a shortage of research examining the adverse effects of this initiative.

From an alternative viewpoint, Sadowski and Bendor (2019) claim that the concept of a smart city has been regarded as a sociotechnical imaginary. Although this imagined future has not yet materialised, it already existed in a collective vision. The definition of sociotechnical imaginaries relates to collective and institutionalised visions of desirable futures influenced by advancements in science and technology (Sadowski and Bendor, 2019). According to Jasanoff and Kim (2009), sociotechnical imaginaries frequently develop and expand due to national policies and regulations. In this context, smart cities can be regarded as commercial projects driven by multinational technology corporations that intend to maximise their financial profits. Sadowski and Bendor (2019) argue that it is vital to consider who benefits from its success and who holds the agency to control smart city initiatives.

Furthermore, *data-in-place* highlights the inseparable connection between data and its particular environment or surroundings, indicating where data is collected (Taylor *et al.*, 2015). The data-rich environments incorporate the more comprehensive connectivity infrastructure located in specific locations with deployed sensors and IoT devices. The functions may include traffic light management, CCTV monitoring, waste management, streetlight control, parking space management, and public services, including healthcare, social care emergency, and transport services (NCSC, 2021). The ultimate goal of this interconnected network is to improve resource allocation and operational efficiency for a place, which in turn contributes to sustainable development, growth in the economy, and the well-being of residents (Mohanty, Choppaliand and Kougianos, 2016).

3.5.2. Connected place

> *"A connected place can be described as a community that integrates information and communication technologies and IoT devices to collect and analyse data to deliver new services to the built environment and enhance the quality of living for citizens."*
>
> *(NCSC, 2021)*

Comparable to the term smart city, connected places include a broader range of physical locations. This concept indicates urban spaces and other geographics, such as small-scale towns, suburban regions, and rural areas (NCSC, 2021). For instance, connected technologies, which refer to technology enabling connected places, can be employed to offer services around predictive road maintenance, environmental monitoring, and healthcare services (DCMS, 2022). According to the Department for Digital, Culture, Media and Sport (DCMS) (2022), the term *smart* contains ambiguity of what smart technologies can do. Thus, organisations in the UK, including DCMS, the National Cyber Security Centre (NCSC) and The Centre for the Protection of National Infrastructure (CPNI), prefer the term *connected places* to integrate a broader spectrum of locations and their characters (DCMS, 2022). In contrast with the vast amount of literature allocated to smart cities, however, there is a shortage of academic research touching connected locations.

3.6. Issues and challenges of 4IR and connected places

Although 4IR and place-based implementation are anticipated to bring various advantages and opportunities, numerous issues and challenges have been highlighted across various levels, from the individual to the global. The literature identifies the following as challenges: (1) privacy and security, (2) transformation of labour, (3) scalability and complexity of systems, (4) policy and regulatory lag and others.

First, although 4IR and connected technology, such as IoT, wearable devices and AI, enable data collection through digital and information technology, this increased connectivity and data collection raise concerns regarding privacy and security. The issues become apparent when managing large quantities of sensitive data, which requires safeguards at multiple stages to prevent unauthorised access (Butt and Afzaal, 2019). For instance, the rapid growth of IoTs accelerates these concerns (Farhan *et al.*, 2017; Alferidah and Jhanjhi, 2020). Alferidah and Jhanjhi (2020) argue that protecting privacy and ensuring the security of IoTs are essential, as they can be applied in different contexts such as individual uses, business operations and transportation. They also warn that the architecture of IoT systems, which has become more intricate and extensive, enables hackers to exploit vulnerabilities that potentially result in attacks on IoT networks (Alferidah and Jhanjhi, 2020).

Furthermore, privacy concerns are associated with wearable technology, making revealing users' sensitive data possible. Through conducting a literature survey, Kapoor *et al.* (2020) draw attention to the privacy issues of wearables. First, the authorisation and authentication of the personal data is ambiguous. Second, data collected via wearable is threatened by unauthorised access to data that hackers can exploit. Third, third-party access to data could result in the misuse of the information for a corporation or personal interest. Fourth, one privacy concern is the possible real-time discourse of location data. Finally, mobile application providers responsible for managing users' data can misuse the data leading to privacy violations (Kapoor *et al.*, 2020).

The second issue concerns labour transformation resulting in 4IR. The concept of automation and autonomy has brought about substantial changes in how work is performed, such as robots replacing human workers (Pol and Reveley, 2017). This transition has also promoted questions about the role of human beings. Although the advancements of the 4IR may generate job opportunities in the technology sector, organisations have faced the challenge of preparing current workers to adopt and employ digital systems (Morrar and Arman, 2017). Moreover, Fields *et al.* (2020) point out that developing countries lacking skilled labour may struggle to bridge economic and social gaps, improve education, apply 4IR technologies, and develop infrastructure. This lack may accelerate the divide between developed and developing nations (Fields *et al.*, 2020). In connection with the second point, technological unemployment become an increasing concern (Caruso, 2018). The rate at which human labour is being supplanted by robotics appears to be increasing significantly, particularly in blue-collar sectors such as service and delivery (West, 2018).

Third, issues around the scalability and complexity of digital systems related to 4IR exist. For instance, IoT systems include various devices and infrastructures characterised by a protocol stack, data format and architecture design. This complicates large-scale connectivity and integration within heterogeneous IoT systems (Alferidah and Jhanjhi, 2020). Van Deursen and Mossberger (2018) point out that diverse dimensions within the systems result in less clarity and increasing ambiguity. These systems include interconnected and numerous organisations with diverse initiatives that may sometimes be in conflict (Van Deursen and Mossberger, 2018). Moreover, the increasing use of digital and information technology has reinforced connectivity, allowing sensors and devices to collect user data. This growth in technology has raised concerns regarding the possibility of a comprehensive system that individuals may not be able to completely disconnect from (Greenfield, 2010).

Fourth, one of the most significant challenges is that discussions regarding appropriate policies and regulations have lagged behind the rapid transformations of systems and everyday life caused by advancing technologies (Fields *et al.*, 2020). Cardullo and Kitchin (2019) state that initiatives and programmes of smart cities frequently adopt a top-down approach that is predominately concerned with socioeconomic values. This approach raises concerns regarding allowing algorithms to introduce private lives without visibility and considerations (Cardullo and Kitchin, 2019). For example, Shin, Kim and Chun (2021) criticise that more attention should be paid to integrating various social groups in implementing cutting-edge technologies, which may worsen the digital divide and impede the long-term sustainability of a city. Consequently, policymakers are challenged by an intricate dilemma of the digital divide within smart cities (Shin, Kim and Chun, 2021). In addition, how to effectively engage the general public in the decision-making process is also questioned (Cardullo and Kitchin, 2019).

In addition to the challenges and issues described above, numerous other challenges have emerged. For instance, Alferidah and Jhanjhi (2020) point out that the energy consumption of IoT devices is a critical factor because batteries frequently operate them. This reliance on energy leads to a question of carbon emission and sustainable energy consumption. They also highlight the challenge caused by the 5V (variety, volume, value, and velocity). This challenge is about how to ensure the 5Vs with the increasing number and advancement of digital technology. Consequently, there is a growing demand for modern networks that show enhanced reliability and performance (Alferidah and Jhanjhi, 2020).

3.7. Strategies to navigate the 4IR challenges

As previously explored, most studies have recognised that the 4IR is a double-edged sword, providing opportunities and challenges. Its duality may cause more wicked problems (Ruysenaar, 2020). In response to the challenge, academic fields outside of design research have advocated for developing a new collective ethical awareness based on social agreements (WEF, 2016a). In particular, researchers, including How *et al.* (2019), suggest employing collective intelligence to address intricate challenges that emerge from the 4IR. According to Yun *et al.* (2019), collective intelligence is valuable for creating innovative ideas and encouraging both internally and externally. Peters (2015) defines *collective intelligence* as the capacity of human beings to collaborate in creation, innovation, and invention intellectually. This capacity becomes significant in a society relying on knowledge facilitated by digital networks (Peters, 2015). In relation to collective approaches, Morrar and Arman (2017) highlight that adopting inclusive approaches is essential. This adaptation includes integrating a collaborative platform and promoting collaboration among experts from diverse fields, such as engineering, social science and art. They claim that such multidisciplinary collaboration produces innovative solutions to emergent problems.

Imagination is another strategy discussed in the literature to address the 4IR challenges. According to Manu (2006), imagination enables individuals and organisations to construct experimental platforms to observe their surroundings with a fresh perspective. Adopting this fresh perspective may encourage individuals to reconsider their current situation and identity and develop a new outlook on the future. In other words, individuals can create significant breakthroughs by bridging the gap between imagination and reality through perceiving elements that may not be apparent (Manu, 2006). In science and technology studies (STS), imagination has been explored. This field employs imagination to shape an imaginary future to envision and understand how society will be influenced by science and technology (ST). According to Vicente and Dias-Trindade (2021), imagining possible social realities and the impact of ST is characterised as iterative. This process is convergent between imagined mediations and mediated imagination. Imagined mediations include informed sociotechnical systems, while mediated imaginations incorporate the experiential contexts of non-experts impacted by future projections (Vicente and Dias-Trindade, 2021). Their argument, including non-technological experts in the imagination process, aligns with the strategy of collective intelligence and inclusive approaches to navigate the 4IR challenges.

3.8. Summary of Chapter 3

This chapter focused on the Fourth Industrial Revolution (4IR), exploring the meaning of revolution, including previous industrial revolutions throughout history. Revolutions are characterised by an unexpected interruption that transforms the institutions and legislation of a nation. Industrial revolutions indicate events that generate substantial social transformations and opportunities via introducing innovative technologies that increase labour productivity and manufacturing efficiency. The First Industrial Revolution began in the UK in 1784 through the mechanisation of the textile industry; the second revolution introduced electric power-driven mass production between 1870 and 1940. The third, initiated in the 1950s, resulted in advancements in information technology, digital technology, electronics, and automated production.

This chapter also reviewed the 4IR and its key technological drivers. This study investigates the capacity of individuals without technology and speculative design expertise to envision and design the future of digitally interconnected public spaces. The focus of this research justifies the focus on the 4IR. From the literature explored, the convergent of digital and physical spaces has been facilitated by the 4IR. The key technological drivers explored in this chapter include big data and cloud computing, sensor technology and IoTs, edge and fog technology, wearable technology, AI, advanced robots, autonomous vehicles, and drones. The selection is based on investigating place-based technology implementations relevant to smart cities and connected places. For instance, the less relevant areas to the research focus were not discussed, such as biotechnology and material science, which are included as the 4IR's drivers in the literature (Schwab, 2013, 2017).

Then, it discussed the implementation of place-based technologies as one of the 4IR's aspects, focusing on smart cities and connected places. The concepts of smart cities were examined from two perspectives: integrating digital technologies to improve governance and management of urban areas and technology company-led initiatives to increase economic outputs, including creating more jobs. The concept of connected places includes a broader spectrum of physical environments than urban areas. Connected places integrate IoT and ICT to improve services and quality of life in places. However, the literature review underlines the relative scarcity of academic research regarding connected places compared to smart cities.

Despite the benefits and opportunities of the 4IR and place-based implementations, several issues and challenges have emerged. The identified challenges in the literature include the following: (1) privacy and security concerns, (2) transformation of human labours and jobs, (3) connected system complexity and scalability, and (4) policy and regulatory lag towards emerging technologies, and others. In order to address these challenges, the literature review explored the strategies proposed by other academic fields that were not in design. The two strategies discussed here are (1) collective intelligence, including collaborative and inclusive manners, and (2) imagination of technological and non-technological experts about the future.

Through this exploration regarding the 4IR and place-based implementations, the researcher understood the holistic view of the considerable transition of digital technology and potential positive and negative impacts on organisations, institutes, and individuals. Based on this understanding, the next chapter will explore place and placemaking practices through the literature review. The chapter aims to understand place starting from the definitions of place and two perspectives: (1) place as a way of understanding and (2) place as a community. As the research focuses on digitally connected public spaces, this chapter will examine the concept of public spaces. Then, placemaking practices that encourage collaboration among policymakers, professionals, and community members will be discussed. Lastly, relevant to the 4IR emergence, it will explore digital placemaking, which combines placemaking practice with digital technology.

4. Place and Placemaking

The previous chapter presented an overview of the 4IR, including the definition of revolution, the previous revolutions, the key technological drivers of the 4IR ranging from various connected technologies and the two concepts of smart cities and connected places as place-based implementations of 4IR. The Industrial Revolution introduced innovative technologies and enhanced processes in literature, triggering significant social transformations throughout history. The 4IR is an ongoing transition of integrating digital technologies in physical settings. The concepts of smart cities and connected places indicate place-based technology implementations. These implementations revolutionise the performance of governance and maintenance of the areas by implementing connected technologies. Compared to smart cities, connected places encompass various scales of locations, including urban scale.

Although there are numerous promising benefits of the 4IR and connected places, the issues and challenges have been discussed in the literature:

1. Privacy and security concerns are raised from substantial data collection through deployed sensors and systems.
2. The value of human labour is questioned as advanced technologies, such as robotics replace human workers.
3. Third, increasing the complexity and scalability of connected systems makes understanding their process and impacts challenging.
4. Fourth, there is lagging in necessary policies and regulations towards emerging technologies.

Even further complicated challenges exist. While the researcher examined the challenges, the strategies explored collective intelligence and futuristic imagination of technological and non-technological experts.

Based on the exploration of the technological side, the researcher explores literature in place to understand place conceptually and relevant practices, including placemaking and digital placemaking. This exploration builds the theoretical foundation to support the examination of PSD approaches in further research. Thus, this chapter will provide a comprehensive assessment of the definitions regarding place, concentrating on two aspects of place as a way of understanding and community. Following that, this chapter will look into placemaking practices, which consist of collaborative efforts, engaging with diverse stakeholders and policymakers to improve physical environments and the well-being of communities. Concerning the emergence of the 4IR, digital placemaking, which facilitates community engagement via digital media, will be examined. Finally, the chapter will summarise key points and state the research gaps and aims by signposting the findings.

4.1. Definitions of place

When searching the term place on Google, one of the definitions provided is *"a portion of space designated or available for or being used by someone"* (Oxford Languages, n.d.). As the dictionary definition suggests, a place indicates a geographic and physical space, including different scales (National Geographic, 2020). Moreover, '*used by someone'* implies that places go beyond geographic settings, including people in place. Cresswell (2010) compares a similar term, *landscape,* to *place*, which is often discussed in geographical literature. He highlights that landscape indicates the physical arrangement and terrain. Landscapes might appear as naturally formed attributes or identifiable human-made features. The distinct difference Cresswell (2010) features between landscape and place is that humans may observe landscapes instead of residing in them. Cresswell (2010) also compares space and place. In his comparison, space indicates a meaningless domain similar to time, and that forms the foundation of human existence.

When humans impart significance and form emotional attachments to a specific space segment, the space becomes a place (Cresswell, 2010). Foth (2017) describes that by inhabiting a physical environment, humans have produced and given numerous intangible and tangible assets, including customs, cultures and atmosphere, in addition to buildings and artefacts. This phenomenon continues even in the present with human existence (Foth, 2017). In this context, Peng, Strijker, and Wu (2020) explain intangible assets containing subjective components that can differ among individuals. These components may consist of information collected by others over various periods ranging from the past (*e.g.*, history) to the future (*e.g.*, anticipation) (Peng, Strijker, and Wu, 2020). Furthermore, it can be influenced by different spatial dimensions, which vary from local to national, as well as by modern society and globalisation (Arefi, 1999). In other words, places encompass not only physical surroundings but also people in places and their actions and behaviours that distinguish them from landscapes and spaces. Therefore, the following parts will focus on how individuals understand the world and perceive a place as a community.

4.1.1. Place as way of understanding

Foth (2017) claims that individuals turn spaces into places with their meanings. The meanings are associated with individuals' perspectives on the world as a way of understanding. Cresswell (2010) also explains that individuals adopt different perspectives through a place, which influences their attitude to recognise the world and how to observe it. For this reason, he states that understanding a place should combine quantitative and qualitative data to understand complicated interactions between humans and places. It facilitates the identification of individuals' emotional bonds and associations with their environment, examining various meanings and varied experiential aspects inherent in places (Cresswell, 2010). According to

Antonsich (2010), humanistic geographers have articulated these assets and subjectivity in various terms, including through the concepts of place identity, sense of place, and place attachment. The difference between terms is discussed within the field of environmental psychology. Place identity is predominantly related to cognitive components, while place attachment is primarily linked to affective elements. These terms may differ by the degree of personal awareness (Antonsich, 2010). For instance, people can contribute to forming a place identity by constructing an iconic building and creating place attachments socially and subjectively. To some extent, the formation may be influenced by physical settings that distinguish one place from another (Peng, Strijker and Wu, 2020). Nevertheless, individuals attribute place identities to abstract elements and tangible qualities, such as the historical accumulation of a place (Arefi, 1999).

4.1.2. Place as community

Canter (1986) describes three main elements of places: activities, evaluative conceptualisation, and physical properties. This definition indicates a place associated with more than one type of human behaviour in its physical characteristics (Canter, 1986). Russell and Ward (1982) argue that the definition of place has become an intricate arrangement of immediate and distant places, from minor to more prominent. Defining places also presents the hieratical relation of supra and sub-places. For instance, a city as a supra place consists of sub-places such as parks, neighbourhoods, and city centres (Bonnes *et al.*, 1990). Project for Public Spaces (PPS) suggests a concept, *Power of 10+*, of thinking about place scale according to human activities (**Figure 16**). According to this concept, prosperous cities comprise more than ten destinations that compose their identity and images, making them attractive for new residents, businesses, and investments. It defines a destination where people want to go, such as a downtown square, a main street, a waterfront, a park or a museum. Furthermore, within a destination, there are more than ten places where people can do certain activities, like drinking coffee, reading a book, sitting, meeting friends, and playing with children (Project for Public Spaces, 2016).

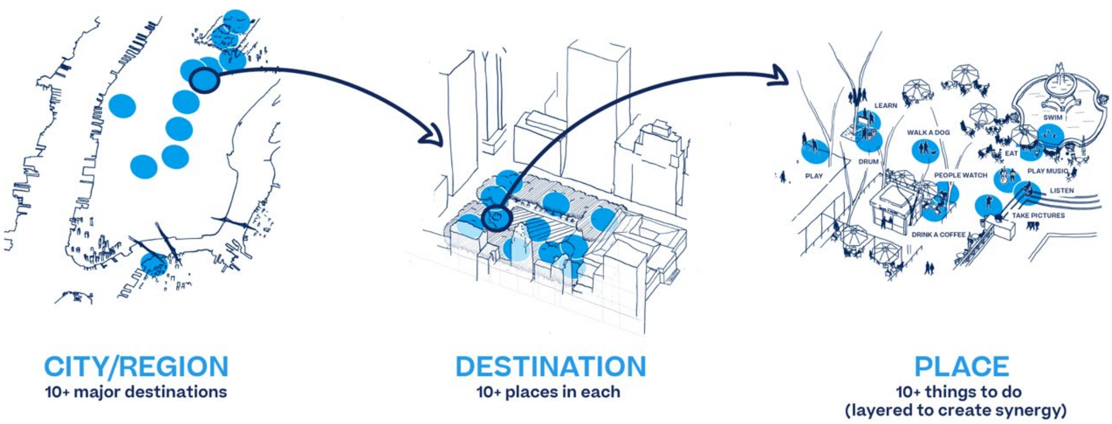

Figure 16. *Power of 10+, how cities transform through placemaking (source: Project for Public Spaces)*

The concentration of people in certain areas leads to dense populations. This population drives economic values and quality of life by building strong social interactions and infrastructure. Lima and Jones (2020) argue that diverse communities are required to make a place *more 'productive, sustainable and liveable'*. They point out that even though there are critics of high urban density, which causes a wide range of social and economic problems, dense places bring a more positive impact on fostering diverse and vibrant communities. For instance, influential firms have moved increasingly from suburbs to cities, where highly dense places look for well-educated and talented workers. Moreover, recent analysis shows the migrant pattern of millennial workers who have moved not only to look for jobs but also to access diverse social activities, solid communities, and social interactions (Lee, Lee and Shubho, 2019).

However, places have been transformed by modernity and globalisation. The term *non-place* (or similarly placelessness) was coined by Webber (1964) and indicates the new era of place beyond the *proximity and propinquity* of physical places. This term became famous with the publication of Marc Augé's book, *"Non-Places: An Introduction to Supermodernity,"* in 1992. It refers to interchangeable and homogeneous sites that are characteristic of late modernity. Examples of non-places include airports, strip malls, supermarkets, office blocks, and executive hotels. These places lack a distinct identity and historical connection to their surrounding environment (Trigg, 2017). Due to the advance of telecommunications technology, the traditional concept of a *place-centred community* has changed and even weakened, and non-places have emerged. The appearance of cyberspace has accelerated the changes in the loss of connectivity and social obligations (Arefi, 1999). The issue with non-places arises from the lack of consideration given to emotional, interpersonal, and practical connections with the world (Trigg, 2017).

4.2. Public space

This part examines places in the public context, outlining the attributes and challenges of public spaces. Public spaces combine the concepts of place as a way of understanding and community. As Carr (1992) described, public spaces serve as communal areas where individuals can come and participate in social interactions. Goodsell (2003) describes urban planners' perspective towards public spaces as essential to shaping cities and streets. Public spaces like shoreline beaches, pedestrian pathways, parks, plazas, arcades, and squares are associated with urban well-being and community identity (Goodsell, 2003). For this reason, they have been studied in various academic fields, such as sociology, geography, political science, anthropology, planning, architecture, design, and philosophy (Bodnar, 2015).

Banerjee (2001) states that public spaces as a social domain are conceptually situated between individual and organisational agencies. Oldenburg and Brissett (1982) define a *third place* as an external refuge between home (the first place) and workshops (the second place), where people can visit and socialise with friends, family, neighbours, and even strangers. Oldenburg and Brissett's work primarily focuses on the social dimensions of third places, highlighting their characteristics. Comfortable atmosphere, frequent visits and uses by people and opportunities with familiar and unfamiliar individuals characterise them. Third places typically consist of diverse areas such as stores, cafes, coffee shops, bars, pubs, restaurants, parks, and community centres (Oldenburg and Brissett, 1982). These spaces offer several values, including providing residents with an escape from the city's stresses and chaotic atmosphere, fostering social connections among people, contributing to a sense of community identity, and serving as venues for political dialogue and protest, according to Goodsell (2003). Based on the third-place theory, Mehta and Bosson (2010) claim that public spaces comprise tangible and intangible attributes that influence individuals' attachments. Thus, it is required to examine diverse characteristics of public spaces and integrate elements into place to develop a strong and unique place attachment.

However, public spaces in urban contexts have been confronted with several challenges. Chitrakar, Baker and Guaralda (2017) argue that emerging technologies have transformed and introduced challenges in city public spaces. They provided an example of introducing automobiles influencing transportation infrastructure, including implementing traffic signs, ensuring parking spaces, and progressively displacing pedestrian areas and public spaces. This displacement has led to the dominance of cars in urban spaces until now. The example indicates the challenge of considering the potential impacts of new technologies in public spaces in the long term before implementation. In individual aspects, applying new technologies shapes individual behaviours in public spaces, as evidenced by the blurring of boundaries between private and public domains in their surroundings. Wei and Leung (1999) provide an example of this phenomenon regarding the introduction of mobile phones. The appearance of the phone has replaced some in-person meetings with conversations via a phone call in public spaces. As a result, traditional private and personal integrations take place in public spaces by privatising them (Wei and Leung, 1999).

From a pragmatic point of view, the current public spaces may suffer from a lack of maintenance, neglect, and recurring issues. Chitrakar, Baker, and Guaraldai (2017) state that the problems caused in urban settings include littering, garbage accumulation, graffiti, air and noise pollution, congestion, vandalism, excessive traffic, and more. Mandeli (2019) clarifies that the increase in local authorities' responsibilities has contributed to causing problems, stating that their expanding responsibilities have comprised their capacity to maintain public spaces adequately. In addition, the constraint of limited financial resources was discussed, which presented difficulty in allocating adequate funds to maintain the spaces (Mandeli, 2019).

In addition, Chitrakar, Baker and Guaralda (2017) criticise that the earlier modernist urban planning practices resulted in a lack of distinctiveness and positive contributions to users of public spaces. Urban planning in the twentieth century was influenced by modernist idealising of technical, efficient, and large-scale city plans. These practices were criticised by post-modernists in the late twentieth century and transited to urban design that combines or redefines previous aesthetics within a fragmented, temporary, and heterogeneous setting (Irving, 1993). Despite the transition of practices, the absence of distinctive characteristics has remained in some public spaces. This absence is explained by the concept of non-places, which indicates a lack of relational, historical, and identity-based attributes in place, proposed by the French anthropologist Marc Augé in 1995 (Augé, 2020). Without inheriting or incorporating accumulated identities and memories, these spaces are intentionally designed for particular purposes, such as commerce, transportation, and leisure, frequently interacting with users via signage and instructions (O'Keefe and Kerr, 2015).

4.3. Placemaking

According to Horgan (2019), placemaking is an approach that involves policymakers, selected professionals, and community members collaborating to bring about a shared vision for transforming the physical surroundings and promoting community well-being. This concept originated in the 1960s with the proposals of Jane Jacobs, an American Canadian urbanist and activist, and William H. Whyte, an American urbanist, and other studies. Since then, placemaking has advocated a community-centred and place-based approach to urban planning and design against conventional urban practices, including car-dominance planning (Quigley, 2022). Thus, placemaking is relatively new compared to urban planning, urban design, and architecture. According to Courage (2020), it is a *paradigm transformation* in urban planning and design, from constructing macro urban forms to creating public spaces and the activities of people in those spaces. It encompasses both the practice and the process of creating an improved built environment and fostering thriving communities (Horgan, 2019). There are three phases of placemaking ranging from top-down to bottom-up. In the first phase, placemaking is regarded as a spatial arrangement. This phase focuses on physical settings and considers places as end-products. The next phase of placemaking shifts the focus from the top-down approach to the democratic approach by increasing the roles of stakeholders within the process. Lastly, placemaking aims to become an empowering tool to build a strong connection between place and people (Strydom, Puren and Drewes, 2018).

Wyckoff (2014) categorises the four types of placemaking: standard placemaking, strategic placemaking, creative placemaking, and tactical placemaking. First, standard placemaking is the umbrella term that embraces other types of placemaking. Placemaking has been promoted through the Project for Public Spaces (PPS), a non-profit organisation established in 1975 based in the US (Project for Public Spaces, n.d.). In general, placemaking can be applied to improve the quality of a place for an extended period through many small projects and activities. Wyckoff also highlights that placemaking requires the engagement and empowerment of diverse stakeholders.

Therefore, various projects and activities should be included to encourage the public, non-profit and private sectors (Wyckoff, 2014).

As described above, the time scale of placemaking might be a long-term perspective of as much as 25-year planning, which requires a strategic approach. This approach is called strategic placemaking (or sustainable placemaking) (Wyckoff, 2014). Strategic placemaking aims to accomplish goals to attract more investments and improve the quality of the place. It includes investment goals in building pedestrian-centred shopping centres, food courts, open spaces for events, entertainment centres, and public transportation nodes (Lew, 2017). Ultimately, strategic placemaking aims to make a place more attractive for talented workers to live and work (Wyckoff, 2014).

According to Markusen and Gadwa (2010), creative placemaking is an approach that requires active collaboration and participation of various stakeholders representing the public, private, non-profit, and community domains. The objective is to purposefully reshape the urban and rural landscapes of a neighbourhood, town, city, or regional area through cultural and artistic initiatives. They also argue several benefits of creative placemaking that integrate art and cultural activities. The benefits include revitalising buildings and street environments, renewing public and private spaces, promoting public safety, enhancing the sustainability of local businesses, and ultimately fostering a sense of unity among community members (Markusen and Gadwa, 2010).

Finally, Wyckoff (2014) states that tactical placemaking (or tactical urbanism) is conducted through various temporary and experimental projects. Historically, the earlier example of tactical placemaking was in the 1500s Paris, where the first informal pop-up stores were installed (Mould, 2014). The well-known strategy might be closing car roads and opening them to pedestrians and bicycles. For instance, the Chilean government launched the Santiago city centre mobility initiative, Plan Centro, in 2013. This plan aimed to foster a pedestrian-friendly environment in the central region, which significant governmental organisations and corporations densely populate. As a part of the initiative, it prioritised pedestrians and cyclists by removing on-street parking, replacing car lanes with substantial improvements to sidewalks and pedestrian amenities, introducing cycle paths and improving bus stops (Herrmann-Lunecke, Mora and Sagaris, 2020). Moreover, tactical placemaking projects include temporarily turning certain places into entertainment or craft markets. These projects enable people to rethink what they can do in those places they have taken for granted (Wyckoff, 2014).

Foth (2017) explains city development's evolving relationship between governments and citizens (**Table 6**). This is worth examining to understand the dynamic relationships of stakeholders in placemaking. Traditionally, urban environments have focused on managing essential living elements such as infrastructure, taxation, and waste disposal. This view can be referred to as the Cities 1.0 stage, a government which considers citizens as residents of the urban place. However, he points out that as the concept of the smart city has emerged, driven by technology companies, global accounting firms, and consultancy service providers, it has transformed this perception. In Cities 2.0, the relationship between city governments and citizens has changed between service providers and consumers. Viewing placemaking not solely to maximise commercial benefits in urban spaces but as a strategy to drive profound social transformation and revitalisation through grassroots democratisation changes this perspective to Cities 3.0. In this stage, city governments adopt the role of facilitator to accelerate democracy involving citizens as participants. However, in line with Courage's (2020) argument, successful placemaking requires joint efforts of architects, urban designers, artists, policymakers, planners, developers, and the community. This collaborative approach, Cities 4.0, recognises individuals as co-creators in a collaborative approach to shaping the city.

	City Government	Citizens
Cities 4.0	Collaborator	Co-creator
Cities 3.0	Facilitator	Participants
Cities 2.0	Service Provider	Consumer
Cities 1.0	Administrator	Residents

Table 6. *The evolution of the relationship between city governments and citizens, according to Foth (2017)*

4.3.1. Digital placemaking

As previously stated, this study aims to explore the transition of 4IR and focus on the potential impact of digital influence in the physical environment. Thus, the following will examine digital placemaking in relation to the advent of the 4IR and the transition of placemaking practices influenced by digital technologies. The term *digital placemaking* relates to developing a sense of place for individuals by maximising the functionalities of digital technology to maintain and foster a bond with a place, according to Halegoua and Polson (2021). Since 2015, digital placemaking has emerged as part of creative placemaking applications, explored in media studies (Basaraba, 2023). The background of digital placemaking originated from the application of information and communication technology (ICT) and ubiquitous computing in the built environment since the mid-1990s (Foth, 2017).

Foth (2017) argues that a benefit of digital placemaking is building contextual narratives through AR and VR and highlighting local history, which is often overlooked in urban planning and development. Related to this perspective, there are applications for digital placemaking, including heritage, education, entertainment, and community engagement (Pang *et al.*, 2020; Halegoua and Polson, 2021; Basaraba, 2023). In the heritage sector, digital technology enables people to experience historical events, employing digital devices, such as realistic virtual simulations that immerse visitors in the past. Another domain in which digital placemaking has been applied is edutainment, which combines education and entertainment. Through digital placemaking, learners can benefit from obtaining knowledge and engaging with interactive digital narratives (Halegoua and Polson, 2021). In addition, Pang *et al.* (2020) explore location-based games (LBGs), one of the digital placemaking applications. They argue that the potential of LBGs is to facilitate placemaking, support community awareness and engagement, and explore a city among residents as they navigate the various spaces and locations within their cities (Pang *et al.*, 2020).

There are challenges regarding digital placemaking. First, Foth (2017) points out the potential challenge of involving digitally isolated communities in digital placemaking. As the digital transformation is ongoing, it is significant to consider these communities more and develop strategies to engage with them. Aligned with Foth's argument, Halegoua and Polson (2021) argue that digital placemaking practices may reveal or worsen pre-existing inequalities and exclusions depending on the accessibility of digital media and technology. In order to overcome these challenges, Foth proposes the implementation of transdisciplinary methodologies such as action research and participatory design (Foth, 2017).

4.4. Summary of Chapter 4

This chapter examined the literature regarding places to understand what places are and the current practices of placemaking. According to the exploration of definitions, place indicates tangible surroundings containing intangible components that human beings have shaped. Places are distinct from notions of landscapes or spaces. Unlike those notions, places are inhabited by humans and their meanings are added by them. The chapter also looked into the definitions of place, focusing on these intangible components related to human beings: (1) a way of understanding and (2) community. Places as a way of understanding indicate that places influence individuals' viewpoints to recognise and observe the world and emotional connections. This perspective acknowledges the complex interactions between humans and places, which are often identified concepts such as place identity, sense of place, and attachments. Moreover, places are viewed as communities where people can socialise and interact with others. In this perspective, places offer various activities and services that become opportunities for social interaction.

Moreover, public space was examined as it exemplifies both distinct attributes of places as a way of understanding and community. They function as communal spaces, provide a sanctuary from the stressful environments of urban areas and foster political discussions among people. However, the challenges of public spaces have been found in the literature. The challenges include the displacement of existing practices by adopting new technologies, inadequate maintenance and neglect resulting in problems such as pollution and littering in the practical aspect, and modernist design that fails to reflect on the distinctiveness of place.

In the following, placemaking, a collaborative approach to improve the physical environment and foster the community's well-being as a result, was discussed. Engaging and empowering various stakeholders is essential in placemaking. Effective placemaking requires the active participation of the participants, including the community, architects, urban designers, artists, policymakers, and developers. Then, the four different types of placemaking were explored in this chapter: (1) standard placemaking, (2) strategic placemaking, (3) creative placemaking, and (4) tactical placemaking. In the meantime, the advent of digital technology led to digital placemaking in the 1990s, a relevant subject of this research focusing on 4IR and digital influence. Digital placemaking enables the community to be involved in placemaking processes via digital media. While it can potentially contribute to diverse areas, such as heritage, education, entertainment and community engagement, the challenges highlighted in the literature include excluding certain communities and accelerating current inequalities. The strategy to overcome these challenges was discussed, and a transdisciplinary strategy incorporating action research and participatory design to ensure inclusiveness.

Through this chapter, the researcher could classify place definitions and understand the relevant concepts regarding public spaces, placemaking practices and their challenges. The following part will present key findings from the literature review and then demonstrate research gaps. The research gaps are identified based on the literature review of key subjects in this study, such as design, the 4IR and place and placemaking. It includes the process of forming the research question in this study. Then, the research aim will be explained, including the gaps that have been discussed, which influence the research methodology.

4.5. Research gaps and aim

The literature review was presented in **Chapters 2** to **4**. It helped the researcher to build a theoretical understanding and holistic views of design, the 4IR, and place and placemaking. **Chapter 2** looked into design and design approaches, and the key findings are the following:

1. Design has evolved following the trends and historical events, in particular, the Industrial Revolutions, meeting the needs of the times from graphics to systems.
2. Human-centred design approaches were formulated to focus on human needs and understanding them. The disciplines share the values of Human-centred design, such as participatory design, co-design, service design, and design for policy.

3. Critical design and speculative design can provoke discussions about emerging technology by envisioning near futures and encouraging critical thinking about the potential impacts.

Based on the findings, the researcher identified research gaps in the field of design:

1. Speculative design approaches have been criticised for lacking diversity when formulating fictional futures. Because certain groups have demonstrated speculative futures, these limited voices can be considered as a top-down approach.
2. In response to this challenge of speculative design, there are diverse speculative design projects with participatory settings. Participatory speculative design (PSD) approaches include non-designers or non-technology experts who design speculative fiction and prototypes. However, PSD still needs to be explored; for instance, there are challenges to adopting different contexts in the design process.

These findings enabled the researcher to formulate a question of how PSD can be employed to make speculative design more inclusive and collectively embrace the diverse imagination and creativity of non-experts in technology or design.

The next chapter explores the history of the Industrial Revolutions from the first to the fourth. Then, it focused on the 4IR, its technological drivers and place-based implementations, including smart cities and connected places. As a result, the findings are the following:

1. The 4IR is a double-edged sword with both opportunities and challenges. In particular, digital technology is pervasively and invisibly reshaping physical spaces.
2. The key drivers explored here are Big Data and cloud computing, sensor technology and IoTs, fog and edge computing, wearable Technology, AI, advanced robots, and autonomous vehicles and drones.

After the exploration of the literature, the researcher found gaps in the context of 4IR and Connected Places:

1. There are emerging concerns regarding cybersecurity risks, ethical issues, and data collection reliability.
2. There is a lack of policies and regulations to regulate technology implementation. This gap raises concerns about invading individual privacy and equity, which challenge policymakers. In literature, for instance, it was revealed that they have faced issues of the digital divide, which means people without digital connectivity are excluded from others with the connectivity. Thus, policymakers should ensure that public participation is more inclusive.

3. Social science and STS fields have suggested strategies for these challenges, such as collective intelligence and imagination. Collective intelligence can bring multiple insights to address the challenges of 4IR, while imagination is valuable for envisioning and speculating on how technology can potentially influence people and places.

These findings helped the researcher narrow down the focus of their study to how PSD can help policymakers manage new technological deployments in physical spaces, encouraging collective engagement and imagination.

Last, **Chapter 4** presented a literature review of place and placemaking, aiming to understand what places are and the practices of placemaking. Consequently, the findings are the following:

1. Places include not only geographic environments but also people's usage.
2. Places relate to plural cognition and interpretations of individuals affected by emotional connection, such as place attachment.
3. Places are social spaces where people can do various activities and form communities.
4. Placemaking is a collaboration to shape a place to increase the well-being of communities.

Based on these findings, the researcher identified the gaps in the context of places and placemaking:

1. There are several challenges when adopting emerging technologies in public spaces. First, the adaptation blurs boundaries between private and public domains, which can lead to an invasion of privacy or publicity. Second, there is a lack of a system for maintaining public spaces, such as littering and pollution. Third, the modern design of public spaces does not reflect places' distinctive and relational characteristics.
2. Ensuring inclusivity is essential for placemaking, requiring a transdisciplinary approach such as combining participatory design and action research.

The identified gaps enabled the researcher to formulate the main gap. The existing literature and projects explore speculative design with participatory and collaborative approaches in tackling inclusivity and diversity to create speculative futures by involving people not necessarily with design or technology expertise. However, the main gap is incorporating and adopting contextual perspectives within PSD projects. The emerging area of PSD still needs to be explored to define practical strategies and has yet to be employed in diverse contexts, including policymaking. Further exploration could be essential to deal with issues regarding emerging technology in envisioning and designing futures and to support policymakers. Therefore, this research aims to develop and examine PSD approaches, inviting non-experts of design and technology in the early stage of speculative design to create connected places. In addition, the research looks for where and how policymakers can adopt and use PSD in policymaking regarding the future of connected places. The further details of this research methodology and design will be explored in the next chapter.

Section 3. Research Methodology and Design

Section 3 includes **Chapter 5**, which explains the research methodology and how this doctoral research is designed based on it. The figure below shows the structure of the following chapter.

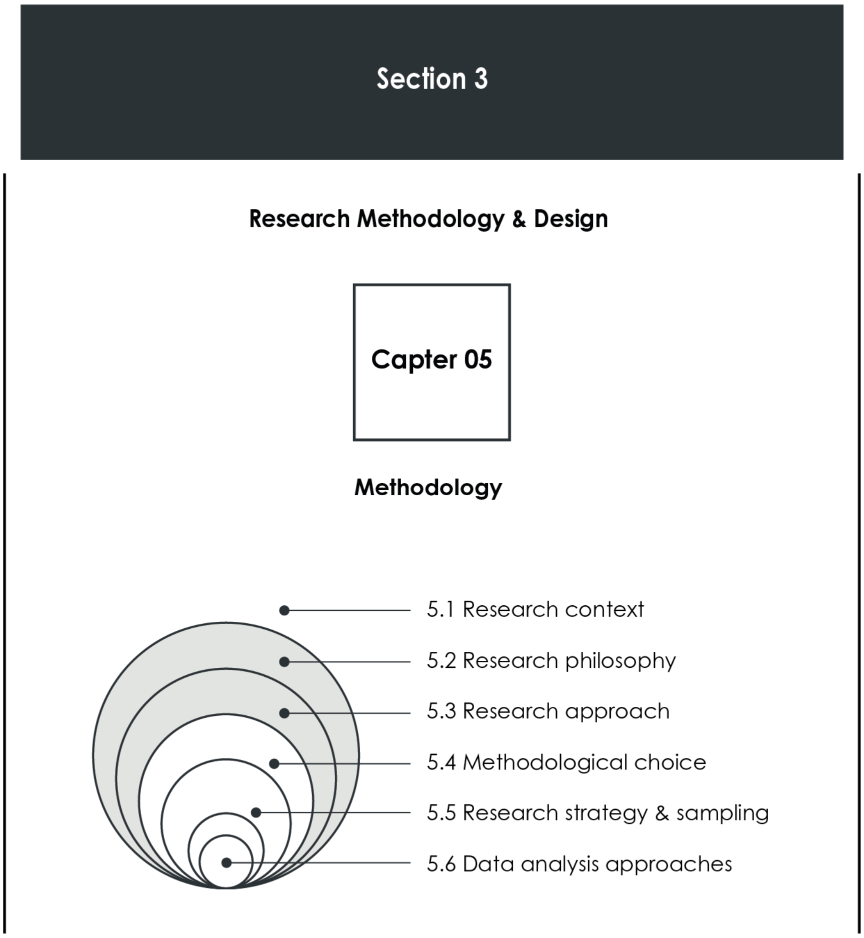

Figure 17. *The overview of Section 3*

5. Research Methodology

The literature review presented in previous chapters demonstrated three main areas: design, the fourth industrial revolution, and place and placemaking. This study aims to develop and evaluate PSD approaches that involve non-experts' either in technology or design, in designing and speculating the future of connected places. In order to accomplish the research aim, this chapter presents the research methodology of this study, which is a rationale for *why* a researcher chooses specific research methods and conducts the research (Crotty, 2020). To present the methodology, the researcher adopted the theoretical concept of a *research onion* (**Figure 18**) initially presented by Saunders, Lewis, and Thornhill (2009) and modified it (**Figure 19**). The concept is to explain the research design following the order of the onion's layers step by step, from the outer layer to the inner layer. It starts with research philosophy, approaches, methodological choice, strategies, research time frames (time horizons), techniques and procedures and finally, data collection and analysis methods (Melnikovas, 2018).

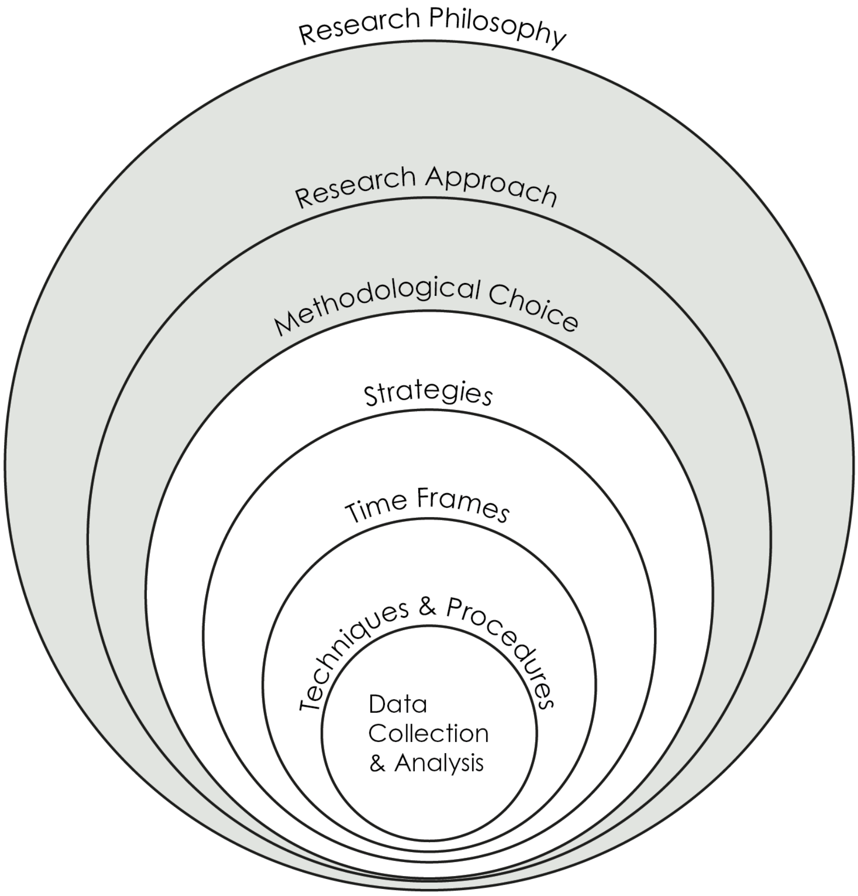

Figure 18. *The concept of research onion, adopted by Saunders, Lewis and Thornhill (2009)*

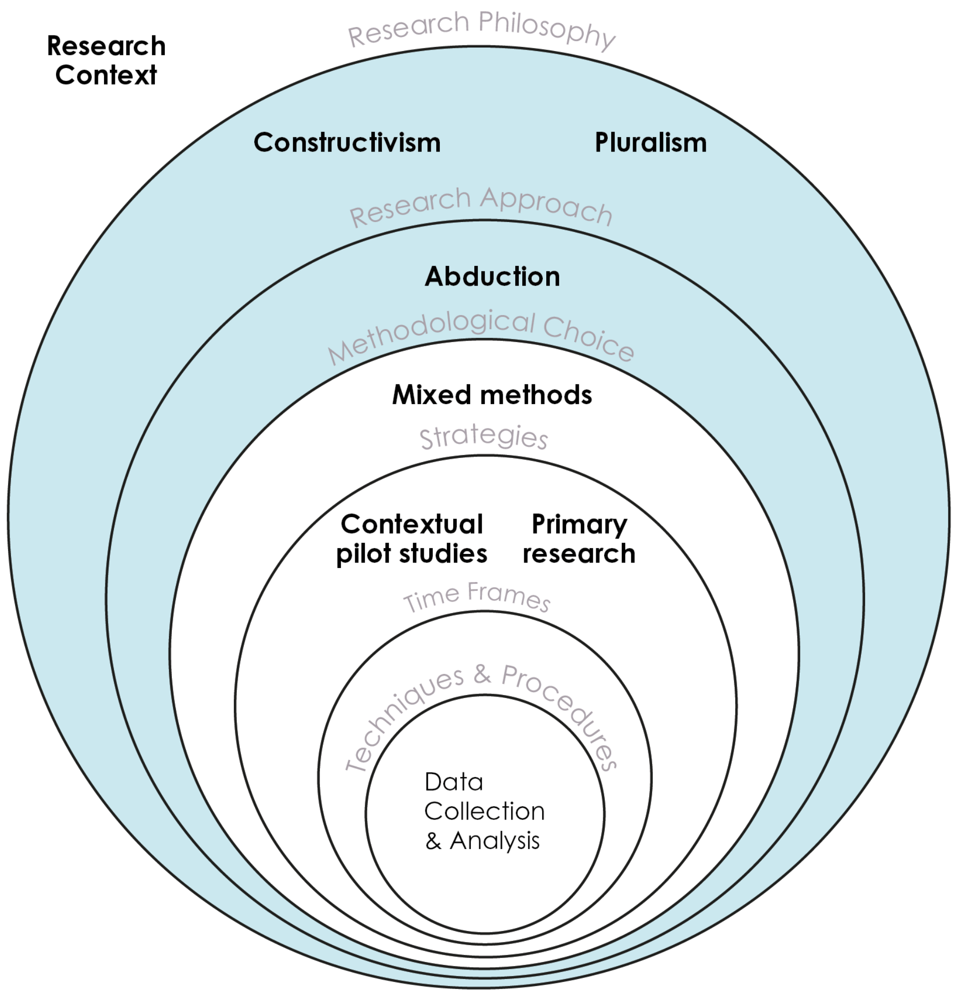

Figure 19. *The research onion of this research*

To begin with, in addition to the onion layers shown in **Figure 19**, this chapter starts by providing the research context as an overview to explain how the research environment influenced the study. Then, adopting the structure of the onion, first, research philosophy as the researcher's world views, **constructivism** and **pluralism**, is explained as how the researcher has had to see, understand, and interpret the world. So, the research context and philosophy provide the rationales for why the approach, **abduction**, and methodological choice, **mixed methods**, were decided, which are presented in the following parts. Then, in more detail, it explains the research strategy, conducting **contextual pilot studies** and **primary research**. This part includes explaining the sampling and time frames of the research, data collection, and analysis methods.

5.1. Research context

Lancaster is a city located in northern England, in the United Kingdom (**Figure 20**). The city is situated along the river Lune and inland, neighbouring coastal towns, such as Morecambe and

Heysham, near Morecambe Bay. Lancaster is historically significant, including landmarks such as the Roman Bath, Lancaster Castle, Lancaster Priory Church and Ashton Memorial. During the 17th century, Lancaster rapidly grew thanks to its strategic location along the River Lune, allowing easy access to ocean-faring vessels. This advantageous location resulted in robust trade with the West Indian and North American colonies. The active business resulted in Lancaster's growth as a prominent UK port engaged in importing goods and participating in the slave trade. However, this maritime prosperity declined over time (Johnson, n.d.).

In the modern era, Lancaster is a university city with two universities, Lancaster University and a branch of Cumbria University. The city has grown and expanded significantly since the establishment of Lancaster University in 1964. According to Census 2021, the city's population is 52,660, while the broader Lancaster district has a record of 142,931 people. In 2021, the population of university students has increased to 13,000. This transition has substantially influenced the city, bringing over **£100 million** annually to the local economy. With its growth as a university city, it is constructed by combining historical landmarks and modern facilities (Fenton, 2022).

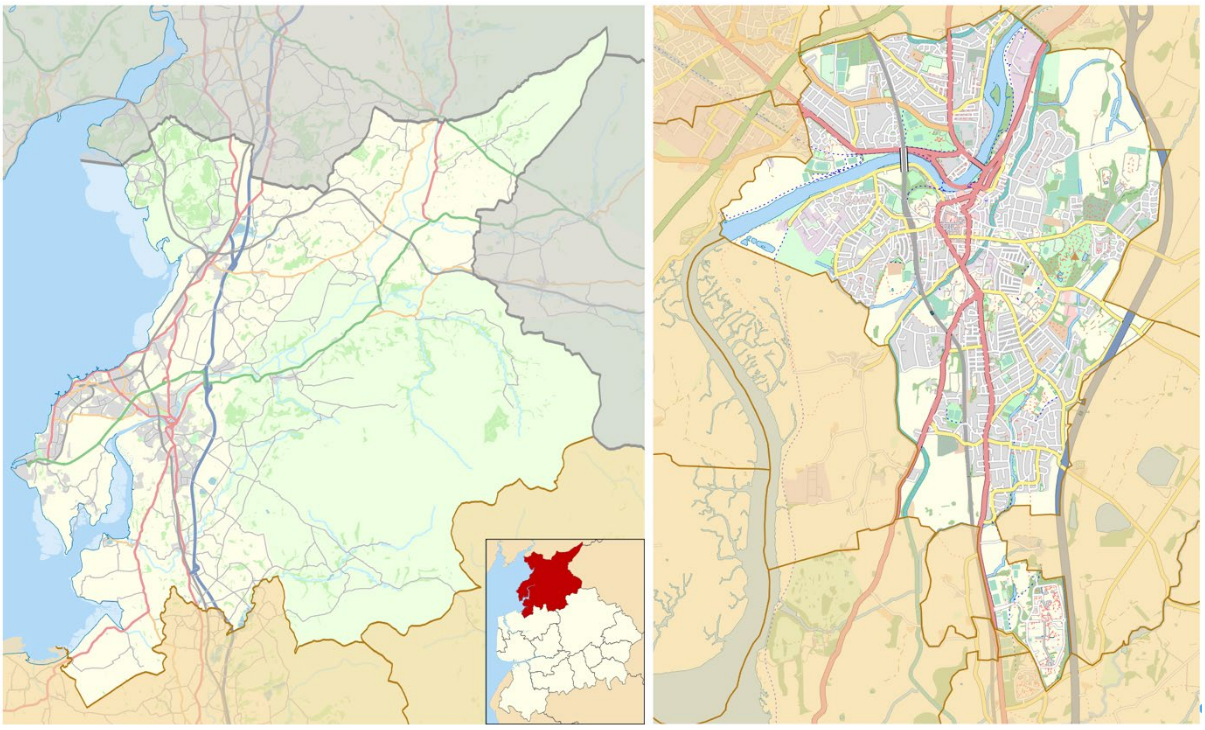

Figure 20. *Maps of Lancaster District (Left) and City of Lancaster (Right) sourced from OpenStreetMap (2018)*

ImaginationLancaster is a cross-discipline design research centre at Lancaster University. In 2019, it launched *Beyond Imagination* to expand the design team by creating 33 new positions, including ten lecturers, ten postdoctoral research associates, and ten PhD students. Research

England funded the project with a budget of £13.2 million. As part of this project, this PhD study was also funded by the *Beyond Imagination* project (ImaginationLancaster, n.d.).

The *Beyond Imagination* project included five key clusters of research: Home and Living, Communities and the Public Sector, Factories and Workplaces, Cities and Urban Areas, and Population and Policy. These clusters were also explored through four themes: Sustainability, Health, International, and Prosperity (**Figure 21**). In each cluster or theme, research teams consisting of a professor, one or two lecturers, a postdoctoral researcher, and a PhD student were formed to research topics related to the cluster or theme (Cruickshank, Cooper and Dunn, 2022).

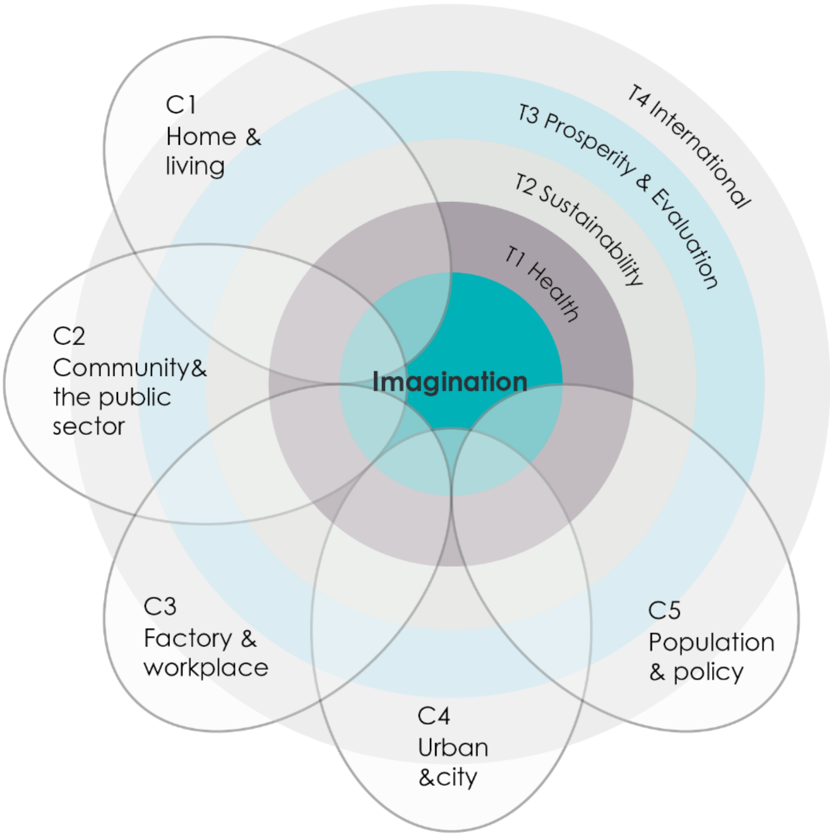

Figure 21. *Five key research clusters and four cross-cutting themes of the Beyond Imagination project*

The researcher of this PhD was a part of the Population and Policy cluster. Her involvement in this research team was a valuable opportunity to learn new research areas and design methodologies by engaging with other researchers' projects and conducting her doctoral research. Initially, the researcher focused on developing design solutions for challenges related to the 4IR. However, being part of the cluster allowed her to broaden her research context into policy and policymaking and to explore relevant cases. In particular, she participated in three research projects and activities, which enabled her to become familiar with the fields and turn them into contextual pilot studies presented in **Chapter 6**. In addition, through these experiences, she developed research skills and gained practical knowledge to conduct her primary research, as shown in **Chapters 7** and **9**. The overall structure of this research is illustrated in **Part 5.6.3** of this chapter.

However, the COVID-19 pandemic affected this entire research's work with critical challenges and limitations. Restrictions, such as lockdown, social distancing measures, and encouragement of remote work, resulted in an isolated research environment. Communication with the cluster and other researchers was limited to regular online meetings. The absence of in-person interaction constrained effective collaboration. Moreover, there were limited opportunities for the researcher to participate in academic activities, such as conferences, which could be a platform for developing academic networks. The pandemic also presented challenges in data collection and participant recruitment for this research.

5.2. Research philosophy

Research philosophy, or philosophical worldview, indicates a fundamental set of beliefs that leads to the actions of a researcher (Cuba, 1990). It becomes a framework for understanding and analysis of research design and findings. Creswell and Creswell (2017) claim that researchers should carefully consider their philosophical worldviews, which construct assumptions for the study and link to research methods and design. Based on this understanding, the researcher states that this study adopts constructivism as a research philosophy that acknowledges the values of human experiences and interactions in constructing reality. Constructivists argue that individuals actively construct knowledge which is subjective and context-dependent.

With the lens of constructivism, this research investigates how PSD can help engage diverse individuals in the speculative design process, applying their lived experience and knowledge in a place. Design and design practices were investigated in **Chapter 2** through the literature review. Especially in literature, PSD (**Part 2.4.8**) is an emerging practice to utilise individuals' design skills, imagination, creativity, and critical thinking. These inputs reflect on the individual's worldview and visions of the future. Moreover, guided by the constructivism philosophy, this study explores how PSD can integrate into policymaking by examining benefits and applications. Thus, this research attempts to investigate how individuals can actively contribute to imagining and designing speculative prototypes that can be meaningful in policymaking.

Furthermore, within the context of this study, the researcher argues that places consist of not only physical environments, including natural and human-made elements but also intangible assets. These intangible assets, such as culture and history, are constantly shaped by human interactions, behaviour, and experiences, explored in **Part 4.1.1** of the literature. Based on the constructivist perspective, the researcher designed this research to discuss challenges in public spaces in the city of Lancaster with the implementation of digital technology. By doing so, the study aims to highlight upcoming issues and explore areas where design activities and methods can be fit in policymaking.

This research adopted another philosophy, pluralism, based on the rationale that the challenges of 4IR should be addressed by collective and democratic approaches, as defined in **Part 3.7**. Thus, this doctoral research appreciates the value of different sources of information (May, Hunter and Jason, 2017) and participation from the public. The public, here, is based on Dewey's view and definition of the public. Dewey proposed that a public should not be perceived as a homogeneous group but as a distinct group with a shared purpose to address specific issues. Rather than being a predefined social group, a public is a distinct coalition of individuals influenced by circumstances and environments. (Dewey, 1991). When acting as a public, these people aim to tackle those circumstances and the outcomes that arise from them (Le Dantec, 2016; Dewey, 1991). Le Dantec (2016) states that engaging diverse participants and resisting the urge to oversimplify pressing concerns is crucial in the design process to tackle social issues. Instead, examining wider interrelationships and less obvious prospects for intervention is vital. Achieving this necessitates actively collaborating with various stakeholders (Le Dantec, 2016).

5.3. Research approach

According to Saunders, Lewis, and Thornhill (2009), a research project is designed to validate or formulate a theory. Research approaches can be influenced by the research philosophy discussed in the previous part, constructivism, and pluralism in this study. Based on this philosophy, the researcher employed an abductive approach, integrating elements of deductive and inductive methodologies.

Dewey (1933) states that the enquiry paradigm includes deductive and inductive approaches. First, a **deductive approach** is to conduct research based on existing theories and concepts(Bryman, 2016). In other words, when researchers adopt a theoretical lens and interpret data collected through that lens, the research uses a deductive approach (Saunders, Lewis and Thornhill, 2009). This approach enables researchers to test through empirical observation or experimentation the process of corroboration of the theory established (Gray 2014). In this study, the researcher employed two theoretical lenses from the literature: first, the participatory design process, which could include a broader range of voices in the design process, and second, speculative design, which could help imagine technological futures and provoke discussions.

On the other hand, an **inductive approach** is that research starts without a theoretical lens, and the research outcome forms a theory. An inductive approach is adopted to a research project when researchers want to explore a topic without substantial literature and build a theory based on data collection and analysis (Creswell and Creswell, 2017;Saunders, Lewis and Thornhill, 2009, p48). After data collection and analysis, patterns indicate relationships. This observation may lead to the establishment of generalisation, relationships, and even theory. The researchers should be aware of coming up with hasty generalisations and conclusions (Gray, 2014). In this study, the inductive approach was also utilised to develop and test the methods to achieve collectiveness and participatory speculation and evaluate their outputs in policymaking.

An **abductive approach** combines deductive and inductive approaches (Suddaby, 2006). This approach is used to collect data to investigate a phenomenon, themes, and patterns and create a new theory or adjust an existing theory which researchers test by collecting additional data (Saunders, Lewis and Thornhill, 2009, p145). Therefore, the purpose of using the abductive approach in this study was to explore the concept of participatory speculation and its potential to address complex issues arising from connected technology.

5.4. Methodological choice

According to Saunders, Lewis and Thornhill (2009), methodological choice identifies whether a researcher employs quantitative, qualitative, or a combination of both. In broad terms, quantitative research entails using numerical data and mathematical procedures, while qualitative methods require collecting descriptive data (Creswell and Creswell, 2017) (**Table** 7). The mono method, here, refers to the research solely utilising quantitative or qualitative data collection. On the other hand, mixed methods indicate using both quantitative and qualitative methods within the same research. This is because it aims to achieve different objectives and supplement the limitations of the mono method (Creswell and Creswell, 2017; Melnikovas, 2018). This study employed mixed methods integrating quantitative and qualitative research procedures. The following sections provide definitions of quantitative, qualitative, and mixed methods and thoroughly explain how the researcher utilised mixed methods by including both quantitative and qualitative research approaches across all phases of the study process.

Quantitative	Qualitative
Numbers	Words
Point of view of a researcher	Point of view of participants
Researcher distant	Researcher close
Theory testing	Theory emergent
Static	Process
Structured	Unstructured
Generalisation	Contextual understanding
Hard, reliable data	Rich, deep data

Table 7. *The comparison between quantitative and qualitative (Bryman, 2016)*

5.4.1. Quantitative research

Quantitative research involves empirical research that includes collecting and analysing numerical data (Muratovski, 2015). Quantitative research generally implements a deductive approach that adopts aspects of natural science and objectively analyses social reality (Bryman, 2016). Based on this understanding, this research includes collecting and analysing numerical data to test hypotheses and explore relationships among numerous variables (Muratovski, 2015). Quantitative research utilises objective data collection and analysis methods, such as surveys, experiments, and tests (Creswell and Creswell, 2017). This methodological choice is to explore cause-and-effect relationships and generalise results extrapolated from the tested sample to a broader demographic (Muratovski, 2015). Despite its objective data advantage, quantitative research has some limits, including a risk of oversimplification and incapacity to capture and explain complex phenomena. In order to address the constraints, quantitative research is used with qualitative research to complement each other by offering a means to test hypotheses that emerged from qualitative findings (Creswell and Creswell, 2017).

5.4.2. Qualitative research

Qualitative research is characterised by its in-depth approach (Muratovski, 2015). Qualitative research has an inductive perspective on the connection between theory and research. In other words, the theory emerged from qualitative research (Bryman, 2016). It includes collecting data from various forms and sources and analysing it from different angles. As a result of qualitative data, an insightful view of complex reality can be developed (Muratovski, 2015). Miles, Huberman and Saldana (2013), cited by (Gray, 2014), state a distinctive characteristic of qualitative research based on particular fields or real-life contexts. A researcher can build a comprehensive understanding by integrating participants' perspectives. Themes defined from data are often reviewed with participants or externals to ensure validation.

However, Bryman (2016) states that there are constraints in qualitative research. One of the constraints is vulnerability to its subjectivity because of the researcher's individual perspectives, which may lack a systemic framework. Second, it has an unstructured nature, which causes difficulty in replicating in another context. Third, there is a potential risk of overgeneralisation to other situations or contexts. Fourth, methods for data analysis may lack clarity, which leads to the lack of transparency in a research process. Moreover, researchers may face the challenge of handling a large and overwhelming volume of data in a short period (Bryman, 2016).

5.4.3. Mixed methods

Mixed methods research integrates qualitative and quantitative research and data in a study. This approach allows for a comprehensive understanding of the research topic, utilising the rich detail provided by qualitative data and the numerical analysis of quantitative data (Gray, 2014). Creswell and Creswell (2017) explain **explanatory sequential mixed methods**, a research approach that is mixed quantitative and qualitative, involving a two-phase data collection project. In general, the researcher collects quantitative data, analyses the results, and then employs the results for the second phase of qualitative data collection. The results from the first phase inform the researcher of what questions should be asked in the next stage. The aim is to have the qualitative data help explore the initial quantitative results in more detail, so connecting the two data sets is essential (Creswell and Creswell, 2017).

This choice reflected the researcher's aim to understand the current situation comprehensively based on quantitative assessment and then explore qualitative contexts. In this research, the quantitative data collection assessed the individuals' understanding levels and preferences using quantitative rates. Subsequently, the researcher interpreted quantitative findings to design the following qualitative data collection. For instance, in Stage 1, before the workshops, the researcher distributes the questionnaire as a quantitative data collection method to evaluate participants' understanding of connected technology. The results of this questionnaire influenced the development of a workshop about speculative prototyping for connected places. These workshops played an essential role in collecting qualitative data, such as the participants' perceptions of the places, imaginations, and criticisms of connected places. Then, in Stage 2, the researcher measured the number of individuals selecting different options for the exhibited prototypes. In the meantime, the qualitative data was also collected by asking the visitors to provide written opinions. The quantitative data collected in Stage 2 affected the workshop design in Stage 3, helping the researcher decide which prototypes to present to the policymakers. The research design process of the primary research with three stages is presented below in **Figure 22**.

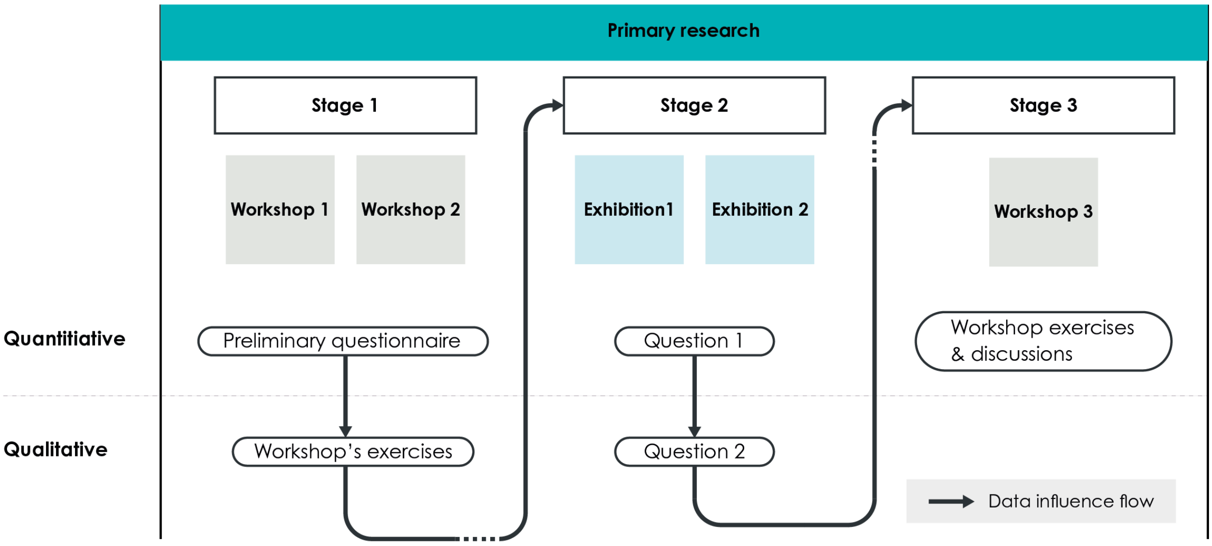

Figure 22. The research design process of the main data collection

5.5. Research strategy and sampling design

A research strategy is a comprehensive approach to support researchers in selecting primary research methods or a combination of research methods for data collection. By selecting appropriate research methods, researchers can address research questions and objectives (Melnikovas, 2018). Thus, this part provides two research strategies for data collection, explaining why and how the researcher collected data for her study. The first strategy is to conduct contextual pilot studies by participating in three research projects related to the research topic at ImaginationLancaster (the context is described in **Part 5.5.1**). The second strategy is to adopt an explanatory sequential mixed method design (explained in **Part 5.4.3**). The timeline in **Figure 23** shows that the project took place at different durations and times.

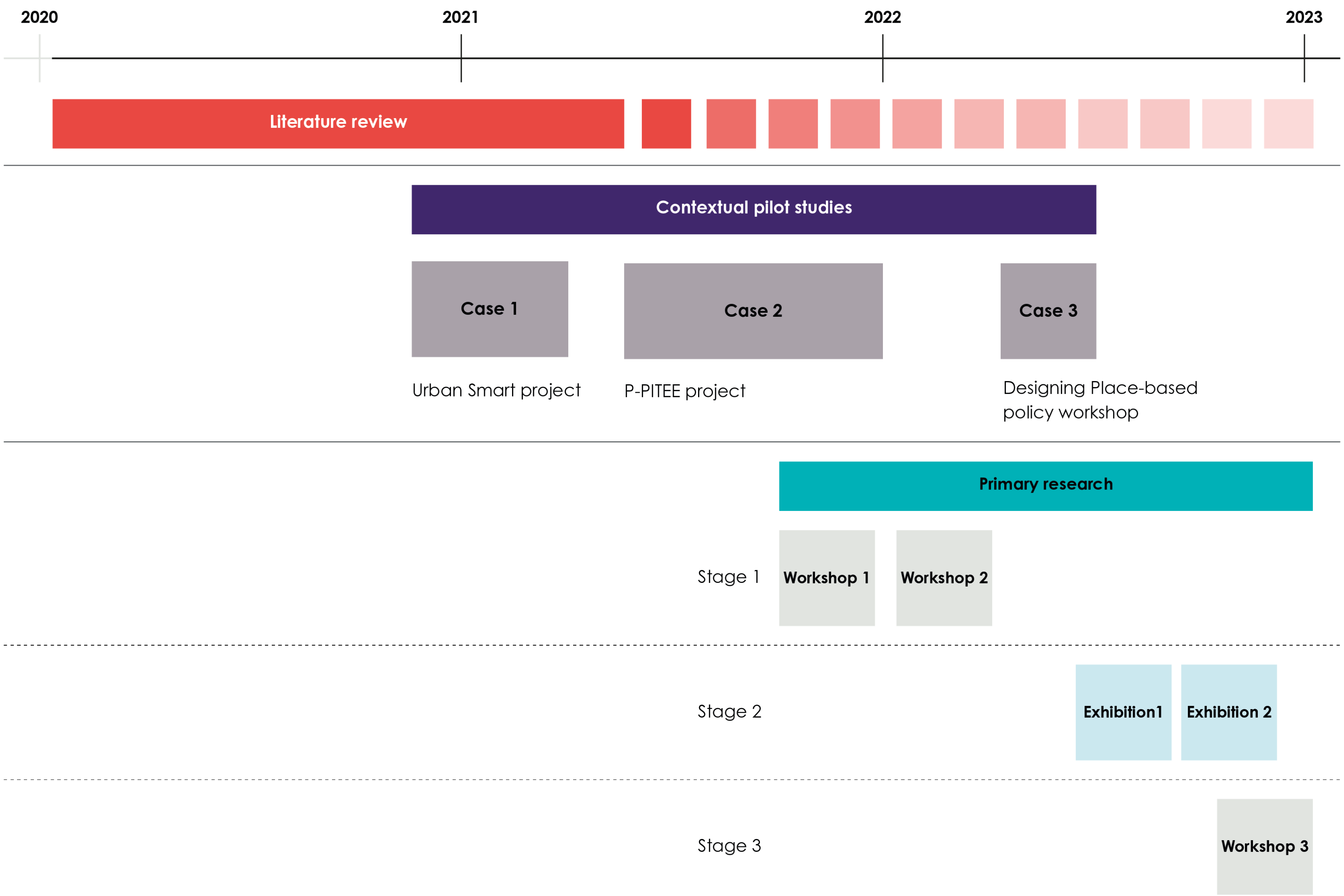

Figure 23. *The research timeline*

5.5.1. Contextual pilot studies

Following the research strategy described above (**Part 5.5**), the researcher conducted contextual pilot studies. These studies are exploratory case studies that reveal current issues and research focuses being investigated in research projects, the methods used, and findings from them (Yin, 2009). According to Ayres and Gast (2010), conducting a case study is to study and explain an in-depth and comprehensive analysis of one or more cases which may describe individuals, events, activities, or processes. The case study methodology investigates a particular topic or social phenomenon within a specific context. It assists researchers in understanding how and why it is relevant to that context (Starman, 2013; Yin, 2009). A case study demonstrates the rationales behind a specific decision, which becomes a focus of case studies, decision-making processes, and resulting outputs (Schramm, 1971). Case studies have been widely used in social sciences and practice-oriented fields, including education, management, public sectors, and social work (Starman, 2013). By focusing on a case, researchers can understand comprehensive and practical aspects essential to studying individual life cycles, small group behaviour, and other similar phenomena (Yin, 2009). Case study research can be structured to include single or multiple cases. A single case study is often conducted when there is no option for multiple cases. According to Yin (2009), multiple cases benefit is easily detecting patterns that emerge from the cases, which strengthens a theory. Data collection methods for case studies include interviews, surveys, observations, and document analysis. The outputs of case studies provide significant insights into real-life contexts and can contribute to future research, policies, and practices (Yin, 2009).

Some concerns exist about adopting case study research. As Yin (2009) explained, case study research depends on the researchers' choice to utilise either a single case or multiple case studies to answer a research question. For researchers, selecting an appropriate case or cases is also crucial in addressing a theoretical framework. The generalisability of single case studies is constrained, while multiple case studies require repetitive processes to establish validity. In particular, there are concerns regarding case study research's internal and external validity in generalising research findings because they depend on specific contexts that may not apply to others. Thus, rigorous analytical methods are required to increase the validity and alignment of findings with a theoretical framework (Yin, 2009).

In this study, the cases were demonstrated in **Chapter 6** because of the opportunities within the researcher's context as part of the Population and Policy Cluster in the *Beyond Imagination* project. The selection process included relevant research contexts, convenience, strategic sampling, and generative participation, where the researcher took advantage of the opportunities and explored what unfolded. In particular, the involvement in research projects enabled the researcher to understand better the context related to Lancaster City Council, the connected technology, including IoT deployments in public spaces, and design practices. Furthermore, reflections and learning outputs from these projects helped to shape the research question for the PhD and research design. **Table 8** presents an overview of each case's research activities and participant sampling.

Case	Case 1	Case 2			Case 3
Activity	Online workshop	In-person walkshop (IW) Virtual walkshop (VW)	Workshop 1	Workshop 2	Workshop
Sampling (number of participants)	Local policymakers (6) Researchers (20)	IW. Local policymaker (8) VW. IoT experts (12)	Research team (2)	Local policymaker (4)	Policymakers (5) Researchers and designers (10) Policy Lab (3)

Table 8. *The activities and sampling strategies of complementary case studies*

5.5.1.1. Case 1. *Urban Smart* project

The first case study, *Urban Smart* Project (**Part 6.1**), was chosen to explain how the researcher could understand and analyse the policies and strategies Lancaster City Council implemented. The *Urban Smart* project included an online workshop to develop a comprehensive vision for smart urban Lancaster. This project invited policymakers and academics to share their expertise and perspectives. In total, 26 participants were involved in this project, including six policymakers from the City Council and County Council in Lancaster and 20 academic researchers in various disciplines at the University. The researcher gained experience through this project, which helped shape the primary research. This experience offered her an understanding of policies and policy practices in Lancaster, so she could use one of the County Council's strategies as the context of the workshop in the primary research.

5.5.1.2. Case 2. *P-PITEE* project

The second pilot project is *Participatory Policy for IoT (at the Edge) Ethics* (presented in **Part 6.2**), abbreviated as *P-PITEE*. The researcher actively contributed to this project, acquiring valuable insights into implementing IoTs in public spaces and developing an in-depth knowledge of connected places and designing tools for design research, particularly design fiction. This project involved two participant groups, city council officers, and IoT experts. The research team organised a series of in-person and online walking workshops called *walkshop*, followed by a testing workshop and a policy prototyping workshop. The researcher's approach in this study was significantly influenced by the understanding gained from this project, for instance, how participants were prompted during speculative prototyping. The prompt questions were based on the learning in this project covering various aspects of IoTs, such as their functions, data collection processes, maintenance and access of data and devices, and perceptions from the public.

5.5.1.3. Case 3. *Designing Place-Based Policy* workshop

The *Designing Place-Based Policy* (presented in **Part 6.3**) workshop was selected as the third case study to provide an understanding regarding plural views of the places, considerations for place-based approaches, and opportunities and challenges of design methods and practices. A wide range of professionals, such as academics, designers, practitioners, and policymakers, was invited to this workshop. During the workshops, the participants exchanged their viewpoints on the notion of places and fundamental elements that needed to be considered in designing policy for specific places. Consequently, the researcher deeply understood places' attributes, complexities and dynamics in developing place-based policies.

5.5.2. Primary research

The primary research of this study consisted of three stages of research activities: two workshops in Stage 1, two public exhibitions in Stage 2, and a workshop in Stage 3. The three stages were demonstrated in **Chapters 7** and **9**. A design intervention occurred between Stage 1 and Stage 2 when the researcher and an external 3D artist worked together to refine and visualise the data. These refined outputs were presented in Stage 2 as prompts. **Table 9** shows overall activities and sampling strategies of primary research.

Stage	Stage 1		Stage 2	Stage 3
Activity	Workshop 1 & 2	Intervention	Public exhibition 1& 2	Workshop 3
Sampling (number of participants)	W1 MA Students (23) W2 BA Students (31)	Researcher and 3D artist	General public (120)	Policymakers (3)

Table 9. *The activities and sampling strategies of primary research*

5.5.2.1. Stage 1 Workshop 1 & 2 with students

Two workshops were held with students from Lancaster University: MA Design Management and MA Arts Management students (Workshop 1) and first-year BA Architecture students (Workshop 2). The workshops are utilised as a research method to investigate the phenomena associated with construction or deconstruction in this study to answer how non-experts in speculative design can collectively create prototypes of the connected technology in public spaces. Adopting the workshop as a research method provides an explicit methodological choice that allows for iteration, refinement, and adaptation of the research design across different contexts and over time (Melnikovas, 2018). The workshops were planned with module convenors as a part of their teaching activities and aligned to the learning outcomes of the modules.

The first rationale for student engagement was that Lancaster University and the student population in Lancaster had played a significant role in Lancaster. Lancaster is considered a student city, as mentioned (on Page 98). A local newspaper media, *LancsLive,* highlighted that the university has continuously grown since its establishment in 1964. Now, the university boasts a student population of more than 13,000, while the total population of Lancaster was around 52,600 in 2021 (Office for National Statistics, 2022). Also, the university's founding resulted in a significant transformation of Lancaster. It used to be a mill town but turned into a city in 1937, with its population increasing almost double that of a century ago. The student population in Lancaster has also brought an extensive economic impact on the city. According to estimations, the significant number of students residing in Lancaster contributes over **£100 million annually** to the local economy. Its absence would lead to the loss of numerous local jobs and businesses (Fenton, 2022).

However, according to Russo, van den Berg and Lavanga (2003), students are often considered an *invisible* population despite the contribution of the student population in the city. This is because their residencies are more flexible than other communities. For instance, students may move to another city after graduation or other events in life. Consequently, their involvements are limited in local policymaking and decision-making processes, and their role in social development is unclear. Therefore, this research attempted to bring the voices of this invisible population by involving university students in creating futures of public spaces and informing policymakers about their views to discuss the values of their insights and participation.

The second rationale for involving the students in Stage 1 was that the in-person workshops were organised between November 2021 and January 2022, which overlapped with the ongoing COVID-19 pandemic. The initial initiative was to recruit members of local communities to test experimental PSD methods and processes with them. However, the social restrictions of the pandemic, such as wearing face coverings, quarantine, and working at home to reduce transmission, significantly constrained participant recruitment and data collection channels. At that time, despite students and workers being advised by the UK government to return to schools and workplaces, these restrictions were still in place (HM Government, 2021) during the planning and designing of the workshops for this research. Consequently, the researcher could not recruit local communities in Lancaster for face-to-face workshops with social restrictions. The in-person workshops were carefully planned involving university students as they returned to the university to attend face-to-face lectures and seminars with health and safety measures, such as wearing masks. In both workshops, the students had mixed nationalities and backgrounds; most were newcomers to Lancaster or had lived there for less than a year. As a pilot to test out PSD, this study invited them to reflect on the non-experts' and newcomers' views of the place.

Workshop 1 sampling

The workshop was held as a part of the Design Research Methods module, which aimed to *"introduce a range of research paradigms and methodologies for approaching research problems,"* according to the module handbook (Lancaster University, 2021). During the module, scenarios and speculative design topics were covered in Week 8, synchronising with the workshop sessions that focused on speculative prototyping and scenario building. These workshop activities aimed to improve the students' understanding of design research methods. The workshop was three hours long and had 23 participants organised into the same groups they had worked with throughout the module. Each group were a group of five on average. Most participants of Workshop 1 were international students, primarily from Asian backgrounds, such as China and India, with a few from European backgrounds, and aged between 20 and 40.

Workshop 2 sampling

According to the module handbook (Lancaster University, 2020), the learning outcomes for BA Architecture included *"Apply appropriate architectural research skills - site analysis, conceptual development and reflection - in design development."* Architecture students were already conducting site analysis for the module the workshop was part of. Thus, during the workshop, the students in the group worked on a specific site assigned in the module. The workshop lasted three hours, the same as Workshop 1, and had 31 participants who formed a group in the same groups they had worked with throughout the module. On average, each group consisted of six members. Compared to the participants of Workshop 1, who were international students primarily from Asian backgrounds and aged between 20 and 40, the participants of Workshop 2 were mostly local, some with European backgrounds, and in their early 20s, making them younger than those in Workshop 1.

Figure 24. *Workshop 2 with the first-year students from Architecture*

5.5.2.2. Stage 2. Public exhibition

An exhibition can be used to disseminate research (Rust and Robertson, 2003) but also serves as a research activity for gathering and capturing knowledge from visitors as exports (Chamberlain and Yoxall, 2012). The exhibition in this research aimed to showcase the prototypes created in Workshop 1 and Workshop 2 and gather feedback and suggestions from a broader audience beyond Lancaster University. Exhibition 1 was held in the Lancaster University Library as a pilot exhibition, and then Exhibition 2 was exhibited in the Lancaster City Museum. The following sections explain more details about the sampling strategy for the exhibitions.

Public exhibition 1

Exhibition 1 was a pilot exhibition held in the Lancaster University library. It was held in a designated exhibition area near the library's entrance. The University library is on campus, several miles from the city centre. This distanced library location attracted audiences from university communities, such as university students, researchers, and staff members with international backgrounds and aged between 20 and 50. The exhibition lasted two days and attracted an estimated 60 individuals.

Figure 25. *Exhibition 1 poster displayed on a noticeboard on the University campus*

Public exhibition 2

Following Exhibition 1, Exhibition 2 was organised to reach a broader audience beyond the university communities. With a strategy to prompt the exhibition, the researcher applied to be included in the ESRC Festival of Social Science (FoSS). FoSS is an annual celebration of social science research projects supported by the Economic and Social Research Council (ESRC). This festival offers opportunities for the public to explore a wide range of social science topics through a series of activities organised by researchers from 34 universities in the UK. The activities included talks, performances, exhibitions, participatory events, and panel debates. The festival was held across the UK from 22 October to 13 November 2022. The main theme of the 2022 festival was *my local area*, with many events exploring partner universities' regions, including their history, dialect, political landscape, and future. As the exhibition of this research, *Dalton Square 2032: Beyond SMART City*, which explored the future scenarios of the local public space, aligned with the focus of FoSS. Consequently. it was selected as one of the FoSS events and advertised nationally via its website (https://festivalofsocialscience.com/events/dalton-square-2032-beyond-smart-city/).

Figure 26. *Exhibition promotion on the website of the ESRC Festival of Social Science*

Exhibition 2 was set up in the corridor on the first floor of the City Museum. The museum is located at the heart of the city centre, which ensures it is easily accessible to local people. Compared to Exhibition 1, it was expected that more diverse members of local communities would visit Exhibition 2. The exhibition was scheduled for two days, specifically on Wednesday and Thursday. Due to the school's half-term break in the UK and the farmers market opening on Wednesday, a substantial turnout was anticipated. As anticipated, approximately 60 individuals visited the exhibition in total. The visitors were mostly local from all age groups, from children visiting with their families to senior adults.

5.5.2.3. Stage 3. Workshop 3 with policymakers

In Stage 3, the researcher conducted an in-person workshop inviting local policymakers as participants in Lancaster City Council. The workshop aimed to explore and discuss how PSD methods can be used in policymaking to address issues of implementing connected places and collect public insights. Stages 1 and 2 of the primary research tested PSD methods and collected speculative ideas about public spaces. Thus, Stage 3 focused on exploring local authorities' views and examining the methods with them. The participants was recruited through the *Beyond Imagination* project officer. The officer effectively coordinated and managed Lancaster City Council's involvement in the *Beyond Imagination* project at Lancaster University. The workshop was advertised to aim at policymakers concerning planning, place, and technology. As a result, three council officers participated in the workshop, specialised in different areas: partnership, information government, and Information and Communication Technology (ICT) services.

5.5.3. Data collection methods

Clarke, Braun, and Hayfield (2015) define a *research method* as a process or tool used in qualitative research to collect and analyse data. As mentioned in the introduction of this thesis, this study combines two main disciplinary approaches: participatory design and speculative design. Thus, the methods and tools used in this study employed participatory approaches to speculative design in creating collective futures of connected places. The following parts explain each method used in this research, including their definitions, advantages, disadvantages, and justification of why and when they were employed.

5.5.4. Questionnaire

Surveys are a widely employed approach to quantitative research (Muratovski, 2015). This type of research entails gathering information about a specific group by posing questions and organising the responses in a structured way using questionnaires. In other words, the goal is to draw general conclusions about the entire population based on the findings from the sample (Creswell and Creswell, 2017). In this research, the researcher employed an online questionnaire tool before Workshops 1 and 2 during Stage 1. This method is a convenient way of distribution during the pandemic and gets more responses than a written questionnaire (Muratovski, 2015). It was also a suitable approach for the researcher to target both groups of participants: students at the University who have access to and are familiar with the Internet and who would be attending the workshops.

The online questionnaire was intended to assess the student's level of understanding regarding connected technology. The researcher designed the questionnaire with a set of questions, including scale and open-ended questions. First, a scale question was framed: *"How familiar are you with the term [technology]?"* This question was chosen because inquiring about the familiarity of a participant requires an assessment of an individual's understanding, avoiding the limitations of a binary "yes" or "no" response (Muratovski, 2015). Second, open-ended questions are needed to raise questions that have yet to have easily measurable answers. Although it produces qualitative responses, there are occasions when researchers require them to gather extra information from the participants (Muratovski, 2015). In this case, the researcher used open-ended questions to prompt participants to describe their understanding of various technological concepts in their own words, aiming to comprehend the reasoning behind their responses to the scale questions.

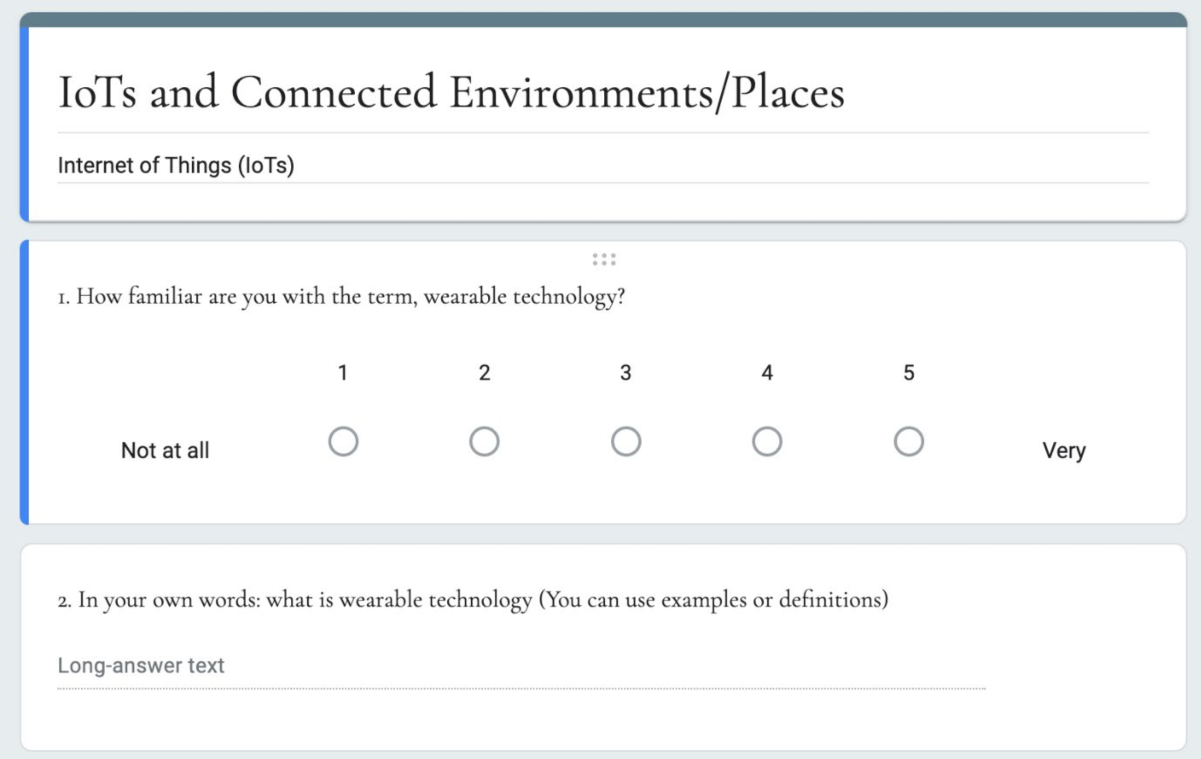

Figure 27. *The questionnaire on Google Forms*

5.5.5. Observation

Creswell and Creswell (2017) describe observation as the behaviour of researchers in qualitative research in which they observe and take notes about participants' actions or comments on a research site. Thus, it is often entailed with field notes (**Part 5.5.6**), which record data or questions that researchers would be interested in exploring later in an unstructured or semi-structured manner. In particular, according to Grack, Nelson and Cohn (2015), there are unstructured and structured observations in exhibition settings. When researchers conduct structured observations, a checklist or protocol is required to document certain behaviours systemically. Timing and tracking are two systemic approaches employed in museum settings to monitor visitors' reactions and interactions with exhibitions. On the other hand, unstructured observations do not require checklists or protocols to take notes observing behaviours or moments (Grack Nelson and Cohn, 2015). Typically, observers assume several roles ranging from non-participants to fully engaging participants. These observations include open-ended interactions in which researchers throw generic questions to enable participants to express their viewpoints without limitations (Creswell and Creswell, 2017).

The researcher mostly used unstructured observations in this research, remaining non-participants but facilitators on some occasions. There are two rationales behind this strategy. First, the researcher needed to observe other researchers to learn how they facilitated and led conversations at the research site when she started her PhD programme. She participated in planning projects and designing their activities, which were used for the contextual pilot studies. When the activities were ongoing, the researcher took the role of non-participants to observe how other researchers with experiences facilitated discussions and interactions. This observation experience became a valuable opportunity to learn skills of effective questioning, promoting and delivering information to participants. Another objective was to observe how participants interacted with the tools designed by the researchers during the activities. By observing the participants, the researcher could reflect on the tools' effectiveness and identify areas for improvement. During the exhibitions in Stage 1, the researcher observed visitors paying attention to how they reacted to the exhibited prototypes and interacted with hands-on tools. During Exhibition 1, she stayed at the library for observation from 9 am to 5 pm for two days. Then, due to a medical reason, she could observe on the last day of Exhibition 2. As observed, she took detailed notes and used photographs to capture the moments and document observations.

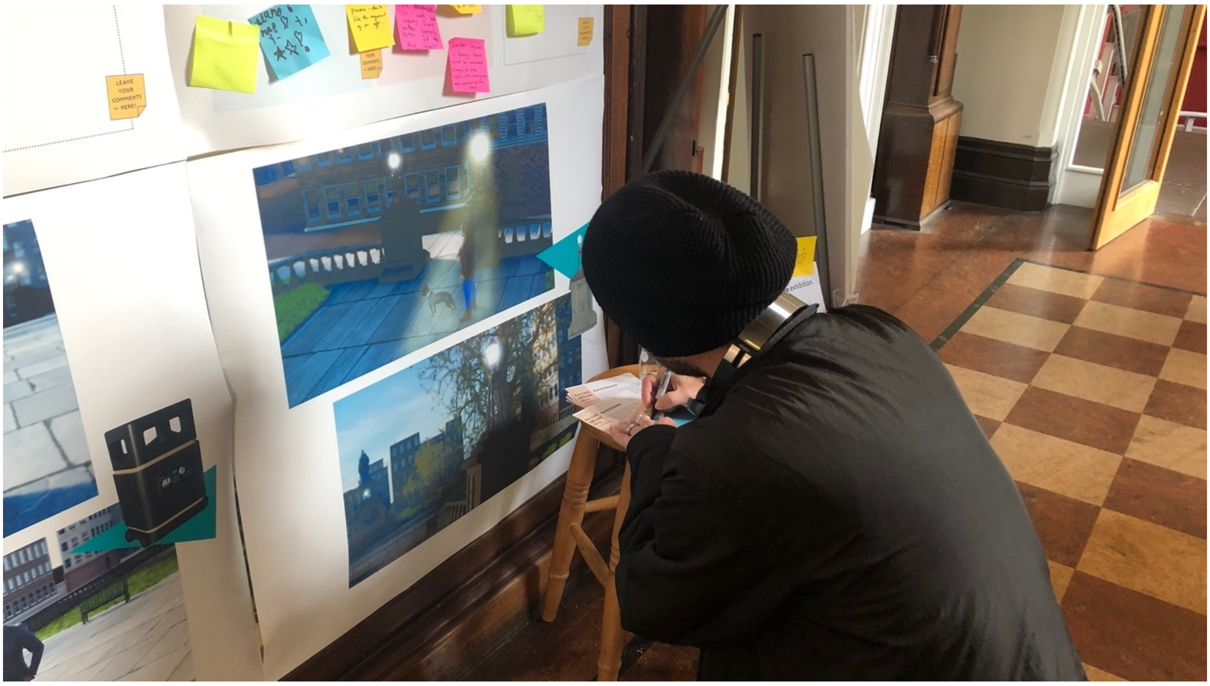

Figure 28. *Overserving a participant using tool in Exhibition 2*

5.5.6. Field notes

According to Gray (2014), field notes are fundamental for researchers who employ qualitative data collection methods, particularly observation. In this research, the researcher has constantly taken notes with details in both online and in-person activities. During the activities, she could capture significant insights on the field notes about what topics and interests emerged from discussions among participants or researchers, observations of how the participants reacted and interacted with tools and prototypes, and even her reflections on the research activities. Gray

(2014) acknowledges that producing meticulous and comprehensive field notes at research sites is challenging. Researchers are especially likely to face this challenge when they focus on field observations deeply and feel additional pressure to capture their findings in written format. Thus, to address this challenge in this research, the researcher utilised different methods to supplement field notes during the ongoing activities. The supplementary methods used are photography as a part of her visual research method (**Part 5.5.9**), audio recording (**Part 5.5.10**), and paper-based tools (**Part 5.5.8**) to capture data.

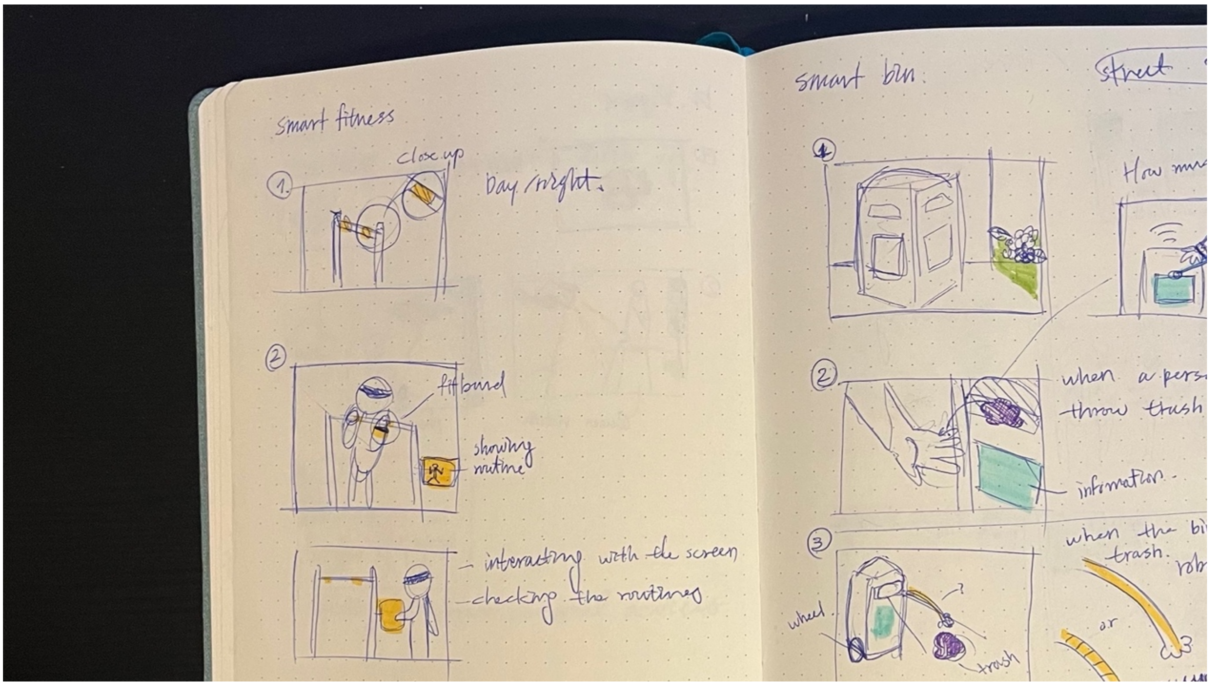

Figure 29. *The researcher's field note*

5.5.7. Digital data collection

Digital data collection refers to utilising digital media and platforms in research to collect data through them. Utilising digital data and platforms became widely used during the COVID-19 pandemic as a way to address social restrictions such as social distancing and working at home (Rogers *et al.*, 2020). The digital tools enabled the researcher to prompt collaboration and ideation remotely among participants and researchers. They allow participants to participate in diverse online activities, such as brainstorming and sketching (Seita *et al.*, 2022). Hossen *et al.* (2018) highlight that the benefits of employing digital data are practical, secure, and prompt. Also, they can be collected from any geographic location with Internet connectivity and be edited promptly, such as online questionnaires. After collection, digital data can be transmitted to other platforms or software programs, such as Microsoft Excel, for analysis (Hossen *et al.*, 2018)

As this research was conducted during the pandemic, the researcher employed digital tools in different projects, such as contextual pilot studies and primary research. It involved participants online instead of face-to-face, overcoming the restriction, such as online workshops and questionnaires. This study used various digital collaboration platforms, such as Miro Board, Google Forms, Google Documents, and digital conferencing platforms, such as Zoom, MS Teams, and Gather Town.

5.5.8. Paper-based data collection

Paper-based data collection uses physical materials, such as paper, to capture data in written format during research. Wilcox *et al.* (2012) state that researchers commonly use this method because of its simplicity and cost-effectiveness in developing and distributing research tools based on paper. For instance, handing out paper tools to participants is easier and cheaper than providing digital devices. Another advantage is that it enables researchers to capture prompt feedback at the site and easily monitor it. However, this method has limitations in managing data, such as requiring space to store paper tools (Wilcox *et al.*, 2012). In the research, participants were asked to engage in hands-on activities, such as drawing, sketching, or writing, which the researcher could then capture and analyse. The resulting data provided insights into participants' experiences and perspectives on research topics. In addition, this thesis includes the development of a tool as a physical hands-on material in which the researcher can collect qualitative data from different research activities.

Figure 30. *The paper-based data collection in Workshop 1*

5.5.9. Visual research method

Visual research methods are a means to capture non-verbal information and spatial layouts that are challenging to explain through other data collection methods. They are beneficial in complementing other data sources, such as interviews and questionnaires, to enhance an overall understanding of the research environment. Banks (2018) states visual research is generally categorised into two types in social science areas. The first category indicates occasions when researchers generate visual images, such as photographs, film, videotapes, drawings, and diagrams. The creation of those images aims to collect social interactions during research activities and to analyse them from different angles after collection. All these methods involve the researcher creating images independently of whether the research participants are aware, comprehending, or interested in these images. The second category of visual research is to collect and review visuals produced by participants during the activities. In this case, research projects are designed to focus on visual elements and how studied subjects will interact with visuals when they visualise their inputs, such as ideas and concepts (Banks, 2018).

In this research, the researcher adopted two types of visual research. The first type was utilised in that the researcher produced visuals to understand the context and capture how the participants used or interacted with the tools. The method used is photography to collect visual information that emerged during the workshops, such as physical settings and participants' non-verbal expressions. For instance, the researchers took pictures of participants' hands and movements to analyse and understand the effectiveness of the tools without showing their faces. Before the activities, ethical considerations around informed consent were addressed by providing the participants with an information sheet and consent form. After the activities, the researcher produced diagrams and tables to describe findings, identify emerging patterns and themes, and provide insights relevant to research questions and objectives.

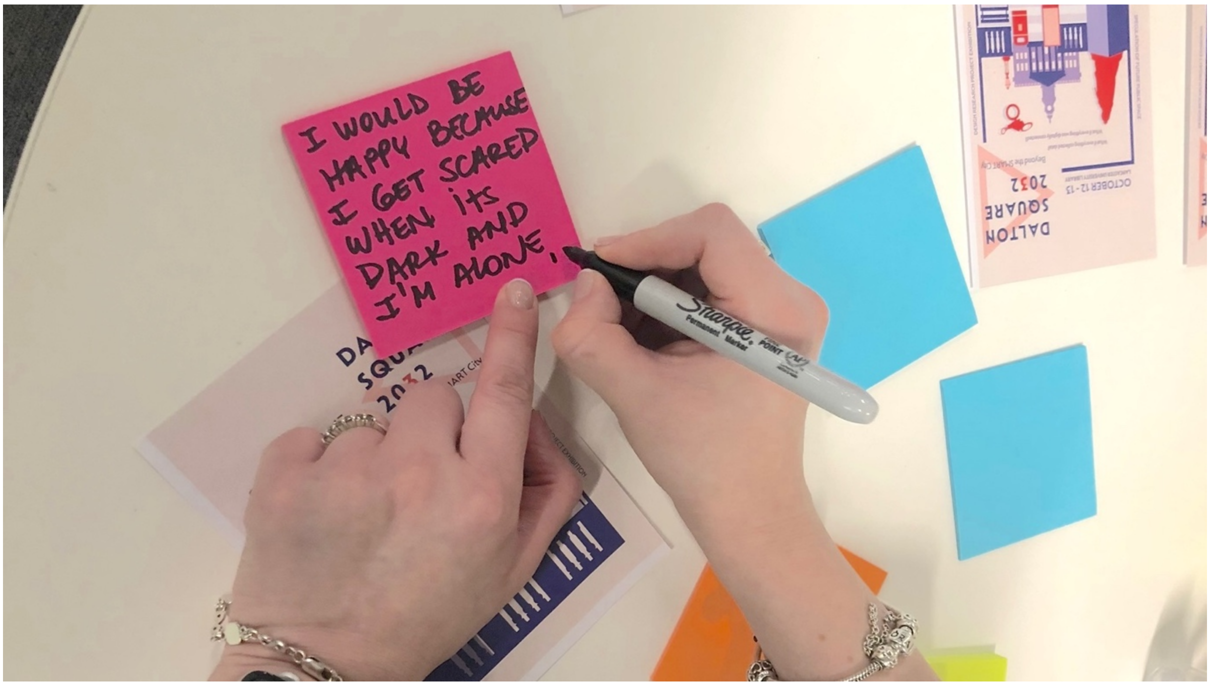

Figure 31. *The photography to capture how a participant interacted with the tool in Exhibition 2*

Second, the researcher also utilised the second approach, which focuses on analysing images, to scrutinise the visual data produced by the participants. Specifically, in the first stage of the study, during the workshops, the participants were asked to generate ideas for artefacts through writing and drawing and to create storyboards for those artefacts. The researcher then collected and analysed these visual data to prepare for the subsequent data collection stage. These visual data were indispensable for comprehending how the participant groups viewed the places in the plurality context and envisioned the diverse possibilities for public spaces in the context of connected technology.

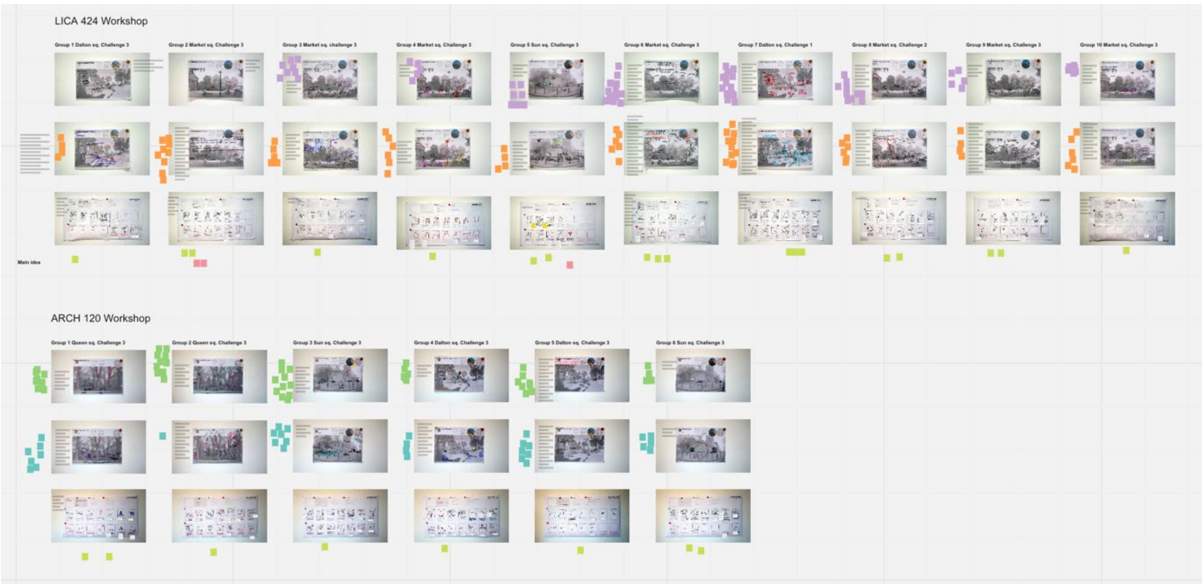

Figure 32. *Analysing visual data produced by the participants in Workshops 1 and 2*

5.5.10. Audio recording

This research utilised audio recording as a data collection method in Stage 3 to capture discussion among local participants. Gray (2014) states that audio recording allows researchers to document whole conversations. This method typically requires a process of transcription before data analysis. A challenge claimed by Gray (2014) with audio recording emerges in a group conversation, such as a moment when participants speak simultaneously. Thus, he argues that recording quality should be optimal for data collection (Gray, 2014).

5.6. Data analysis approaches

As defined in Part 5.4.3, this research employed a mixed methods approach, in particular following explanatory sequential mixed methods design. The overall research strategies for data collection were presented in the previous **part 5.5**. The data collection process is divided into two phases in the primary research, first using quantitative methods and then engaging with qualitative methods. This approach was because the researcher designed her research with explanatory sequential mixed methods to analyse quantitative and qualitative data accordingly and then interpret them by connecting them. The researcher could plan a follow-up step using qualitative methods based on quantitative data collection (Creswell and Creswell, 2017). Therefore, the following parts will describe how the researcher approached and analysed both quantitative and qualitative data accordingly.

5.6.1. Quantitative data analysis

As described above, the methodological choice of this research is explanatory sequential mixed methods so that quantitative data was analysed and then influenced the following activities of qualitative data collection. In Stage 1, the researcher collected quantitative data via an online questionnaire on the Google Forms platform to assess students' understanding of connected places and their relevant technologies. Based on the analytical information provided by the platform, the researcher could effectively visualise the outputs of the questionnaires into graphs. The findings of this quantitative data, the understanding levels of students, were helpful for the researcher in designing the next qualitative research activity, speculative prototyping workshops inviting the same groups of students. During the exhibitions in Stage 2, the researcher collected feedback from the visitors about their preferences for the exhibited prototypes. Their responses were collected in quantitative data formats, asking yes-or-not questions. After collection, the data was imported into Excel and analysed to measure percentages of the preferences. For instance, the Smart Bin prototype received 57% of visitors' agreement, while 43% disagreed. This result helped the researcher understand how the public would feel about the technology, and it may be controversial if it is going to be deployed. The findings of the quantitative data contributed to planning Stage 3. Reflecting on the public's responses, the researcher selected several controversial prototypes to discuss with the policymakers.

5.6.2. Qualitative data analysis

According to Creswell and Creswell (2017), the alignment between data collection and analysis methods is essential in qualitative studies. As the researcher captured data primarily based on textual, visual and audio data, this qualitative data analysis focused on identifying themes and meanings that emerged from them. Making sense of the data included breaking it down and analysing it to achieve an in-depth understanding (Creswell and Creswell, 2017)**.** The following parts will present two methods of data analysis used in this research: thematic analysis and comparative analysis.

5.6.2.1. Thematic analysis

In this research, thematic analysis is used, a qualitative analytical approach involving identifying, analysing, and interpreting patterns within a qualitative dataset (Gray, 2014; Clarke, Braun, and Hayfield, 2015). Throughout the process of data coding, researchers can develop themes. It is a theoretically flexible method rather than a theoretically delimited methodology. It can be flexibly shaped with different approaches (Clarke, Braun, and Hayfield, 2015). The thematic analysis, especially the reflexive thematic analysis described below, was conducted to generate themes and patterns in the data collected during the study.

Reflexive thematic analysis

According to Braun and Clarke (2021), reflexive thematic is applying an adjective reflexive approach to thematic analysis. This way of analysis acknowledges that researchers are individuals embedded in subjectivity, contextual awareness, and critical thinking. Consequently, reflexivity from researchers distinguishes it from other types of thematic analysis. In this context, reflexivity includes utilising crucial reflection on a researcher's positionality, practices, and processes. Thus, this analysis method is aligned with the value of a qualitative research paradigm (Braun and Clarke, 2021).

Reflexive thematic analysis was utilised in each stage of this research. After the workshops in Stage 1, the researcher employed reflexive thematic analysis to understand how the participants viewed a public space based on the method of place mapping. Then, by analysing data produced by speculative brainstorming, she captured themes from the participants' innovative ideas for the future. In Stage 2, based on the feedback from the visitors, the researcher analysed six prototypes and their emerged themes related to potential concerns, excitements, and recommendations. Lastly, in Stage 3, this method was utilised to analyse policymakers' opinions as citizens towards the prototypes and insights related to current policymaking practices. This research followed six phases of the process of reflective thematic analysis, which was suggested by Braun and Clarke (2021). The six steps are as follows:

1. **Data familiarisation**

In the first stage, data familiarisation, the data on the paper-based tools was transferred to the Miro board (https://miro.com/), a digital whiteboard platform enabling users to visualise ideas and processes. By transferring the data, the researcher became familiar with what the participants had written or drawn on the hands-on materials. In the case of audio recordings, they were transcribed first and then analysed. Transcribing was a part of data familiarisation for the researcher, who listened and paid attention to what participants said.

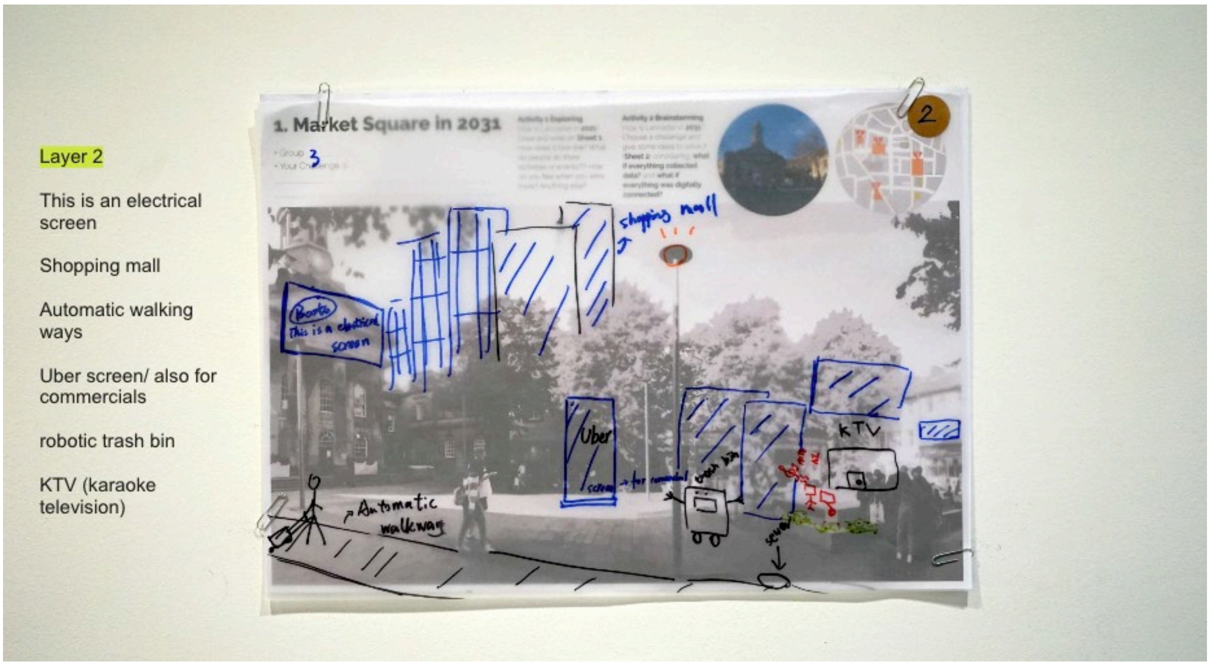

Figure 33. *The data familiarisation on the Miro Board*

2. **Data coding**

In the second stage of analysis, the researcher started coding the data. Some keywords relevant to the latent meanings of participants' quotes and notes were highlighted during this process. Those keywords were used for coding, a critical process of data analysis involving organising materials into smaller, more manageable sizes or segments of text. These segments are then assigned a word or phrase to develop a general sense of them. The coding process gave the researcher a more straightforward navigation and understanding of complex systems (Creswell and Creswell, 2017).

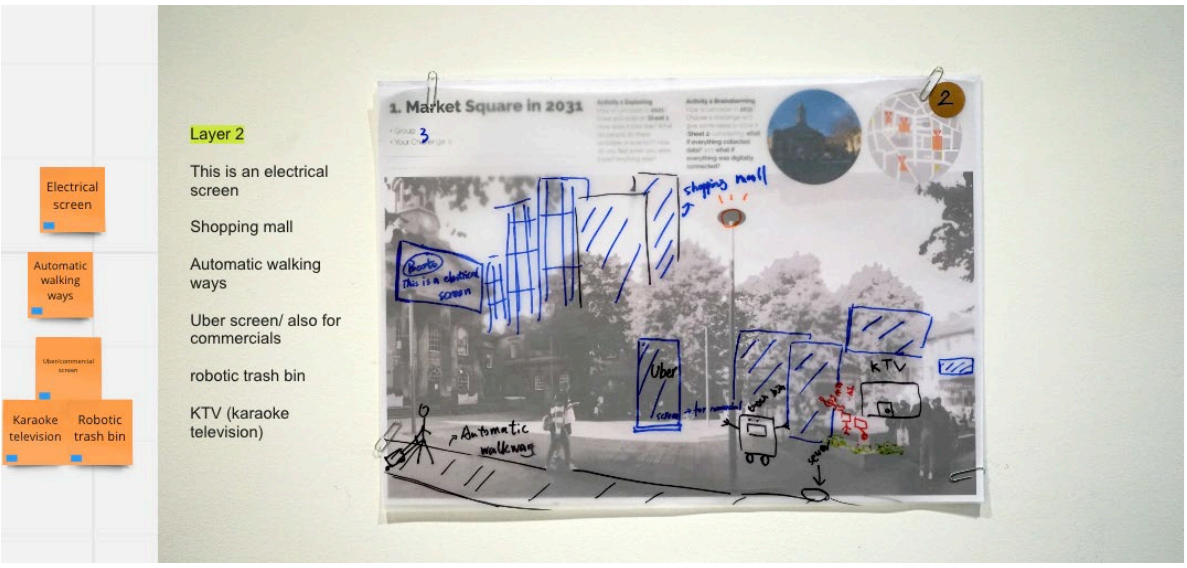

Figure 34. *Coding data on Miro Board*

3. Initial theme generation

The researcher roughly created the initial themes based on codes defined in phrase 2. This process was conducted by categorising and clustering codes with the obvious themes, mapping the connection between them (Clarke, Braun and Hayfield, 2015). The researcher employed the Miro board, a visual tool that facilitated the visualisation of these connections.

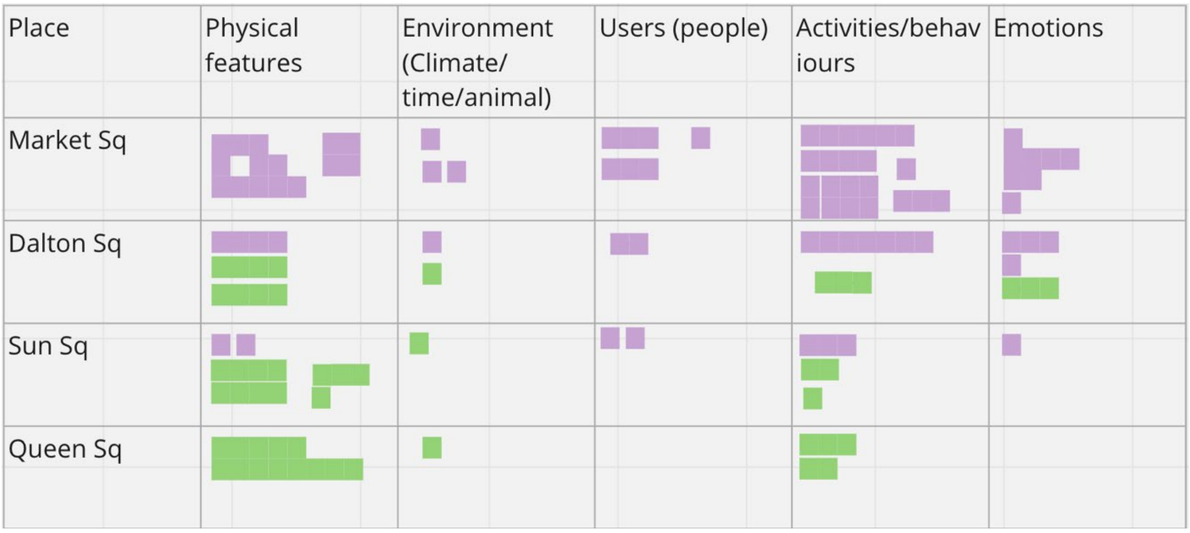

Figure 35. *Categorising and clustering data on the Miro Board*

4. Theme development and review

At this stage of developing and reviewing themes, the researcher followed eight recommendations suggested by Ryan and Bernard (2003) on how to identify the themes as follows:

- **Repetitions** refer to topics that appear repeatedly through data.
- **Indigenous typologies** or **categories** are local expressions that may be unfamiliar or used unusually.
- **Metaphors** and **analogies** refer to participants' methods of representing their ideas using these literary devices.
- **Transitions** indicate how topics change in transcripts and other materials.
- **Similarities** and **differences** refer to examining how participants might approach a topic differently or diverge from one another in specific ways or by comparing whole texts such as transcripts and noting their differences.
- **Linguistic connectors** are words like *because* or *since* that point to a causal connection in the participant's mind, and their use is explored.
- **Missing data** refers to reflecting on what is not in the data, such as what participants miss from their answers to questions.
- **Theory-related materials** involve using social scientific concepts as a starting point for themes.

In particular, the researcher focused on three points: the strategy of **repetitions**, **similarities** and **differences**, and **missing data**, when she developed and reviewed the themes.

5. **Theme refining, defining, and naming**

The process of refining, defining, and naming themes is closely linked with phrase 6, delivery. This involves writing theme definitions that highlight the main aspects of each theme. This is an iterative process of refining and defining, which is done by writing up the description.

6. **Delivery**

The researcher wrote descriptions for each theme, explaining its characteristics and making comparisons. The analysis is presented in **Chapters 7** and **9**.

5.6.2.2. Comparative analysis

According to Yin (2009), comparative analysis (also referred to as the cross-case synthesis technique) can be conducted whether the individual case studies were conducted as independent research studies by different authors or as planned components within the same study. In both situations, each case study is treated as an independent study within the analysis. When faced with a given outcome arising from various conditions, researchers can turn to comparative analysis designed to address this complexity (Ragin, 1999). This approach is also beneficial, as it includes the potential for simpler analysis and more reliable findings compared to analysing a single case (Yin, 2009; Swanborn, 2010). Ragin (1999) suggests the four phases for comparative analysis: selecting cases, making a table to define their relevant characteristics, testing the sufficiency of conditions, and deriving and interpreting the results. He states that the analysis summary should be part of an extensive discussion with more evidence.

In the current research, the research activities that were pre-designed and carried out during the primary research are regarded as independent studies. Each data collection phase in this research includes similar activities conducted with distinct participant groups. For instance, in Stage 1, two workshops engaged students from diverse disciplines, while Stage 2 involved two public exhibitions held in different locations with distinct audiences. By replicating certain research activities in Stages 1 and 2, Stage 3 generated data that can be compared to the previous stages. As a result, the researcher treated each stage as a separate case, allowing for comparative analysis to be presented within each stage.

5.6.3. Overview of the research structure and data collection and analysis

Based on the explanation above, this research claims an epistemological position between constructivism and pluralism. The researcher acknowledges that individuals construct their world views even when they are related to physical places, such as public spaces. Thus, she argues that their perspectives should be included in understanding the areas and discussing shaping public spaces. This research philosophy influenced the research approach, an abductive approach combining deductive and inductive methods to investigate phenomena and patterns. Based on the approach and methodological choice, this study explored how PSD can bring different voices in speculative design and address intricate issues caused by connected technologies.

Under the strategy and aim of the research, the research consisted of contextual pilot studies and primary research. The pilot studies were selected based on the relevance of the reheard topics and the researcher's opportunities within the *Population and Policy* Cluster of the *Beyond Imagination* project, described in the research context. The selected research projects and activities are related to policymaking, design methods, connected places, and place-based approaches. The primary research used a mixed methods approach to collect quantitative and qualitative data. In particular, the study utilised an explanatory sequential mixed methods design in which the collection of quantitative data influences qualitative data collection.

The researcher utilised various data collection methods throughout the study, including observation, research field notes, digital-based data collection, a questionnaire, paper-based data, visual research methods, and audio recording. Quantitative data was analysed using software and digital platforms such as Excel and Google Forms to calculate question response rates. On the other hand, qualitative data was processed through reflexive thematic analysis. Furthermore, the research involved conducting similar activities with different groups in each phase. Those activities were considered as cases to conduct comparative analysis. An overview of these methods and processes can be found in **Figure 36**.

	Contextual pilot studies							
	Case 1	Case 2			Case 3			
	Primary research							
			Workshop 1	Workshop 2		Exhibition1	Exhibition 2	Workshop 3
	Data collection							
Observation	●	●	●	●	●	●	●	●
Field note	●	●	●	●	●	●	●	●
Digital-based data collection	●	●	●	●				
Questionnaire			●	●				
Paper-based data collection		●	●	●	●	●	●	●
Visual research method		●	●	●	●	●	●	●
Audio recording								●
	Data collection							
Quantitative			●	●		●	●	
Qualitative	●	●	●	●	●	●	●	●

Figure 36. *The overview of the methods and processes*

Section 4. Research Findings

Section 4 presents research findings from contextual pilot studies in **Chapter 6** and primary research consisted of three stages in **Chapters 7** and **9**. Then, **Chapter 10** will provide a comparative analysis of testing the same methods in different stages. The overview of this section is shown in **Figure 37**.

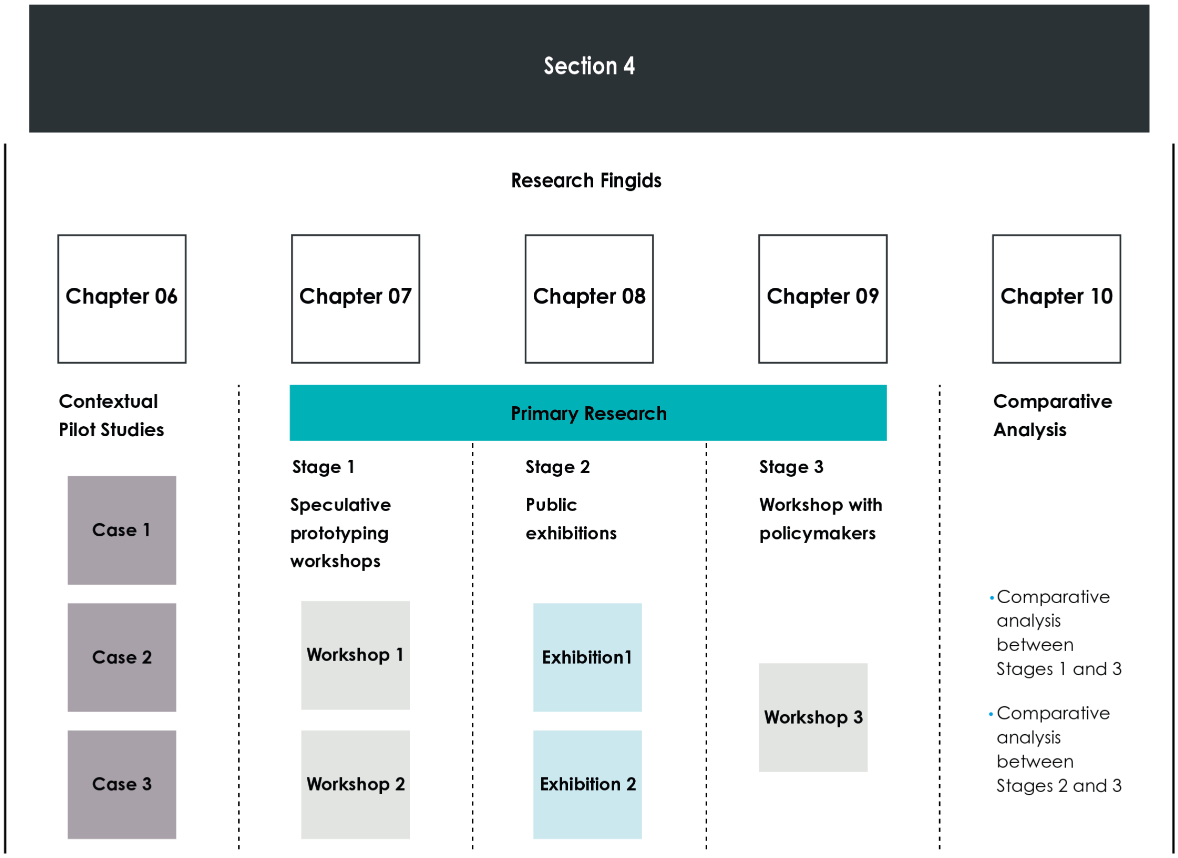

Figure 37. *The overview of Section 4*

6. Contextual Pilot Studies

The previous chapter explained the research methodology, including the research context, philosophy, approaches, methodological choice, research design and sampling, and specific data collection and analysis methods. This research is situated within the philosophical framework that includes constructivism and pluralism. This framework acknowledges that individuals can construct their perspectives of certain places. Thus, incorporating their plural views of public spaces is essential in discussions and decision-making procedures. Following the framework, this study employed an abductive approach and utilised mixed methods to investigate PSD and its capacity to effectively address challenges caused by implementing digital technologies and supporting policymakers. The chapter demonstrated that this study consisted of contextual pilot studies and primary research.

This chapter offers contextual pilot studies that were highly relevant research projects and activities to the research topics conducted by the researcher during her doctoral study. As described in the research context in **Part 5.1** in the previous chapter, this PhD research was conducted as part of a larger project, allowing the researcher to participate in various projects and activities with different scales. The projects and activities presented in this chapter are pilot projects: the *Urban Smart* project, the *P-PITEE* project and the *Designing Place-based Policy* workshop. These cases significantly influenced this doctoral research, narrowing the focus to policymaking, participatory, or place-based approaches. Each case will describe overall research backgrounds, methods, processes, findings, and learnings. The learning from these cases shaped the primary research presented in **Chapters 7** and **9**.

6.1. *Urban Smart* project

Smart cities can benefit their residents, workers, and visitors by utilising the capabilities of their surroundings (Cavada, Tight and Rogers, 2019). Cavada, Hunt and Rogers (2014) argue that the concepts of smartness are diverse and still need to be explored locally, nationally, or internationally. Based on this argument, a pilot project, *Urban Smart*, was imitated to explore different smartness capabilities in the urban policy context. This project was funded by the *Beyond Imagination* project. This project included collaboration between the research team, Lancaster City Council, and Lancashire County Council and began in September 2020. The project aimed to develop a vision for *smart* Lancaster and support the council's digital strategy to create a sustainable and healthy district through technology. The project reviewed current policies in Lancaster City Council, mapped the policy context, and prioritised the policy areas for a smart urban vision (Cavada, Kwon, and Cooper, 2023). The research team comprised a researcher, a professor, a project manager, and a postgraduate researcher. In this project, the researcher played a role in designing tools for activities and visual representations, analysing data, and supporting research activities, such as facilitating workshops.

6.1.1. Methods and process

The project aimed to develop a vision for Smart Lancaster using the SMART tool (Cavada, Tight and Rogers, 2019). The approach to developing the comprehensive vision for Lancaster involved analysing and integrating local policies and strategies. Integrating local policies and strategies was essential in this project due to the nature of policymaking often developed in independent, separate, and isolated settings. Thus, by analysing their interrelationship, the project primarily attempted to identify existing gaps and inform the external partner, the Lancaster City Council, to improve them effectively. The research team comprised a researcher, a professor, a project manager, and a PhD researcher. The research process involved four steps:

1. Policy analysing and mapping
2. Mapping the interconnectivity between policies and strategies
3. Using the SMART tool for assessment
4. Conducting an online workshop

6.1.1.1. Policy analysis and mapping

The project's scope includes reviewing existing urban policies, plans, and strategies to formulate a holistic vision for Smart City Lancaster. The research team first focused on the Lancaster City Council Local Plan for the assessment. The choice was because the plan is a significant document for the council, which needs to be reviewed every five years by law. This plan is guided by the National Planning Policy Framework, which prioritises sustainable development. The plan aims to achieve economic, social, and environmental objectives. The objectives include building the economy, creating healthy communities, preserving green areas, and reducing waste and pollution. The plan consists of several documents presented in **Figure 38**.

Figure 38. *The nine sections of Lancaster local plan (Kwon, 2022)*

Furthermore, the team reviewed additional plans and strategies published by Lancaster City Council, marked in the grey area in **Figure 39**. In particular, it was helpful for the researcher to construct this doctoral research by examining strategies: the Movement Public Realm Strategy and the Digital Strategy.

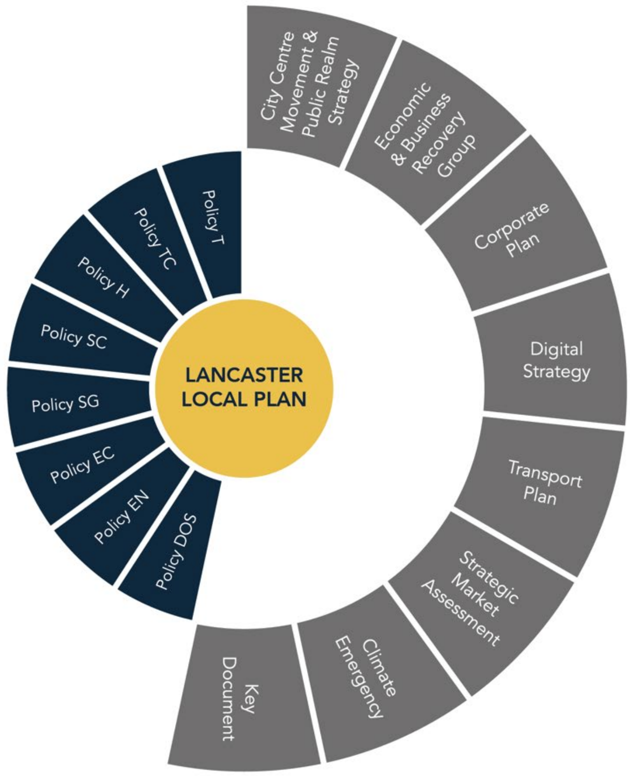

Figure 39. *The overview of Lancaster local plan, including strategies and plans (Kwon, 2022)*

Movement public realm strategy

The Movement Public Realm Strategy was collaboratively established by Lancaster City Council and Lancaster County Council. The document provides an overview of the strategic vision and potential for Lancaster's city centre, responding to mobility and climate transitions. This strategy shares the value with the Smart Futures vision presented, which aims to improve the city centre. The document offers a range of urban adaptations to encourage sustainable travel and decrease car use. The adaptations include proposed plans for Dalton Square, Penny Street Bridge, and Spring Square.

Digital strategy

The Lancaster City Council Digital Strategy was written in 2020. This ten-year plan aims to transform the Lancaster area into a 'gigabyte district' using digital methods in various sectors such as technology, healthcare, innovation, environment, and education. This strategy states that digital transformation will benefit local communities and businesses. Moreover, this plan aims to improve council services and accessibility to WIFI and increase digital communications among council teams and officers. It acknowledges the importance of collaborating with universities, the National Health Service (NHS), and other public sectors to achieve the strategy. However, after the team's analysis, collaborations may not directly relate to the objectives presented in the Local Plan strategy.

6.1.1.2. Mapping the interconnectivity between policies and strategies

After examination of the policies and strategies, the research team developed a map of their connections and identified common themes. As a result, four distinct themes emerged in the Local Plan Policies and Strategies. This mapping analysis facilitated the team's understanding of the key focuses of the City Council described in policies and strategies. Based on the map, the team could conduct an assessment.

Thematic areas	Policies	Strategies
Corporate Priorities	• Sustainable Communities (SC) • Transport (T) • Housing (H)	• Corporate Plan • Movement public realm strategy • Digital Strategy
Sustainability	• Development Opportunity Sites (DOS) • Environment (EN) • Economy (EC) • Sustainable Growth (SG) • Sustainable Planning (SP) • Sustainable Communities (SC) • Housing (H)	• Movement public realm strategy • Digital Strategy
Urban Design	• Sustainable Communities (SC) • Housing (H) • Transport (T)	• Movement public realm strategy
Economy	• Economy (EC) • Sustainable Planning (SP)	• Digital Strategy

Table 10. *The links and themes between local plan policies and strategies*

6.1.1.3. Using SMART tool for assessment

According to Cavada, Tight and Rogers (2019), the Smart Assessment Resilient Tool (SMART) was developed as part of the Liveable Cities research project (**Figure 40**). The tool aims to evaluate cities' smartness based on four criteria: Society, Environment, Economy, and Governance. Cavada, Tight and Rogers (2019) assessed four cities using the SMART to evaluate their smartness. The cities include Birmingham, London, Copenhagen, and Singapore (Cavada, Tight and Rogers, 2019). Within the *Liveable City* project, Boyko (2017) proposed improving the tool by adding a health assessment. In addition, the COVID-19 pandemic has influenced people's lifestyles, mental health, working conditions, mobility, governance, and mental health. Consequently, the team included the health lens in the assessment (Cavada, Kwon, and Cooper, 2023).

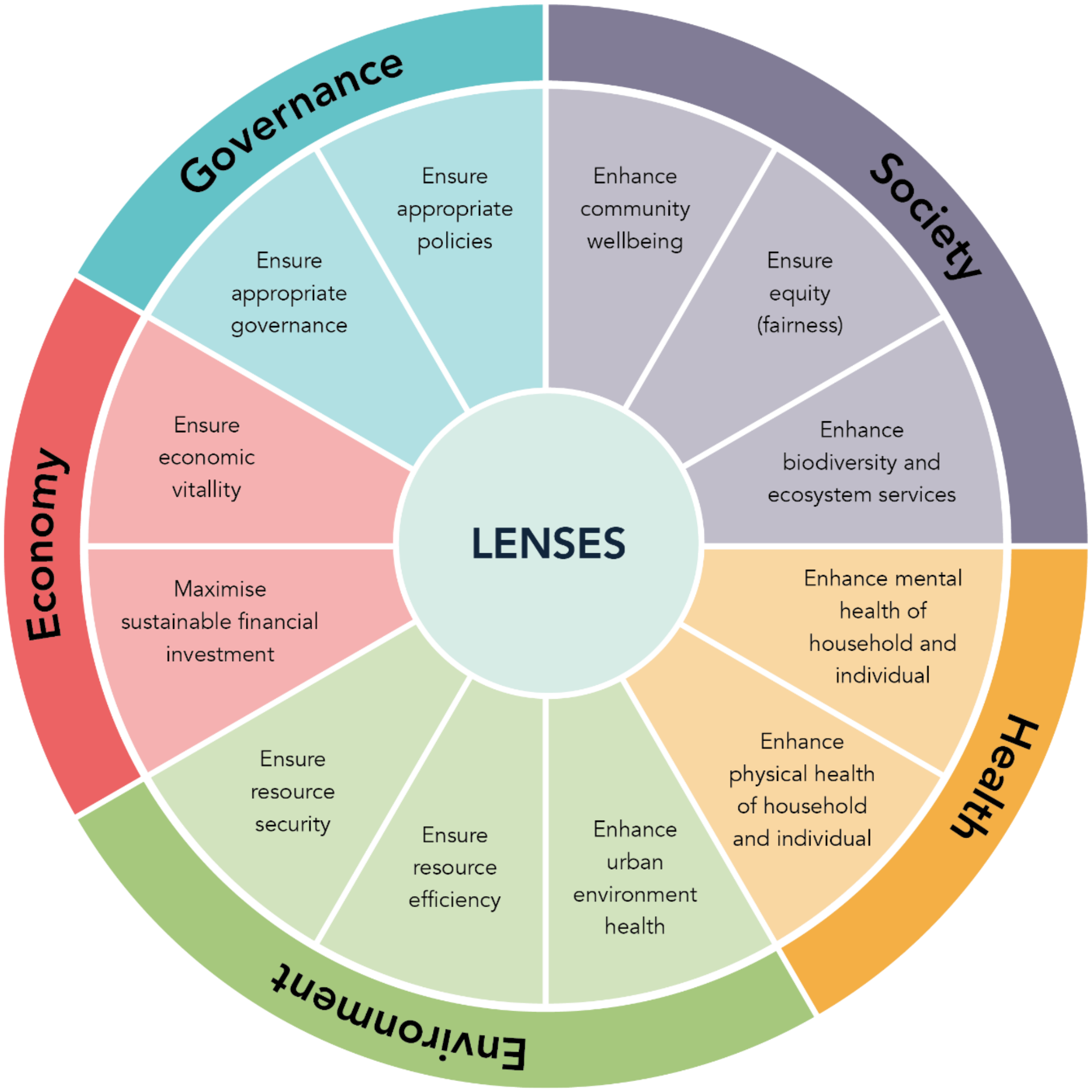

Figure 40. *The SMART criteria and areas of research (Kwon, 2020, adapted from Cavada, Tight and Rogers (2019))*

The mapping activity findings indicated that the policies and strategies significantly highlighted two criteria: society and environment. In other words, the city would be notably influenced by them. In contrast, health criterion has comparatively less influence than society and the environment. In addition, the other two criteria, economy and governance, were found to have limited influence. The finding indicates that although Lancaster has built a robust and resilient community, there needs to be more public involvement in governance and economic considerations. According to the SMART tool assessment result, the local policies in Lancaster need to focus on improving the economy and finance, governance, and policy criteria. The current priorities of each criterion are shown as percentages in **Figure 41**. These results were utilised as a primary indication to plan open discussion with local policymakers, academics from different disciplines and researchers from the *Beyond Imagination* project who had some prior knowledge of local urban matters—the workshop aimed to discuss the urgent priorities that should be considered and create continuity in urban research.

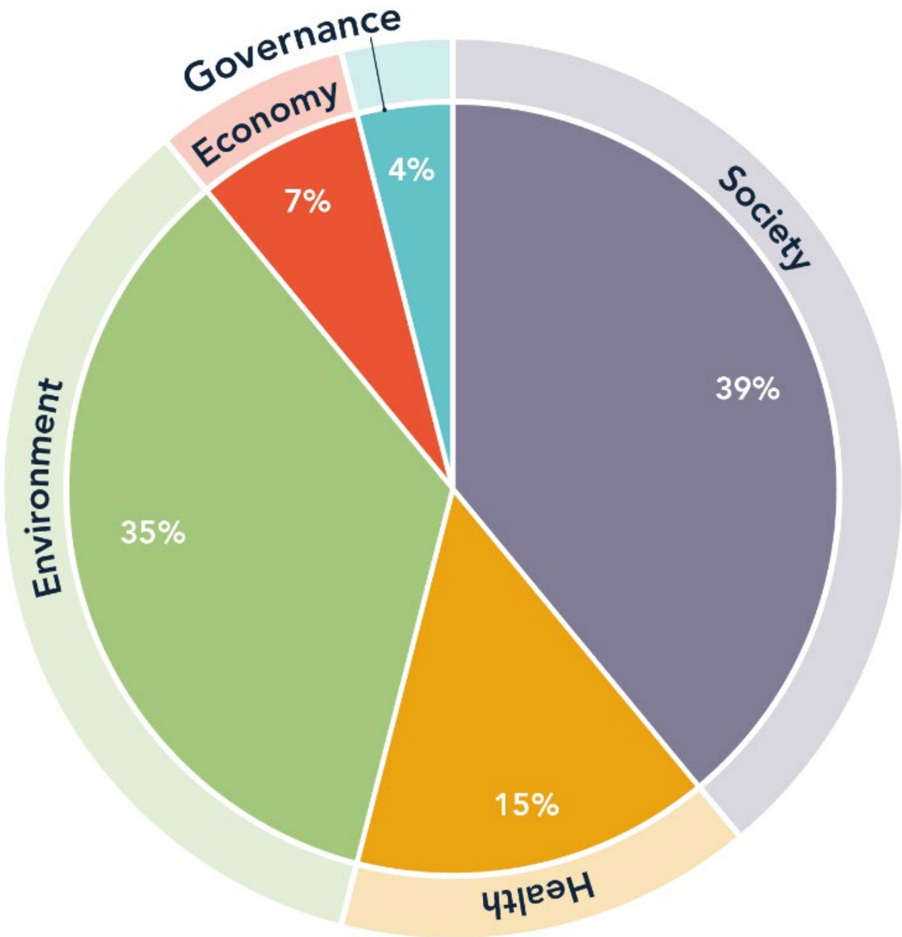

Figure 41. The result of priorities evaluated by the research team

6.1.1.4. Conducting an online workshop

Academic researchers and officers from Lancaster City Council and Lancashire County Council were invited to participate in a workshop to continue urban research in the area. Due to COVID-19 limitations (the workshop was conducted in 2021), the workshop was held online and involved three steps:

1. presentations by the research team from ImaginationLancaster, the Lancashire County Council, and the City Council
2. dissemination and discussion of the *Urban Smart* findings
3. workshop discussion and recommendations

The workshop had 26 participants, including five from the City and County Councils, one officer working between the Lancaster Council and Lancaster University, and 20 academic participants, including PhD students and individuals from various academic disciplines and departments. Despite the small attendance, discussions were more straightforward to develop with better facilitation than larger participant gatherings. This workshop entailed individual as well as group activities. For the group activities, the participants were sent to different breakout rooms based on what criterion the participant chose in the first individual activity.

In the workshop discussion, the first individual activity was to map the priority of five criteria from low to high: society, environment, health, economy, and governance. The research team counted the responses between the high and low-priority sections (**Figure 42**). The research team noted that some responses were strategically situated between the high and low-priority sections, indicating participants' uncertainty towards categorising them strictly as high or low priorities. These responses were calculated to + and – responses. Overall, the high priority side shows that society received the highest priority score, followed by environment and health. Economy, finance, governance, and policy were placed lower and lower, giving them less priority than other criteria. On the other hand, the priority side shows that society received fewer votes, followed by environment and health. Finally, economy and governance were marked more than the others.

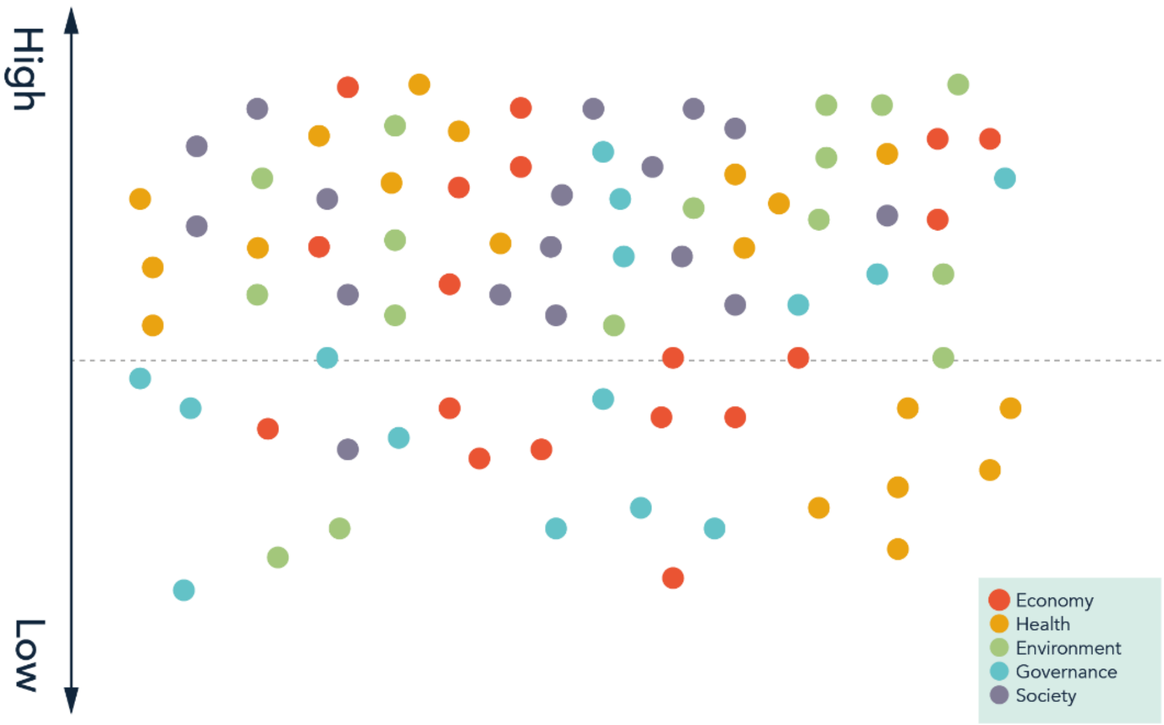

Figure 42. *The priorities of the lenses marked by the participants during the workshop*

Second, the participants were virtually sent into several breakout rooms. Dividing the participants based on which one of the criteria they selected was the most significant in the first activity. In the group discussions, they were asked to think about the priorities within a criterion they selected and then define specific goals to achieve those priorities. After the breakout room discussion, they returned to the main room as a whole group for further discussion.

In the group focusing on the society criterion, the participants identified five themes: public spaces, event spaces, spaces for diverse age groups, technology, and safety. They discussed goals, such as increasing cycling safety, promoting a night-time economy, providing accessible event venues, opening more spaces for young adults to socialise, and expanding the availability of community centres, accessible pavements, and indoor facilities.

The health-focused group set a series of key priorities, such as promoting active travel, decreasing air pollution, and increasing accessibility to clean water. First, they built an idea to encourage physical activities such as walking and cycling, boosting dwellers' health. They suggested implementing campaigns and utilising wearables to monitor and record individual activity. The significance of inclusivity in cycling infrastructure was highlighted during the discussion. In order to support inclusivity, they ideated several initiatives, such as promoting safe cycling for children and increasing the accessibility of bike storage facilities. Due to the limited time, the second priority was briefly stating how to decrease air pollution through better transportation services and increase communication with the public through clean air campaigns.

The environment criterion group discussed improving air quality, building more green infrastructure, increasing resilience to climate change's impact, and protecting biodiversity. During the discussion, they stated that promoting cycling and decreasing dependence on automobiles is essential to improve air quality. Related to this context, a range of initiatives were ideated, such as building more covered bike shelters and improving the conditions of bike lanes. In addition, the group argued the importance of collaborating between the environment and health sectors to enhance the availability of green spaces. Furthermore, increasing co-housing and co-living spaces was suggested to boost resilience against climate change. In particular, creating permeable surfaces and rain gardens was proposed as a strategy against flooding. Several initiatives were proposed to ensure biodiversity, such as building green corridors and no-mow areas.

The participants in the group, who focused on the economy criterion emphasised prioritising the decentralisation of the city centre in Lancaster to improve residential facilities and conditions. They highlighted the *Eden* project[1], the tourism economy, and transport as critical priorities. The priorities were identified to ensure procurement of materials from local businesses for the *Eden* project, develop public engagement activities for tourism industries, and enhance transport infrastructure to support the flow and distribution of goods and services.

The group highlighted four priorities while working on the governance criterion. These priorities included improving communication across different levels, educating citizens, promoting local experiences, products, and histories, and increasing citizen participation in infrastructural decision-making. They proposed several ideas, such as transforming political cultures, setting long-term education plans, promoting Morecambe's heritage, and empowering citizens to inform infrastructural decisions. The significance of public involvement was acknowledged for better decision-making and governance, and initiatives were proposed to notify the public about policy and its potential impact.

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[1] The *Eden* project aims to build a new attraction that redefines the seaside experience by offering a harmonious blend of indoor and outdoor encounters in Morecambe Bay, near Lancaster City. Eden Project Morecambe has received a substantial £50 million allocation in the second round of the UK Government's Levelling Up Fund. The undertaking is a collaborative effort involving the creators of the inaugural *Eden* project in Cornwall in partnership with local entities such as Lancaster University, Lancaster City Council, Lancashire County Council, and the Lancashire Enterprise Partnership. (Source: https://www.edenproject.com/new-edens/eden-project-morecambe-uk)

6.1.2. Findings and learning: evaluating priorities in the *Urban Smart* workshop

This project was the researcher's first involvement in the research project since she started her postdoctoral study. The project employed the existing model, SMART, which offered insights into how to use and develop the model further. By participating in the project, the researcher gained opportunities to holistically examine the existing policies and strategies of Lancaster City Council and County Council. This opportunity allowed her to explore different governance levels and insights from the City and County councils by communicating with officers from both organisations. She also developed an understanding of the existing policy priorities in Lancaster and Lancashire and identified crucial areas that need additional attention. However, it was conducted during the COVID-19 pandemic, which caused a significant challenge to the project. The restricted research method of conducting an online workshop was applied. Even though the online workshop allowed the team to interact with participants, it provided limited space for communications, only allowing verbal communications and online interactions, such as utilising chat functions. In addition, the project focused on the existing model, so there was limited space to explore other methods and approaches.

In the project, the researcher, as a part of the team, examined the policies on the agenda of the local authorities and their directions while understanding priorities developed by the academic participants, such as society, environment, and health. The analysis included highlighting shared perspectives and differences in policies. However, the researcher observed that although the current *Movement Strategy* articulated the vision of the future in public space, there needs to be more consideration of digital influences and implementations in those places. This defined gap is of great concern, especially considering the growing role of digital technology in public domains and its potential advantages for communities. In addition, the *Digital Strategy* attempts to transform Lancaster into a *gigabyte district* by utilising digital technology to improve services for local communities and businesses. However, its dysconnectivity from the Local Plan policy was revealed in the research by discovering the lack of ideas and assessments to implement digital technology.

Through this project, the researcher discovered the absence of considering digital technology implementation in Lancaster's existing policies and strategies. At the same time, while participating in the project, the researcher explored the existing literature related to the 4IR. As the literature review emphasised the need for urgent and agile responses to digital influences, this realisation allowed the researcher to formulate a question of what public spaces in Lancaster would be like if connected technology was implemented. Her understanding of policies and strategies enabled her to organise workshops for primary research with students and employ the *Movement Strategy* as the context for the workshop. Furthermore, the following case study, the *P-PITEE* project, enabled the researcher to overview the complexity of deploying connected technology in public spaces and utilise experience in the online workshop. This will be presented in the next part.

6.2. *P-PITEE* project

Local governments and other organisations increasingly use Internet of Things (IoT) sensors and edge computing in public spaces. However, digital technology initiatives require careful examination of practical, methodological, and ethical elements as they could influence unexpectedly broad and even negatively. The *Participatory Policy for IoT (at the Edge) Ethics* (*P-PITEE*) project was funded by PETRAS (which stands for Privacy, Ethics, Trust, Reliability, Acceptability, and Security) National Centre of Excellence for IoT Systems Cybersecurity. The project aimed to support the development of new policies by utilising design methods for deploying secure, transparent, and ethical IoT sensors in public spaces. This project was a collective effort from ImaginationLancaster, Lancaster City Council, and the University of Aberdeen. The research team from ImaginationLancaster consisted of a primary investigator (PI), a postdoctoral research associate (PDRA), and a postgraduate researcher.

The project was founded on the PI's previous work, the *TrustLens* project. One of the project's outputs was developing a tool to assist organisations in examining the transparency of IoT systems (Jacobs *et al.*, 2022). The *P-PITEE* project achieved the advancements of this tool to support local authorities in reviewing data management procedures and their use, as well as sharing and addressing questions related to cybersecurity and privacy before IoT deployments in public spaces. The project aimed to investigate IoT's potential benefits, risks, and challenges in public spaces. This investigation was explored by design fiction and participatory design methods like walking workshops. The second aim was to assist local governments in effectively reviewing IoT deployment proposals and their uses by other parties while considering practical, technical, and ethical factors. Based on those aims, the primary objective was to deliver a tool of fully implemented IoT transparency guidelines. This tool can be used by organisations planning IoT deployments that wish to examine transparent and ethical data use.

6.2.1. Research methods and process

The *P-PITEE* project employed a speculative design methodology with multiple methods and approaches:

1. The walking workshop (called *walkshop* in the project) was an experiential method for investigating diverse issues related to technologies and their impacts on people and places. The Walkshop method is an educational encounter that combines elements of an

urban walking tour, group discussions, and spontaneous discovery (Greenfield and Kim, 2011).

2. A virtual walkshop was held in a digital Lancaster city centre built on Gather Town, a video conferencing platform.
3. Based on the discussion from the walkshops, the *TrustLens* toolkit was developed as an output of the project in the form of a series of questions to prompt critical thinking regarding IoT deployment in public areas. Before its official website launch, the toolkit underwent testing with an external research team from the Beacons project, involving a comprehensive review and resolution of the questions.
4. A workshop was held with policymakers from Lancaster City Council to draft an IoT policy for public spaces. The activities involved analysing and categorising policy statements and identifying stakeholders around the policy.

6.2.1.1. Physical walkshop

The first walkshop was planned in person, inviting participants from different departments of Lancaster City Council. As part of planning, the team attempted to identify existing IoT and sensors in the city centre. The inquiry was made by consulting with council officers. However, it was revealed that there was an absence of a comprehensive record of IoTs and sensors in Lancaster. This lack of information made deciding which sensors and data to discuss during the walk challenging. Consequently, the team looked for any visible sensors while walking the city centre and included the sensors near the centre, excluding those in the distance.

The research team also created fictional scenarios based on connected place implementations in other cities, referencing the existing deployments. The route was selected by observing ordinary objects and routines in public spaces and merging them with fictional scenarios. Design fiction objects were created to represent the fictional deployments, and existing features in the city centre were transformed into smart lighting and smart bins. The team also considered provocative and speculative elements to explore challenging questions, such as the implications of using AI monitoring and systems in a busy high street. The walkshop included eight stops in the city centre.

Figure 43. *The physical walkshop*

In order to gather data during the walkshop, the research team looked for inspiration from diverse sources, including previous work conducted by a team member (Mullagh, 2022), existing field guides, and a collection of *i-SPY* books. This book series was designed for children in the UK who identify objects in different locations. As a result, they created a hands-on tool formed as a field guide, which took the form of an A5-sized booklet. This guide contained a list of each stop and six questions for participants to answer. After completing the guide, participants turned it in for data analysis. The questions included:

- *What is it? And how does it work?*
- *What data does it collect and why?*
- *What are the potential benefits?*
- *What are the potential risks?*
- *Are there any security challenges?*
- *Are there any ethical challenges?*

In addition to the field guide, extra tools like stickers, a map, and fictional signs were designed to support participant interactions. The stickers provided supplementary artefact information but were distributed after the participants speculated the first question: What is it? And how does it work? The gap between moments before and after handing out the stickers allowed the participants to imagine and speculate what mundane look-like objects could possibly do and guess if they were real or fictional. In addition, a tourist map of the city centre was provided, showing the stop locations and a suggested route. Finally, the signs were designed for some fictional objects, while others were intentionally left without signage. The reason is to replicate the reality of public spaces where the IoT sensors are placed without information to some extent. The designs of the signs delivered some info with different levels of transparency. These signs also contained different styles of typography and graphics representing the diversity of visual communications throughout the city, such as traffic signs, public advertisements, and warnings.

6.2.1.2. Virtual walkshop

The virtual walkshop was organised to gather data from IoT experts despite travel restrictions during the Pandemic. It was an opportunity but, at the same time, a challenge to recruit participants from a distance and organise a *walking* workshop. The research team created virtual 2D spaces on the Gather platform that referenced the tourist map of Lancaster City Centre (**Figure 44**). Gather is an online conferencing platform that enables users to choose an avatar and video chat with other users' adjacent avatars. The avatars can virtually move around the space to start and end the conversation with others using direction keys (Jacobs and Lindley, 2021). The challenge of this experimental workshop was how to transfer experiences of a physical place to a limited digital platform. This feature of Gather, virtually walking, enabled the team to partially recreate the experience of the physical walkshop.

Figure 44. *The virtual walkshop on Gather Town*

Some pictures of public spaces were embedded in Gather as part of the background to represent some parts of the route. However, due to the limited functions of Gather, it was only built in a pixelated environment with low fidelity rather than a photo-realistic representation of the city. As a result of this constraint, the 2D city was built abstractly, and only certain spots were highlighted. In order to complement this limited spatial experience, all stops were video-recorded in 360 degrees and embedded in the Gather space. In addition, this virtual walkshop included hands-on tools by sending physical tools, such as a printed field guide, map, and stickers, to participants before the walkshop.

6.2.1.3. Workshop with Beacons project

As a result of the two walkshop, the team developed a toolkit, *TrustLens*, that consisted of a set of questions. The questions can assist organisations planning IoT deployments in public spaces to critically analyse their initiatives. The toolkit was built upon the previous work by the *TrustLens* project (Jacobs *et al.*, 2022). The toolkit went through iterative modifications while the *P-PITEE* project was ongoing. Before officially launching the website, the toolkit was tested with another research team, the Beacons project. Each toolkit question was reviewed in the workshop with the Beacons project team.

The *Beacons* project aimed to develop and deploy Bluetooth beacons in various sites in Lancaster city. The beacons are small devices that can send information, such as tourist information in this research context, to nearby smart devices. One of the objectives of this project was to develop a walking trail in Lancaster to promote awareness regarding sustainable food farming in urban areas. The activity was timed to coincide with COP26 events[2] happening nationally and in Lancaster, but the trail has continued beyond that timeframe. In addition, the trail incorporated several projects linked to enhancing health and wellness results for communities around Morecambe Bay through pervasive technology. The project combined beacons and a mobile app to minimise the batter power and data usages required from the public (https://www.lancaster.ac.uk/trustlens/#casestudies).

In the workshop, the Beacons Project team, as participants, reviewed a series of questions set by the toolkit reflecting on the Beacons Project processes. The feedback from the participants helped to test and improve the toolkit. As a result, the Trustlens was finalised as a series of question cards with categories of 14 *big question*s (**Part 6.2.2**). The toolkit was provided in different digital formats, such as a Miro board, a PowerPoint and a pdf file. The Beacon project research team could discover previously overlooked elements by reviewing the toolkit. For example, they raised a question of land ownership regarding whom they should ask permission to deploy beacons. In addition, interestingly, the complexity of deploying beacon devices in public spaces

[2] From October 31 to November 13, 2021, Glasgow served as the host city for the 26th UN Climate Change Conference of the Parties (COP26) held by the UK. (https://www.gov.uk/government/topical-events/cop26)

was revealed despite beacons being relatively passive technology. This workshop offered the researcher a better understanding of the actual case of IoT deployments in public spaces.

6.2.1.4. Workshop with policymakers

The third case is about a workshop with policymakers from Lancaster City Council. This workshop aimed to create a policy draft for implementing IoT in public realms. The researcher built an in-depth understanding of policymaking, including diverse perspectives and stakeholders that policymakers should consider. In the first part of the workshop, the research team presented potential policy statements that could be included in the policy. The statements were printed on cards so the participants could sort and categorise the cards. They selected some cards that could be part of the policy draft. Consequently, the research team wrote the draft based on the discussions held during the workshop.

Figure 45. *The policy prototyping activity with the policymakers*

Second, the participants were asked to identify stakeholders from four categories:

1. Citizens and communities
2. Government
3. Organisations and institutions
4. Companies and supplier

The stakeholder mapping was from the Lancaster City Council's perspective to assess their involvement in a policy for IoT deployments in public spaces. **Figure 46** shows the stakeholders identified by the participants in the four categories. In terms of the category of citizens and communities, the participants recognised third-sector partners, such as Community Voluntary Solutions (CVS) [3], Citizens Advice Bureau (CAB), charities, community groups, and city councillors. They also included the public as far from the policy.

In the government category, the participants identified several organisations they intended to collaborate closely with. The organisations included the Information and Communication Technology (ICT) sector, the Information Commissioner's Office (ICO), the National Cyber Security Centre (NCSC), Info Gov, and The Office of Government Property (OGP). They also highlighted the central government and county council at the middle level, procurement and planning departments, and parish and town council at the next level. The participants ranked central policies and universities as their top priorities in organisations and institutions. The following prioritised organisations are the Chamber of Commerce, the Business Improvement District (BID)[4], and other public sectors and partners related to health, police, and fire. Lastly, the participants recognised utilities and small and medium-sized enterprises (SMEs) related to infrastructure and devices, and large firms specialising in software, consultancy, and data, such as Vodafone.

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[3] Established in 1972, Lancaster District Community Voluntary Solutions (LDCVS) is a charitable organisation. They support the voluntary, community, faith, and social enterprise sector (VCFSE), aiming to elevate these entities' recognition, significance, and representation. (https://lancastercvs.org.uk/)

[4] BID Lancaster, a non-profit organisation, is managed by a board predominantly composed of private sector members who contribute to enhancing the city centre's prosperity (https://lancasterbid.org/).

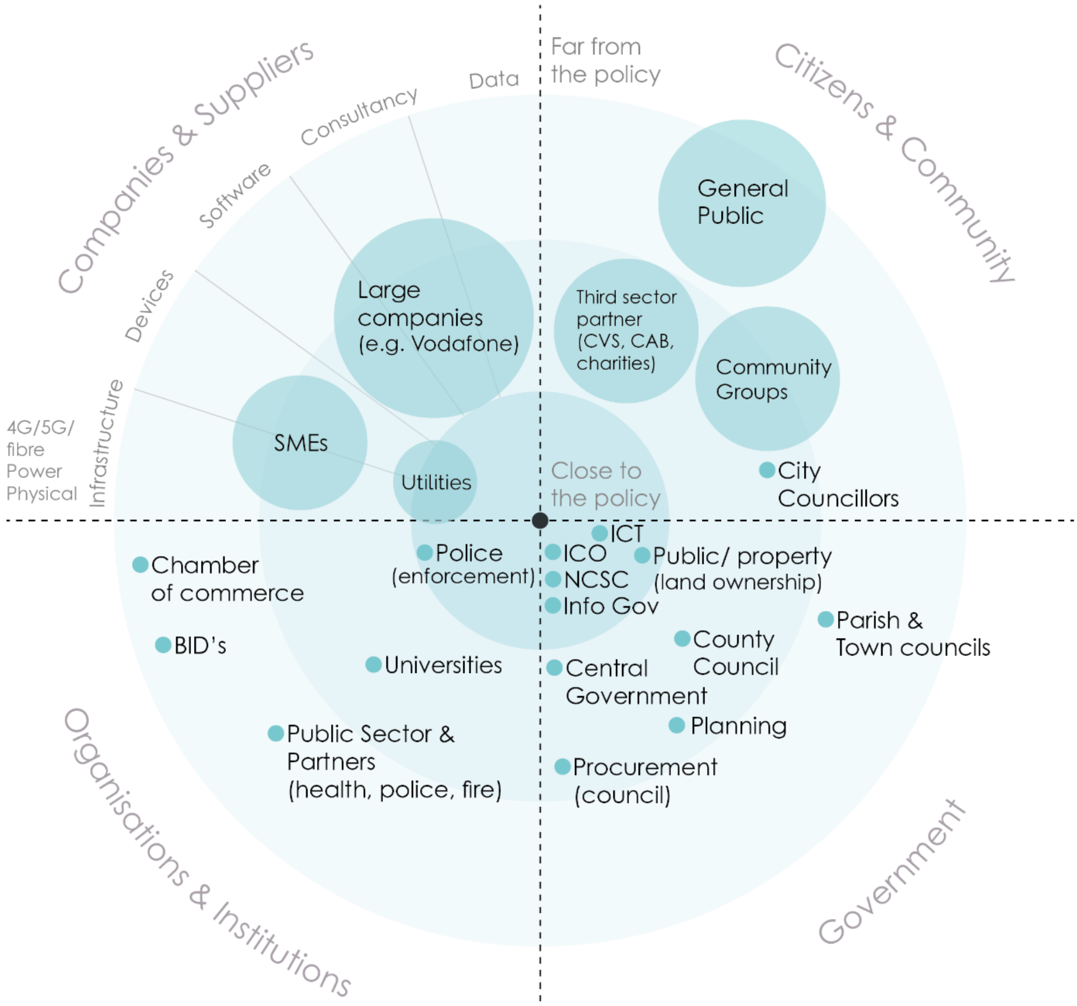

Figure 46. *The stakeholder map for IoT deployments in public spaces in Lancaster*

6.2.2. Findings and learnings: exploring design fiction and diverse perspectives in IoT deployments

In terms of practices and methods, after participating in the *P-PITEE* project, the researcher gained valuable insights into utilising design fiction in research. In the initial phase, she could learn formulation and consideration of implementation design fictions. During the research activities, the opportunity was to observe how design fiction can effectively prompt dialogue between the participants and the research team. In addition, the researcher built a hypothesis that speculative design can help policymakers imagine multiple possibilities of IoT deployments and communicate with the public. After the in-person walkshop, the team gathered feedback from the city council participants on the speculative walkshop. The participants described the walkshop as a channel to build dialogues and raise awareness of emerging technology. They also stated that they gained more understanding of AI and IoT systems. Significantly, one of the participants mentioned that it could be beneficial for them to think more about interconnectivity and the responsibility of policy and management in IoT deployments. This comment underlines the importance of building a holistic map of IoT deployments from an operational perspective (Kwon *et al.*, 2023).

Regarding research contexts, the project helped her learn about the current circumstances that the City Council faces with IoTs and the ongoing and potential risks around IoTs in public spaces. It was observed that despite the growing use of digital technology in public spaces, there exists an absence of communication channels, planning, and policy around implementing IoTs in those areas. In particular, the lack of a centralised management and record system within the local government was noted. During the walkshop, one of the participants from Lancaster County Council revealed a bin with a sensor. Interestingly, most participants had not noticed the existence of sensor-enabled bins in the public areas even though they worked in the council and passed by that area frequently. This finding highlights the need for a centralised communication channel in the City Council. This finding aligns with the observation made during the *Urban Smart* project, which uncovered a gap in attention to digital technology. Thus, this actual case of the deployment was used as a prompt in the workshops in the primary research (**Chapter 7**).

Moreover, the researcher broadened her understanding of implementing IoT in public spaces by being involved in developing the *TrustLens* toolkit. The toolkit consisted of 15 critical questions (https://www.lancaster.ac.uk/trustlens/). The questions addressed diverse elements of IoT deployments, including project goals, the scale of deployment, physical devices, participant and public interactions, infrastructure, data production, storage and sharing, privacy and legal compliance, and potential risks.

1. What are the goals of the project?
2. What is the scope and scale of the deployment?
3. What physical devices will be used?
4. How will you interact with participants?
5. How will you interact with the public?
6. What infrastructure supports the deployment?
7. What will the sensors do?
8. What data will be produced?
9. How will you deal with personally identifiable data?
10. How will you deal with sensitive data?
11. How will data be used?
12. Where will the data be stored?
13. How will the data be shared?
14. What risks might the deployment introduce?
15. How will you ensure legal requirements are met?
    (https://www.lancaster.ac.uk/trustlens/)

Furthermore, the stakeholder map created by the local policymakers reveals the City Council's perspective. They especially highlighted the complexity of implementing IoT in public spaces, unveiling the participation of numerous organisations, groups, and institutions across different levels and timeframes. The discussion indicated that policymakers encounter increased complexity due to their many involvements.

In this project, the challenges and opportunities of IoT in public spaces were examined in both in-person and virtual walkshops. The benefits are recognised, such as increasing management efficiency, optimising finances, saving time and enabling more focused and targeted decision-making through data collected from IoT devices. On the other hand, the potential risks were acknowledged, including physical damage to IoT installations, cyber-attacks, and data manipulation. Topics such as using AI agents as a central control system, technological literacy, and public acceptance of digital technology were also discussed. These findings affected the development of speculative prototyping workshops with students (**Chapter** 7). The *big questions* of the *TrustLense* Toolkit were used to formulate prompt questions in the workshops to encourage students to consider negative future technology-related scenarios.

The follow-up phase of the *P-PITEE* project is named, *Taking IoT for a Walk,* conducting walkshops as a means of public engagement and council officer training. The project was carried out in four cities in the UK. Interestingly, each city has different approaches to IoT and levels of awareness. While the project is ongoing, it has been observed that a place-based approach is required to address the distinct requirements of each place. For example, Hounslow is a suburban district in west London where the council considered Smart bins less relevant. Even though Smart bins offer to inform the council of their fill levels, this function is unnecessary in busy locations where bins tend to fill rapidly and must be emptied frequently. Another example is Weymouth, a seaside town in southern England, which has explored a plausible fiction in which drones could be used to locate lost children on the beach during the summer. These examples emphasise that different locations require different needs and approaches to implement technology in different settings.

6.3. Designing Place-Based Policy Workshop

The third case study is about a workshop held at ImaginationLancaster on May 3rd and 4th, 2022. A research team comprised a professor, a post-doctoral research associate, a researcher, and a postgraduate researcher—the workshop aimed to investigate the utilisation of design in developing place-based policies. As a research team member, the researcher actively organised the workshop by designing activities and tools for discussions and supporting graphic design. The *Beyond Imagination* project supported the workshop. The invitations were sent to people from the local and national administrations, as well as designers and researchers from across the country. The Policy Lab, a multidisciplinary team across the UK government (https://openpolicy.blog.gov.uk/), also participated in the workshop. Their insights were valuable for the workshop as they employ design, innovation, and people-centric methodologies to innovate in policy development. The objectives of the workshop were:

- To investigate the emerging field of place-based policymaking
- to define definitions of the term, place
- to explore the integration of design into place-based policymaking
- to evaluate the necessity of developing novel design tools and methodologies in this field
- to formulate a strategic direction and a roadmap for future work (Mullagh, Cooper and Kwon, 2022).

6.3.1. Research methods and process

The *Designing Place-Based Policy* workshop was conducted over two full days and included a series of activities. The following parts describe an overview of each activity in detail.

6.3.1.1. Workshop

The workshop lasted for two full days, including presentations of the relevant research projects, which helped prompt discussions and interactive activities with participants. The five activities of the workshop are as follows:

- Activity 1. What is a place?
- Activity 2. What do we need to know about a place?
- Activity 3. Who do we need to work and engage with?
- Activity 4. Methods and processes for place-based policymaking
- Activity 5. Building a manifesto for place-based placemaking (Mullagh, Cooper and Kwon, 2022).

The research team used hands-on tools to collect comments and ideas that emerged during the workshop. The outline of each activity, along with the insights gained, is explained below.

6.3.1.2. Day 1

Activity 1. What is a place?

In this activity, the team asked the participants what a place is. The activity aimed to outline participants' definitions of place and reflect on them. Guided sub-questions were provided to assist discussions. How do you define a place in terms of size or scale? What are examples of places, such as a house or street? What is the difference between a physical location and a digital one? What are the characteristics and features of a place? For this activity, the participants were divided into two groups.

Figure 47. *The workshop tool for the task, what is a place?*

The first group discussed the size and scale of places. They explored various concepts of places ranging from political districts to psychological perceptions. The borders of places, such as artificial borders and geographical boundaries, such as rivers and mountain ranges, were also discussed. However, they empathised that people should not be overlooked when understanding places such as communities and tribes.

"Pluralistic: I am always in several places at once, physical and digital."

(Workshop participant 1)

The second group argued that a place is formed not only by its physical and geographical environment but also by the existence of people. They also explored other elements affecting places, such as the availability of resources, connectivity to different places, and shared purposes of people. This discussion led to the statement that it is essential to understand the dynamics of the communities in the place, whether they are unified or not. Furthermore, the emphasis was placed on community formation's organisational and economic aspects, including ownership, capabilities, and activities.

Activity 2. What do we need to know about a place?

The second activity is to discuss elements of place in order to identify those elements that will assist in the development of place-based policies. This activity included three locations in Lancashire to facilitate discussion. Those locations are Dalton Square in Lancaster, West End in Morecambe, and Wray in Lancashire, with different locations, sizes, and characteristics. This activity aimed to enable the participants to consider a variety of places by presenting other places. The tools were printed on A3 papers, including a picture of each place, a map, reviews captured from Google Maps, and descriptions. In addition, four policy focuses were provided, quoted from the Levelling-up the United Kingdom white paper document (HM Government, 2022).

1. Boost productivity, pay, jobs and living standards by growing the private sector, especially in places where it is lagging.
2. Spread opportunities and improve public services, especially in those places where they are weakest.
3. Restore a sense of community, local pride and belonging, especially in those places where they have been lost.
4. Empower local leaders and communities, especially in those places lacking local agency.

Afterwards, the participants were divided into three groups for the discussion. Each group selected a policy focus and chose a place to work on. The first and second groups decided to work on Dalton Square in Lancaster, while the third group worked on West End in Morecambe.

Figure 48. *The workshop tools for the task: what do we need to know about a place?*

The first group that chose Dalton Square addressed the first policy focus: Boost productivity, pay, jobs, and living standards. During the discussion, some participants argued the importance of gathering data relevant to productivity, jobs and living. The data they suggested include economic indicators, such as employment rates. Other documents, such as pre-existing development plans and employment regulations, were also highlighted. In addition, they suggested investigating employment opportunities that Lancaster offers in different professional fields, crime rates, and educational offerings. Regarding the elements to know about places, the group highlighted the significance of examining the community's vision and developing channels to involve them in decision-making. As a means, they proposed surveys and focus groups to investigate their needs and preferences.

The second group also selected Dalton Square and chose the third policy focus: restoring a sense of community. However, this policy focus faced criticism of the word *restore* on the white paper. The participants found the term inappropriate because it sounds like the current sense of community is damaged, even though it may not be. Therefore, it should be replaced by *bringing* or *enhancing*. The group discussed diverse sources of information to know about the place. These sources enable place managers and policymakers to understand the nature of communities and identify a sense of place-based communities. Thus, they argued that the importance of prioritising and understanding people in place should be accompanied by examining physical conditions, health and wellbeing of residents, and connections and flow of the place. In addition, the conversation focused on reviewing the education system and the ethical beliefs, values, and political aspects that characterise the residents in the area and eventually shape the sense of place. In particular, regarding methods and approaches to gather information about the place, some suggestions included utilising digital resources, such as museums and art, using data and statistics. Utilising creative engagement can help foster empathetic understanding. Observation was also acknowledged as a fundamental approach to learning about a place.

The third group started a conversation, disagreeing with the *levelling up* national policy. The participants criticised the policy, employed a top-down approach and overlooked the specific requirements of local communities. Thus, they chose to have an open conversation instead of selecting one of the policy focuses. During the discussion, the value of ethical engagement with residents was highlighted. They argued that organising ethical engagements aims to create dialogues between top-down and bottom-up approaches. The participants also empathised to understand local history beyond examining the built environment. As other groups suggested, the third group stated the significance of identifying the people who live there to outline the current strengths of the place and communities included or excluded. In addition, they proposed the idea of effectively managing expectations and maintaining a sense of optimism. Finally, the importance of collaborative efforts was described, including many stakeholders to address any issues related to the place.

"Not just about the built environment."

(Workshop Participant 2)

According to this group, understanding a place, starting by learning from people who live there and are trusted, is essential, as is considering lived experiences and qualitative data. They also agreed that ethnography can be helpful, as can developing a policy vision and taking action. However, because policymaking takes time, managing expectations and keeping people motivated is essential. At this point, one of the participants stated that it could be achieved by building trust first.

Activity 3. Who do we need to work and engage with?

Activity 3 was to identify stakeholders of place on the stakeholder map tool. Mapping the stakeholders allowed the participants and team to visualise the dynamic of different groups that need to be involved in policymaking. The map was categorised into four groups: private organisations and institutions, citizens and communities, public organisations and institutions, and government. The stakeholder map is demonstrated in **Figure 49**.

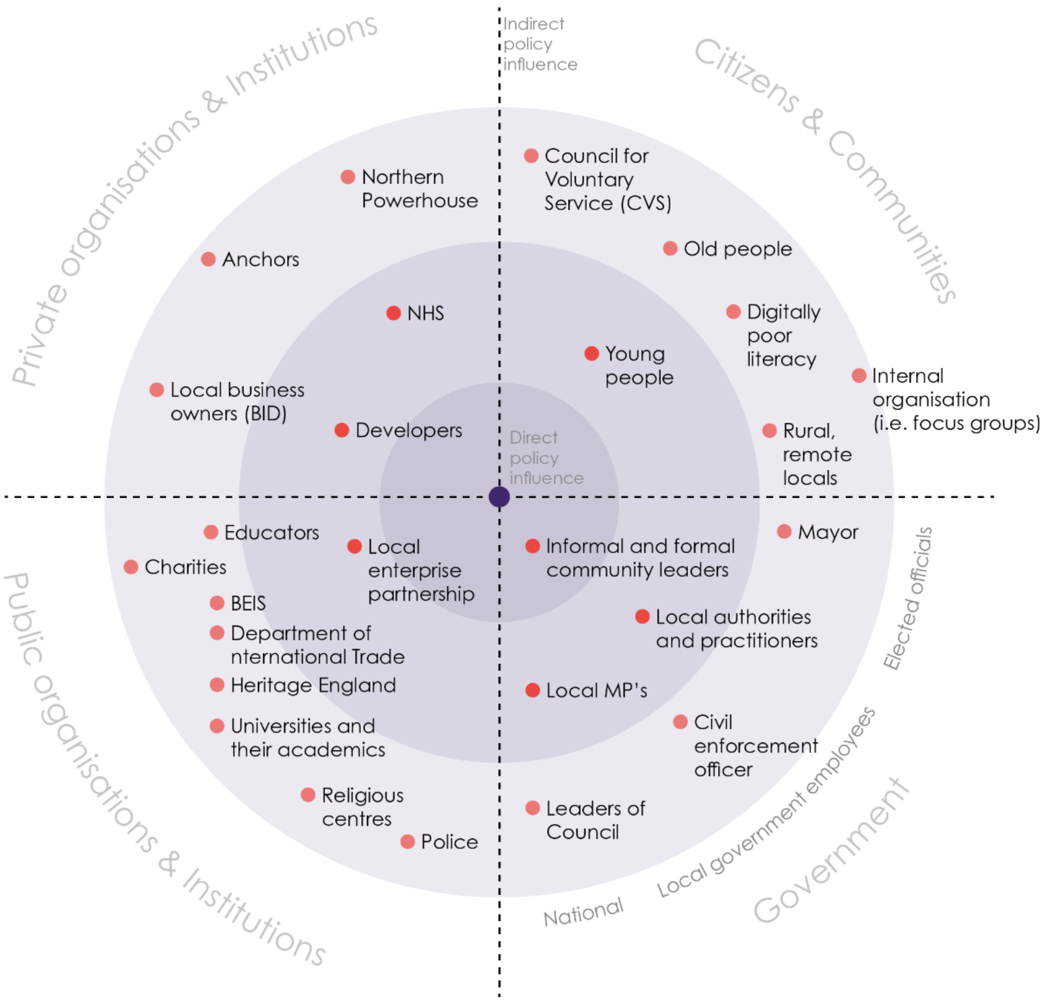

Figure 49. *Stakeholder map for place-based policymaking*

Regarding private organisations and institutions, the participants stated working with NHS and developing economic feasibility were important. In particular, the NHS's involvement is crucial as the fundamental foundation for healthcare strategy. However, a challenge is outlined by the complex relationship between national and local systems. In addition, they identified the indirect influencers of place-based policies, such as Northern Powerhouse[5], local business proprietors, and anchors[6]. However, they also highlighted the potential challenge because, on some occasions, commercial entities' profits overlook social values, and vision is absent.

In the category of citizens and communities, the importance of involving young people was stated as the next generation would be influenced by the policy currently discussed. Indirect stakeholders were discussed: the Council for Voluntary Service (CVS), older adults, those with low digital literacy, and people living in rural and remote areas. The participants discussed the digital divide issue, which could be a barrier to engaging with older adults.

The category of government is divided into three subcategories: national government, local government employees, and elected officials. The participants acknowledged that informal and formal community leaders were influential in policymaking. At the national level, Members of Parliament (MPs) and Council leaders were indicated as decision-makers. Local authorities, practitioners, and civil enforcement officers were mentioned at the local level. One of the participants said that these officials, including MPs, should be actively engaged in policymaking to foster connections and engage in lobbying efforts. However, another participant pointed out the complex nature of MPs affiliations with diverse political parties.

In the category of public organisations and institutes, the local enterprise partnership was considered significant in understanding the Lancashire region for the policy. However, the participants argued that it might be challenging to engage with them because of their political limitations. The prioritised groups the participants indicated are educators, charities, government departments, including the Department for Business, Energy, and Industrial Strategy (BEIS), the Department of International Trade (DIT), Heritage England, Police, and religious centres. As Lancaster is a university city, universities and their academic involvements are considered valuable for problem-solving.

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[5] The Northern Powerhouse represents a plan to enhance economic expansion in the northern regions of England, leveraging an already robust economy and facilitating businesses across the nation in capitalizing on the prospects that arise from Brexit. (https://northernpowerhouse.gov.uk/)
[6] Anchor institutions are generally significant non-profit entities whose ongoing viability is linked to the welfare of the communities they cater to (NHS, n.d.).

6.3.1.3. Day 2

Activity 4. Methods and processes for place-based policymaking

On the second day of the workshop, they explored how methods, tools, and processes can be utilised in place-based policymaking. The activities of the second day were related to the previous day's activities, which focused on people and their needs. The first part explored methods and tools customised to address locations' unique needs and characteristics.

Figure 50. *The workshop tool*

This activity employed a tool showing various methods and tools as prompts. The participants were encouraged to look into them and add others they have been using or aware of. The participant highlighted that successful place-based policymaking requires methods and tools to involve local communities, collect information, and encourage social changes. The discussed. The discussed methods and tools are the following:

- **Co-design** is an effective method for place-based policymaking. In this context, co-design enables local communities and other stakeholders to work collaboratively to design frameworks and policies that meet their needs.
- **Design activism** is an approach to promote social and political transitions. It includes initiatives like inclusive evidence gathering, storytelling curation, and oral histories.
- **Deep mapping** and **visualisation** are necessary to understand complex relationships and interconnectivity of places. The utilisation of theatre performances and film

documentaries can also be powerful in actively involving communities and effectively delivering complex concepts.

- **Ethnography**, **observation**, and **citizen science** are essential in collecting evidential data and understanding the needs of local communities.
- **Art and cultural activities** can promote social change and foster community engagement. For instance, implementing open commissions of artists and designers and artist-in-residence programs can foster creativity and encourage community engagement in policymaking.
- Regarding **design fiction**, one of the participants noted that thinking beyond the patterns and trends of the past and future is advantageous. This way of thinking helps people to consider potential impacts. This comment suggests that design fiction can remove current constraints and provide possibilities for investigating alternate futures.

"Good for breaking the cycle of past and future open possibilities."

(Workshop Participant 3)

The following discussion examined processes of place-based policymaking. However, most participants claimed the complexity of place-based policymaking processes. Although it is too complicated to define each step, there are essential steps that should be considered. The first step is to develop a map regarding the assets of a place and maintain trust with stakeholders. Secondly, it involves implementing distributed leadership and fostering mature relationships with partners. Lastly, multiple perspectives should be considered. The significance of collecting and displaying data was discussed. For instance, visualisations are used to gain knowledge and reveal insights rather than focus on outcomes.

Activity 5. Building a manifesto for place-based policymaking

Activity 5 is to form a manifesto for design in place-based policymaking based on discussion with the participants. While they agreed with the capabilities and benefits of design and design methods, they discussed several objectives to prompt design potential and support implementing design and design methods in policymaking. The objectives are:

- developing a White Paper to inform policy
- building a strong argument for design
- investigating R&D opportunities
- advancing knowledge and theories in design
- creating funding and development opportunities
- establishing a database of impact projects
- developing a network of practitioners and researchers to share knowledge and tools.

The conversation focused on the actions to actualize the integration of design into place-based policymaking. The actions included:

- identifying pre-existing networks
- understanding the policy framework at all levels of governance in the UK
- delivering the research agenda between the government and academia
- identifying areas for financial support and strategic advancement
- establishing a network to connect individuals with shared interests in policy areas in preparation for funding and other prospects (Mullagh, Cooper and Kwon, 2022).

6.3.2. Findings and learnings: Understanding place and placed-based policymaking

Participation in this workshop allowed the researcher to gain valuable insights into the notion of place and the necessity of place-based approaches in policymaking. The first-day discussion revealed the diversity of definitions of places depending on size, scale, borders, geographical boundaries, and people, such as local communities and tribes. Other invisible elements, such as ethics, religion, values, and politics, were discussed. Thus, it is essential to examine a place with different perspectives and especially involve local communities with lived experiences beyond examining its built environment. This learning from the first day was helpful for the researcher in the analysis of the primary data. For instance, the researcher utilised the method of place mapping in the speculative prototyping workshops in Stage 1 (**Chapter 7**). This method allowed her to collect data on the participants' experiences, feelings, and observations about public spaces in Lancaster. With this method, the researcher could understand how participants perceived the places and how the perceptions influenced the speculative ideas they generated in the next activity.

The workshop also explored the opportunities and challenges of different design methods and approaches on the second day. Speculative design was one of the methods discussed, featuring the benefit of removing the current limitation and helping people to move beyond it. In addition, the stakeholder map unveiled the intricacy of engaging stakeholders in place-based policy. Despite the intricacy, the importance of the stakeholder and public engagement was highlighted. This learning helped the researcher to understand the dynamics that policymakers face. Moreover, it enhanced her skill and capacity to facilitate a workshop with policymakers in Stage 3 of the primary research (**Chapter 9**) by understanding their languages, challenges, and perspectives.

6.4. Summary of Chapter 6

This chapter has demonstrated the contextual pilot studies, which offer backgrounds of the primary research presented in **Chapters 7** and **9**. As part of the large project, *Beyond Imagination*, the researcher could participate in various research projects and initiatives, including the *Urban Smart* project, *P-PITEE* project, and *Designing Place-Based Policy* workshop presented as case studies in this chapter. These cases significantly impacted this study as they are highly relevant to the research areas, such as policymaking, participatory methods, design methods, and place-based approaches. Thus, this chapter has explained each project's background, methodologies, findings and learning, describing how they influenced the researcher's practices and the primary research.

7. Stage 1. Speculative Prototyping Workshops

The previous chapter has presented the contextual pilot studies of the *Urban Smart* project, *P-PITEE* project, and *Designing Place-Based Policy* Workshop. These studies were conducted alongside the primary research and included relevant research topics, such as policymaking, connected places, design fictions, and participatory and place-based approaches. Based on the findings and learning from the contextual pilot studies, this primary research was structured by considering connected places, embracing speculative design with participatory approaches (PSD), and adopting a place-based approach to assist policymakers. The research involved the collection and analysis of data in three stages.

- Stage 1. Speculative prototyping workshops with students
- Stage 2. Public exhibitions
- Stage 3. Workshop with policymakers

This chapter, therefore, focuses on Stage 1, which includes two speculative prototyping workshops. The purpose of these workshops was to invite non-exports in technology and speculative design to envision the possible futures of public spaces in Lancaster in the context of connected places. The participants in Stage 1 are two groups of university students, MA Design Management and Arts Management in Workshop 1 and BA Architecture in Workshop 2. This chapter will explain a series of methods used in the workshops: place mapping, speculative brainstorming, and positive and negative storyboard building. Moreover, it will present the process and results of data analysis conducted by thematic analysis and comparative analysis methods, as well as the findings from the analysis.

7.1. Stage 1: Workshops with Students

7.1.1. Context: Lancaster City Centre Movement and Public Realm strategy

As described in **Part 6.1** of **Chapter 6**, the researcher reviewed several policies and strategies of the Lancashire County Council and Lancaster City Council (2020) during the *Urban Smart* project. Based on the review, the *Lancaster City Centre Movement and Public Realm Strategy* (referred to as the Movement strategy from this point) was used to formulate the challenges the participants had to consider during the workshop. The strategy aims to foster and deliver sustainable transport improvements and support the housing supply within the central Lancaster area. In addition, the strategy suggests rethinking what kind of city centre *we* want. By analysing current situations relating to crucial issues and challenges, it presents visions of the destination in Lancaster for 2031 and how they will look after conducting the strategy (**Figure 51**).

Figure 51. *Dalton Square in Lancaster Before (left) and After (right) presented in Lancaster City Centre Movement and Public Realm Strategy (Lancaster County Council and Lancaster City Council, 2020)*

The strategy consisted of five themes:

- inclusive environment
- ease of movement
- quality of place (public realm)
- safety and public health
- economic benefits

The strategy defines opportunities to redesign public spaces and prioritises the mobility of pedestrians and sustainable transportation based on the five themes. For example, opportunities included increasing green areas by planting more trees, prioritising pedestrian movement and wider pavements to encourage spill-out and dwelling (Lancaster County Council and Lancaster City Council, 2020). Although the strategy is for the public realm, it is lacking in considering the digital elements in the space. Thus, this lack of technological vision in the strategy was used as the prompt in the context of the workshop to supplement the digital perspective in public spaces. The researcher harnessed the strategy in the workshop to question whether the strategy is still reflective enough of the new vision of public spaces suggested by the County and City Council without digital influence.

The workshop aimed to create future prototypes and scenarios of digital technology deployments in public spaces in Lancaster. Based on the strategy, the challenges were formulated as design problems that the participants, as designers, needed to tackle in terms of local issues, considering digital technologies. The challenges played a role to test what futures would be with a digital influence in a public space when groups of people formulated them. For the workshop, the five themes of the strategy were merged into three challenges to narrow down the local scale. For instance, the theme of *ease of movement* was removed because it is more difficult for participants to imagine this future, requiring physical and infrastructural changes.

- Challenge 1. How can this place be more inclusive for vulnerable users (older people, children, disabled people?)?: Comfortable, easy to navigate, accessible, etc.
- Challenge 2. How can this place be safer for the community?: Reducing crime, noise level, air quality, number and severity of collisions, etc.
- Challenge 3. How can this place be more liveable and attractive for locals and tourists?: Place activities, street furniture, quality of maintenance and cleaning, etc.

In addition, the strategy presents four public spaces in the city centre: Dalton Square, Market Square, Sun Square and Queen Square. The workshops asked the participants to work on these public spaces. There were two rationales behind this facilitation choice. The first was to bring social challenges the local authorities are trying to tackle. Second, as there was less consideration of digital technology implementation, it was to compare the two different views of the future based on the current policy projected and the future participants produced imagining implementation of the technology.

7.2. Stage 1: Speculative prototyping workshop

7.2.1. Workshop structure

The workshop aimed to reflect on participants' experiences, memories, and feelings of place and use those reflections to speculate on future implementations of connected technology. It consisted of five steps: a questionnaire before the workshop and four methods. The methods are Place Mapping (Method 1), *What-if* Questions (Method 2), Speculative Brainstorming (Method 3), and Story Building: positive and negative futures (Method 4). The following subpart will explain each method and the process of how it was used.

7.2.1.1. Questionnaire

Before the workshops, the students were asked to complete a questionnaire. The questionnaire measured their understanding of devices and systems of connected places, such as wearable technology, sensor technology, IoT, and the concept of connected places. The questionnaire includes two parts: closed and open questions. First, the respondents selected a number representing their familiarity with each technology, from 1 (not aware) to 5 (extremely aware). The second part includes open questions to explain each technology in the respondents' own words. The open questions allow them to articulate their thoughts. This data was used as insights to design the workshops and to facilitate building imaginary and fictional futures.

7.2.1.2. Presentation

The workshops began with a presentation which included a brief explanation of the research project, the concept of connected places, and an introduction to related technology such as wearable devices, IoT, and AI. Based on the questionnaire results, the presentation aimed to build an understanding of connected technology. It provided information about connected places and the changes driven by digital technology. For instance, a picture of a mundane artefact, a waste bin located in Lancaster city centre, was shown during the presentation. Then, the participants were asked to guess what they could see (**Figure 52**). This example was one of the findings from the *P-PITEE* project (**Part 6.2** in **Chapter 6**). None of the students realised that the bin included an embedded sensor (a yellow cup inside the bin, shown in **Figure 52**). In this workshop, the image was a provocation for students to reflect critically on implementing pervasive digital technologies.

Figure 52. *An example of deployed IoT, is a litter bin with a sensor in Lancaster City Centre*

7.2.1.3. Method 1. Place Mapping

The first exercise aimed to brainstorm participants' emotions, experiences, and observations by asking, *"How is Lancaster in 2021?"* (Workshop 1 was conducted in 2021). The tool to capture them consisted of two parts printed on the A3 paper: a grey-scaled picture of each of the four selected places with a map, a picture with different angles, and a tracing paper overlay (**Figure 53**). Participants were instructed to work in groups when they received the tool. The students were asked to choose one of the four city locations and use the tracing paper to describe the appearance, activities and feelings related to the place. As participants openly drew and wrote, this activity enabled them to make sense of their knowledge of place and build a collective understanding of place for the next activity. This collective understanding served as a baseline of the present before undertaking speculative exploration. Interestingly, it was observed in both workshops that some students searched for places on Google Maps, checking the location and the images.

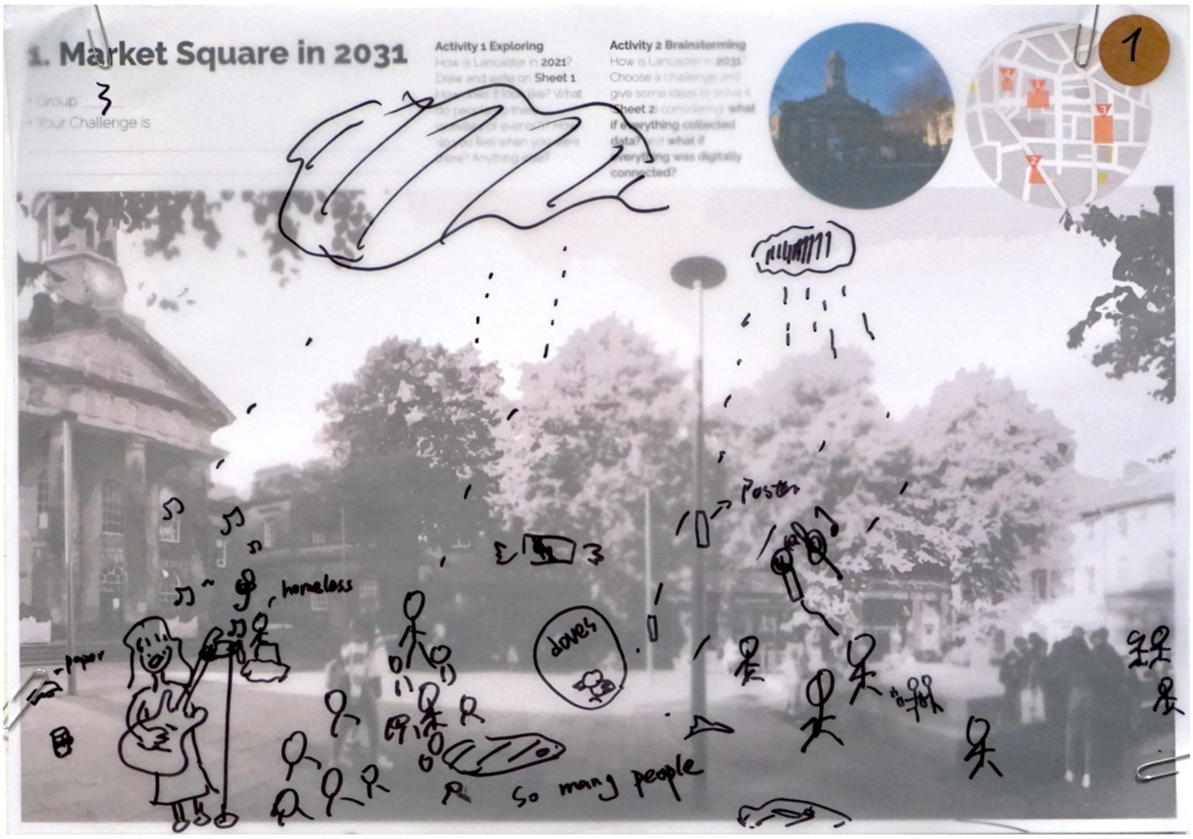

Figure 53. *The tool for Method 1. Place Mapping*

Before moving on to the next exercise, the facilitator invited the students to *time travel* by presenting a GIF picture (animated image) of time travel. Then, the facilitator announced that they had arrived in Lancaster in 2031. The moment of travelling helped them immerse themselves in the imagination of being in the future.

7.2.1.4. Method 2. What-if Questions and Method 3. Speculative Brainstorming

The second exercise was to design speculative prototypes for the public spaces based on the discussion of the first exercise. Before designing, the participants had to choose one of the challenges formulated from the movement strategy. Then, the researcher facilitated the introduction of hypothetical *What-if* questions. Stickdorn and Schneider (2012) define *What-if* questions as broadening a spectrum of scenarios rather than one single event. This method has been utilised in service design and speculative design. Within service design, the questions help service providers consider various occasions of how a service can be impacted by different elements, such as technological, societal, and cultural aspects (Stickdorn and Schneider, 2012). Speculative designers often utilise the *What-if* questions to construct possible future scenarios. Bleecker *et al.* (2022) compare *How-to* and *What-if* approaches. They state that the *How to* questions often prioritise solving problems. This approach may lead to a partial understanding of the potential outcomes. Alternatively, the *What-if* approach enables the reflection of purpose, intention, values, and needs. The reflection results in a deeper understanding and thorough achievement of objectives (Bleecker *et al.*, 2022). Thus, following the rationales from the literature, this exercise employed the questions to encourage the students to imagine multiple future scenarios freely rather than jumping into solutions. The two *What if* questions are:

1. *What if* everything was digitally connected?
2. *What if* everything collected data?

Finally, the students were asked to move to a new sheet of tracing paper to draw ideas for possible implementation of connected places (**Figure 54**). In a metaphoric sense, tracing paper represented the imperceptibility and invisibleness of digital technology. The technology has been embedded in or added to the pre-existing-built environment (Ampanavos and Markaki, 2014). By replacing the *present* paper from the first activity, the participants could reflect on the differences between present and future scenarios.

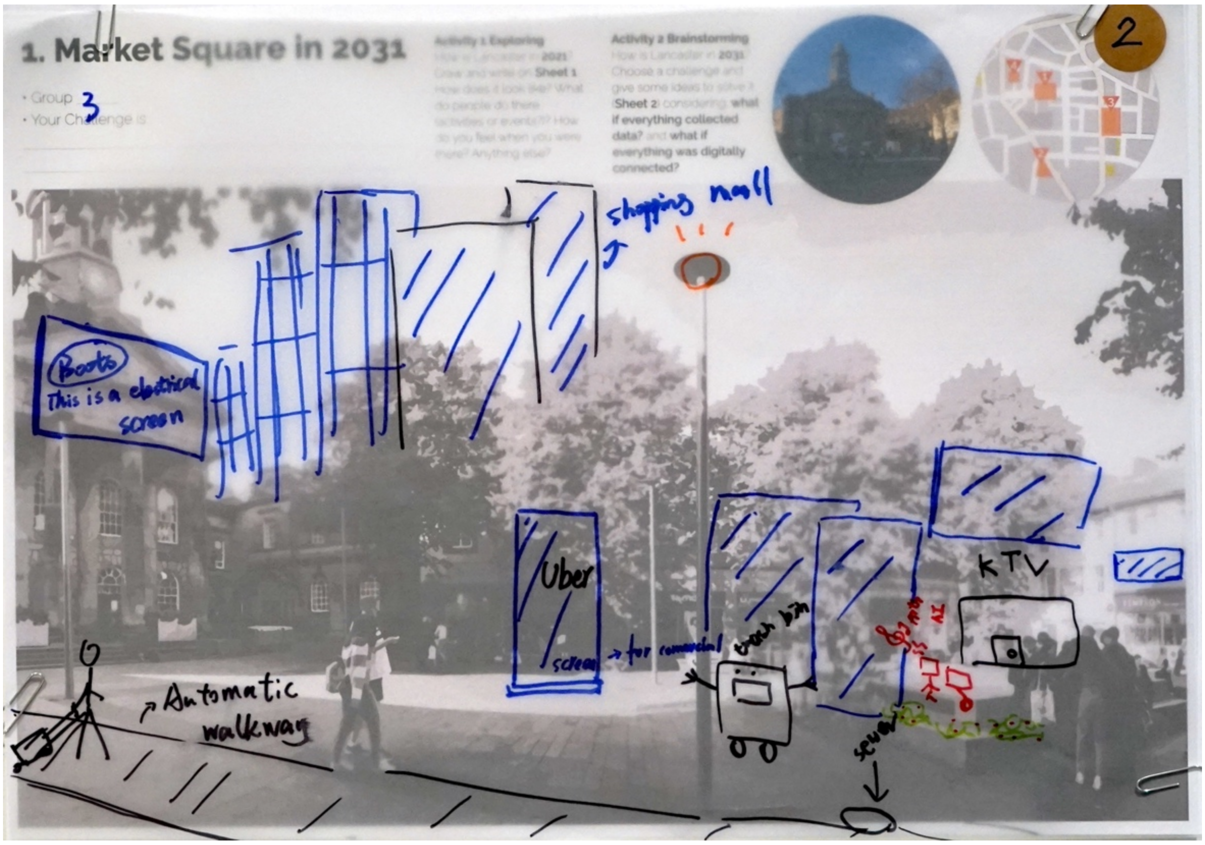

Figure 54. *The Tool for Method 2. What-if Questions and Method 3. Speculative Brainstorming*

7.2.1.5. Method 4 Story Building: positive and negative futures

The last exercise aimed to develop two storyboards of future technology, which a group imagined. For this activity, the groups were asked to select one idea of the technology from Activity 2. Again, considering the international backgrounds of the participants, simple language was used in the tool. For instance, *positive* and *negative* futures were used instead of *utopian* and *dystopian* futures. A storyboard demonstrating a series of illustrations is widely used in service design areas to describe events sequentially. It is often used to visualise hypothetical situations implementing a new service. The tool is mainly used to envision the perspective of a *user* who would use the service (Stickdorn and Schneider, 2012). In this activity, this feature of the storyboard was significant in prompting the participants to think about *technology*, *place,* and *people*. In the first part of the activity, particularly, the students were asked to imagine a utopian future where everything works seamlessly as they designed and to reflect on some prompt questions:

- *Which object is digitally connected?*
- *How does it work?*
- *How and when is the data going to be collected?*
- *Who will have access to data and manage it?*
- *How will the behaviour of the public change?*

Also, the students were reminded to consider setting, time and place. They were asked to think outside the box, adding that a story does not have to start in their chosen public space. Nevertheless, they should focus on some main characters and their activities and behaviours related to the place and the technology. The storyboard was printed on a big piece of paper, which allowed the participants to work collaboratively. Consequently, it was frequently observed that the drawings were of different styles on the storyboards because several participants drew on them.

Figure 55. *The storyboard tool for Activity 3 used by participants*

After the first part, the positive future, they were encouraged to think *critically* about the optimistic scenario they made and to develop a version of a negative future. The prompt questions were also provided to help the students consider cyber security, data tampering, physical damage to devices and infrastructure, and impact on residents and authority. These perspectives arose in the *P-PITEE* project, which questioned the participants about the potential benefits, risks, and ethical and cybersecurity challenges (**Part 6.2** of **Chapter 6**).

- *What if the device/infrastructure got cyber-attacked?*
- *What if the data was not accurately collected?*
- *What if the device/infrastructure got physically damaged?*
- *What would happen to the residents or authority?*
- *What else...?*

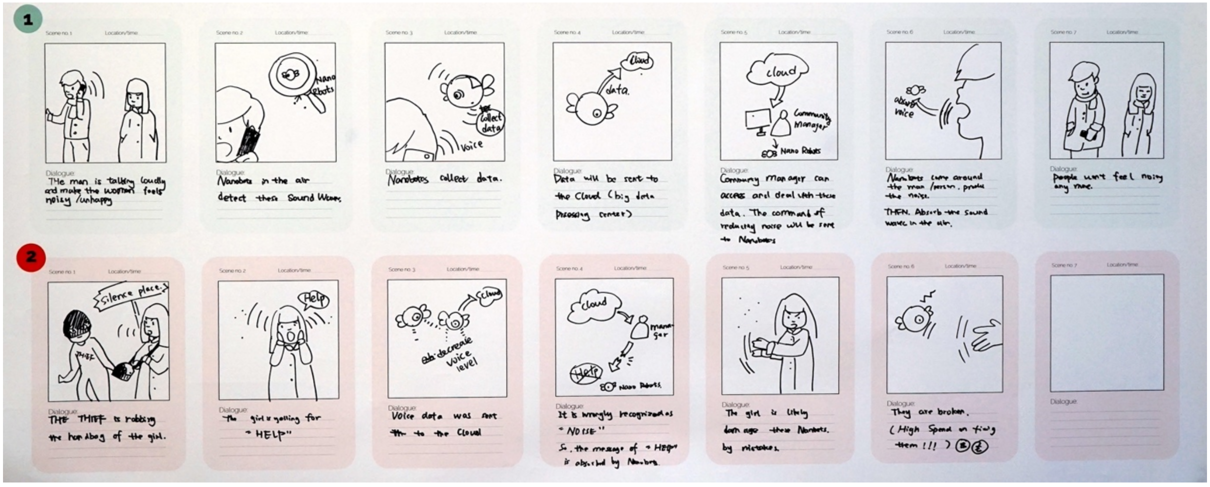

Figure 56. *The storyboard of Nanobots*

For example, one of the groups developed the concept of *Nanobots*. They are invisible devices at a nanoscale operated by autonomous computing. According to their story, the Nanobots can collect sound data, including conversations among people and sense noise levels in the public space. In the positive scenario, implementing this technology would be beneficial in reducing noise pollution. As the robots record conversations, a community manager, who may be either a human or an artificial intelligence, receives the recording and decides to cancel unwanted noises. The participants imagined that, ultimately, the robot and its system would increase the well-being of people in the public space.

On the other hand, the negative storyboard presents two challenging occasions for implementing Nanobots. Within the story, a woman encounters a thief who unlawfully takes her belongings, and she shouts for help. However, the community manager, who can be a person but also an AI, judges her request as noise and cancels her voice. This scenario indicates the challenge of determining the criteria and identifying the agency responsible for it. The second challenge described was the physical damage of the devices. The participants speculated that they could be easily vandalised by people, consciously or unconsciously, as Nanobots were invisible.

7.3. Stage 1: data analysis

During Stage 1, both quantitative and qualitative data were collected. The quantitative data was collected and visualised using Google Forms, an online questionnaire platform. The qualitative data collected from the methods, including Place Mapping, Speculative Brainstorming, and Story Building, conducted analysis using the thematic analysis method (**Chapter 5**). Thus, this part offers an overview of the outputs at each stage of Workshop 1 and Workshop 2 and the resulting findings. Lastly, a comparative analysis between Workshop 1 and Workshop 2 is presented towards the conclusion of this part.

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7.3.1. Workshop 1 with MA Masters students

7.3.1.1. Questionnaire analysis

Sixteen students responded to the questionnaire, a total of 23. The questionnaire results revealed that the levels of understanding of the technologies varied among the different technologies and the students themselves. The most familiar term for the students was wearable technology. 31.3% of the students selected an understanding level of either 4 (moderately aware) or 5 (extremely aware). Students described wearable technology as *"Electronic devices that can be worn as accessories or included in clothing"* and *"implanted in the user's body."* In addition, one of the features mentioned was that *"they (wearables) will often work/ be compatible with another device such as a phone."* They also gave examples of Smart glasses, Smart rings, respirators, Apple watches, and prosthetics. Interestingly, another student focused on the impact of the technology by describing *"machines that make a huge difference in our real-world interactions and perception by wearing them."*

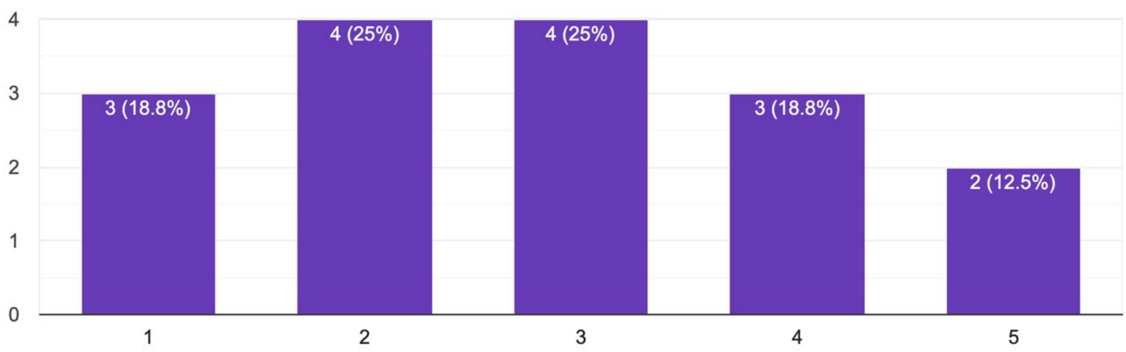

Figure 57. *Workshop 1: The response to the question, "How familiar are you with the term wearable technology?"*

Regarding the term sensor technology, more students indicated they were less familiar with it than with wearable technology. A few students explained sensor technology based on their understanding, such as *“it can detect a physical movement”* and *“microchips.”* On the other hand, the others responded with comments like, *“No idea”* and *“I am not clear.”*

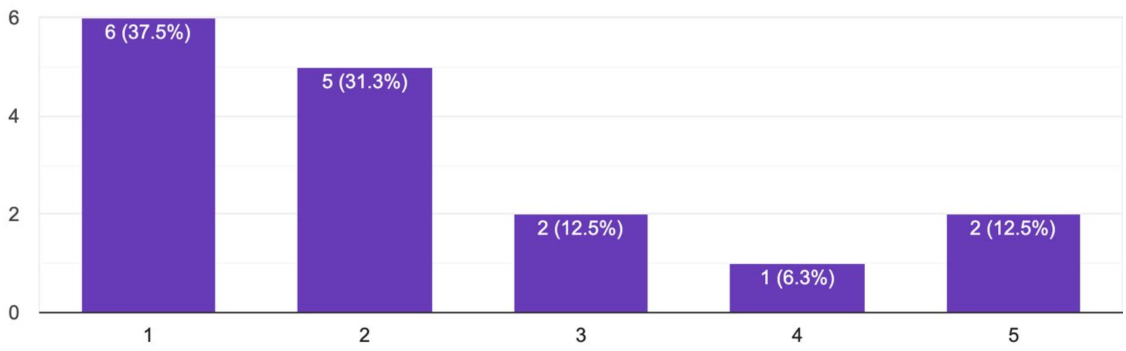

Figure 58. *Workshop 1: The responses to the question, “How familiar are you with the term sensor technology?”*

When asked about their familiarity with the Internet of Things, more than half (75%) of those who answered the questions were unaware of IoTs. Compared to wearable technology responses, responses from 1 (not at all) to 2 (slightly aware) radically increased. In the open question, most students responded, *“I am not quite familiar with it,” “no idea,”* or *“not clear.”* A few students gave descriptions, for example, *“The Internet of Things (IoT) is based on digitalization and information technology, which enables objects to exchange information or communicate through information media”* and *“something to do with physical objects representing sensor applications?”*

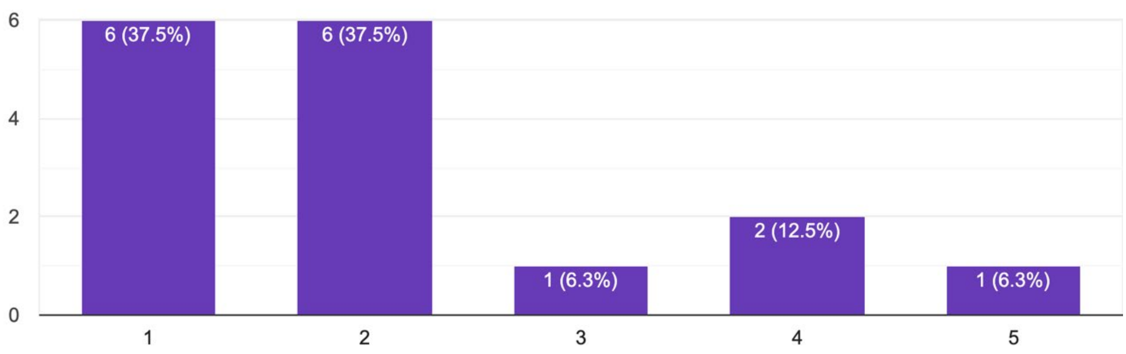

Figure 59. *Workshop 1: The responses to the question, “How familiar are you with the term Internet of Things (IoTs)?”*

In the section about the connected place, ten students out of sixteen replied to level 1 (not at all). Even though some students speculated the term linked to “data,” the others did not respond to the question or comment such as, *“not clear”* or *“I’m not quite familiar with it.”* However, despite that, interesting answers were collected about how the participants understood and defined a connected place. Some students understood connected places as inclusive spaces between nature and humans, considering the context of sustainability. It was observed that the students might not have the technological knowledge or deep understanding of connected technology. However, a general understanding had been formed by using existing products or cases exposed in the media.

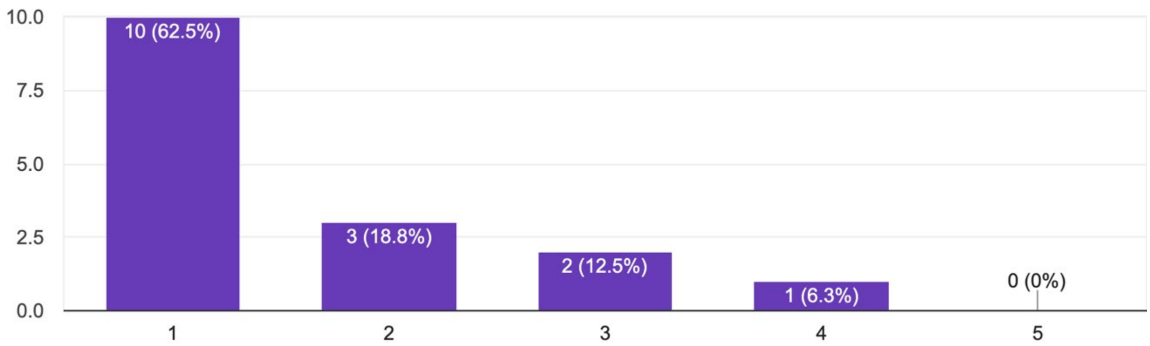

Figure 60. *Workshop 1: The responses to the question, "How familiar are you with the term connected place?"*

The questionnaire result indicates that the MA students understood less connected technology and connected places less than wearable technology. It proved they were more familiar with wearable technology by encountering the terminology in everyday life. Based on the results, the presentation was adjusted to explain the concept and examples of critical technologies.

7.3.1.2. Method 1. Place Mapping analysis

In Workshop 1, the ten groups remained consistent with the teams they had formed during the module. In Activity 1, Place Mapping, seven groups selected Market Square, two worked on Dalton Square, and only one chose Sun Square.

Public Space	Number of Groups
Dalton Square	2
Market Square	7
Sun Square	1
Queen Square	0

Table 11. *Workshop 1: the choice of public space*

The comments and drawings about the places on the first tracing paper were gathered. Thematic analysis was used to review the comments and understand the themes of each place (**Table 12**). The codes were clustered into five categories:

1. Built environment

2. Geographical features and biodiversity
3. Users of the place
4. Activities
5. Emotions and feelings.

Place	Built environment	Geographical features and biodiversity	Users of the place	Activities	Emotions and feelings
Dalton Square	“Greenery”, “Ferris wheel”, “Lots of grass”, “Queen Victoria”	“Sun shining”	“Food vendors”, “Local vendors each weekend”	“Ice skating”, “Christmas markets”, “Tourism”, “Pictures”, “People sitting”, “People enjoying the park”	“Playful”, “Joyful”, “Relaxed”, “Happy people”
Market Square	“Clock”, “TK Maxx (department store)”, “Museum”, “Trash”, Puddles*, “Poster”, “Heritage”, “Nature (tree)”, “Stalls”, “Litter”, “Restaurant”, “Cinema”	“Raining”, “Pigeons”, “Doves”	“Homeless”, “So many people”, “Couples”, “Singers”*, “Musicians”, “Homeless and drunk people”	“Feeding the pigeons”, “Shopping”, “Hanging out”, “Chatting”, “Eating”, “Sunbathing”, “Events”, “Performances”, “Socialising”, “Rest”, “Learning”, “Singing”, “Walking”, “Sitting”, “Riding”, “Talking”	“Historical”, “Feels quite dark”, “Feels underdeveloped”, “Sometimes feel good”, “Sometimes feel not nice”, “Crowded”, “Noisy”, “Busy”
Sun Square	“Litter”, “Music room”	N/A	“Family”, “Child”	“Playing”, “Socialising”, “Walking”	“History (music room cafe)”

*Source of codes: “”= Quotes, *= Drawing*

Table 12. *Workshop 1: the five categories of codes with quotes and drawings*

While most groups worked on Dalton Square and Market Square, only one chose Sun Square. None of the groups worked on Queen Square, a relatively minor and less well-known public space than the others. The participants in Workshop 1 mainly selected destinations they had already visited, Dalton Square and Market Square. The two famous squares are bigger public spaces than the others and are in more city centre locations with high foot traffic.

Place	Highlighted theme
Dalton Square	Green space Historical Space Multi-purpose uses
Market Square	Shopping area Historical space Socialising space Diverse events High foot traffic Diverse users
Sun Square	Music Room café Socialising space

Table 13. *Workshop 1: the three public spaces and highlighted themes*

The participants described that Dalton Square has been used for multiple purposes, such as the Ferris wheel, Christmas Market, and ice skating. In their descriptions, the local farmers' market was held in the square, and local vendors and food vendors were included. At this time, the market was temporarily organised in this place to ensure space for social distancing during the COVID-19 pandemic. This market was held initially in Market Square, Market Street, and Cheapside Street every Wednesday and Saturday. Another characteristic of the square described is a historical and green space. This description matches the surroundings of 18th-century Georgian buildings, including the Town Hall building built between 1906 and 1909. Queen Victoria's memorial statue, located in the centre of the square, was built in 1909 (Lancaster City Council, 2013b).

The students who worked on Market Square described diverse activities, including shopping, socialising activities (chatting, hanging out, talking), and street performances. First, the observation of shopping is related to the surroundings of the public space, including a department store, TK Maxx and the traditional market held every Wednesday and Saturday (relocated back from Dalton Square after the most severe period of the pandemic). Also, there are many events and street performances in the space during the market and seasonal festivals. The participants described the place as a place for socialising with diverse groups of people, such as *"couples", "street artists,"* and *"musicians."* Another theme that emerged is Market Square as a historic space. The theme is related to Market Square's main feature, the City Museum (which used to be the Old Town Hall built in 1668) and a group of historic municipal buildings (Lancaster City Council, 2013a). Although small, Sun Square has a distinct square shape and offers a feeling more enclosed than Dalton Square and Market Square. The group who worked on Sun Square observed the place as a socialising space used by families with children and couples. In the Square, there is an iconic local café, Music Room. The primary users of the spaces were mainly the café customers.

7.3.1.3. Method 2. Speculative Brainstorming analysis

In Method 2, the students were asked to choose one of three challenges to improve the public space. Eight groups out of ten selected challenge 3 to make the space more liveable and attractive.

Challenge	Number of Groups
1. How can this place be more inclusive for vulnerable users?	1
2. How can this place be safer for the community?	1
3. How can this place be more liveable and attractive for locals and tourists?	8

Table 14. *Workshop 1: the choices of challenges*

In Method 2, the students were asked to choose one of three challenges to improve the public space. Eight groups out of ten selected challenge 3 to make the space more liveable and attractive.
For the analysis, the ideas of Method 2 were first categorised into two categories: 1. ideas related to technology and 2. others' ideas not related to technology but of activities and suggestions for a place. This study focused on analysing the first category to examine how PSD methods work to design and speculate the futures of connected places in Lancaster with the participants. For the data analysis in the category, thematic analysis was conducted using technology-related ideas. The degree of the complexity of technology sorts the ideas. Six levels of automation in connected places were adopted from SAE levels of driving automation, indicating the extent of automation and management a vehicle possesses regarding its driving functions (SAE International, 2014) (explained in **Part 3.4.7**) and redefined for the connected place contexts. Levels 1 and 2 indicate less complicated ideas for simple sensor deployments and electronic devices. Moreover, humans involved in these levels play the significant role of an operator, decision-maker, or supervisor. Higher Levels 3, 4, and 5 indicate more complex ideas, including autonomous systems and services. While in Level 3, human engagement is more minimised than the previous levels, no

human interventions are required in Level 4 and Level 5. **Table 15** below presents the levels and descriptions.

	Level		Description
Non - technology related ideas	0	No deployment	There are no deployed sensors and systems in a public space.
Technology related ideas	1	Assistance	Deployed sensors and systems supply constant data to assist the decision-making of human operators in a public space.
	2	Partially automated devices and systems	The deployed devices and systems provide advanced analysis of data and services for a public space but necessitate the human agent's engagement and continual supervision of the assistance features provided by the installed systems.
	3	Conditionally automated and autonomous systems	The systems automatically carry out all aspects of maintaining and managing public space. However, human agents are required to help and be prepared to take over when needed.
	4	Highly automated and autonomous systems	The systems and devices at this level can **intervene in a malfunction without necessarily involving human agents.**
	5	Fully automated and autonomous systems	The systems fully employ advanced technologies in which human intervention is not needed.

Table 15. *The level of automation in connected places (SAE International, 2014)*

Following the automation level presented in **Table 15**, the ideas generated in the workshop were sorted. Overall, most ideas included sensor technology and features of IoT, but not many ideas were described as integrating with AI or autonomous systems. In **Figure 61**, the shaded areas are marked, and the lines are connected to show the similarities of the concepts formed by various groups. The numeral written above the ideas signifies the group they belong to.

Level / Place	Human driver monitors the driving environment		Automated driving system ("system") monitors the driving environment		
	1	2	3	4	5
	Assistance	**Partially automated devices and systems**	**Conditionally automated and autonomous systems**	**Highly automated and autonomous systems**	**Fully automated and autonomous systems**
Dalton Square	Vending machine [7]	Smart road for blind [7] Interactive road [1] Big interactive screen [1]	Umbrella lamppost with sensor [7]	Smart statue [7] AI bin [1]	
Market Square	Electric screen [2&3] LED screen for street performance [4] Holographic projector [4&9] Benches which can control streetlights [2] Automatic walking ways [3]	Screen presenting events and level of crowds [2] Display windows [6] Hologram show [6] Smart lamppost with CCTV [4] Variable air volume controller [4]	Smart screen connected with Uber and showing adverts [3] Interactive board showing tourist and shopping information [6] Smart mirror for try-ons [4] Flying vehicle [9] Meal delivery robot [4] Smart floor [8]	Robotic bin [3] Robot cleaner [6] Air purification machine [9] Dr Pigeon [9]	Nanobots and the control centre [8] Flying AI Detective [8]
Queen Square			Interactive screen [5] Food delivery drone [5]	AI system monitoring data [5] Environmental sensors to control climate [5]	

Key: Idea [Group number]

Figure 61. *Workshop 1: the speculative ideas organised according to the levels of automation*

Because brainstorming is an open-ended exercise, only some presented ideas specify how the technology operates and the type of data it will gather and utilise. However, a significant portion of ideas lack clarification. The absence of details made it difficult to categorise the levels of automation. However, the analysis still provides interesting insights into what features and functions of technology the groups explored. One of the points identified is that several groups developed similar ideas, such as interactive screens and Smart Mirror, Smart bins, robot bins, flying aircraft for food delivery, and drones for surveillance. Furthermore, some ideas are created across several different public spaces.

There are two possible explanations for this. First, street furniture, such as a bin, street lighting, and seating, are ordinary in any public space. For instance, a lamppost was linked to Smart lighting ideas created for Dalton Square and Market Square, which already have lampposts. Second, the students tended to brainstorm ideas related to the familiar forms of digital technology, such as Smartphones, tablet PCs, and a drone. For example, electronic touchscreen ideas were commonly described in various formats and with different purposes. Touch panel interfaces are popular in HCI and come in various models and types (Nishino *et al.*, 2011).

7.3.1.4. Method 4. Story Building: positive and negative futures analysis

The connection between Method 1 and Method 4 becomes evident when analysing the illustrations and quotes provided in Method 1, place mapping (**Table 16**). Presumably, it is because the participants in Workshop 1 mainly selected destinations they have already visited with high foot traffic, Dalton Square and Market Square. The students tended to come up with the idea of connecting with existing street furniture, local businesses, personal observations, or previous experiences in the public space. For instance, a group created Nanobots because they remembered how noisy Market Square is and shared that with the researcher during the workshop. Another group generated their idea of Dr Pigeon, a drone for tourism and surveillance, based on observing some pigeons in a public space.

Selected place	Relevant codes about the place from Method 1	Link to place (Method 1)	Selected Idea in Method 4
Dalton Square	N/A	Existing street furniture	Smart Bin
Dalton Square	Queen Victoria Statue*, “Ice skating”, “Ferris Wheel”, “People sitting and enjoying the park”	Existing street furniture	Smart Statue

Market Square	Lamp post*, "Hanging out", "Chatting"	Existing street furniture	Smart Light
Market Square	"Trash", "So many people"	Existing street furniture	Smart Bin
Market Square	"Hang out", "Events", "People"	Experiences in the events held in the place	Interactive Floor Carpet
Market Square	"Events", "Shopping", "Busy"	Observation	Smart Mirror
Market Square	"Shopping", "Events-stalls"	Observation	AI Controlled Shop
Market Square	"Pigeons", "Couples"	Observation	Dr Pigeon
Market Square	"Walking", "Sitting", "Singing", "Talking"	Experiences in the crowded public place	Nanobots
Sun Square	"Family socialising", "Music festival"	Existing street furniture	Interactive Screen

*Source of codes: ""= Quotes, *= Drawing*

Table 16. *Workshop 1: the connection between Method 1 and Method 4*

The stories they created were based on their experiences in the places chosen. The students described those places sophisticatedly, including the people's behaviours and the surrounding environment's characteristics. **Table 17** below summarises the selected ideas, features, and functions described on the positive future storyboard. Although some storyboards provide enough information, including the type of data collected and its purposes, other prototypes still need to be described more explicitly and precisely. The unclear and vague descriptions are due to the limited timeframe given to the participants to create the storyboards. In addition, it may be related to the questionnaire findings that students did not have enough knowledge about connected technology.

For the data analysis, the researcher highlighted the features and functions of the technology and the positive consequences described on the storyboards created by the students. Then, she captured certain patterns throughout the storyboards by categorising and labelling the themes. The themes are defined based on these patterns of utilising technology, which would benefit public spaces and their users. The themes include waste management, energy efficiency, tourism, data collection and analysis for local businesses and individual needs, public safety and health, and new interaction between humans and AI agents. **Table 17** demonstrates the prototype ideas described on the storyboards and defined themes.

Selected idea	Feature and function	Themes in positive futures
Smart Bin	• Provide dietary recommendations based on disposed of waste	• Management efficiency • Public safety and health • New interaction between human and AI agents
Smart Statue	• Interactive statue such as informing weather, autonomous umbrella, robotic toilets	• New interaction between human and AI agents
Smart Light	• Allows users to adjust the brightness by the mobile application	• Management efficiency
Smart Bin 2	• Gives penalties to people when they dispose of trash illegally.	• Data collection and analysis
Interactive Floor Carpet	• Interactive floor tiles on the street changing colours and lights when people walk over	• Artistic and aesthetic considerations
Smart Mirror	• Collects data from passers-by • Enables people to try on clothes virtually • Provides tailored suggestions based on data analysis	• Data collection and analysis
AI Controlled Shop	• Suggests products or services from local businesses based on analytical information collected	• Data collection and analysis
Dr Pigeon	• Guide tourists • Patrol in the place	• Tourism • Public safety
Nanobots	• Collect data and send it to a centralised system • Absorb the noise from people	• Data collection • Public health
Interactive Screen	• Presents 3D art generated in real-time when people pass by.	• Artistic and aesthetic considerations

Table 17. *Workshop 1: the features and functions, and themes featured in positive futures based on the analysis of the codes, six themes were generated.*

1. **Management efficiency**: This theme concerns managing resources, including human resources, to manage waste and energy resources in public spaces. For instance, implementing Smart Light could be beneficial in effectively using energy with low costs.
2. **New interactions between humans and AI agents**: This theme was based on the description that there would be new ways of interaction between human and non-human agents, such as robots and AI.
3. **Data analysis and collection**: The theme highlights the features of the prototypes that would collect and analyse data from various sources, such as passers-by devices. Based on this collected data, the prototypes envision benefits for local dwellers and businesses, such as providing tailored suggestions and market strategies from the data. Some storyboards illustrated a centralised system to store data and provide analytical information.
4. **Tourism**: With this theme, implementing technology would be advantageous to boost local tourism, leading to the development of the local economy. For instance, Dr Pigeon guides tourists and has patrols to ensure safety.
5. **Public safety and health**: The theme is about the benefit of technology, which would ensure public safety and health in the area. For example, implementing Nanobots could reduce noise pollution caused by the public, and Smart Bins could penalise individuals who engage in illegal behaviours.
6. **Artistic and aesthetic considerations**: This theme includes using technology to create a visually appealing and artistic environment. For example, it was described as employing real-time 3D art when someone walks by so that it could contribute to constructing an interactive and attractive place atmosphere.

On the other hand, negative storyboards include possible problems and unwanted consequences. These resulted from building negative storyboards, which pushed the participants' boundaries to speculate critically on negative future scenarios and their implications in detail. The table below summarises each prototype's possible issues, negative consequences, and defined themes. The negative future storyboards describe various potential challenges, including individual behaviours and environmental effects.

Selected idea	Possible issues	Themes in negative futures
Smart Bin	• A user feels that the bin violates his privacy • He vandalises the bin	• Privacy violation • Physical damage
Smart Statue	• The statute provides inaccurate information. • The surrounding devices malfunction	• Malfunctioning devices
Smart Light	• The lights' malfunction • Users get injured due to malfunction	• Malfunctioning devices
Smart Bin 2	• The bin penalties a member of the public due to biased AI programming	• Privacy violation • Biased AI programming
Interactive Floor Carpet	• The sensors are physically damaged • Hackers engage in hacking	• Cybersecurity • Malfunctioning devices
Smart Mirror	• The mirror collects data of passers-by without their consent • The mirror malfunctions	• Privacy violation • Malfunctioning devices
AI Controlled Shop	• Hackers engage in hacking and manipulating their systems • Users cause physical damage to the facility • Promotion of consumption has negative impacts on the environment	• Privacy violation • Physical damage • Cybersecurity • Environmental impact
Dr Pigeon	• A member of the public attempts to physically damage the drone	• Physical damage
Nanobots	• Biased AI makes a biased decision	• Biased AI programming • Physical damage
Interactive Screen	• The system collects data of passers-by without their consent	• Cyber security

Table 18. *Workshop 1: the possible issues and themes featured in negative futures*

The analysis provided six themes covering various issues concerning technology implementation, such as privacy violations, environmental impact, and biased AI programming.

1. **Privacy violations**: This theme describes users' fears about their privacy being infringed by utilising various devices in public spaces. The theme was especially highlighted in those prototypes, such as the bin and the mirror, which collect data without user consent.
2. **Malfunctions**: There are possibilities of malfunctioning devices and systems. Several storyboards contain these occasions, such as lights, mirrors, and interactive floor tiles. According to the storyboards, the consequences of malfunctions include biased decisions about devices and injury to the public.
3. **Physical damage**: It describes the cases of devices deployed in public spaces physically damaged by human actions such as vandalism. This theme is illustrated in stories such as Smart Bin and Dr Pigeon (drone).
4. **Environmental impact:** Environmental impact should be considered before deploying technology in public spaces. In particular, the storyboard criticised technology as supporting the commercial sector and prompting consumerism by providing analytical and tailored information about customers to businesses; eventually, it will boost unsustainable consumption and negatively impact the environment.
5. **Cyber security**: This theme highlights the increasing cyber security risks in connected places. As described in the stories, there are possibilities that hackers hack systems to infringe on the public's privacy and even manipulate them to cause harm.
6. **Biased AI programming**: It illustrates the risks that human programmers' biases can be reflected in the programs that make crucial public decisions. This theme was described in various prototype ideas, such as the bin and the drone, which result in unfair penalties or decisions for the public.

7.3.2. Summary of Workshop 1

This part has revealed the result of Workshop 1, where the MA students in Design Management and Arts Management were tasked with brainstorming about the current public spaces (Method 1) and speculating about the multiple futures of the spaces in Lancaster (Methods 2, 3, and 4). During Method 1, named place mapping, each group selected one of four public spaces in Lancaster and brainstormed their experiences, observations, and feelings about the place. Their outputs were categorised into five groups: (1) built environment, (2) geographical features and biodiversity, (3) users of the place, (4) a person's activities, and (5) emotions and feelings. Dalton Square and Market Square were the most popular public spaces. According to the participants' descriptions, Dalton Square is being characterised as a historic and green space used for different purposes. At the same time, Market Square is a hub for socialising and shopping with diverse events and users. Sun Square was characterised as a compact gathering area with a nearby café, while Queen Square was not chosen.

Method 2, *What-if* Questions, helped the participants hypothetically speculate about the alternative futures linked to Method 3. In Method 3, speculative brainstorming, the students had to choose one of three challenges regarding improving public spaces. The most chosen challenge was Challenge 3, which was to make the space more liveable and attractive. Then, the participants imagined and brainstormed ideas for the technological solutions for their selected public space. The analysis involved categorising the ideas into six levels of automation, ranging from thoughts unrelated to technology to ideas about entirely automated and autonomous systems. Most concepts focused on sensor technology and IoT features at Levels 1, 2, and 3, with fewer ideas including AI or autonomous systems at Levels 4 and 5. Moreover, the analysis revealed that different groups developed some similar concepts.

Method 4, story building: positive and negative futures involved each group selecting one idea from the exercise of Method 3 and building stories positively and negatively about implementing technology in public spaces. First, in positive story building, the outputs were categorised into six themes highlighting technology's positive impact on the spaces. These themes include management efficiency, new interactions between humans and AI agents, data analysis and collection, tourism, public safety and health, and artistic and aesthetic considerations. Then, in negative story building, each group had to examine their idea critically and develop a story exploring the hypothetical scenarios of the prototype functioning differently. As a result, the negative storyboards effectively demonstrated the prototypes' possible issues and unwanted consequences. The analysis included six themes ranging from privacy violations, malfunctioning devices, physical damage, environmental impact, and cybersecurity to biased AI programming.

7.3.3. Workshop 2 with BA Architecture

This part provides the details of the workshop conducted with students from the BA Architecture program and presents the data collected through the methods and its analysis.

7.3.3.1. Questionnaire analysis

As with Workshop 1, the pre-workshop questionnaire was sent to the students via the module convenor two weeks beforehand. 19 Architecture students out of 31 responded to the questionnaire. The questionnaire result shows that, as with workshop 1, the students were more familiar with wearable technology than other technology. The majority, twelve students (63.2%), responded between level 3 (somewhat aware) and level 4 (moderately aware), and one student (5.3%) selected level 5 (extremely aware). In the open question, the features of lightweight and portable wearables were highlighted in the responses. One student described wearable technology as *“pieces of technological equipment that can be added conveniently to one’s outfit, without need for exterior carrying devices, to improve the quality of life of the user*.” Another student defined the technology as that *“can almost be described as an accessory, for example, a smartwatch, etc. It’s an electronic device which is portable and manufactured to be lightweight.”*

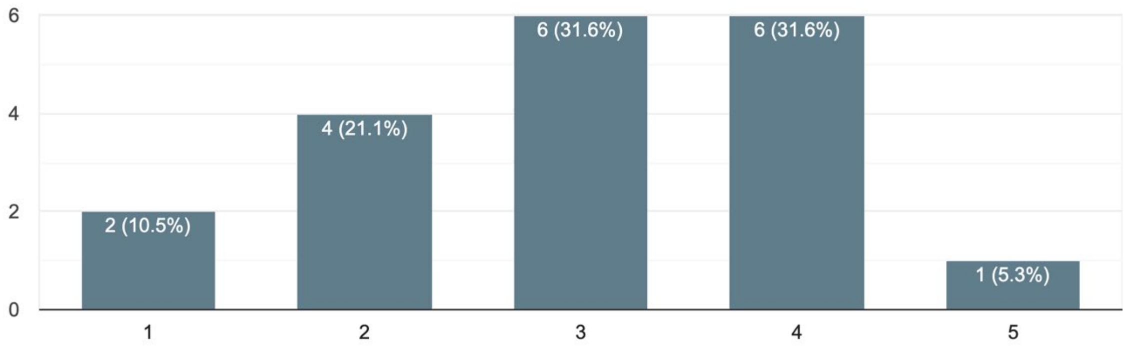

Figure 62. *Workshop 2: the responses to the question, “How familiar are you with the term wearable technology?”*

In the second question, asking about sensor technology, the responses at levels 1 (not at all aware) and 2 (slightly aware) were increased. In comparison, only a few students responded to levels 3 (somewhat aware) and 4 (moderately aware).

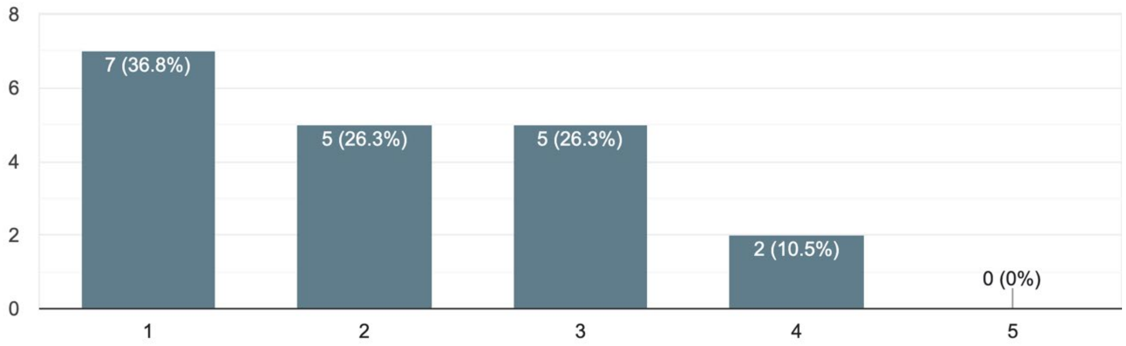

Figure 63. *Workshop 2: the responses to the question, “How familiar are you with the term, sensor technology?”*

When asked about IoT, most respondents (57.9%) selected level 1 (not at all aware). Many students described IoTs vaguely, such as *“Physical things that use internet?”* and *“smart temperature controls, forest fire detectors.”* It seems evident that the students might know the concept of IoT but not in depth.

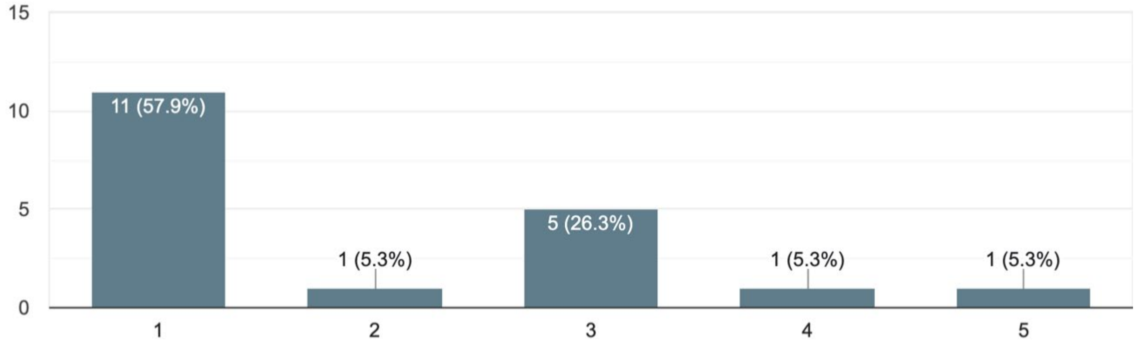

Figure 64. *Workshop 2: the responses to the question, "How familiar are you with the term, Internet of Things (IoTs)?"*

By contrast, when asked about connected places, fewer students (42.1%) selected level 1(not at all aware), with more responses to the other levels. However, it seems there was unfamiliarity with the term because a few students related it to the natural environment and sustainability, including descriptions such as *"Connecting between human and nature"*, similar to the misunderstanding observed among Workshop 1 participants. In the meantime, there were some interesting definitions of connected places, such as *"A place which is connected using technology/ modern practices to inform design decisions and create more integrated and inclusive communities"*; *"A place where there are satellites, wifi, surveillance etc (somewhere connected to the internet/ info online)"* and *"A physical area that can be associated with or without someone."*

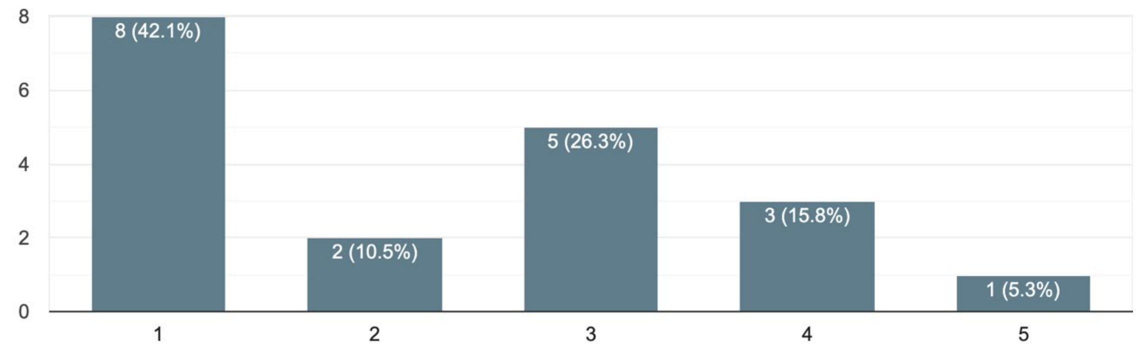

Figure 65. *Workshop 2: the responses to the question, "How familiar are you with the term connected place?"*

7.3.3.2. Method 1 Place Mapping analysis

In Workshop 2, the students were already assigned a specific site by the module convenor of their course. Thus, none of the groups worked on Market Square.

Public Space	Number of Groups
Dalton Square	2
Market Square	0
Sun Square	2
Queen Square	2

Table 19. *Workshop 2: the choice of public space*

As with Workshop 1, the comments collected by the first tracing paper were categorised into five codes and analysed by thematic analysis: built environment, geographical features and biodiversity, place users, a person's activities, and emotions and feelings. The researcher ensured consistency by employing the same classification framework and facilitated a subsequent comparison between Workshop 1 and Workshop 2.

Place	Built environment	Geographical features and biodiversity	Users of the place	Activities	Emotions and feelings
Dalton Square	"Glow" (night club), "Litter", Queen Victoria*, Benches*	"Provide shade in summer (tree*)"	N/A	People in the square*, Walking dogs*, Resting*	"Feel relaxed", "Feel inspired", "The view during the day and night are different"
Sun Square	"The music room cafe", "Car park spaces", "Private car park", Parked car*, Bicycle*, Bench*, Tree*, Outdoor tables from music room	"Seagulls"	N/A	People walking a dog*, Sitting*, People sitting in front of the music room*	N/A
Queen Square	"Park bench", "Car parking", "Tree", "Cycle path", "Green spaces", "Whale tail cafe", "Car	"Shade"	N/A	"Transport", Park bench (Public use) *, After parking* (So people can	N/A

	park", "Retail", "House", "Bike lanes", Tree*, Grass*, Bicycle*			explore the city on foot), Dog walking*, Sitting*	

*Source of codes: ""= Quotes, *= Drawing*

Table 20. *Workshop 2: the five categories of codes with quotes and drawings*

The architecture students tended to focus on observations of natural and built environments. Some students described how the place changes throughout the day from morning to night or marked street furniture on the tracing paper. Unlike Workshop 1, none of the groups specifically described the users of the place, even though they mentioned some site behaviours. Furthermore, the emotions and feelings of the place were not represented. The exception to this was one group that worked on Dalton Square and commented that the area causes different feelings over time. The following part describes the highlighted themes from the data (marked in **bold text**).

Place	Highlighted Theme
Dalton Square	• Historical Space • Nightlife • Green space • Resting Space
Sun Square	• Music Room Café • Café customers • Diverse activities • Green space
Queen Square	• Cycling • Parking • Green space • Resting Space

Table 21. *Workshop 2: the three public spaces and highlighted themes*

According to the students' description in Activity 1, Dalton Square is surrounded by trees that provide shade during summer and has a Queen Victoria Memorial statue, which indicates the themes of **greenery** and **historical spaces**. The students observed that the users of the place were walking and **resting**. An interesting theme emerged from the observation: the site caused different feelings over time. It is because the **nightlife** vibe from a nightclub near the square brings a different atmosphere at night from daytime.

Sun Square is hidden from high foot traffic compared to the other three places (Lancaster County Council and Lancaster City Council, 2020). The feature highlighted by the students is the Music Room Cafe, and the primary users of the place are the customers of the café. In addition, the students pointed out private parking spaces and bicycle racks.

The group who worked on Queen Square highlighted infrastructure for parking and cycling. This infrastructure was seen as necessary due to Queen Square's location in a bustling and well-connected street network, as described by the comment, *"After parking (So people can explore the city on foot)."* The space is quieter than other big squares far from the dense street, allowing people to socialise and rest (Lancaster City Council, 2013a).

7.3.3.3. Method 3 Speculative Brainstorming analysis

In Method 3, all six groups chose to work on Challenge 3. The result of selecting Challenge 3 may be because the other two challenges, making a place more inclusive for vulnerable users and safer for the community, might require more experiences to reflect, specific considerations, or professional knowledge than challenge 3, making a place more liveable and attractive.

Challenge	Number of Groups
1. How can this place be more inclusive for vulnerable users?	0
2. How can this place be safer for the community?	0
3. How can this place be more liveable and attractive for locals and tourists?	6

Table 22. *Workshop 2: the choices of challenges*

As with Workshop 1, six levels of automation were used to analyse the level of automation adapted to fit the context of connected places (**Table 15**). First, the ideas of Activity 2 were sorted into two categories: 1. ideas not related to technology but to activities and suggestions for a place (Level 0) and 2. ideas related to technology (Level 1 to Level 5). According to the focus of this study, thematic analysis was conducted using technology-related ideas. The less complex ideas, like automated and electronic devices, are placed in Levels 1 and 2. In contrast, the more complex ideas, like autonomous systems and services, are grouped in Level 3 to Level 5.

Most ideas were non-technology-related ideas (Level 0). For instance, the students suggested planting more trees and installing a fountain. There are a few ideas related to digital technology and connected places. The ideas were categorised in **Table 5** based on their automation and human engagement level. Most concepts incorporated sensor technology and minimum IoT features (Levels 1 and 2), while a few ideas were found related to conditionally Automated and autonomous systems (Level 3). There was no idea about the description or features of AI or advanced technology (Levels 4 and 5). The coloured areas and lines are used to highlight similarities in concepts generated by different groups. The numeral above each idea indicates the group that created it (**Figure 66**).

Place \ Level	1	2	3	4	5
	Human driver monitors the driving environment		Automated driving system ("system") monitors the driving environment		
	Assistance	**Partially automated devices and systems**	**Conditionally automated and autonomous systems**	**Highly automated and autonomous systems**	**Fully automated and autonomous systems**
Dalton Square	Bin sensors [4&5]	Fitness station (wearables and smart watches) [4] Tech farm with sensors [4] Hologram and information [5] Bench heated by solar panels [5] Lights using energy from a wind farm [5]	Drone food delivery [5] Robot street performers [5] Wind farm hidden by trees [5]		
Sun Square		Interactive tiles [3] Digital info map [3] Light sensors [3]			
Queen Square		Light sensors [1] Smart light [6] Bicycle sensors [2] Sprinklers with sensors [1]	Automatic lawn mowers [1] Cycling reward system [2]		

Key: Idea [Group number]

Figure 66. *Workshop 2: the speculative ideas are organised according to the levels of automation*

7.3.3.4. Method 4 Storyboard Building analysis

Similar to Workshop 1, a link between Method 1 and Method 4 was identified. The students tended to develop ideas by connecting with the current street fixtures and personal observations in the public space. Particularly, in Workshop 2, the students mainly described the place based on their observation because they visited the site as a part of the module activity to analyse it. For example, one of the groups observed benches in Dalton Square and developed the idea of a heating bench with a sensor. They connected their observation that it rains regularly in Lancaster, so they found the benches were wet on many occasions.

Assigned place	Relevant drawing (*) and quote (“”) about the place from Activity 1	Link to place (Method 1)	Selected Idea in Activity 3
Dalton Square	People are walking dogs and resting*	Observation	Smart Fitness
Dalton Square	“Benches-public seating”	Existing street furniture	Heating Bench with sensor
Sun Square	“Bin bags”	Observation	Smart Bin, Fountain with sensor
Sun Square	People are walking a dog*, Walking*	Observation	Interactive Tiles
Queen Square	“Trees-Green Spaces”	Observation	Water Fountain with LED Lights
Queen Square	“Bike Lanes”, Bicycle*	Existing street furniture	Cycling Reward App

*Source of codes: “”= Quotes, *= Drawing*

Table 23. *Workshop 2: The connection between Method 1 and Method 4*

The table below summarises the selected concepts, attributes, and roles described in the positive future storyboards and themes. The storyboards produced in Workshop 2 include technological aspects, explaining what data types were collected and how they would be handled or used, but not in detail.

Selected idea	Features and function	Themes in positive futures
Smart Fitness	• Looks like a pull-up bar • Provide the exercise information	• Public health
Heating Bench with sensor	• Heats the seat powered by solar panel Embedded a phone charger and a cupholder	• Public health • Management efficiency • Sustainability
Smart Bin	• Distinguishes materials of trash • Reused water in the fountain	• Management efficiency • Artistic and aesthetic considerations • Sustainability
Interactive Tiles	• Lights on by people's movement	• Management efficiency • Artistic and aesthetic considerations
Water Fountain with LED Lights	• Turns on LED lights by time	• Management efficiency • Artistic and aesthetic considerations
Cycling Reward App	• Residents can get a reward when they cycle around the area • Cycling hours will be measured and turned into points	• Public health • Sustainability

Table 24. *Workshop 2: The features and functions, and themes described in positive futures*

The following themes were created after analysing the codes.

1. **Public health**: This theme is related to the positive impact of implementing technology to improve the health and well-being of the public. For example, Smart Fitness, which looks like a pull-up bar, can offer users exercise routines and information. Ultimately, it will benefit the users by improving their health conditions by exercising more with tailored suggestions. Another idea is a cycling reward app that rewards users who cycle instead of using cars. While the users become healthier by cycling more, it will contribute to the overall public health in the area with less carbon emissions by reducing the use of cars.

2. **Sustainability**: This theme is newly featured from Workshop 2, which indicates when technology is applied to save, generate, and reuse energy. For instance, there were many ideas related to connected devices powered by solar panels and fountains to reuse water. Also, it includes promoting cycling culture through a cycling reward app that measures cycling hours and turns them into points. Eventually, the culture would contribute to reducing carbone emission.
3. **Management efficiency**: Similar to Workshop 1, this theme describes the benefit of technology in improving management efficiency regarding resources such as energy and human resources. The same ideas, such as Smart Bins and Smart Lights, were developed within this theme.
4. **Artistic and aesthetic considerations**: This theme explores using technology to enhance a place's artistic and aesthetic features. It was related to students' belief that it could attract tourists by making the place more artistic and aesthetic. For instance, similar to Workshop 1, the idea of installing interactive tiles that light up people's movement was developed.

On the other hand, the storyboard describing negative futures addresses issues and challenges, highlighted as themes presented in **Table 25**. In the negative storyboards, some students tended to describe the consequences of what would happen in the places when devices or systems were malfunctioning or physically damaged. Other students connected the stories with external elements of the place, such as weather conditions. A comparison was made between sunny and rainy days and positive and negative futures. For example, a group speculated that many people would actively use the public space when it is sunny. In contrast, fewer people would be, and the place would not be well managed on a rainy day. The analysis identified three overarching themes from the codes: malfunctioning, physical damage to devices or systems, and cybersecurity.

Selected idea	Possible issues	Themes in negative futures
Smart Fitness	• An individual vandalises the Smart equipment	• Physical damage
Heating Bench with sensor	• Malfunctions of the device/system • Misuse by the public • Cybersecurity	• Physical damage • Cybersecurity
Smart Bin, Fountain with sensor	• The sensors get damaged and the rubbish overflows	• Physical damage
Interactive Tiles	• The lights are not on	• Malfunctions

Water Fountain with LED Lights	• The sensors were damaged	• Malfunctions
Cycling Reward App	• The cycling app gets hacked, and users lose their cycling points	• Cybersecurity

Table 25. *Workshop 2: The possible issues and themes described in negative futures*

1. **Malfunctions**: Malfunctions are related to possible occasions when connected devices or systems technically malfunction. The technical malfunctions could result in the technology becoming ineffective and unreliable. Physical damage to the devices and systems could also be one of the causes. For instance, one of the storyboards regarding Smart Bin describes that trash was overflowed because of its damaged sensor, which checks the fill level.
2. **Physical damage**: Related to the theme of malfunctions, physical damages were featured in some negative storyboards. In particular, this theme is related to intentional vandalism caused by individuals to the deployed sensors and devices. The damages could result in expensive repairs and service disruptions, which would cause inconvenience for the public.
3. **Cybersecurity**: The theme explores the risks related to cybersecurity, such as hacking and privacy infringement, when utilising technology. This theme is also interconnected with malfunction, which could be one of the consequences of cyberattacks.

7.3.4. Summary of Workshop 2

This part summarises the analysis of Workshop 2, where BA Architecture students engaged in envisioning multiple possible futures for public spaces in Lancaster. In Method 1, the architecture students were already assigned a specific site before the workshop. The comments and drawings from Method 1 were categorised into five codes and thematic analysis was used to identify themes. Notably, the students in Workshop 2 did not describe the users or emotions of the place. The students' descriptions of three public spaces in Lancaster were summarised. Dalton Square was characterised by trees providing shade and a historical statue, with the observation that the site caused different feelings over time due to the influence of a nearby nightclub. Sun Square had lower foot traffic and was centred around the Music Room Cafe, with private parking and bicycle racks available. Queen Square was highlighted as a gateway to the city centre, with infrastructure for parking and cycling, and was a quieter space for socialising and resting.

In Method 3, all six groups chose Challenge 3, which involves making a place more liveable and attractive. First, the groups' ideas were categorised into non-technology-related and technology-related ideas. And then, the latter group of ideas were organised based on the automation and human engagement level. Most fell into Levels 1 and 2, focusing on sensor technology and IoT features, and only a few related to autonomous systems (Level 3). No ideas about AI or advanced technology were suggested (Levels 4 and 5).

The first part of Method 4, storyboard building, focused on the positive futures. Four themes were created from the positive future storyboards: public health, sustainability, management efficiency, and artistic and aesthetic considerations. The storyboards concentrated on technological aspects with little detail. The negative future storyboards highlighted potential issues with the use of technology in public spaces. The second part of Method 4 aimed to create negative storyboards. The students described the consequences of technical malfunctions, physical device damage, and cybersecurity risks associated with connected technology in public spaces. The storyboards also examined how different weather conditions would influence public space use and management. As a result, the analysis identified three themes: malfunctions, physical damage, and cybersecurity.

7.3.5. Comparative analysis between Workshop 1 and Workshop 2

The previous parts presented the thematic analysis of Workshop 1 and Workshop 2. The following part provides a comparative analysis between these two workshops to comprehend how diverse groups of participants focused on different aspects and attained outcomes. **Table 26** demonstrates different settings and samplings of the workshops.

	Workshop 1	Workshop 2
Number of Participants	23	31
Participant's background	MA Design Management MA Arts Management	BA Architecture
Living experience in Lancaster	Less than one year	Less than one year
Free to select a public space (Y/N)	Yes	No
Free to select a challenge (Y/N)	Yes	Yes

Table 26. *The comparison between Worksop 1 and Workshop 2*

In Methods 1, Workshop 1's MA students were free to choose a public space they wanted to investigate. As they selected the place based on familiarity and preference, Market Square was the most selected place in the city's centre. Based on their understanding, they could discuss various elements of the place, such as physical attributes, people's behaviours, and even experiences of emotions while being there. On the other hand, Workshop 2's architecture students were allocated a particular site by their module convener before the workshop. They had relatively less personal experience in the places. Thus, they focused more on architectural built environments and less on understanding people and the feelings connected to the location.

Methods 2 and 3, *What-if* Questions and Speculative Brainstorming contributed in both workshops to generate various speculations merged with reflections of the public spaces in Method 1. For instance, speculative ideas of Smart Bins and Smart Lights were integrated with street furniture, such as litter bins, streetlights, and interactions between humans and objects in public spaces. Then, the analysis of Method 4, storyboard building, revealed the common and different themes between the workshops. The overlapping themes include management efficiency and artistic and aesthetic considerations. However, the differences are that Workshop 1 produced more diverse themes from discussions on public safety and health, tourism, data analysis, and new interactions between human and AI agents, which were not discussed in Workshop 2. Instead, Workshop 2 focused on public health and sustainability, which was not addressed in Workshop 1. The second part of Method 4 was to build a storyboard considering negative occasions. The analysis revealed similar themes in both workshops, such as malfunctions, physical damage, and cybersecurity issues. Also, there are different discussions in the workshops. In particular, Workshop 1's participants pointed out the potential risks of AI, which could be programmed with the bias of human programmers and contribute to exacerbating social inequalities (**Table 27**).

Overall, there are distinct differences observed between Workshop 1 and Workshop 2. The design students in Workshop 1 were likely to develop artefacts or services. In addition, they were more interested in the consequences of technology deployment, such as ethics, so the stories of dystopian futures describe how the technology would lead to unethical occasions. Furthermore, through the materialisation of ideas, students increased their awareness of the different considerations involved in developing these technologies, ranging from physical damage and malfunctioning device decision-making issues regarding dynamics of public spaces, cyber security, privacy, and ethics to misleading general needs. On the other hand, the focus of the participants in Workshop 2, who were the students in architecture, was sustainability. For instance, they proposed a heating bench with solar panels and a reward system for cyclists to encourage the use of bikes to reduce carbon emissions. They also considered various environmental conditions, such as weather or the difference between day and night. A significant element was for them to develop stories connecting their previous experiences with assumptions of people's interactions in a place. For instance, when it rains, residents are presumed to stay at home, so the IoT services are not functional or attractive.

<table>
<tr><th></th><th>Theme</th><th>Workshop 1</th><th>Workshop 2</th></tr>
<tr><td rowspan="2">Positive futures</td><td>Common</td><td>• Management efficiency
• Artistic and aesthetic considerations</td><td>• Management efficiency
• Artistic and aesthetic considerations</td></tr>
<tr><td>Different</td><td>• Public safety and health
• New interactions between humans and AI agents
• Data analysis and collection
• Tourism</td><td>• Public health
• Sustainability</td></tr>
<tr><td rowspan="2">Negative futures</td><td>Common</td><td>• Malfunctions
• Physical damage
• Cyber security</td><td>• Malfunctions
• Physical damage
• Cybersecurity</td></tr>
<tr><td>Different</td><td>• Privacy violations
• Biased AI programming
• Environmental impact</td><td>•</td></tr>
</table>

Table 27. *The comparison of Method 4 between Workshop 1 and Workshop 2*

7.4. Findings of Stage 1

This part presents findings in Stage 1, which includes the speculative prototyping workshops with two groups of university students who were non-experts in either connected technology or speculative design. At this stage, the researcher identified four findings, discussed below.

7.4.1. Interdisciplinary approach and engaging diverse groups

The findings from the workshops propose the capacity of an interdisciplinary approach and the importance of engaging diverse groups in creating speculative artefacts. As the different disciplines have different focuses and approaches, the involvement of diverse disciplines can examine challenging issues with different perspectives. The researcher observed different focuses on two groups, one with Design Management and Arts Management disciplines and the other with Architecture. While the students with the design management discipline tended to develop products and services while considering ethics, the students from the architecture focused on improving the aesthetics of places, including landscaping, and solving environmental issues. Furthermore, there was a biased selection of the challenges for the places. For example, most students selected *Challenge 3: How can this place be more liveable and attractive for locals and tourists?* At the same time, there needs to be more attention paid to challenge 1 to make a place inclusive and challenge 2 to make a place safer. It is assumed that it might be challenging for university students to develop *inclusive* and *safe* without opinions of the groups or interests and expertise in the areas. The result reveals the need to involve more diverse perspectives to understand and build holistic views of public spaces and reflect the needs. The insights gathered through the involvement can be valuable to inform policymakers to detect overlooked and unforeseen issues.

7.4.2. PSD with place-based approaches

In this stage, the researcher found that speculative design in placemaking requires the individual's experiences, knowledge, and expertise in places. After the workshops, these inputs from the participants enabled the researcher to understand the places in the present, including the needs, which would be valuable insights for policymakers to provide tailored solutions for the place. Also, residents' input is crucial in employing a place-based approach in PSD. In the process of speculative prototyping, it was observed that the relevance of the prototypes is closely related to the participants' experiences and observations in the places. The participants who were more familiar with an area could generate more relevant thoughts. For instance, the Workshop 1 participants who had the freedom to choose their familiar place developed an idea which could be a solution to improve the conditions of the places. Some groups reflected on their feelings of insecurity at night and proposed Smart Lights to make the places safer.

In contrast, the Workshop 2 participants could not select the places instead assigned, so they struggled to reflect on the place and integrate it with their experiences. Therefore, the generation of meaningful speculative prototypes for places is significantly influenced by participant's perceptions of places. Employing a place-based approach in PSD offers more opportunities to address local challenges and demands than top-down and generative approaches.

7.4.3. Speculative design for building awareness

The value of this exploratory approach is not only to incorporate various perspectives but also to create a space for experiential learning and foster awareness of emerging technologies that have not yet been developed or commercialised. The students harnessed their experiences in the workshops to integrate with their imaginations, and envisioning futures. This process allowed them to think about how everyday life would be changed with the connected technologies and arouse attention to the possible issues. For instance, when the researcher presented the existing bin with a sensor, it drew the participants' attention, providing the environment to speculate in the near future that *this is happening*. It also prompted speculations related to their mundane spaces. Several students commented that they were surprised by the example and realised the changes were already happening in their familiar place. They stated that the speculative process helped them become more aware of the technologies and their issues. This reflection demonstrates that the public may not be aware of technology implementations in public spaces without efforts from technology practitioners, policymakers, and urban planners.

7.4.4. Challenges to facilitating PSD

During the workshops, the researcher encountered some challenges in playing a role in facilitating PSD. In the beginning, delivering complex information regarding connected technologies was challenging. In particular, as the questionnaire revealed, the participants were unfamiliar with the connected technologies. Also, they had diversity with different backgrounds, work experiences and nationalities. Despite the attempt to explain the overview of connected places, the limited time frame of the presentation (fifteen minutes long) was not enough for the participants to fully understand the concepts and terms.

Another challenge faced was engaging the group with diversity during the prototyping. For instance, the language barrier became challenging for several international students to describe their ideas verbally. Also, the participants' willingness to participate in speculative thinking significantly influenced the outputs of the speculation exercises. When particular students were less motivated or did not actively participate, the group generated fewer ideas, or the quality was lower than groups with motivated students. Moreover, considering which skills will be required should be considered as a way to encourage the participants to make the prototypes without fear. For example, some students hesitated to draw the storyboards during the workshops because they did not have enough drawing skills. Challenges might differ with a broader and more diverse population, for instance, when working with underrepresented communities.

Moreover, covering diverse topics that should not be overlooked can be challenging in PSD without planning the scope of participants. There was a limited selection of design challenges in this stage related to urgent social issues and needs, such as safety and inclusivity. The researcher employed the Movement strategy of the Lancaster City Council and County Council as the context to formulate the challenges. There were two rationales behind this faciltation choice. The first was to bring social challenges the local authorities are trying to tackle. Second, as there was less consideration of digital technology implementation, it was to compare the two different views of the future based on the current policy projected and the future participants produced imagining implementation of the technology. However, in terms of the challenge selection, although the facilitator introduced the urgent and necessary challenges based on the current strategy, she failed to direct participants to work on diverse topics. Eventually, most students choose Challenge 3: How can this place be more liveable and attractive for locals and tourists? As described above, assumedly, it was because the participants, university students, did have less interest, expertise or experience in the areas. This finding indicates PSD practitioners' planning, and facilitation challenges related to who should be involved in PSD to tackle the diverse topics and how to address and appeal those topics to participants who will design the future. For instance, to tackle the challenge of inclusivity, a practitioner can consider inviting participants who work to enhance inclusivity and citizens with inclusivity needs.

7.5. Summary of Chapter 7

This chapter detailed Stage 1 of data collection, which implemented PSD methods in two speculative prototyping workshops with two participant groups. Workshop 1 was conducted with MA Design Management and MA Arts Management students, and Workshop 2 involved first-year students in BA Architectures. The workshops aimed to develop speculative prototypes for connected places in Lancaster, employing the place-based approach. The workshops consisted of four steps, including a pre-workshop questionnaire and three exercises.

This chapter explained each method used in the exercise in detail and findings. The exercises are (1) Place Mapping (Method 1), (2) *What-if* Questions (Method 2) and Speculative Brainstorming (Method 3), and (3) Story Building, including both positive and negative future scenarios (Method 4). After the analysis, this chapter provided a comparison between the workshops, examining different elements and outputs produced. From this stage, the four findings were highlighted: (1) the significance of the interdisciplinary approach and engaging diverse groups in PSD, (2) the benefit of place-based approaches in PSD, (3) the advantage of PSD in fostering public spaces and (4) challenges to facilitate PSD.

The following chapter will introduce Stage 2 of data collection involving the two public exhibitions held in two locations. The aim of the exhibitions was to present six prototypes produced in Stage 1 to the broader audiences in Lancaster and collect their views, revealing their expectations, hopes and fears. The chapter will explain the exhibition process, including the selection criteria of the exhibited prototypes, the audiences' comments on each prototype and the themes identified. It will also present a comparative analysis between the exhibitions. Subsequently, it will discuss the findings of Stage and then provide the chapter summary.

8. Stage 2. Public exhibitions: *Dalton Square 2032*

The previous chapter focused on Stage 1, including the speculative prototyping workshops of the primary research. It presented the methods utilised during Workshops 1 and 2, the collected data and its analysis, including the comparative analysis between the workshops. In Stage 1, the researcher could conduct experiments utilising participatory and speculative methods involving non-technology experts. The workshops collected visual and descriptive views of public spaces in Lancaster and produced speculative prototypes and their positive and negative storyboards employing connected technologies.

Based on the outputs of Stage 1, Stage 2 involves wider communities in Lancaster in the speculation process. The objectives were to create a space where these communities would be encouraged to imagine the future and collectively address their expectations, concerns, and suggestions towards speculative prototypes. In order to achieve the objectives, the researcher organised two public exhibitions in different locations in Lancaster. Thus, this chapter will demonstrate a process of organising the exhibitions, including the intervention phase—in which the researcher and an external 3D artist intervened between Stages 1 and 2 to refine the outputs of Stage 1. Then, the chapter covers data collection and analysis of Stage 2, examining visitors' comments on each prototype and developing themes from the comments.

8.1. Intervention by researcher and 3D artist

Following Stage 1, the researcher organised two exhibitions with the intention of displaying the prototypes and storyboards designed during the workshops. The exhibitions were to gather opinions from a broader audience beyond the University communities. These exhibitions were held in different locations. The first exhibition, Exhibition 1, was a pilot display held at Lancaster University Library on campus, a few miles from the city centre. This was followed by Exhibition 2 at Lancaster City Museum, which is in the centre, making it easily accessible to locals. A more diverse audience was expected to attend Exhibition 2 compared to Exhibition 1.

As a result of Stage 1, in total, 87 ideas were created (55 from Workshop 1 and 32 from Workshop 2), including concepts related to connected technology and additional suggestions for the places, such as a recommendation to plant more trees. The researcher received consent from 83 students to showcase their ideas in the exhibitions, but one student from Workshop 2 did not give consent. As it was impossible to distinguish individual work within the group and the researcher was unable to contact the students to clarify which group they belonged to, the decision was made not to display any prototypes from Workshop 2 in the exhibition to ensure the research ethics were adhered to. As a result, six prototypes were selected. The selection criteria were:

1. Whether a student gave consent to the researcher to exhibit their idea
2. Whether an idea was engaged with more than one connected technology or not.

Some ideas were merged if they had features in common. For example, the Smart Bin was commonly mentioned but with different aspects. So, the storyboards created by different groups were merged. Similarly, Smart Lights were described by several groups, and integrated with other ideas. Each idea was added as bullet points on the poster depicting the attributes of the prototypes (**Table 28**).

Prototype	Description
Smart Light	• an advanced way to control lights in Dalton Square • contains software that connects to an app so people can adjust to dim or brighten the light when they are nearby • has sensors that identify day and night, so they automatically brighten the lights according to the time • detects the movements of the public and brightens more when people are nearby
Smart Bin	• an intelligent robot to manage waste in Dalton Square • provides you with analytic information based on what you throw it into, for instance • gives penalties and fines to people who throw away trash illegally
Smart Mirror	• looks like a regular mirror, but it has an electronic display behind the glass • collects information from a camera, sensors, and your wearable devices and mobile phone • analyses your shopping habits and styles and suggests products based on the analytical information • shows your reflection with virtual images of items such as clothing and accessories • has a touch screen which enables you to interact with the virtual items, check the prices and purchase the items • provides promotions from local businesses and notifications of local events
Smart Statue	• an interactive statue located in the middle of Dalton Square • can have a conversation with visitors • tells you about local history as well as weather, local news, events
Dr Pigeon	• a drone for surveillance as well as a local guide

	• first-time visitors can book Dr Pigeon for a guided tour • patrols local area to support local polices • does not make any noises
Nanobots	• invisible robots working at the molecular scale • checks noise level in the area and sends the information to the control centre • cancels noises in the public space according to a decision of the control centre

Table 28. *The six prototypes and descriptions*

At this point, the researcher decided to focus on only one public space, Dalton Square, instead of four to simplify and clarify information to viewers. Dalton Square was selected for the exhibitions because Methods 1 Place Mapping of the workshops characterised it as having diverse activities and events. This result illustrates its multi-purpose uses of public spaces, including local farmers' markets during the pandemic and ice-skating links in winter. The space's active uses would help people imagine the place with different scenarios.

After discussion with the researcher, a 3D artist produced a 3D model of each prototype to print with a 3D printer and render images. In this process, his interpretation and skill influenced the final 3D models of the prototypes. For instance, although Dr Pigeon was initially described as looking like a real bird, its 3D model was developed as a futuristic drone. The reason behind this was that the artist found it challenging to draw a model with every detail of the actual bird within the time frame (**Figure 67**). Along with the 3D models, he created a virtual Dalton Square in 3D spaces to locate the prototypes and illustrate how they will interact with the public.

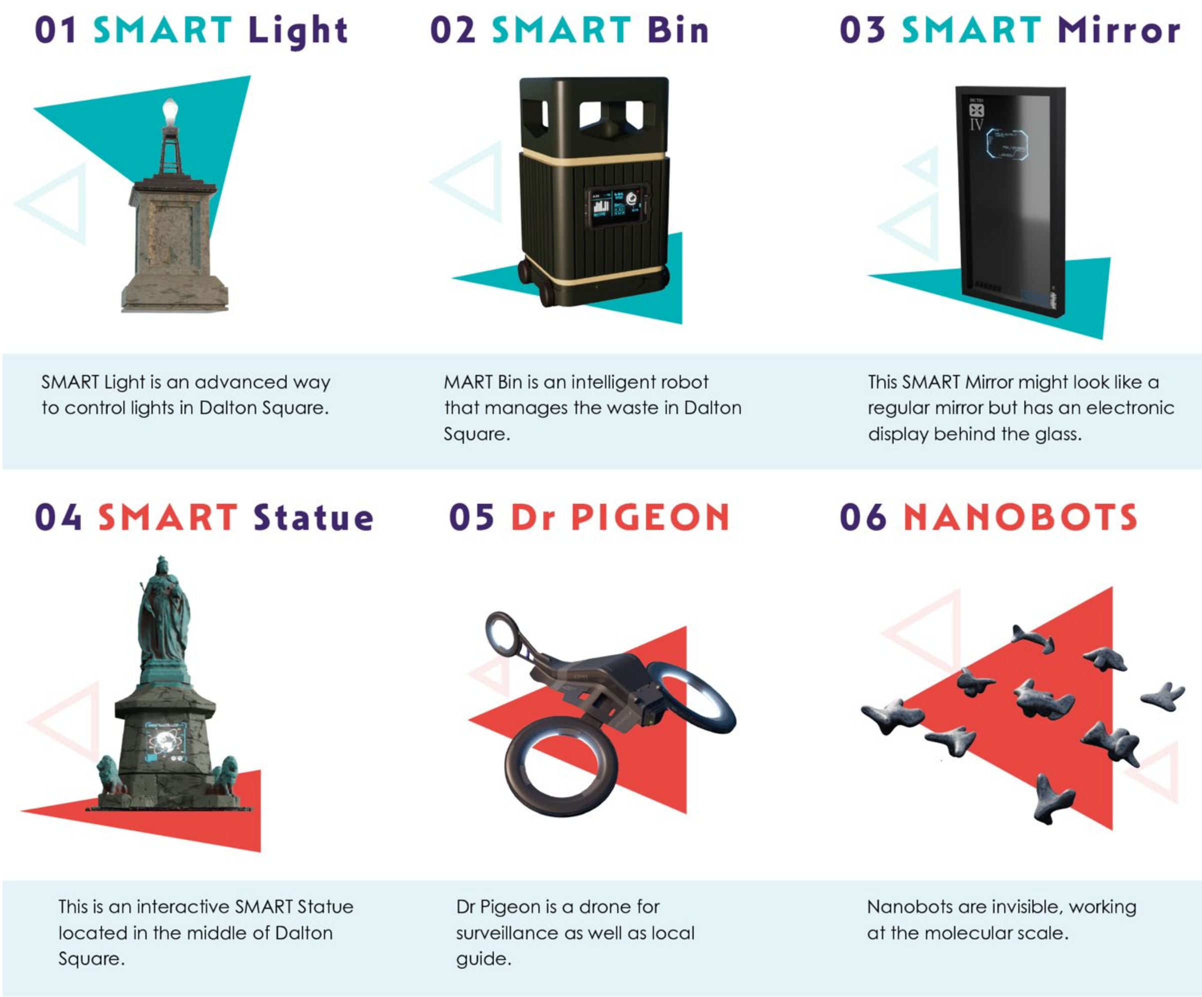

Figure 67. *The 3D modelled prototypes presented in the exhibitions*

8.2. Public exhibitions: *Dalton Square 2032*

Two public exhibitions were entitled *Dalton Square 2032: Beyond the SMART City*. The title was intended to provoke criticisms of Smart City initiatives by showcasing speculative prototypes and their positive and negative storyboards. The word *smart* was utilised instead of the *Internet of Things (IoT)* or *connected technologies* in the content of the exhibitions. This decision was made because the results of the questionnaire showed that fewer students were familiar with those terms. In contrast, *smart* has been used widely in diverse fields (Choi, 2011) and is well known to the public, from Smartphones and smart devices to Smart Cities. The exhibition's brand was developed with red, green, and purple (**Figure 68**). The red colour was linked to the meaning of dystopian futures, alertness, and warning. At the same time, green represented the technologies' utopian futures and benefits.

Figure 68. *The exhibition branding*

The exhibition welcomed visitors with a poster presenting the background and acknowledging the students and the 3D artists as designers. Some students' names appeared anonymised according to their choice on the consent form of the workshop. The poster for a prototype includes a short description, key features outlined as bullet points, positive and negative storyboards and questions addressed to visitors. As the storyboards were drawn and written by participants in Stage 2, they occasionally had different writing styles, which made them difficult to read. Thus, their handwritten text was transcribed into printed text to improve legibility. In addition, at the bottom of the poster, there were questions directed at visitors, which are the following:

1. Are you happy to have this [technology] in Dalton Square? (Yes/No)
2. If yes, could you tell us why you will be happy to have this technology? If not, what are you concerned about this technology?
3. What would you like to change/add to this technology?

Sticky notes and Sharpies were placed on a table at the exhibition entrance to capture the visitors' responses. Also, there was a sign on the table, *"This is an* ***interactive*** *exhibition. Feel free to* ***draw, write*** *and* ***stick!"*** (**Figure 69**). It was to encourage passers-by to participate in the exhibition and interact with the posters.

Figure 69. *The welcoming prompt positioned at the entrance to engage with the tool within the exhibition*

The prototypes were exhibited from less controversial to more controversial and from less probable to more probable prototypes. Smart lights, Smart bins, and Smart mirrors are considered less controversial and less ambiguous prototypes because the ideas were based on common elements of public spaces, such as street furniture. Also, these ideas were created by more than one group, so there are more descriptions of how the technology would work. On the other hand, the other prototypes, Smart Statue, Dr Pigeon and Nanobots, were considered the more abstract and potentially controversial technologies for three reasons. First, the Smart Statue was based on a particular historical figure in the place, Queen Victoria's memorial statue. Second, the purpose of the other two ideas was policing in public spaces, which could be potentially linked to surveillance issues. The last reason was that each concept was created by one group, so less description was provided about the technology. A lack of information may give viewers more space to fill the gap with their own interpretations and imaginations.

At the end of the exhibition, a poster of Futures Cone was presented to ask the visitors to map out which prototypes are probable, plausible, and possible futures for them (**Figure 70**). Importantly, it was asked what the most preferred technology is for Dalton Square in 2032. The poster contains a short description of each future to help the visitors to understand the terms.

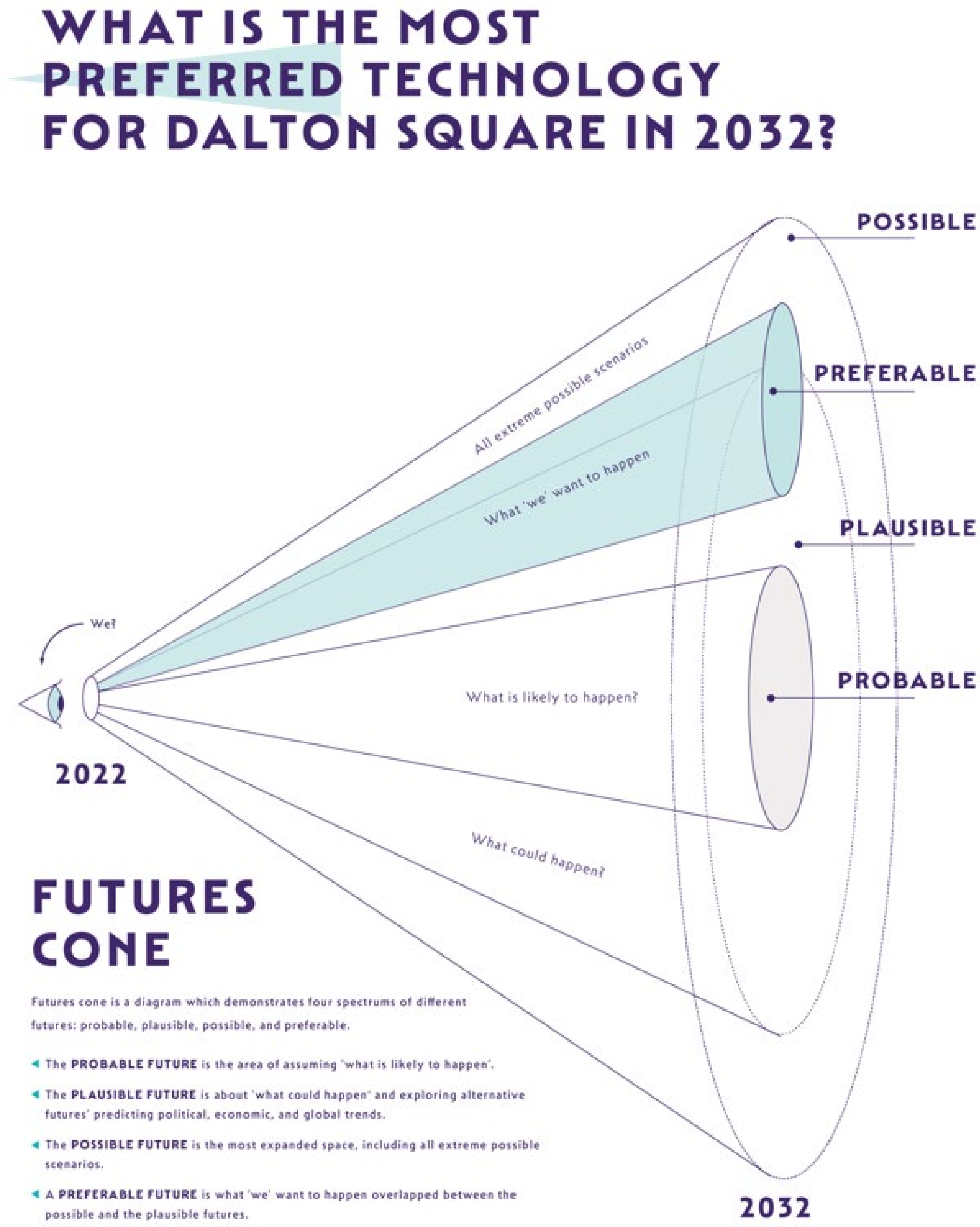

Figure 70. *The futures cones tool used in the exhibitions*

8.2.1. Exhibition 1 in the University Library

Exhibition 1 was organised in an exhibition space just inside the entrance of the Lancaster University library. The library is located on campus, a few miles from the city centre. This characteristic of the location led to specific audiences, such as university students, researchers, and staff, during the exhibition. The exhibition was two days long and attended by approximately 60 visitors. Up to 24 people interacted with the posters by pasting the stickers and leaving comments on the sticky notes. Some visitors tended to check other visitors' comments and then reply. In addition, some students who participated in one of the workshops visited to see how their ideas were presented, checked their names on the acknowledgement poster, and interacted with the posters.

Figure 71. *A participant leaving comments on the poster*

Apart from the posters, a video was also exhibited in the exhibition. It was filmed in Dalton Square and was repetitively played on *MagicBox*, a box-shaped display with one comprising an interactive touch screen (**Figure 72**). It was a facility of the university library. The video was filmed in a static shot, not moving a camera but capturing the movement of people, animals, vehicles, weather, and lights. It shows the place, the activities of people, and the environment. Moreover, it played a role in attracting passers-by who were heading to the library directly. A few visitors came closer to the box to see the movement of the video and then started looking at the posters.

Figure 72. *Exhibition 1 was held in the library and included the MagicBox (in the middle)*

8.2.2. Exhibition 2 in Lancaster City Museum

Exhibition 2 was held in the corridor space in the City Museum located in the middle of the city centre (**Figure 73**). The accessible location enabled more locals to attend the exhibition than Exhibition 1. The exhibition was two days long, on Wednesday and Thursday. A high number of visitors were expected because those two days were during the school's half-term break, and the farmers market was open in the city centre on Wednesday. Approximately 60 visitors attended the exhibition, the same as Exhibition 1.

Figure 73. *Exhibition 2 setting in the Lancaster City Museum*

Approximately 12 people interacted with the hands-on materials. Like Exhibition 2, a few people read the contents of the posters and what other visitors wrote on the sticky notes and left their comments. However, the noticeable difference from Exhibition 1 is the participation of children. Another interesting observation was that when a family came, a parent explained by reading the description and the storyboards to help children understand the technology.

Figure 74. *Family visitors in Exhibition 2*

In addition to the poster, 3D-printed prototypes were displayed in front of the posters. The prototypes offer tangibility to visitors, which they could interact with, imagining them to be situated in the place. However, in the case of Nanobots, no 3D model was displayed since the feature of the Nanobots is sized at the molecular scale. Instead of presenting a 3D model, a sticky note was placed:

"Nanobots here. Look closely..."

(Exhibition 2 Nanobot's Prototype Signage)

The note sounded humorous but also helped the visitors, particularly children, to understand what *molecular scale* means.

Figure 75. *The 3D printed prototypes and the absence of Nanobot's 3D printed prototype*

8.3. Stage 2: Data analysis

This part describes what data was collected in the research and analysis. At this stage of the study, quantitative and qualitative data were collected through public exhibitions. The first part demonstrates the quantitative data, which is the response rates of the public between yes and no for the first question: 1. *Are you happy to have this [technology] in Dalton Square?* The following part presents the qualitative data and its analysis, which was analysed using thematic analysis. It presents visitors' highlighted codes (marked in bold text) to represent each technology's essential aspects and then summarises general themes. This part presents quotes and initial themes from the qualitative dataset, which are responses to the second and third questions: 2. *If yes, could you tell us why you will be happy to have this technology? If not, what* *are you concerned about this technology?* And *3. What would you like to change/add to this technology?*

8.3.1. Exhibition 1. in Lancaster University Library

The subsequent analysis demonstrates the responses from the participants in Exhibition 1 for each prototype developed in Stage 1. The researcher simplified each prototype name by assigning code to clarify a further analysis process and detect the source of themes. The codes for the prototypes are the following:

- Smart Light (01SL)
- Smart Bin (02SB)
- Smart Mirror (03SM)
- Smart Statue (04SS)
- Dr Pigeon (05DP)
- Nanobots (06NB)

Moreover, the identified codes for thematic analysis (marked in **bold text**) and quotes from exhibition visitors are presented below.

8.3.1.1. Smart Light (01SL)

In the first question, 28 people responded overall. Fifteen people (54%) said they liked Smart Light, while 13 (46%) said they were unhappy. In the second question, some visitors agreed to have the light due to the benefits of **enhancing public safety** and **saving energy**. Furthermore, customising the lights would create a unique place and boost **the place's identity**.

"I would be happy because I get scared when it's dark and I'm alone."

(Exhibition 1 participant 1)

"I like the idea of customisation and personalisation to make the area unique."

(Exhibition 1 participant 2)

On the other hand, others were concerned about the technology for four main reasons:

1. One concern is the need for more **transparency** because a proper explanation for the **app's data collection procedure** was not provided on the storyboard. The respondents pointed out that users' location-based data should not be collected when scanning the QR code to install the app.

2. Another issue highlighted was that **malfunctioning** street lighting would endanger the public at night. One comment described the possibility of manipulating the light to make a public space less safe. This point leads to the question of whether there is a minimum level of brightness.
3. The residents near public areas might not want the light to be controlled by the public at certain hours. This concern is linked to the importance of making a **public agreement** before the technology is deployed, especially with nearby residents.
4. Several visitors questioned the Smart Light **design flaw** because multiple users attempted to control the light simultaneously.

"What happens if people different levels of brightness?"

(Exhibition 1 participant 3)

"Maybe have a minimum brightness of the motion sensors so no complete darkness?"

(Exhibition 1 participant 4)

The main suggestion for this prototype is to embed a sensor which counts the number of footfalls to determine the brightness of the lights. Also, following the concern, a visitor suggested eliminating the possibility of a clash between two or more users in the case of simultaneous use.

Smart Light (01SL)	Code
Positive side	• Place identity • Saving energy • Public safety
Negative side	▪ Transparency ▪ Personal data collection ▪ Public agreement ▪ Malfunctioning ▪ Design flaws

Table 29. *Exhibition 1: the positive and negative aspects of 01SL and suggestions*

8.3.1.2. Smart Bin (02SB)

For the Smart Bin, positive responses were slightly higher than negative reactions in the first question. In total, 23 people responded to the question. 13 people (57%) were happy with the technology, whereas 10 people (43%) were unhappy. Many respondents agreed that the Smart

Bin would increase **efficiency** in the waste management system. In terms of analysing data and providing suggestions, one of the respondents imagined that it would be helpful in policy for **public safety**, such as to track criminals by collecting evidence, as the bin could impose penalties and fines on individuals unlawfully disposing of their garbage.

While the bin was praised for its advantages, it received criticism for making **generalisations** about diversity for dietary requests. For instance, the visitor speculated different cases of individuals. Varied dietary requirements exist among individuals, and some may face restrictions in their food choices. Furthermore, not all healthy food options may be accessible in their locality. Despite availability, some individuals may still opt for unhealthy options such as junk food. There were also concerns that it could risk **mental health** because the unsolicited suggestions can create a sense of guilt or shame around food. When the bin tells people they should eat a certain way, it can lead to feelings of inadequacy or self-doubt. A participant pointed out that unwanted comments on the bin would annoy people and attract **potential vandals**.

"Because I'm too self-aware of my weight... I would go nuts!"

(Exhibition 1 participant 5)

The possibility that a Smart Bin tracks what individuals throw away and stores personal information without consent became a concern. This action may result in **privacy violations**. For example, the collected data may contain details about an individual's food choices, dietary habits, and even medical conditions. If this **data is mishandled**, it could be used to discriminate against people with certain conditions or even endanger their **health and safety**.

For suggestions, a visitor recommended that the bin should provide suggestions and **recommendations** instead of strict enforcement or policing. Another suggestion was to use optional buttons, as calorie counting may be uncomfortable or inconvenient for some individuals.

Smart Bin (02SB)	Code
Positive side	• Management Efficiency • Public safety • Reducing crime
Negative side	▪ Generalising diversity ▪ Mental health ▪ Causing vandalism ▪ Privacy violation ▪ Mishandling data

Suggestions	♦ Recommendation instead of rules

Table 30. *Exhibition 1: the positive and negative aspects of 02SB and suggestions*

8.3.1.3. Smart Mirror (03SM)

Smart Mirror was chosen as the most unpreferred technology. The difference in the responses was more evident than in other prototypes, with 73% negative reactions, 23% displaying positivity, and 5% expressing uncertainty. A few visitors considered Smart Mirror attractive, which can change colours and styles of clothing and fashion items. Moreover, a feature allowing virtual try-ons of clothes from online stores would **save time and effort** for users travelling to shopping centres.

"Would be good to see what items of clothing from online stores look like on. It would be good for time spent travelling to shop, centre."

(Exhibition 1 participant 6)

On the negative side, several visitors expressed concerns about the Smart Mirror. Some visitors perceived it as a product promotion that contributed to the fast fashion industry. Notably, the Smart Mirror was criticised because it would not connect with the **place identity** of Dalton Square, a historical place, and would encourage people to be more **consumerist**.

"Why is public space being given to advertising?"

(Exhibition 1 participant 7)

"I don't think that a public space is a right place for this technology."

(Exhibition 1 participant 8)

Several visitors expressed concerns about using private data that is unsuitable for public spaces. One commented that he or she would not want to show personal preferences on display for strangers, as it would **violate privacy** significantly. Another person replied to this comment, suggesting adding a privacy filter on the screen so that other people cannot see it in use.

"I don't want strangers to look at me while displaying my preferences. It would be a huge privacy invasion."

(Exhibition 1 participant 9)

→ *"Maybe there needs to be a privacy filter screen like the one on the laptop."*

(Reply from Exhibition 1 participant 10)

By agreeing with the criticism of being misplaced, Smart Mirror was suggested to be placed in a *"better"* location, like a clothing store or a private space.

Smart Mirror (03SM)	Code
Positive side	• Saving time and effort
Negative side	▪ Place identity ▪ Consumerism ▪ Privacy violation

Table 31. *Exhibition 1: the positive and negative aspects of 03SM*

8.3.1.4. Smart Statue (04SS)

The Smart Statue, a speaking Queen Victoria Memorial Statue, received positive responses among the six prototypes exhibited. While 96% of participants were happy with the idea, only 4% responded negatively. The high number of positive responses indicates that the prototype fits the historical aspect of the **place's identity** by interacting with the historical figure. A few respondents agreed that the statue would be beneficial in assisting people to revisit historical events and local history. Doing so can offer exciting and interactive learning opportunities accessible to a wide range of people. According to the comments, becoming aware of local history can promote **tourism** in the area. In addition, speaking with the statue may help people struggling engage with others to communicate.

However, while many people supported the idea, it was suggested that the notification function should be utilised to be more **interactive**. A visitor commented to avoid creating a situation similar to the automated COVID notice near the hospital, which emits an alarm every time someone passes (In fact, a recorded voice is turned on whenever some people pass outside the infirmary building in Lancaster, encouraging them to wear masks and keep a social distance to stop spreading the virus). An arrangement like this could annoy people looking for a relaxing outdoor environment, like a park, for a quiet lunch.

On the negative side, one visitor criticised that the interactive feature may overshadow the **statue's significance** since many statues have a substantial historical or heritage value. Another comment pointed out that visitors could become frustrated if they could not get the information they need from the machine.

From the suggestive side, holographic projection technology was recommended to facilitate **communication** between humans and autonomous agents. Another comment suggested adding a function enabling users to leave comments or messages for other users. Last, the remarks addressed the **subjectivity of history** and whether or not people will be able to edit information on historical places in a collaborative way, similar to Wikipedia.

Smart Statue (04SS)	Code
Positive side	• Local history • Tourism • Interaction with humans and technology
Negative side	▪ Subjectivity of history (importance of sculptures) ▪ Experiencing frustration
Suggestions	♦ Interaction with humans and technology (communication) ♦ Subjectivity of history

Table 32. *Exhibition 1: the positive and negative aspects of 04SS and suggestions*

8.3.1.5. Dr Pigeon (05DP)

For Dr Pigeon, positive and negative responses were evenly distributed among the respondents. However, the proportion of positive responses was slightly higher—52%. Some visitors mentioned that the wayfinding function would help people navigate and avoid **crowds** in crowded areas**.** It might be beneficial for those who cannot utilise smartphones. Second, Dr Pigeon might help **reduce crime and vandalism** with the function of a surveillance drone. Some visitors commented that the drones could help people who are drunk at night while serving as **tour guides**.

Dr. Pigeon's main concern was that some people would feel uncomfortable about being under-tracked since it could violate individuals' **privacy**. A participant referred to the concept as Orwellian, comparing the dystopian society illustrated in George Orwell's novel 1984. In the novel, society employs technology to surveil and control the public by collecting their data (Berild Lundblad, 2004). Last, there were comments that people would become distracted by drones or fail to notice their surroundings as they follow the drown, which could cause **crashes or accidents**.

"I like the name but I don't like policing idea."

(Exhibition 1 participant 11)

→ "I agree."
"It's a little too Orwellian for me..."
"Depends on purpose ok for a guide but not for surveillance given problems with bias 'AI' suggests."

(Exhibition 1 participant 12's reply to participant 11)

On the suggestion field, there was a comment that using a drone as a tour guide is acceptable but not for **surveillance** due to potential issues with biased AI. Also, a participant asked how the drone can identify first-time visitors to provide a tour in local areas, while others suggested adding functions like pausing or cancelling a tour.

Dr Pigeon (05DP)	Code
Positive side	• Crowd dynamics • Reducing crime • Reducing vandalism • Tourism
Negative side	▪ Dystopian (Orwellian) ▪ Design flaws (accidents or collisions)
Suggestions	♦ Not for surveillance

Table 33. *Exhibition 1: the positive and negative aspects of 05DP and suggestions*

8.3.1.6. Nanobots (06NB)

Responses regarding Nanobots that were positive (52%) higher than the negative (39%). Notably, 9% of responses were placed between the positive and negative areas, indicating neutrally. A few audiences welcomed the idea of Nanobots, referring to their ability to **reduce noise** and **control overly crowded areas**. However, concerns were raised regarding possible applications to control crowds during protests, for instance, which could lead to negative implementations depending on the social and political context. Furthermore, another visitor questioned whether the nanobots would be utilised to **monitor individuals' living** conditions or how they would influence **blind people**. The other participant questioned the **judgment criteria** to decide which noises should be muted and for what purpose.

Notable in this case is the fact that some respondents placed their stickers in the middle of the positive and negative response options. One suggested using the technology to reduce noise from vehicles or construction instead of voices. A visitor recommended considering the *third-place* concept for public spaces between homes and workplaces in the suggestion area. The feature of Nanobots, cancelling noises, could lead to decreased sociability. In this regard, the suitability of Dalton Square as a third place may be limited due to noisy events, such as the Pride parade, winter ice skating, and Ferris wheel activities, which may necessitate implementing measures to minimise their impact.

Nanobots (06NB)	Code
Positive side	• Crowd dynamics • Noise pollution
Negative side	▪ Privacy violation ▪ Vulnerable users ▪ Decision making (criteria)
Suggestions	♦ Third place

Table 34. *Exhibition 1: the positive and negative aspects of 06NB and suggestions*

8.3.1.7. Futures cone

Eleven visitors participated in the futures cone activity, where they were questioned about their favoured technology for Dalton Square in 10 years, specifically in 2032 (the exhibition took place in 2022) (**Figure 76**). The activity involved mapping each prototype into four categories of future realms: probable, plausible, possible, and preferable, considering various timeframes ranging from the near future (2022) to the distant future (2032).

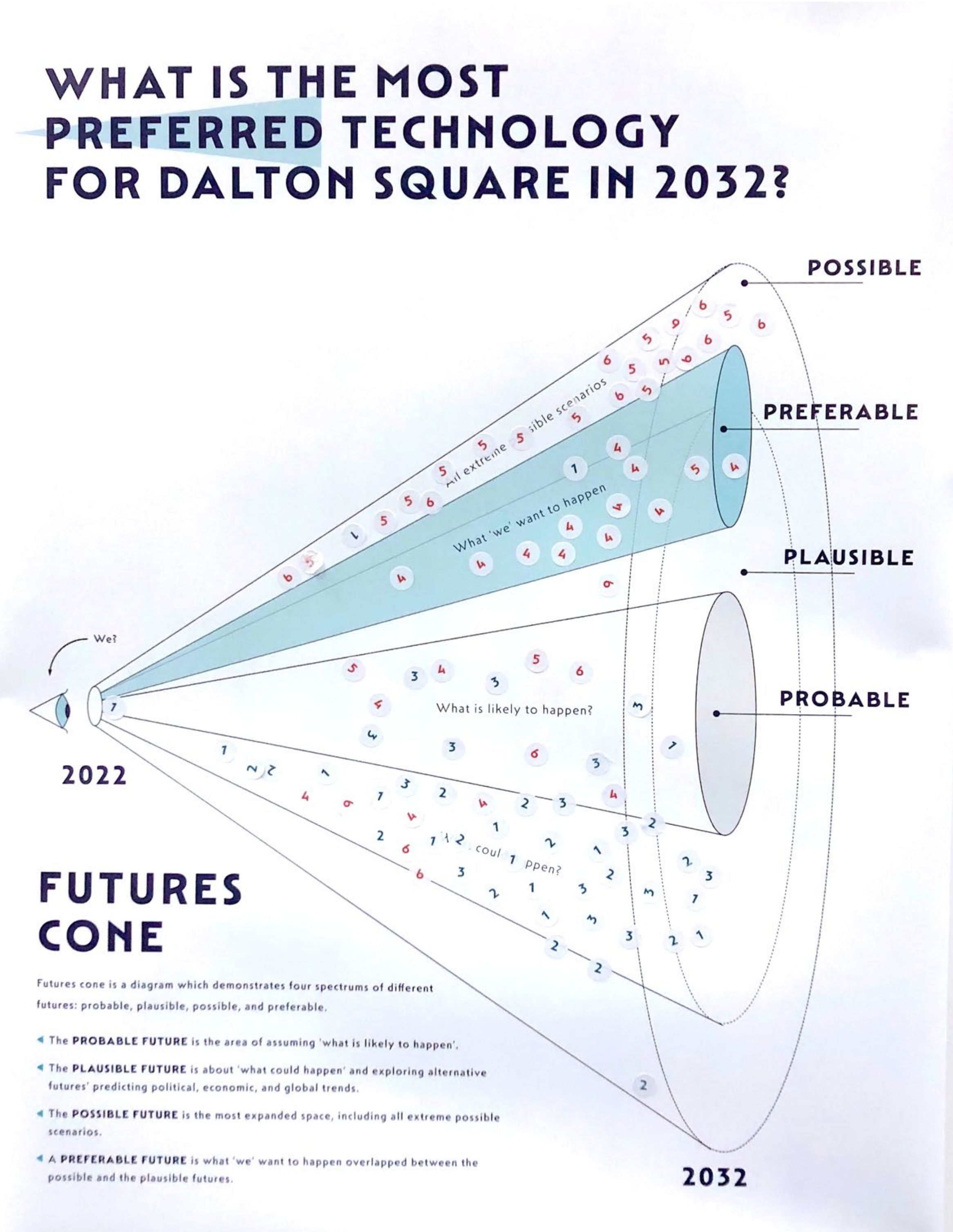

Figure 76. *The futures cone tool used in Exhibition 1*

The researcher separated the votes of each prototype to see the distribution, what technology people thought was probable, plausible, possible, and preferable, and when they expected it to happen (**Figure 77**). Most voters indicated that Smart Light falls within the realm of a plausible future. In the realm of the probable future, one visitor placed the sticker in the near future, whereas another positioned it in the distant future. There was only one vote for each future category, possible and preferable. As for the Smart bin, most voters considered it plausible, while two individuals voted for a possible future. None of the visitors chose it as a preferable future. Half of the respondents considered the Smart mirror plausible, while the other half opted for a plausible future. Again, none of the visitors selected it as a preferable future. Some people chose the Smart statue as a preferable future, while others saw it as plausible. Dr. Pigeon and nanobots in the preferred future. Most visitors believed these two technologies would likely occur further in the future.

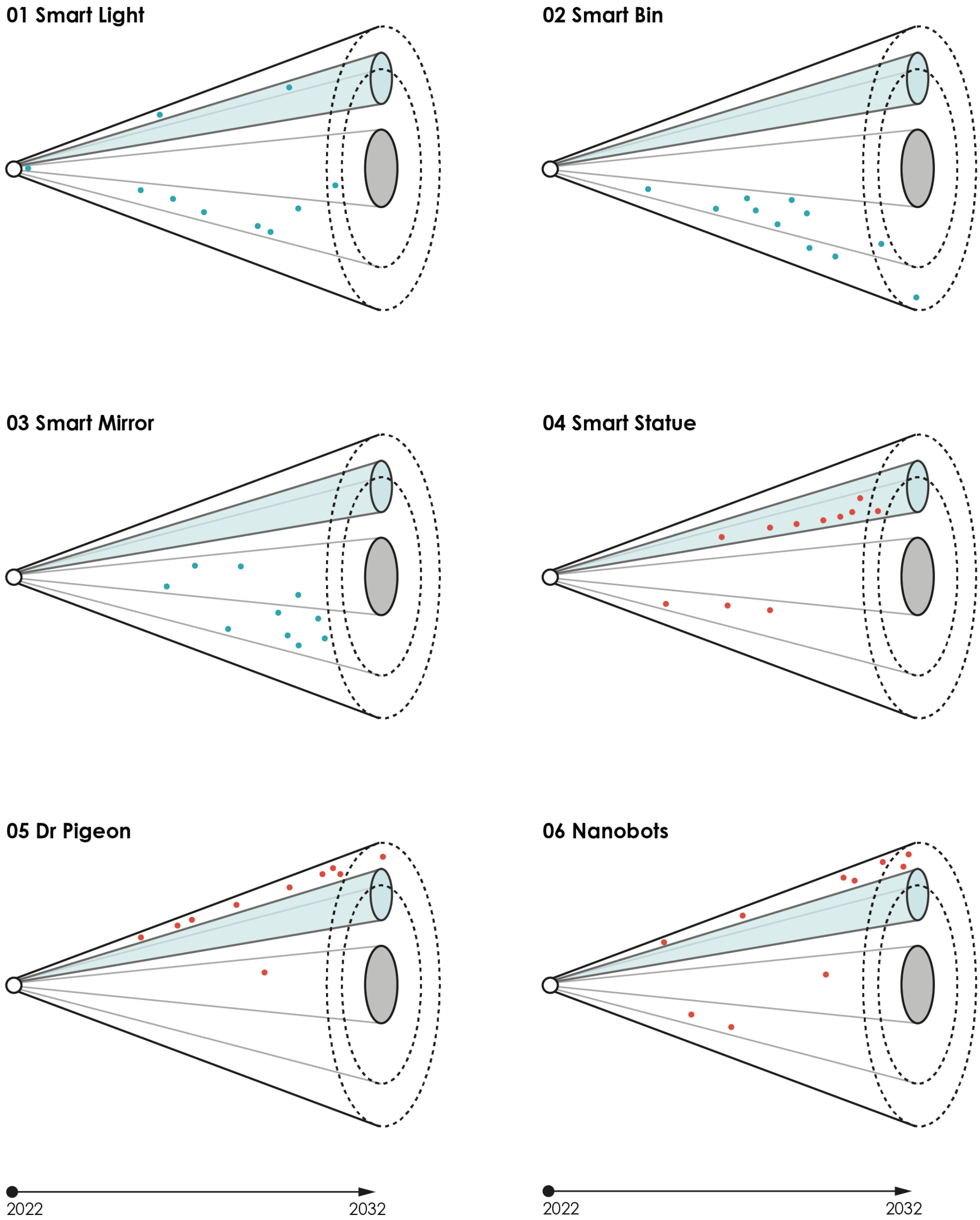

Figure 77. *The futures cones of the six prototypes*

8.3.1.8. Exhibition 1: The defined theme summary

This part demonstrates a summary of themes defined from the dataset: comments on each prototype from Exhibition 1's visitors. The table below shows the themes, highlighted codes on the positive and negative sides, suggestions, and their respective sources (indicated in parentheses).

Theme	Codes (Prototype)		
	Positive side	Negative side	Suggestion
Place Identity	• Place identity (01SL) • Local history (04SS) • Tourism (04SS) (05DP) • Interaction with human and technology (04SS)	▪ Place identity (03SM)	♦ Third place (06NB)
Efficiency	• Saving energy (01SL) • Management Efficiency (02SB) • Saving time and effort (03SM)		
Public Safety	• Public safety (01SL) (02SB) • Reducing crime (02SB) (05DP) • Reducing vandalism (05DP) • Crowd dynamics (05DP) (06NB)		
Public Health	• Noise pollution (06NB)	▪ Mental health (02SB) ▪ Causing vandalism (02SB) ▪ Consumerism (03SM) ▪ Experiencing frustration (04SS)	
Surveillance		▪ Dystopian (Orwellian) (05DP) ▪ Surveillance (05DP)	♦ Recommendation instead of rules (02SB)

Data and Privacy		▪ Transparency (01SL) ▪ Personal data collection (01SL) ▪ Privacy violation (02SB) (03SM) ▪ Mishandling data (02SB) (06NB)	
Plurality and Contextuality		▪ Public agreement (01SL) ▪ Generalising diversity (02SB) ▪ Subjectivity of history (04SS) ▪ Vulnerable users (06NB) ▪ Decision making (criteria) (06NB)	
Design Flaws		▪ Malfunctioning (01SL) ▪ Design flaws (01SL) (05DP)	

Table 35. *Exhibition 1: the defined themes from the prototypes*

Two themes, place identity and public health, describe both positive and negative aspects. While efficiency and public safety themes represent the positive effects of the technology, the opposing sides were empathised by the themes of surveillance, data and privacy, plurality, and design flaws. A detailed explanation of each theme will be presented in **Part 8.4**, which will combine the themes from Exhibition 2.

8.3.2. Exhibition 2 in Lancaster City Museum

The following parts demonstrate the responses collected in Exhibition 2 regarding the six prototypes. The codes that have been recognised (highlighted in **bold text**) are presented in the following, with quotations from Exhibition 2 attendees.

8.3.2.1. Smart Light (01SL)

According to the first question's result, 69% of the respondents said "Yes" to the Smart Light, while 23% said "No", and 8% said they were not sure (responded by placing their sticker between yes and no areas). In the second "Why" question, the respondents' comments demonstrate various opinions regarding the value of lights and lighting in public spaces. Some participants stated that smart lighting could be beneficial since it would improve night vision and help individuals know their location. An alarm or warning system was suggested to alert people and **improve safety** at night. The other commentator considered installing an automated brightness function to **save energy**. The participants generally mentioned that balancing security and possible disadvantages of lighting in public spaces, such as light pollution, is essential.

On the other hand, the biggest issue pointed out by the participants may be with installing an app-controlled lighting system in public areas. The prototype did not explain what would happen if several people were using the app at once (**design flaws**). Another scenario was proposed in which an individual constantly attempts to change the light while everyone uses it. Also, there was a possibility that an area with lighting becomes extremely dark by mistake or intention when people need light. Furthermore, several respondents stated that installing such a system would push people to purchase and carry more digital devices. This force would cause tension and discomfort for certain groups of people (**digital exclusion**).

"Obliges people to buy and carry more technology -whether they want to or not."

(Exhibition 2 Participant 1)

In the suggestion section, two suggestions were made. First, it enables the Smart Light to follow voice commands, such as Apple's Siri, to turn on the light on the street. Second, a participant proposed incorporating a colour-changing function to improve the ambience of the lights for special occasions, such as the Christmas market.

Smart Light (01SL)	Code
Positive side	• Public safety • Saving energy
Negative side	▪ Design flaws ▪ Digital exclusion

Table 36. *Exhibition 2: the positive and negative aspects of 01SL and suggestions*

8.3.2.2. Smart Bin (02SB)

The Smart Bin received 57% responses on "Yes" and 43% on "No." This result indicates that a majority of participants still agreed with the prototype. For the second "Why" question, visitors who viewed the technology positively commented that it would benefit **waste management,** maintain the environment clean, and improve recycling accuracy. The function of the bin, picking up litter like a robot vacuum, was acknowledged as a good idea. Eventually, it would encourage people to keep the place clean.

"It pics up liter for you. Maiks shor the plais is tiedy."
(It picks up litter for you. Makes sure the place is tidy)

(Exhibition 2 participant 2)

However, there were mixed opinions when collecting information on what was disposed of. Some participants who placed their sticky notes on the "No" section commented that although it may still be helpful for city planning and improving the recycling system, the bin would be risky for the public to infringe on their **privacy** and cause stress by sending feedback to them on every disposal. Some people also questioned whether **fines and penalties** could be an effective way to encourage waste reduction. They suggested that **education** and **encouragement** may work better.

"It's my business to eat junk food and no one else's."

(Exhibition 2 participant 3)

In the suggestion section, there were some recommendations for adding to the concept of Smart Bin. One ability a participant imagined was to notify the local council when the bin was full. Another idea includes increasing recycling bins and services more widely available to encourage a positive litter disposal culture. Last, some thought providing dietary recommendations depending on disposal was still interesting. However, it would be great to allow people to have the opportunity to **opt in or out** of receiving their analytical data.

"Letting people choose if they want their analytic data or not."

(Exhibition 2 participant 4)

Smart Bin (02SB)	Code
Positive side	• Management efficiency
Negative side	▪ Privacy violation ▪ Ineffective regulations
Suggestions	♦ Encouragement and education ♦ Opt-in or out options

Table 37. *Exhibition 2: the positive and negative aspects of 02SB and suggestions*

8.3.2.3. Smart Mirror (03SM)

The results show that a large proportion of respondents, precisely 69%, answered "No" instead of 31% who answered "Yes." In other words, most participants disagreed with the statement or question. Minor comments suggested that trying on clothes virtually would **save time** and make the process easier. In addition, some comments mentioned that virtual try-on technology might suggest the best clothing options.

"Trying on clothes virtually will save me. Trying on clothes how I usually do."

(Exhibition 2 participant 5)

However, a few participants expressed concerns about the technology, especially in public spaces. Collecting personal data without any notification could lead to the possibility of **data collection being misused**. Also, some people wondered how accurate virtual try-on would be. In particular, clothing can look different on various people depending on their body shapes. Additionally, other comments mentioned that this technology may indirectly force people to purchase more and potentially influence people suffering from **mental issues**, including dementia.

"It's too invasive. It might work inside shops or shopping centres, not on the street."

(Exhibition 2 participant 6)

The comments suggested that virtual try-on technology may not effectively convey the drape and feel of fabrics. Some visitors commented on their concern about how the technology would work for people with sensitivities. While the technology may be *"fun,"* some argue it would be better suited for personal use at home (**misplaced**). Additionally, the other commenter suggested that the technology could be more interesting if it allowed users to see themselves in different periods of **history**, particularly in the context of old Lancaster.

"Sounds fun but perhaps better as a personal tech for your home."

(Exhibition 2 participant 7)

Smart Mirror (03SM)	Code
Positive side	• Management efficiency
Negative side	▪ Privacy violation ▪ Misuses of data ▪ Mental health
Suggestions	♦ Place identity (Misplaced) ♦ Local history

Table 38. *Exhibition 2: the positive and negative aspects of 03SM and suggestions*

8.3.2.4. Smart Statue (04SS)

A significant proportion of participants, precisely 91%, responded positively to the first question, while only 9% responded negatively. This result indicates a general agreement among most respondents towards the statement or question under examination. The comments highlight various positive aspects of an application or technology that provides information about historical features and weather updates. Some participants anticipated the technology would encourage **interaction** with **historical locations**, provide information about daily and weekly weather conditions, and attract **tourists** by showcasing the local heritage. Furthermore, technology would be of particular benefit to visually challenged or illiterate people (**vulnerable users**).

"Or som because it can tel you if it is gaoing to rain un expectedlee."
(Awesome because it can tell you if it is going to rain unexpectedly)

(Exhibition 2 participant 8)

Despite the majority's positive comments, some visitors pointed out possible drawbacks of the statue. First, a participant mentioned that people would think the statue is *"creepy"* if it starts speaking at night (**unpleasant feeling**). Another participant speculated that noise pollution might be caused by the state, which would affect local residents. There are other worries related to mischievous behaviour or **vandalism**. Also, people with dementia or other cognitive issues may find the statue more challenging. For instance, the technology may confuse those who struggle to recognise what is real (**vulnerable users**). Lastly, it might not be cost-effective if the statue consumes energy for 24 hours.

"If it starts talking in the night it might be creepy."

(Exhibition 2 participant 9)

Visitors made three suggestions for improving the Smart Statue. Adding a hologram is one idea. Another suggestion is to enable users to choose languages, making it more accessible to a broader range of users. Lastly, the comment recommended incorporating festive elements to make the statue more exciting and appropriate for different events.

Smart Statue (04SS)	Code
Positive side	• Engagement • Local history • Vulnerable users
Negative side	▪ Unpleasant feeling ▪ Noise pollution ▪ Vandalism ▪ Cost efficiency
Suggestions	♦ Accessibility

Table 39. *Exhibition 2: the positive and negative aspects of 04SS and suggestions*

8.3.2.5. Dr Pigeon (05DP)

For the idea of Dr Pigeon, 27 % of respondents answered "Yes", while 55% said "No". In the meantime, the remaining 18% of the respondents were unsure about it (by pasting their sticker between yes and no). In the positive response section, a few participants highlighted the possible benefits of Dr Pigeon in urban environments. They thought that drones could potentially **reduce street crime** by patrolling the centre and improve traffic flow by better directing cars and people. The improvement of traffic may **decrease traffic pollution**.

"It may help reduce the street crimes."

(Exhibition 2 participant 10)

On the other hand, many visitors expressed concerns about using drones for surveillance. First, some doubts were raised about the **effectiveness** of the technology in detecting criminals. In addition, potential malfunctions could lead to crashes or other unintended consequences (**design flaws**). Also, privacy **concerns** are highlighted, with some commenters arguing that data collection should only occur when individuals have done something illegal. Lastly, from a social perspective, drones in urban environments could cause people to feel awkward about being followed by a drone. It might change people's social behaviours or perceptions.

"Privacy is a human right."

(Exhibition 2 participant 11)

"What about if Dr Pigeon eats your crisps..."

(Exhibition 2 participant 12)

Notably, some comments were placed between yes and no sections with mixed views regarding the use of Dr Pigeon. One comment, for instance, acknowledged it is helpful as a tour guide but expressed concern about its potential use as a surveillance means. There was also a mixed view over the **effectiveness** of the technology in operating as a tour guide. Last, a participant argued the authorities' difficulty balancing **surveillance** and public safety.

"Love Dr P as a tour guide. Don't like Dr P as a surveillance tool!"

(Exhibition 2 participant 13)

For suggestions, a participant proposed that using a human or an app would be better than using drones to prompt tourism instead of using drones. Someone else suggested that Dr Pigeon be formed with an organic and natural look of technology.

Dr Pigeon (05DP)	Code
Positive side	• Reducing crime • Traffic pollution • Public safety
Negative side	▪ Effectiveness ▪ Design flaws ▪ Privacy violation ▪ Unpleasant feeling ▪ Surveillance ▪ Dystopian (Orwellian)

Table 40. *Exhibition 2: the positive and negative aspects of 05DP and suggestions*

8.3.2.6. Nanobots (06NB)

Only 10% of respondents answered the first question on "Yes", while 90% responded negatively, "No." According to the results, most respondents disagreed with the idea of Nanobots. Minor people agreed with Nanobots and thought they would effectively reduce **unwanted noise**, transforming the current busy area into a quieter atmosphere. Another participant commented on the expectation for a more **peaceful and calmer environment.** Furthermore, although the staff members at the City Museum did not write any comments on the tools, they mentioned that they would support Nanobots. Because the museum is located in Market Square, they have often been exposed to and bothered by street musicians' repetitive and monotonous performances all day from the square, which become annoying noise to them.

"This would be a great idea I find Lancaster very noisy due to the traffic."

(Exhibition 2 participant 14)

However, many visitors disagreed with Nanobots, raising concerns about their use in public spaces. Some people pointed out the lack of **transparency** that the Nanobots would be invisible, so people would not know what they do. Regarding the invisible feature, privacy concerns were also brought up. Several people were worried about the potential use of the technology to **monitor and control the public**. Others questioned the decision-making process over which noises should be cancelled. This technology might create a **new *cancel* culture.** There were also concerns about the environmental impact of Nanobots that might lead to unintended consequences. Someone pointed out that due to the invisible feature, it would also be challenging to repair.

"Don't like that you can't see them. Don't know what is being done. Lack of consent."

(Exhibition 2 participant 15)

Apart from the significant disagreement, a suggestion was made for improving Nanobots. Instead of focusing on noise, the technology could detect and respond to air quality.

Nanobots (06NB)	Code
Positive side	• Noise pollution • Improving environment
Negative side	▪ Transparency ▪ Surveillance ▪ Creating a new culture ▪ Environmental pollution
Suggestions	♦ Air pollution

Table 41. *Exhibition 2: the positive and negative aspects of 06NB and suggestions*

8.3.2.7. Futures Cone

The Futures cone exercise in Exhibition 2 was unsuccessful because there was insufficient exhibition space and equipment to put up the poster. Even though the researcher tried to set up an additional flip chart board, it was unsteady and could not stand independently, making it fall over. The researcher decided not to use the board to avoid any accidents for visitors.

8.3.2.8. Exhibition 2: The defined theme summary

The following part presents an overview of the themes identified in the dataset, consisting of comments made by Exhibition 1's visitors about each prototype. The table given includes the themes, along with codes that were highlighted as positive or negative, suggestions, and the sources for each (indicated in parentheses).

Theme	Codes (Prototype)		
	Positive side	Negative side	Suggestion
Place Identity	• Local history (04SS)	▪ Place identity (Misplaced) (03SM)	♦ Local history (03SM)
Efficiency	• Saving energy (01SL) • Management efficiency (02SB) (03SM) • Engagement (04SS)	▪ Cost efficiency (04SS)	
Effectiveness		▪ Ineffective regulations (02SB) ▪ Effectiveness (05DP)	
Public Safety	• Public safety (01SL) (05DP) • Reducing crime (05DP)	▪ Vandalism (04SS) ▪	
Public Health	• Noise pollution (06NB) • Traffic pollution (05DP) • Improving environment (06NB)	▪ Mental health (03SM) ▪ Noise pollution (04SS) ▪ Unpleasant feeling (04SS) (05DP) ▪ Environmental pollution (06NB)	♦ Air pollution (06NB)
Surveillance		▪ Dystopian (Orwellian) (05DP) (06NB)	♦ Encouragement and education (02SB)

		▪ Surveillance (05DP)	
Data and Privacy		▪ Privacy violation (02SB) (03SM) (05DP) ▪ Misuses of data (03SM) ▪ Transparency (06NB)	♦ Opt-in or out options (02SB)
Plurality and contextuality	• Vulnerable users (04SS)	▪ Creating new culture (06NB)	
Digital inclusion		▪ Digital exclusion (01SL)	♦ Accessibility (04SS)
Design flaws		▪ Design flaws (01SL) (05DP)	

Table 42. *Exhibition 2: the defined themes from the prototypes*

Several themes, such as place identity, efficiency, public safety, public health, and plurality and contextuality, describe the technology's positive and negative aspects. Meanwhile, other themes related to the technology's negative aspects include effectiveness, surveillance, data and privacy, digital exclusion, and design flaws. A detailed explanation of each theme will be presented in **Part 8.4** below, combining the themes from Exhibition 1.

8.4. Identified themes from Exhibitions 1 and 2

As a result of thematic analysis, themes were identified from codes of exhibitions presented in **Parts 8.3.1** and **8.3.2**. Both exhibitions shared eight common themes: place identity, efficiency, public safety, public health, surveillance, data and privacy, plurality and contextuality, and design flaws. Exhibition 2 presented two new themes, design inclusion and effectiveness, not identified in Exhibition 1. Thus, the following parts illustrate ten themes in detail, explaining which prototype is related to a theme and why.

8.4.1. Theme 1: Place identity

The theme of place is identified in both exhibitions. Within this research context, this theme related to how connected technologies in public spaces can influence the human sense of connection to a place. The positive aspect of this theme is that digital technologies benefit from promoting local history and tourism. For instance, the Smart Statue includes this theme by integrating digital technologies with the historical monument in the Square. The prototype could enhance the place's identity by turning the passive statue into an interactive one that provides local history and news to people. Consequently, by introducing visitors to local history, tourism could benefit from this unique experience.

On the other hand, this theme also includes the negative side: that digital technologies in public spaces could affect the place's identity by causing it to be lost or disturbed. For instance, the Smart Mirror was considered a misplaced technology by visitors. Although the mirror could assist people in making better purchasing decisions, it could also encourage consumerism. Ultimately, this technology would turn the place into a commercial area, disrupting Dalton Square's unique identity as a historical place. The theme indicates the importance of examining place identity before the deployment. This theme is also related to the third-place concept, highlighted by an Exhibition 1 participant. The third place serves as an area for socialising between home and workplace, contributing to constructing a place identity. During the exhibitions, the possibility was discussed that technologies could negatively affect human social connections (e.g., 06NB). However, it may also create new human-technology interactions and culture (e.g., 04SS).

8.4.2. Theme 2: Efficiency

Efficiency describes one of the benefits people can have from connected technologies in public spaces. The theme was identified from codes, such as saving energy (e.g., 01SL), saving time and effort (e.g., 03SM), and management efficiency (e.g., 02SB). By incorporating the codes, the theme can be outlined as the capacity to achieve maximised results while minimising the inefficient use of resources, such as energy, time, and human resources. Energy efficiency was especially brought up several times as a benefit of connected technologies. One example is the use of Smart Lights, which could use less electricity. Also, using technology might increase productivity and decrease workload by saving time and human effort, such as Smart Bin's function of picking up trash on the street instead of humans. However, in Exhibition 2, the negative aspect of the theme was highlighted because implementing and maintaining deployments may also cause cost inefficiencies. Thus, the plans for deployments should be carefully examined.

8.4.3. Theme 3: Public safety

The theme of public safety refers to implementing connected technologies to ensure the safety and security of the public. The public safety theme involves examining both positive and negative aspects. It includes reducing crime and vandalism and managing crowd dynamics. First, reducing crime and vandalism is one of the positive aspects of technology for public safety, as it helps create a secure environment for the public. In this sense, the Exhibition 1 visitors found that Smart Light can improve safety in public spaces by setting the environment. The implementations can also prevent human activities that can cause vandalism or harm public property. For instance, as a surveillance drone, Dr Pigeon could enforce rules and regulations prohibiting damaging public property. Second, controlling crowd dynamics is another benefit of the possible implementation of technology for public safety. Digital technology can contribute to effective crowd management by informing and redirecting people to avoid crowds. On the other hand, connected technologies have drawbacks that could lead to more acts of anti-social behaviour, including vandalism, due to the negative emotions associated with surveillance, rules, and regulations. This negative side also indicates the consequence when people physically damage devices or systems; their effectiveness in public safety could be decreased.

8.4.4. Theme 4: Public health

The theme of public health relates to how connected technologies in public spaces affect individuals' and communities' physical and mental well-being. This theme covers a range of positive and negative sides. On the one hand, using the technologies could promote public health with an example of Nanobots reducing noise pollution. It was speculated that, ultimately, they could create a more peaceful environment. On the other hand, several negative impacts were discussed. First, overuse of the technologies, including in law enforcement and regulation (e.g., 01SB), could cause mental issues such as anxiety and depression. Second, a failure of technological services could result in frustration and stress, negatively impacting well-being. Third, encouraging consumerism through digital and AI-powered marketing could lead to undesirable behaviours and habits for the public.

8.4.5. Theme 5: Surveillance

The theme of surveillance is placed on the other side of the public safety theme. This theme describes using connected technologies, such as AI, advanced robots and drones, to monitor people in public spaces. Surveillance technologies could benefit public safety by reducing illegal and criminal behaviours. This theme is frequently connected to the concept of an Orwellian dystopian society. This dystopian society is a loss of privacy and freedom because of continuous monitoring and surveillance—the theme raised from worries about possible abuses of authorities and privacy invasions. Regarding the concern, some participants argued that the technologies should be employed to offer advice and education rather than enforcing rules and regulations. They stated that public reward systems may more effectively encourage positive behaviour.

8.4.6. Theme 6: Data and privacy

Data and privacy are related to the possibility that connected devices collect and misuse personal data. Collecting personal data without consent could lead to violating someone's privacy. Regarding this theme, comments were made on several prototypes shown in the exhibitions. In order to avoid any risks related to data and privacy, several participants suggested that individuals should have the option to opt out of services. This theme also covers the importance of transparency in data collection methods and practices. For instance, it should be clarified, such as those who collect and use data and what and how data are collected and used.

8.4.7. Theme 7: Plurality and contextuality

This theme indicates the importance of considering plurality and contextuality in public spaces. There are requirements highlighted in the exhibitions to include diverse viewpoints of public members to understand a place better and more straightforwardly when implementing connected technologies. Several codes characterise the theme in the thematic analysis. The first code, generalising diversity, refers to a risk of algorithms embedded in connected places that generalise the diversity of the public. This risk could cause unintended discrimination in public services. The second code, vulnerable users, doubts the algorithm's ability to serve the needs of marginalised and disadvantaged groups. Third, the subjectivity of history indicates that history is subjective and contextual, so various viewpoints should be considered when utilising the technologies to present and promote history and legacy. The fourth is decision-making (criteria), highlighting the need for regulations and guidelines when algorithms are utilised to make decisions that affect public spaces instead of humans. Lastly, the fifth code, public agreement, emphasises the importance of consent and participation from the public in planning any deployments of connected devices. Based on the codes, the theme addresses how important it is to integrate diverse perspectives and lived experiences when making decisions to implement connected places in public realms.

8.4.8. Theme 8: Design flaws

The theme, design flaws, of connected technologies, addresses the possibility of system malfunctions and design defects. These defects may have severe consequences for the public, such as threats to public safety or severe financial losses. This theme includes an anticipation of technology design flaws. In the exhibitions, participants pointed out several scenarios of the exhibited prototypes being less practical and useful due to a lack of design considerations. As connected technologies and systems become more advanced and sophisticated, the risks of design flaws rise, making them harder to identify and fix.

8.4.9. Theme 9: Design inclusion

In Exhibition 2, the theme of design inclusion was first identified. It highlights the idea of connected technologies that should be designed to be accessible and inclusive to everyone. The theme was recognised from two codes. First, the code of digital exclusion indicates that it could occur because of various reasons, including preferences, age, or income. For those reasons, certain public members may be excluded from accessing and using the technologies in public environments. In the exhibitions, concerns were raised for those who do not want to have digital devices. Second, the accessibility code emphasises how important it is to design public spaces and technological services usable by individuals with different abilities and needs, such as cognitive abilities and languages. Overall, the theme indicates the need for careful consideration of designing connected places for inclusion and diversity.

8.4.10. Theme 10: Effectiveness

The theme of effectiveness is also recognised in Exhibition 2. The effectiveness of connected technologies was discussed in regulations and public safety. First, questions were raised regarding whether implementing the technologies for regulations would be effective. For instance, Smart Bins, which give fines and penalties against individual misbehaviours, were questioned if they would encourage a mature sense of citizenship more effectively than education or positive reinforcement. Second, the theme highlights doubt about the possible advantages of connected technologies in public spaces for public safety. In the case of Dr Pigeon, it was questioned whether technology can reliably and effectively detect criminals without any bias.

8.5. Comparative analysis between Exhibition 1 and Exhibition 2

The previous parts discussed the thematic analysis of Exhibition 1 and Exhibition 2. This part offers a comparative analysis of these two exhibitions to understand how varying aspects influenced different results. **Table 43** provides an overview of the other settings and samples used in the exhibitions.

	Exhibition 1	Exhibition 2
Number of Visitors	Around 60	Around 60
Main audiences	University staff and students	Wider audiences
Location	Lancaster University Library	Lancaster City Museum
Additional setting	Video of the current Dalton Square played in the MagicBox	3D Printed models
Number of participants who interacted with the tools	24	12

Table 43. *The comparison between Exhibition 1 and Exhibition 2*

Each exhibition had approximately 60 visits by different audiences. Regarding the setting, first, different geographic locations led to different audiences. The characteristics of the areas were different between Exhibition 1 and Exhibition 2. Exhibition 1 was organised in a space right next to the entrance of the university library, located on a campus a few miles out of the city centre. Thus, it was attended primarily by university students and staff. On the other hand, Exhibition 2 was held in the corridor space in the City Museum in the middle of the city centre. Exhibition 2 was participated in by broader age groups than Exhibition 1, as the venue was located in a more accessible location. It was visited by various age groups, from children with their parents to older adults.

Furthermore, the additional display items differed in each space. Apart from the posters, in Exhibition 1, a video filmed in Dalton Square was constantly replayed on MagicBox, an interactive touch screen provided by the library. The video showed the place, the activities of people, and the surrounding environment. These additional supports attracted passers-by to visit the exhibition. On the other hand, in the second exhibition, 3D-printed prototypes were exhibited next to the posters. The models allowed visitors to touch and interact with the prototypes tangibly.

Overall, 24 people in Exhibition 1 and 12 in Exhibition 2 interacted with the hands-on materials by pasting stickers and sticky notes. The exhibitions encouraged the visitors to speculate about what could happen with the connected technologies and prompted discussion about ethics, privacy, well-being, and a sense of place. Interestingly, it was observed that the visitors tended to read the previous visitors' comments carefully and then reply to them in both exhibitions. Especially, in Exhibition 2, the researcher observed that older people did not want to write comments on the posters but read others' comments.

8.6. Findings of Stage 2

In this part, the analysis focuses on the results collected during Stage 2, encompassing two exhibitions held in Lancaster University Library and Lancaster City Museum. The table below presents a condensed overview of the primary findings gathered during this phase.

Stages	Stage 2
Activities	Public exhibition 1& 2
Key findings	• Through the exhibitions, many critical comments were collected. • There was a correlation observed between place-based ideas and preferred technology. • The more participants involved, the more diverse topics discussed. • Researcher's multiple roles

Table 44. *The overview of findings in Stage 2*

8.6.1. PSD for critical thinking

The result of the exhibition revealed PSD's capacity to approach topics related to emerging technologies in public spaces with a critical eye. The comments received in the exhibitions about the realisation of connected places in public spaces helped the researcher identify ten themes, which are aspects to be considered and discussed by the public before decision-making. The themes contain three key insights about implementing connected technologies in public spaces. First, technology implementation is a double-edged sword. On the one hand, technologies can benefit the public, such as improving public health and safety, maximining efficiency of managing place, and reinforcing place identity. On the other hand, there are risks for surveillance, marginalising diversity of place, and unwanted consequences caused by malfunctioning and design flaws. The second insight is a place embraces the diversity of people, culture, history, and environments, so it is essential to collect data and reflect on its diversity when making decisions about public spaces. This insight is drawn from themes such as place identity, and plurality and contextuality. Third, the question of how to collect and manage data is one of the questions that should be critically examined before deployments. Answering the question would be beneficial to prevent violation of privacy and any discrimination and exclusions. These insights are the result of participants' critical analyses of Exhibition 2, and they show how PSD can encourage dialogue and critical thinking about emerging technology that may impact on them.

8.6.2. Place-based approach

The findings in Stage 2 reconfirm the value of place-based approaches in a discussion of connected places. While PSD enables the collection of experiences and exercises from participants, place-based approaches narrow the focus of design to match the need for tailored solutions in local settings. The place-based approach in the workshops in Stage 1 relied on Stage 1 participants' experiences and observations, developing relevance to the place's current challenges. For example, the Smart Light concept was developed by participants in Workshop 1 who felt unsafe in the place at night. The group expected their idea to improve it safer with the light. This case shows that the experiences in the place are relevant in speculative prototyping.

In the intervention phase, when the researcher selected six prototypes from the workshops, they were relocated to Dalton Square, although some were not designed for the place. The change allowed the researcher to evaluate if the technologies were directly bound to place identities. For example, most visitors voted to disagree with Smart Mirror in the place. They believed it was inappropriate technology in Dalton Square, which is considered a historical place rather than a business district. In fact, the Smart Mirror was designed for Market Square, which is an area surrounded by local shops and restaurants. If the mirror was placed in the high street, the responses might have different reactions. In contrast, the Smart Statue was designed for the place and chosen as the most desirable technology in the area. Most participants were excited that the technology would better understand the place and allow people to learn the local history. Also, they envisioned the statue would enhance Dalton Square's place identity by interacting with a historical figure, Queen Victoria, rather than a stationary statue.

This observation reveals the importance of taking *place* into account in the speculative prototyping process to detect local issues and needs against the top-down and generative approaches. Each physical place has different characteristics shaped by physical features, people, and culture. The lack of consideration of place identity may generate more complicated wicked problems relating to imperceptible and invisible digital technology. Including place-based approaches requires speculative prototyping for a place. This approach enables the embrace of diverse perspectives of a place, ranging from geographic features, cultures, and local history to the lived experiences of the dwellers.

8.6.3. PSD for broader participation

The two exhibitions enabled the researcher to collect diverse viewpoints through participation. For the researcher, it was challenging to transcribe some of the comments from Exhibition 2 because, assumably, they were written by young visitors with misspelt words and uneven handwriting. It also means that Exhibition 2 was participated in by broader age groups than Exhibition 1.

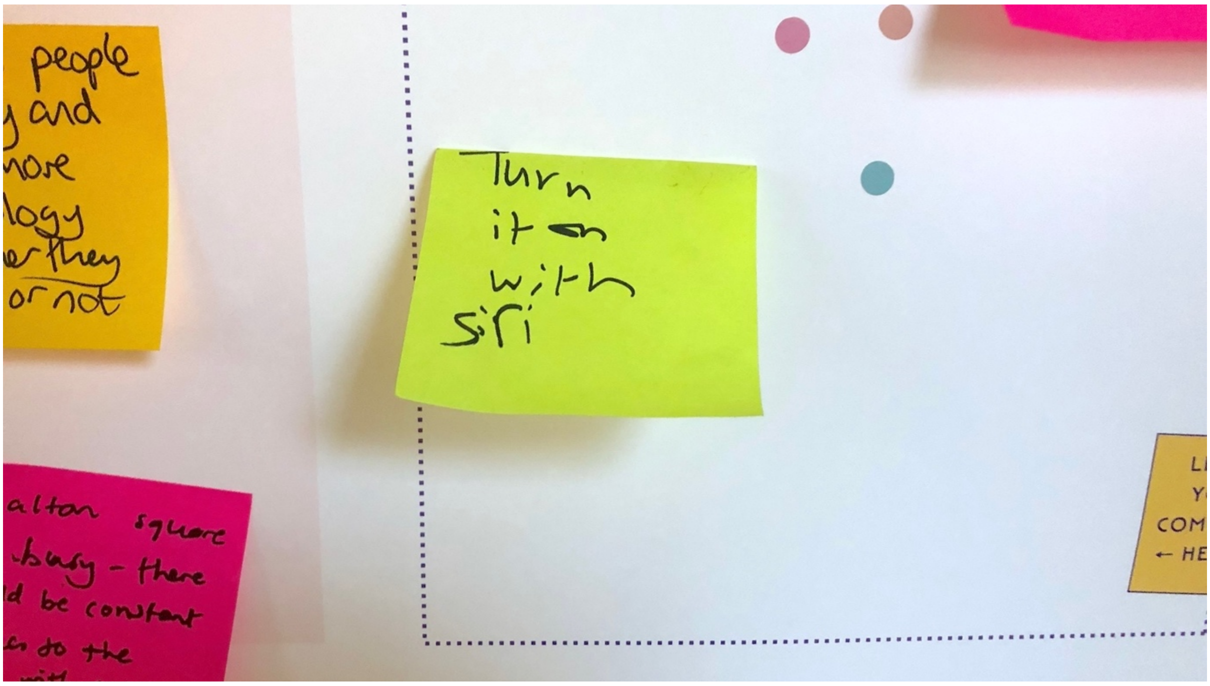

Figure 78. *The comment from a young visitor in Exhibition 2*

Compared to Exhibition 1, Exhibition 2 contributed to developing two additional themes: design inclusion and the effectiveness of implementing connected technologies. First, design inclusion indicates the requirements to design technological services carefully in public spaces to avoid excluding individuals. Also, ensuring inclusion necessitates the design of accessible technologies for individuals with varying abilities and requirements. Second, the effectiveness theme was highlighted from the discussion around whether connected technologies would effectively ensure regulation and public safety. This distinction implies that PSD provides a platform that might be used to collect different viewpoints from different participant groups.

8.6.4. Multiple roles of the researcher

Interestingly, the researcher played several roles in Stage 2, the same as Stage 1. Before Stage 2, in the intervention phase between Stages 1 and 2, the researcher took on the responsibilities of a graphic designer. She refined the storyboards, hand-drawn and written, in Stage 1 to be more inclusive and accessible. In order to improve the blurriness or illegibility of participants' handwritten text, handwriting had to be retyped. The next role undertaken by the researcher was a brand manager. This role involved developing a brand for the exhibitions, such as deciding on a title, logo, colours, and visual materials for the brand.

The researcher's role in Sage 2 was to curate the exhibitions. The researcher was responsible for organising the exhibitions by searching for venues and contacting different organisations, including the library and the museum. The curator's role also included developing a strategy for promoting the events. For instance, the researcher applied for the 2022 Festival of Social Science (FoSS), organised by the Economic and Social Research Council (ESRC), to promote Exhibition 2. As a successful result, the event was promoted across the country. The FoSS also provided funding for the printing of advertising materials. Once more, during this period, the ability to make posters and promotional items like bookmarks and postcards required the skills of a graphic designer.

8.7. Summary of Chapter 8

Chapter 8 explained that the two exhibitions, *Dalton Square 2032 Beyond SMART City*, were organised in Stage 2. Exhibition 1 was held at Lancaster University Library, while Exhibition 2 was exhibited at Lancaster City Museum. Each exhibition displayed prototypes on posters, developed in Stage 1, with short descriptions, features, and storyboards. The posters also included questions for visitors, such as whether they would want the technology in their area and what changes they would make. The prototypes were arranged from less to more controversial. In the future cone exercise, the visitors also mapped out probable, plausible, and possible futures and chose their preferred technology for Dalton Square in 2032. However, the exercise in Exhibition 2 did not succeed due to limited exhibition space and a lack of available surface area to showcase the poster properly. As a result of analysis in Stage 2, the researcher identified eight similar themes in both exhibitions: place identity, efficiency, public safety, public health, surveillance, data and privacy, plurality and contextuality, and design flaws. However, Exhibition 2 introduced two additional themes, design inclusion and effectiveness, which were absent in Exhibition 1. The themes were explored in detail, with positive and negative aspects of each theme discussed.

This chapter has presented a comparison between Exhibition 1 and Exhibition 2, which had different locations and display items. While Exhibition 1 was attended by university staff and students, Exhibition 2 attracted a more comprehensive age range due to its accessible location. Both exhibitions received around 60 visitors and sparked discussions about connected technology's impact on ethics, privacy, well-being, and sense of place. Previous visitors' comments influenced new visitors. Then, this chapter also discussed the findings in Stage 2: (1) PSD as a means to encourage critical thinking and examination, (2) integrating place-based approaches in PSD to discuss the realisation of connected places at a local scale, (3) the need for PSD involving diverse participants to address diverse issues, and (4) emerging various roles for the researcher during PSD.

The next chapter will present Stage 3 of the primary research, which includes a workshop with local policymakers. The workshop aims to explore how the insights of PSD can help policymakers accomplish inclusive policymaking and encourage public engagement regarding emerging technologies. With this aim, in the workshop, the researcher presented some PSD exercises conducted in Stages 1 and 2 to the policymakers to allow them to experience PSD and collect their opinions on the approach. Thus, this chapter will outline the workshop's process, analyse the outputs of Stage 3, and finally provide the findings.

9. Stage 3: Workshop with Policymakers

Workshop 1 and 2 with the students (Stage 1) and the public exhibitions (Stage 2) enabled the researcher to test the methods with those who were not experts. However, the question remains about how the insights of speculative and participatory design approaches can help policymakers deal with the challenges caused by emerging technology. Therefore, a workshop with policymakers (Workshop 3) was conducted to collect their opinions and examine the methods. The following part describes the workshop with policymakers and findings.

9.1. Workshop 3 structure

As the final data collection stage, an in-person workshop was conducted with participants whom Lancaster City Council employs. Workshop 3 aimed to investigate how participatory speculation methods can support policymakers in tackling the challenges of connected places. The workshop had three main objectives as follows:

- To introduce participatory speculation methods (from the workshop and the exhibition)
- To show six prototypes designed by the students and responses from the public
- To investigate the potential policy areas where participatory speculation can be used or not

The workshop consisted of four parts. The first and second parts were planned to achieve the first and second objectives. The first part included modified activities based on the activities from the workshops, and the second part was based on the public exhibitions. The third part aimed to map the current policymaking process for IoT deployment and where participatory and speculative methods can be used. Then, the workshop was wrapped up with the final discussion.

On the 28th of February 2023, the workshop was organised in the Lancaster Town Hall, in front of Dalton Square in Lancaster City Centre. The venue was chosen for easy access for the participants because it is their workplace, but also it was near Dalton Square, the selected public space for the public exhibitions. Three council officers from different departments participated in the workshop.

9.1.1. Presentation

Before the presentation, the researcher asked the participants to introduce themselves, including their role in the council. Then, she briefly explained the background and motivation of the study and introduced the concept of connected places and PSD. Then, the data collection process, Stages 1 and 2, was presented to provide an overview of the research employing PSD methods.

Lastly, the researcher concluded by outlining the aim and objectives of this workshop and providing an overview of activities.

9.1.2. Part 1. Workshop exercises

Part 1 of the workshop introduced the approaches and methods from the speculative prototyping workshops with the students. The first method of the activity, place mapping (explained in **Part 7.2.1.3**), was the same as the earlier workshops. The tool included an A3-sized paper with the grey scale picture of Dalton Square and tracing paper. In the exercise, the participants reflected on what they could see, experience, and feel in a public space in the present and then drew and wrote. In this activity, the participants were asked to reflect on the place as residents in Lancaster rather than policymakers.

Figure 79. *Workshop 3: the place mapping activity being carried out by participants*

After the place mapping, the researcher invited the participants to *time travel* by showing a movie video clip and announcing that they safely arrived at Dalton Square in 2033 (The workshop was conducted on the 28th of February, 2023). Then, the researcher introduced the two *What-if* questions:

- *What if* everything was digitally connected?
- *What if* everything collected data?

Challenge 3 was provided, which the students popularly chose during the workshops:

- *How can this place be more liveable and attractive for locals and tourists?*

After the time travelling, the second tracing paper was provided for the speculative brainstorming method, which allowed the participants to explore the ideas for Dalton Square in 2033. At the end of the activity, the students' explorations were presented to the participants, and they discussed what they thought about them.

9.1.3. Part 2. Public exhibition exercises

Part 2 replicated some exercises from the public exhibitions. Only two prototypes out of six, Smart Statue and Nanobots, were presented because of limited time, including the corresponding storyboards and the comments from the visitors in Stage 2. In addition, those two prototypes were found to be provocative during the exhibitions. For instance, the Smart Statue was the preferable future technology, while the Nanobots received substantial critical comments. The prototypes were printed on the panorama view of Dalton Square in 2023. The participants examined the prototypes and used sticky notes to express their preferences, rationales, and suggestions. The exercise was recreated using the storyboard critique method used in the exhibitions.

Figure 80. *Workshop 3: participants look at the comments from exhibition visitors*

Following the discussion, the responses gathered from the exhibition were introduced to the participants to demonstrate how the public audiences felt about the prototypes. The tool section containing the exhibition audience's reactions was covered in the margin beneath the tool to be revealed to the participants. After the participants read the comments carefully, they discussed the issues of the two prototypes.

9.1.4. Part 3. Policymaking Mapping

Part 3 consisted of two stages for in-depth discussion. The first stage aimed to build an understanding of current practices and processes of policymaking. The hypothetical situation was suggested: What if a Smart Statue were installed in Dalton Square? This idea was chosen because the prototype emphasised the theme of place identity during the exhibitions, which was expected to encourage the participants to discuss place-based policymaking for technology. At this point, the participants were also asked to switch roles from residents to policymakers and reflect on the current policymaking process, including pre-policymaking, during and after policymaking. The tool was printed on a large piece of paper, allowing the participants to see what others think and discuss openly.

In the second stage, the participants were asked to reflect on the methods and activities they experienced in Part 1 and Part 2 and think about where they can be used in policymaking. Stickers were printed with the names of the methods and activities from Part 1 and Part 2. The methods and activities presented were the following:

- Activity 1. Workshop
  - Method 1. Place Mapping
  - Method 2. *What-if* Questions
  - Method 3. Speculative Brainstorming
  - Method 4. Storyboard Building
- Activity 2. Public Exhibition
  - Method 5. Storyboard Critiques
  - Method 6. Prototypes

The participants were guided to mark with stickers the points on the tool where they thought they could use these methods and activities, which they mapped the process of policymaking.

Figure 81. *Workshop 3: Part 3 Tool, Policymaking mapping*

9.1.5. Part 4. Final discussion

After completing Part 3, the workshop proceeded to Part 4, which involved in-depth discussions with the participants. These discussions aimed to gain insight into the participants' perceptions of the benefits and challenges of participatory speculation and identify potential policy areas where it can contribute to policymaking. The pre-prepared questions were as follows:

1. Are the methods helpful to you?
2. In what ways can you integrate the methods into your process?
3. Which policies could be impacted by using these methods in the future?
4. What are the challenges to using these methods?

9.2. Stage 3: Data analysis

This part details the data collected and analysed in Stage 3, which consisted of conducting an in-person workshop with participants who were employees of Lancaster City Council. The following subparts explain the analysis of each part in the workshop: Part 1 workshop exercises, Part 2 public exhibition exercises, Part 3 policymaking mapping and Part 4 final discussion.

9.2.1. Part 1. Workshop exercises analysis

Part 1 consisted of some exercises from the speculative prototyping workshops in Stage 1. The exercises employed the following methods: Method 1 Place Mapping, Method 2 *What-if* Questions, and Method 3 Speculative Prototyping. Due to the time limitation, Method 4 Storyboard Building: Positive and Negative Futures was not included. Instead, the storyboards produced by the students in Stage were presented to the participants in Part 2 of this workshop. The following presents each method used and discusses what data was collected.

9.2.1.1. Method 1 Place Mapping

The participants reflected on Dalton Square, thinking of questions such as *How does it look? What do people do there (activities or events?)? How did you feel when you were there?* In terms of facilitation, a different approach was taken than Stage 1. In this workshop, as there were few participants, each participant was given a tool to use individually rather than working as a group. They could still discuss their thoughts with each other, which allowed the researcher to collect comprehensive data on how the participants think, experience, and feel about Dalton Square in the present.

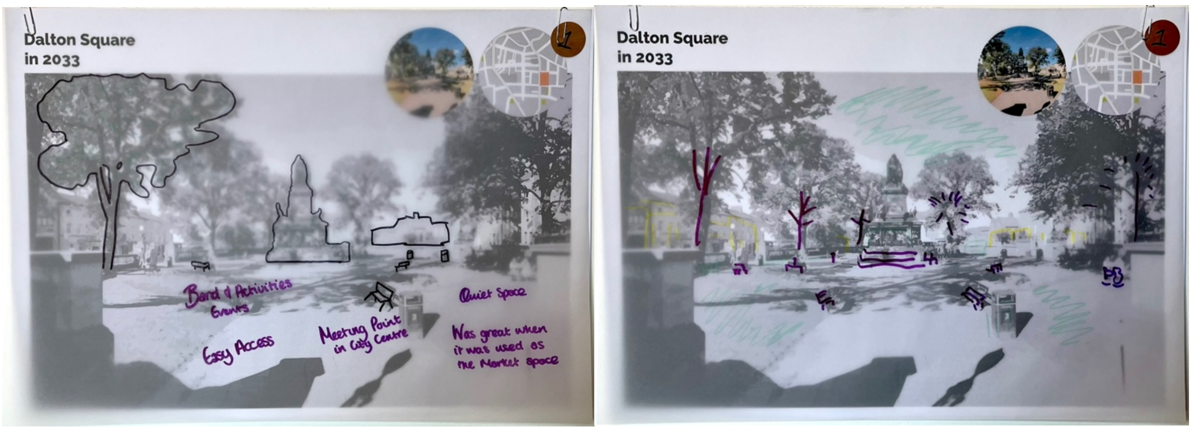

Figure 82. Workshop 3: The place mapping tools used by participants

At this point, the researcher noticed that the participants reflected their role more as long-time residents than policymakers, drawing from their personal experiences living in Lancaster. They mostly expressed their sentiments about the area, using phrases such as *“I enjoy this spot because...”* or *“I often hang out here...”*

Place	Built environment	Geographical features and biodiversity	Users of the place	Activities	Emotions and feelings
Dalton Square	Tree*[1,2], Queen Victoria Statue*[1], Buildings*[1,2], Bench*[1,2], Bins*[1], Green space*[2], "Nature"[3], Road*[3]	Blue sky*[2]	People on benches*[2], People on the grass*[2], People sit near the statue*[2]	"Band, activities, and events"[1], "Easy access"[1], "Meeting point in City Centre"[1], "Was great when it was used as the Market Space"[1], "Socialising"[3], "Relaxing/timeout"[3]	"Quite space"[1], "History"[3], "Noise"[3]

""= Quotes, *= Drawing, 1 to 3 =Participant number

Table 45. *Workshop 3: the five categories of codes from quotes and drawings*

The participants described Dalton Square as a multifaceted location that provides various experiences for visitors. They discussed the benefits of Dalton Square, including its easy accessibility, relaxing ambience, various organised activities, and historic and natural surroundings. First, the squire is in the city centre, becoming an easy meeting point. Furthermore, the participants characterised the square as a relaxing environment that provides an opportunity to rest from a hectic everyday life. One participant coloured the blue sky on the tracing paper to describe her experience sitting on the bench in the square, relaxing and looking up at the sky. In addition, the square offers various activities and events that cover different needs and interests. Another participant highlighted that the square was used as a market space during the pandemic. Lastly, the place is surrounded by nature and historical heritage, including the Queen Victoria statue. However, only some issues were addressed in the square, including one participant's observation regarding the noise produced by the nearby road.

Place	Highlighted theme
Dalton Square	• Green space • Historical space • Multi-purpose uses • Socialising space • Noise pollution

Table 46. *Workshop 3: Dalton Square's highlighted themes*

9.2.1.2. Method 2 *What-if* Question and Method 3 Speculative Brainstorming

Following the time travel exercise, the *what-if* questions were asked. Then, the second tracing paper was given to the participants for the Speculative Brainstorming method. This approach enabled them to generate and explore ideas for Dalton Square's future in 2033 related to making the place more liveable and attractive. However, it was observed that the participants struggled with the brainstorming experiences. They hesitated to draw or write something and described a few ideas on the second tracing paper.

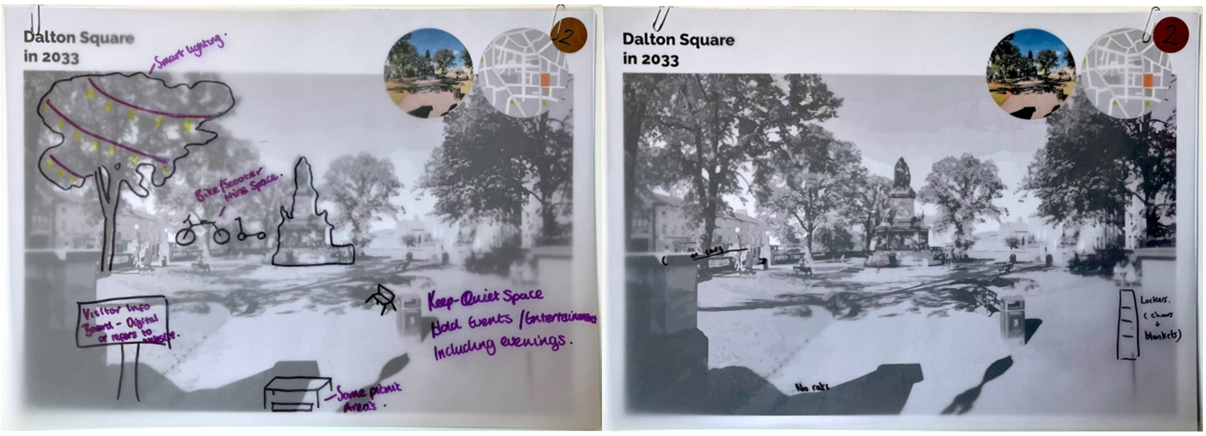

Figure 83. Workshop 3: Speculative Brainstorming tools used by participants

The observation is interpreted as being based on two reasons. First, the participants built a strong place attachment to Dalton Square. Since they had a strong emotional connection to the Square, one expressed admiration for it and reluctance to see any changes made. Second, during the exercise, the participants faced difficulties envisioning ideas beyond their professional roles, primarily focused on regulations and rules. They noted that when they thought of an idea, their minds naturally shifted towards the corresponding set of regulations that would need to be followed.

Following the same criteria of categorising in the workshops (discussed in **Part 7.3.1.3**), the ideas generated during the brainstorming were classified into two distinct groups: 1. concepts linked to technology (Level 1 to 5) and 2. other suggestions and activities for a particular location not associated with technology (Level 0). Notably, the participants focused more on non-technology-related ideas such as maintaining grass and plants in the area and organising more events and entertainment. One participant left a note stating that his intention for the prototypes was to incorporate limited data collection by limiting the information gathered and using hidden sensors to guarantee privacy preservation.

Non-technology-related ideas (Level 0)	Technology-related ideas (Levels 1 to 5)
• Quiet space: Providing a designated quiet space for people to relax and escape the city's noise. • Events and entertainment: Adding events and entertainment, especially in the evenings, to attract more people to the area. • Picnic areas: Add some picnic areas to enjoy the square's greenery. • Lockers for rentable chairs and blankets: Providing lockers which allow people to rent chairs and blankets for picnics to encourage people to spend more time in the square. • No rats: Ensuring no rats in the area. • No noise: Ensuring excessive noise in the area. • Well-maintained grass and plants: Keeping the grass and plants in good condition makes the square more attractive. • Clean paths and walls: Ensuring the paths and walls are clean and well-maintained.	• Smart lighting: Installing smart lighting makes the area more attractive and safer at night. • Bike and scooter hire space: To encourage environmentally friendly transportation, provide space for bike and scooter rentals. • Visitor info board: Adding a visitor information board to provide information about the square and surrounding areas. • Litter control: Ensuring that litter is controlled and the area is kept clean.

Table 47 *Workshop 3: The proposed ideas for Dalton Square: non-technology (Level 0) vs technology-related solutions (Level 1 to 5)*

Then, technology-related ideas were sorted by the levels of automation and autonomy in a connected place (identified in **Table 48**). The levels indicate the degree of technological complexity from automated and electronic devices to autonomous systems and services. Four ideas were highlighted, all between Level 1 and Level 2. This analysis suggests that the ideas under consideration are compatible with a relatively low level of automation and may be implementable using conventional technologies.

	1	2	3	4	5
	Assistance	Partially automated devices and systems	Conditionally Automated and autonomous systems	Highly automated and autonomous systems	Fully automated and autonomous systems
Dalton Square	• Litter control	• Visitor info board • Smart lighting • Bike and scooter hire space			

Table 48. *Workshop 3: the speculative ideas organised according to the levels of automation.*

Once the activity concluded, each participant shared their ideas with the others and discussed their perspectives. Interestingly, a participant expressed that it is difficult because she works under restrictions and regulations, so she thinks about them before imagining something.

"The constraints of my work do not allow me to think beyond what I do."

(Workshop 3 Participant 1)

Furthermore, the participant commented that as a resident, she wanted Dalton Square to stay the same as the present in the future.

"If everything is digitally connected, that would not be the same place."

(Workshop 3 Participant 1)

On the contrary, she suggested creating *de-connected places* at the end of the exercise (so she did not write or describe it on the tool). The idea assumed that people might be mentally overwhelmed by digital technology and connectivity, so the de-connected places would be without internet connectivity but implementing disconnected technology. The participant speculated that the absence of digital influence might affect people positively by prioritising in-person interactions and physical media, such as books and newspapers. However, she also critically analysed the place, highlighting the possibility that the location could be exploited for criminal activities, where individuals may use the space to hide from or evade law enforcement.

Following a discussion, the researcher presented the ideas generated by the students. The participants remarked that they could discern that the ideas were proposed by individuals with less experience living in Lancaster. Nonetheless, the participants stated that the ideas might appeal to them if they were from other places, not their local places, making them more exciting and innovative.

> *"If you gave me a place where I'm not emotionally connected, I would have come up with other ideas."*
>
> *(Workshop 3 Participant 2)*

9.2.2. Part 2. Public exhibition exercises analysis

Part 2 of Workshop 3 employed some of the exercises conducted in the public exhibitions in Stage 2. The prototypes exhibited in the exhibitions were introduced with their associated storyboards. However, due to the time constraint, the researcher facilitated to focus on only two of them, Smart Statue and Nanobots. Similar to Stage 2, the participants commented on the prototypes, including their preferences, reasons, and suggestions for improvement. After the discussion, the researcher also provided the responses collected in Stage 2, allowing the participants to review and compare their comments to the public's.

Figure 84. *Workshop 3: the Part 2 tool with the participants' comments*

First, the participants explored the Smart Statue, considered the preferable technology in both exhibitions. In this discussion, they gave positive feedback featuring its ability to integrate history as well as up-to-date news. They thought that this technology would attract families and children to the place. However, a criticism indicated that implementing the technology in the historical architecture could disrupt the cultural legacy of the place. Responding to the criticism, the participants suggested indirectly installing an interactive display on the statue. Also, they would like to add the functions of changing the language options to increase inclusivity and projecting images instead of installing a screen to preserve the current status.

"Keep Statue natural."

(Workshop 3 Participant 1)

04 Smart Statue	Code
Positive side	• Local history • Attractive place
Negative side	▪ Interference to historical architecture
Suggestions	♦ Inclusivity ♦ Preservation of the current legacy

Table 49. *Workshop 3: the positive and negative aspects of 04 Smart Statue (04SS) and suggestions*

Second, the participants examined the Nanobots. On the positive side, they found reducing traffic noises and providing a safer and quieter environment beneficial. On the negative side, they also pointed out the risk that malicious individuals could manipulate it. Then, it could result in unwanted consequences. They considered it as a temporary remedy for the fundamental issues.

"Doesn't deal with problems – 'stickering plaster.'"

(Workshop 3 Participant 2)

Moreover, they perceived the technology as too invasive and capable of easily infringing on the public's privacy. Also, there were concerns regarding the authority deciding the criteria for determining *bad noise* and the potential of recording conversations, which led to questions about the notion of privacy. Eventually, the technology could limit the freedom of the public to engage in protests or call for help during emergencies.

06 Nanobots	Code
Positive side	• Noise pollution • Safe and quite space
Negative side	▪ Safety ▪ Temporary solution ▪ Privacy Violation ▪ Limited freedoms for the public

Table 50. *Workshop 3: the positive and negative aspects of 06 Nanobots (06NB) and suggestions*

9.2.3. Part 3. Policymaking mapping analysis

This part provides the analysis of data collected in Part 3, which involved a two-part discussion. First, they imagined how they would handle the hypothetical situation of installing the Smart

State in Dalton Square in three different phases: pre-policymaking, during policymaking and after policymaking (in **Part 9.2.3.1**). Second, they reflected on the methods and activities used in Parts 1 and 2 and marked on a map of the policymaking process where they could use these methods and activities (in **Part 9.2.3.2**).

9.2.3.1. Understanding current policymaking processes

The first discussion of Part 3 aimed to build an understanding of the current policymaking process using a hypothetical future scenario: *what if a Smart Statue was going to be installed in Dalton Square?* The Smart Statue was used in this exercise because the public frequently chose it during the exhibition. The participants had a moment to reflect on what they would do considering their practices and processes and marked the steps using the sticky notes on the tool. Then, they discussed the process in three stages: pre-policymaking, during policymaking, and after policymaking.

Pre-policymaking

First of all, to implement the Smart Statue, the policymakers highlighted that it would be necessary to obtain planning permission, which is required when there is a plan to build a new structure, modify a current building and make a change to the use of the building (GOV.UK, n.d.). In order to apply for the planning permission, they also argued that it would be significant to check the ownership of the public space and display and whether it is a listed building before proposing the idea. The listed building is a classification for the heritage of historic buildings in England. Classifying these buildings is essential for identifying, protecting, and safeguarding them (DCMS, 2018). Listed buildings are graded into three categories:

- Grade I buildings are of exceptional special interest.
- Grade II* buildings are particularly important buildings of more than special interest.
- Grade II buildings are of special interest, warranting every effort to preserve them (DCMS, 2018).

In this case, the starting point would be checking the ownership and the category of the listed building status of the Queen Victoria Statue. This check is necessary for them to obtain the required permission to move to the next step. The modification plan will be limited if the statue is graded to a Grade II building. At this point, the role of the officers in the city council is to gather related information, suggest recommendations, and create a report for the councillors, which helps them to make better decisions.

Meanwhile, the activity also led to a discussion among the participants about the paradox of public space ownership, maintenance, and management. Even though the public often considers that public space is gifted to the people of Lancaster, they highlighted the clear responsibility of the City Council to maintain it. Generally, it is presumed that the public owns the public space but cannot make changes without the City Council.

After planning permission, the participants described the process, stating that officers must have a pre-application advisory. This stage includes a conversation with the experts and consultation with members of different community groups. They highlighted that public consultation is a significant step in the pre-policymaking stage. In particular, a pre-consultation process is required when the local authorities are planning public space amendments. The consultation is essential for policymakers to collect the opinions and concerns of the public.

During Policymaking

Following the pre-policymaking stage, the participants continued speculating on implementing Smart Statue and discussed what would happen during the policymaking process. One of the participants summarised the policymaking process as a technical specification, which turns an idea into a policy following the procedures and legal support. However, the participants stated that policymaking could be described as a *black box* because the process could depend on the conditions and results of consultations. Another participant explained that this stage focuses on the legal aspects, examining the existing legislation and deciding the actions policymakers should or should not take.

As there are many variables in this stage, they described relevant departments and teams who would be involved in this process rather than the process itself. The critical players highlighted are the Planning Policy, Public Realm, Legal Service, Information Government and Art and Culture departments. The participants expected that the Public Realm team would be highly relevant because they are in charge of any open public spaces, including promenades and parks, public displays and furniture. Also, the legal team could advise on contracts and work at this stage. In other words, this stage involves multiple collaborations within or beyond the City Council, such as working collaboratively with the Lancaster County Council.

After Policymaking

The participants imagined the actions and events that would occur after policymaking had been implemented to install the Smart Statue. They speculated that the City Council would demonstrate the impacts of the policy and outline the specific change that would be implemented in order to inform the public and stakeholders. This action would include media promotions, including a launch event. The participants pointed out that policymaking is an ongoing and consistent process that would be constantly linked to future planning. At this point, managing feedback channels and monitoring responses are crucial in continuous evaluation. The participants indicated that collecting feedback is comparable to the pre-consultation when individuals are asked a series of questions, such as *Does it look like you think it should look? Are you using it?* And *is it useful?*

Returning to the hypothetical scenarios, the participants anticipated that the idea of the Smart Statue could be controversial even though it was the most preferred technology in the public exhibition. They speculated it would be challenging because of requirements preserving local history and adverse reactions from the public. At this point, they highlighted that managing the public responses and acceptance would be critical because when massive negative publicity is formed, the policymakers would decide to discontinue it.

The discussion moved on to how technology controversy can arise from the public's reflections on the Nanobots. The participants stated that it depends on whether personal data is collected. One participant reflected on the Nanobot case and speculated that while the public might agree with the Nanobot's benefit of cancelling unwanted noises in public spaces, the function of capturing private conversations would be a subject of controversy and debate. In addition, there are complex and tricky questions related to the technology, such as the classification of noises and the authority responsible for determining the classification, which personal judgements can bias. Finally, the participant argued the necessity of rules or guidance from the legislative level to support policymaking for these controversial proposals. At this point, the researcher observed that even though the proposal of the Nanobots may not be plausible in Lancaster, this speculative prototype has effectively provoked discussions covering the potential capabilities of connected technology, the controversial nature of the technology, and the various aspects that need to be considered before the decisions.

9.2.3.2. Using participatory and speculative methods and activities

The result of the workshop exercise with the participants suggests that PSD methods and activities can be utilised in various stages of policymaking, including before, during, and after policymaking (**Figure 85**). The following presents the participants' discussion on each activity and workshop about when and how it can be helpful for policymakers.

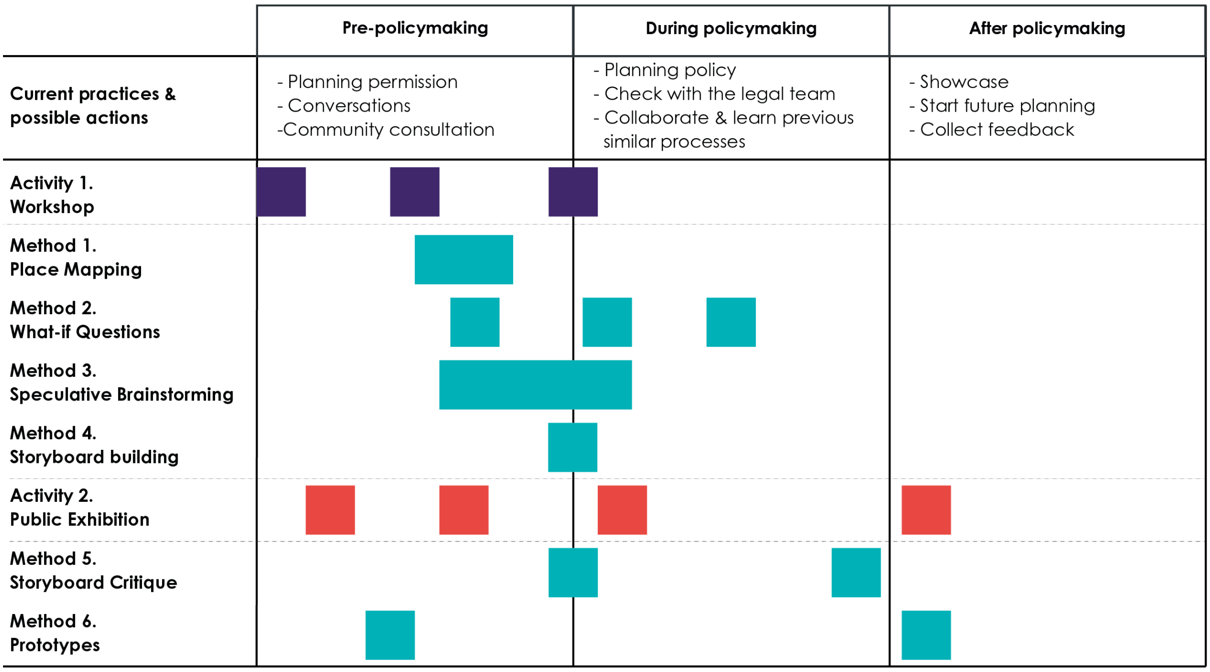

Figure 85. *Workshop 3: the potential areas for participatory and speculative methods and activities*

Activity 1 Workshop

Regarding the Activity 1 Workshop, the participants noted that it could be utilised extensively in the **pre-policymaking** stage and early stages of **during policymaking** to facilitate discussions during planning and consultation.

Method 1 Place Mapping

The participants found method 1, Place mapping, applicable at the pre-policymaking stage to identify a place's attributes and collect local residents' perspectives and experiences.

Method 2 *What-if* Questions

Method 2 *What-if* Questions were considered applicable at the end of the pre-policymaking and the beginning of the during-policymaking process. The participants saw the method as beneficial for policymakers, including themselves, to consider various contexts and scenarios to imagine when a policy is implemented.

Method 3 Speculative Brainstorming

Utilising Speculative Brainstorming can support policymakers in evaluating different scenarios and preparing for future alternations while formulating legislation. The participants emphasised the importance of the policymakers' duty to examine multiple scenarios and address all issues to develop comprehensive legislation. They mentioned that establishing robust legislation requires foreseeing and considering forthcoming variables. Thus, Speculative Brainstorming can be a proactive approach for them to ensure the long-term effectiveness and efficiency of the legislation.

Method 4 Storyboard Building

One method for policymakers to visualise potential policy scenarios is through storyboard building, which can be used pre and during policymaking stages.

Activity 2 Public Exhibition

The participants acknowledged that public exhibition is a useful activity for engaging with different public groups and presenting policy ideas.

Method 5 Storyboard Critiques

Storyboard critiques can be utilised as a part of the iterative process after storyboard building or at the end of the policymaking stage to reflect on the written policy.

Method 6 Prototypes

Based on the highlights made by participants, prototypes can have different functions. One is to demonstrate ideas through materialisation, serving as part of the consultation process, in which case low-fidelity prototypes are appropriate. The other is to present the final product after policymaking, where advanced prototypes are suitable. Prototypes can have different roles in these two stages.

9.2.4. Part 4. Final discussion analysis

Part 4 focused on in-depth discussions about the values, challenges and potential areas of the participatory and speculative design methods and activities, which they experienced in the previous parts, Parts 1 and 2, of the workshop. Although five questions were initially prepared for the discussion, the first and second questions regarding the helpfulness of the methods and activities and where in the policymaking process these might be most useful were already addressed in the previous discussion. Due to the limited time, the discussion primarily focused on the challenges associated with participatory speculation and the potential policy areas where it could be applied.

9.2.4.1. What are the challenges of using PSD methods?

Following the discussion from Part 3, the researcher threw a question about challenges encountered by the participants in adopting these activities and methods. All participants agreed that the Council's primary challenge is related to the availability of resources, particularly financial limitations and staff availability. These limited resources hinder the Council's capacity to involve consultants or fund engaging activities. Thus, they often find exploring and implementing new approaches challenging to engage the public and incorporate their perspectives in policymaking.

Furthermore, the complexity of the consultation process was spotted as another challenge encompassing multiple facets policymakers need to deal with. One participant metaphorically used the word *curveballs* to illustrate the unpredictable and variable nature of the public's responses to a policy proposal. This insight indicates policymakers' need to anticipate and be prepared for the dynamic environments and strategically undertake the process with careful attention.

There was also a reflection on the Council's current practices to inform the public about technology implementation initiatives. They hypothetically discussed the possibility of *simple* deployments, which indicates not collecting personal data. For instance, the simple deployments here include bins with sensors to check fill levels or environmental sensors in a public space to detect air quality. Their anticipation of the Council's action would be taken to provide notifications on the Council website, which is the most accessible and straightforward method, according to the participants. They also highlighted that policymakers should be perceived as accessible and approachable to the public by disclosing information they should be aware of.

The participants addressed again that policymaking processes are dynamic and context-dependent. As the deployment of connected technologies entails numerous variables and stakeholders, the complexity of policymaking regarding the technologies will be increased. One identified characteristic is the need for policymakers to address crucial inquiries before implementation. Those inquiries include how devices collect and share data and how data accuracy varies in different locations.

Lastly, engaging and managing relationships with external parties was highlighted. For instance, policymakers often ask for advice from professionals to understand technological concepts and specific deployments. Another possible scenario was discussed: outsourcing device management and maintenance to externals and sharing data from public spaces with them. The potential collaborations with external entities introduce increased complexity by working with them regarding relationship management and even legal considerations, which make it challenging for policymakers to adopt PSD approaches.

9.2.4.2. What policy can be affected using the PSD methods in the future?

During the discussion, the participants offered their thoughts on how the methods and activities could influence policy areas. One participant stated that they could be beneficial in policymaking related to placemaking, heritage sites, and arts and cultures, where increased public engagement and participation are needed. However, another participant pointed out that the methods and activities would not be able to find *one-size-fits-all* in terms of defining a specific area. He stated that each policy area is unique and depends on its particular contexts and scales. For example, the participants explained that establishing a Smart Statue in Dalton Square would be more controversial and complex than installing sensors in a bin. Also, the complexity would depend on whether it would collect personal data. If the statute collects personal data, it will require a more complex policymaking process.

9.2.4.3. Values of PSD in policymaking

After engaging with PSD methods and observing the outputs of this PSD research, the participants discussed the values of PSD in policymaking. First, they highlighted that PSD can be a valuable tool for individuals to articulate their ideas. One participant stated that involving people early in speculation exercises would be beneficial to collectively imagine the possible impacts before introducing new technologies. Rather than relying on one-directional communication, such as publishing information on a website, these exercises could encourage proactive learning and reflection among the public regarding emerging technology. The second value of PSD is the inclusion of diverse age groups in planning policy. The participant noted that, despite the significance of individuals of various generations, planning consultations often attract only older or retired individuals. This demographic may relatively have more free time and willingness to participate than younger generations. This traditional way may not be a proper way for policymakers to effectively interact with the younger demographic. In order to address this challenge, the participants found PSD to be a creative strategy that enables policymakers to interact with younger generations and gain their insights.

9.3. Findings of Stage 3

This part presents the findings from the observation and thematic analysis of Workshop 3. The table below features five key findings.

Stages	Stage 3
Activities	Workshop 3
Key findings	• The outputs of the methods depended on variables of participants, such as their backgrounds, disciplines, interests, age, etc. • The strong place attachment from participants who had longer lived experiences in Lancaster led to less technological intervention in the place. • The positionality of policymaker's professions constrained imagining the multiple futures. • The PSD methods helped the participants articulate their mundane but unnoticeable issues about the place and learn about emerging technologies. • Speculative prototyping can be used in the pre-policy stage, such as consultation and considering different occasions.

Table 51. *The summary of findings in Stage 3*

First, the study discovered throughout Stages 1 to 3 that a place can be viewed in common but also different views. The three workshops and two exhibitions involved different groups of participants with other variables, such as age, professional background, and areas of interest. For instance, to some extent, all participants agreed Dalton Square is a historical and green place. However, each group had a different perspective on the place. Workshop 2 participants, first-year undergraduate students, addressed nightlife as there was a nightclub near the Square. Meanwhile, Workshop 3 participants paid attention to noise and pest control issues, topics not discussed in the previous workshops. These different views directly indicate the need to involve a broad spectrum of individuals in placemaking to acknowledge the diversity and pluralism of place.

Second, it was observed that Workshop 3 participants, who are policymakers in Lancaster City Council, had difficulty speculating and coming up with ideas during the Speculative Brainstorming exercise. It evidently differed from the first two workshops in Stage 1. The participants mostly struggled to imagine and hesitated to describe their ideas. This hesitation was because of a strong place attachment to Dalton Square, as they stated. They expressed difficulty imagining any changes due to their meaningful and memorable past experiences and wished to preserve the current status of the place as it is. The strong attachment had built because they had more lived experiences in Lancaster than participants from Stage 1. Notably, because of the place attachment, one participant proposed developing an *anti-technology zone*—an idea opposite to adopting connected places.

Furthermore, the policymakers were constrained by their professional positions. The same participant who worked in the Department of Regulation and Rules (and also suggested the anti-technology zone) explained that she immediately considered compliance requirements whenever she engaged in speculation. These observations indicate that tailored facilitation, training and skill sets should be considered to engage no-specialists in the process of speculative design.

Even though imaging the future transitions was challenging for policymakers, the PSD methods enabled them to articulate their issues in a place and learn about invisible and emerging technologies. At this point, the problems include, even if they are unnoticeable. For instance, a challenge to a place was identified, and discussion was prompted when a participant unintentionally brought up a pest issue in Dalton Square, regarded as mundane but unimportant. Also, as Workshop 3 participants stated, PSD has proved its value as a way of learning about emerging technologies, including their capabilities, benefits, and risks. In the realm of policymaking, this way of learning is significant, as it can provide insights into policy developments before the technologies materialise. PSD can develop a holistic view of a place in the context of places, including tangible and intangible assets. This reflection indicates that PSD's inclusivity and involvement principles are beneficial when developing a place-based technology policy.

The final discussion revealed the potential of PSD activities and methods in the pre-policymaking phase. Also, the participants conjectured they could be implemented in context-based policy areas, such as public realms, art, history, and heritage. In these domains, policymakers should comprehend and analyse various perspectives, information, and knowledge incorporated into the policymaking process. This expected potential is linked to the existing challenge in policymaking, which is always context and scale-dependent. This nature of policymaking suggests that there may be no *one-size-fits-all* approaches or formulas as a participant described. Thus, as PSD focuses on involving individuals and incorporating contexts in speculative design, it can be helpful for policymakers to navigate a journey of dynamic and intricate policymaking.

9.4. Summary of Chapter 9

This chapter presented Stage 3 of the primary research that conducted an in-person workshop inviting local policymakers. The aims of this workshop were (1) to introduce and allow participants to experience the PSD methods and activities in the previous stages and their outputs and (2) to discuss the current policymaking practices and challenges they have and examine the potential area of PSD in policymaking.

In order to achieve the aims, the workshop had four parts, including Part 1, the introduction; Part 2, the workshop exercises; Part 3, the public exhibition exercise; and Part 4, the final discussion. Parts 2 and 3 replicated some exercises from Stages 1 and 2, utilising the same methods due to the limited time. For the same reason, participants focused on only two prototypes out of six, Smart Statue and Nanobots, for the discussion. Part 4, the final discussion, addressed the three questions about the challenges of utilising PSD in policymaking, the potential policy areas that can benefit from PSD and the value of PSD in policymaking.

Based on the analysis, the chapter provided five key findings:

1. A place can be described by different factors, such as the backgrounds and interests of individuals, while it consists of a shared view by most people.
2. Forming a strong place attachment by long-term residence can be challenging when speculating future transitions in a place.
3. Another challenge for PSD is the positionality of local authorities who deal with legislation and compliance.
4. Through the activity, the benefit of PSD was featured, enabling individuals to articulate their ordinary concerns and issues and draw intangible and tangible elements of place. In addition, PSD can help individuals to learn about emerging technologies and understand their impacts.
5. Last, PSD methods can be employed in the pre-policymaking phase as a creative approach to overcoming the constraints of current practices.

The following chapter will provide a detailed comparative analysis between Stages 1 and 2 and Stage 3. As mentioned above, the exercises of Workshop 3 were designed using the same PSD methods as the previous stages. Thus, the analysis compares those exercises across the stages, focusing on different settings and participants and drawing insights from them. The chapter will provide an analysis of similarities and differences.

10. Comparative Analysis

The previous chapter presented the data and analysis from Stage 3 of the primary research, which involved conducting a workshop with policymakers to experience and explore PSD methods. Due to the time constraints, Workshop 3 focused on some exercises used in Stages 1 and 2. For instance, when they had to generate ideas for speculative prototypes for a place, only one challenge, Challenge 3, was given: how to make a place more attractive and liveable. Also, during the exhibition exercises, two prototypes out of six were presented to discuss, with one selected as the most preferable and the other the most controversial. Then, the workshop ended with an open discussion with the policymakers inquiring about the questions related to challenges, applicable areas, and values of PDS.

As previously stated, in Stage 3, some PSD exercises were duplicated from the previous stages of the primary research, so comparing the exercises employing the same methods undertaken in different stages will allow the researcher to reflect on what and why similarities and differences occurred and draw insights from them. Thus, this chapter will focus on the comparative analysis across the stages. First, this chapter will demonstrate a comparative analysis of the workshop exercises between Stage 1 and Stage 3. This part includes Method 1 Place Mapping, Method 2 *What-if* questions and Method 3 Speculative Brainstorming. Then, the following will present the comparative analysis of the public exhibition exercises undertaken between Stage 2 and Stage 3, examining Method 5 Storyboard Critiques. In Method 5, the responses regarding the two prototypes utilised, Smart Statue (04SS) and Nanobot (06NB), will be examined. Last, the chapter will offer a conclusion based on analysing the similarities, differences, and elements that caused different results.

10.1. Comparative analysis of the workshop exercises between Stages 1 and 3

This part provides a comparative analysis of the workshop exercises between Stages 1 and 3. This comparison aims to identify any differences or similarities of the outputs and observations that the researcher made. The exercises were initially designed for Stage 1, including Workshops 1 and 2. When the researcher organised Workshop 3 with policymakers, two exercises utilising Methods 1, 2, and 3 from Stage 1 were selected to engage the policymakers with PSD exercises and gain their insights. Before diving into the analysis, it is noteworthy that the participants' demographics in workshops 1, 2, and 3 differ. The first two workshops involved students in their early twenties to thirties with international backgrounds and less experience living in Lancaster. In contrast, the third workshop involved local policymakers over thirty years old with more experience in Lancaster. Given the different demographics, the following subpart analyses the outputs of Method 1 among Workshops 1, 2, and 3 and the comparative analysis.

10.1.1. Method 1 Place Mapping

This part presents themes about Dalton Square gathered through the exercising using Method 1 Place Mapping in Workshops 1 and 2 versus Workshop 3. The purpose of the method was to collect the participants' plural views of a place using their experiences, observations, and feelings. The outputs from the method were sorted out into five categories: (1) built environment, (2) geographic features and biodiversity, (3) users of place, (4) activities, and (5) emotions and feelings for analysis. The table below presents the outputs of the exercises from Workshops 1 and 2 in Stage 1 and 3 in Stage 3. As Workshop 3 only focused on one public space, Dalton Squares, this table shows only outputs regarding the place, even though other public spaces were suggested in Workshops 1 and 2.

Workshop	Built environment	Geographical features and biodiversity	Users of the place	Activities	Emotions and feelings
1	"Greenery", "Ferris wheel", "Lots of grass", "Queen Victoria"	"Sun shining"	"Food vendors", "Local vendors each weekend"	"Ice skating", "Christmas markets", "Tourism", "Pictures", "People sitting", "People enjoying the park"	"Playful", "Joyful", "Relaxed", "Happy people"
2	"Glow" (night club), "Litter", Queen Victoria*, Benches*	"Provide shade in summer (tree*)"	N/A	People in the square*, Walking dogs*, Resting*	"Feel relaxed", "Feel inspired", "The view during the day and night are different"
3	Tree*[1,2], Queen Victoria Statue*[1], Buildings*[1,2], Bench*[1,2], Bins*[1], Green space*[2],	Blue sky*[2]	People on benches*[2], People on the grass*[2], People sit near the statue*[2]	"Band, activities, and events"[1], "Easy access"[1], "Meeting point in City Centre"[1], "Was great when it was used as the Market Space"[1],	"Quite space"[1], "History"[3], "Noise"[3]

	"Nature"3, Road*3			"Socialising"3, "Relaxing/timeout"3	

*Source of codes: ""= Quotes, *= Drawing*

Table 52. *The comparison of Place Mapping data among the three workshops*

Based on the outputs, the researcher developed themes regarding Dalton Square. The common themes are identified, while there are some different themes. The highlighted themes are presented in **Table 53** below. According to the participants' descriptions from Workshops 1 to 3, Dalton Square has distinct characteristics: green and historical space. The characteristics of green space indicate that the place provides a resting area of greenery, including trees, flowers, and grass. Dalton Square is a historical space that is related to its historical significance. It is surrounded by numerous historic buildings and a memorial statue of a historical figure. These assets offer visitors and passers-by with a sense of history. Moreover, in Workshops 1 and 3, another characteristic was mentioned that the place has been used for multiple purposes based on the experiences of various activities hosted there, such as ice skating and a temporary farmers market. In Workshops 2 and 3, the participants also described the place as a resting and socialising space where people can sit on the grass or benches to relax or chat.

On the other hand, each group of participants had a unique perspective on the place. For example, the nightlife theme was emphasised by Workshop 2 participants as there is a nightclub near the square. The participants were first-year undergraduate students who may be more familiar with the nightclub scene. In Workshop 3, the theme of noise pollution was highlighted by participants. Workshop 3 participants were policymakers but also residents in Lancaster more than Workshops 1 and 2 participants. In addition, it is notable that their workplace, Lancaster City Council building, is opposite Dalton Square. Consequently, having gained more experience and spending more time in the place, Workshop 3 participants were able to reflect on an even more unfavourable aspect of it.

Workshop	Highlighted common theme	Highlighted different theme
1	• Green space • Historical Space	• Multi-purpose uses
2		• Nightlife • Resting Space
3		• Multi-purpose uses • Socialising space • Noise pollution

Table 53. *The highlighted themes of Dalton Square across the workshops*

Apart from the results utilising Method 1, the researcher made observations regarding distinct behaviours and interactions with tools made by participants in Stages 1 and 3. In both workshops in Stage 1, she observed that the university students actively used their digital devices —including smartphones and iPads—to access maps or pictures of the square as prompts to recall their memory of the place. Then, they started drawing and writing on the tools. On the contrary, Workshop 3 participants preferred conversations with others and interacted less with the tools. This difference may be caused by generational differences, assuming younger generations who participated in Workshops 1 and 2 may be more familiar with using digital devices than older generations. Also, the policymakers in Workshop 3 did not need additional vehicles to remind them of the place because they already had enough experience and time there. This difference indicates that different ways of interaction depending on participants should be considered in PSD.

10.2. Method 2 *What-if* Questions and Method 3 Speculative Brainstorming

This part shows the number of outputs produced by Methods 2 and 3 in Stages 1 and 3. The methods were used to facilitate speculations about possible digital solutions to challenges for the places. The ideas proposed in Workshops 1, 2 and 3 were categorised based on the automation and autonomy levels to classify autonomous vehicles referenced in **Table 15**. The lower levels 1 and 2 of automatic or autonomous systems require human supervision mostly and partially, while the higher levels 3 to 5 need minimum or non-involvement from humans. The researcher borrowed this framework to analyse the degrees of proximity and distance between ideas on the timeline, as well as the probabilities associated with concepts. This is with the assumption that if an idea is at a higher level, it means that the idea is not near-future technology and is less probable at the moment because the technology might not exist or is on the way to development.

The distribution of speculative concepts across five levels in Workshops 1, 2, and 3 is presented in **Table 54**.

	1	2	3	4	5
Workshop	Assistance	Partially automated devices and systems	Conditionally Automated and autonomous systems	Highly automated and autonomous systems	Fully automated and autonomous systems
1	-	3	1	2	-
2	1	5	3	-	-
3	1	3	-	-	-

Table 54. *Automation and autonomy levels for speculative ideas generated in the workshops*

As shown, while Workshops 1 and 2 produced prototype concepts ranging from levels 1 to 3 and 4 in Workshop 1, the ideas developed in Workshop 3 are only in levels 1 and 2. The difference is reflected in the findings explained in **Chapter 9**: Workshop 3 participants faced challenges in speculating and proposing digitalised solutions because of their strong place attachments and professional roles. For those reasons, they were opposed to implementing technologies in the place. Compared to Workshop 3 participants, those in Workshops 1 and 2 had less time living in Lancaster, so they might not have developed a strong sense of attachment. Another explanation could be the generation difference between Workshops 1 and 2 participants and Workshop 3. Given that Workshop 1 and 2 participants were university students who might be more familiar with and interested in digital technologies than Workshop 3 participants.

Furthermore, the focus on designing speculative prototypes differed across the three workshops. Workshop 1 participants freely described ideas related to advanced technologies such as AI and robotics. In Workshop 2, students focused on sustainability and improvement in landscaping, such as installing solar panels, encouraging cycling to reduce carbon emissions, and increasing green areas. Between the workshops, the different focuses resulted from their disciplines: Design Management and Arts Management in Workshop 1 and Architecture in Workshop 2. In Workshop 3, participants aimed to restrict personal data collection to ensure the public's privacy. This focus arose from their profession as policymakers working in regulations and compliance. These differences among the workshops indicate the importance of setting and engaging with the target audiences according to the aim of PSD when planning the activities. This is because audience inputs based on their backgrounds, disciplines, professions, and interests influence the outputs of speculative prototyping.

10.3. Comparative analysis of the public exhibition exercises between Stages 2 and 3

The public exhibition exercises used in Stages 2 and 3 will be compared in this part. As part of PSD, the public exhibition exercises were initially planned for Stage 2 of this primary research. Because Stage 3, which is Workshop 3, aimed to present the same exercises in Stage 2 to local policymakers and discuss the challenges and opportunities of the PSD exercises with them, the exercises employed in Stage 3 include Method 5 Storyboard Critiques. At Stage 3, only two prototypes out of six were discussed due to the constrained time. The participants' demographics in Exhibitions 1,2 and 3 are various. Exhibition 1's participants were mainly university students and employees, Exhibition 2's participants covered a more diverse audience, including children and older adults, while Workshop 3 engaged with local policymakers. Considering this difference, the following part will compare Method 5's outputs between Stages 2 and 3.

10.3.1. Method 5 Storyboard Critiques

As described above, this part compares the outputs of Method 5 Storyboard Critiques from Exhibition 1, 2, and Workshop 3. The method was to gain participants' opinions on speculative prototypes regarding positive and negative sides and further suggestions to improve. In this part, the outputs of the methods to be compared are codes used during thematic analysis based on the responses received for the prototypes. However, the researcher only utilised two prototypes in Workshop 3: the Smart Statue (04SS) and the Nanobots (06NB). As a result, this part will employ code comparisons rather than themes because themes were identified after coding six prototypes. First, **Table 55** compares the positive and negative codes of 04SS developed from three different exhibitions and workshops. The common or similar codes featured across the events are marked in bold.

	Exhibition 1 (Ex1)	Exhibition 2 (Ex2)	Workshop 3 (Wr3)
Positive side	• Local history • Tourism • Interaction with human and technology	• Local history • Engagement • Vulnerable users	• Local history • Attractive place
Negative side	▪ Subjectivity of history (importance of sculptures) ▪ Experiencing frustration	▪ Unpleasant feeling ▪ Noise pollution ▪ Vandalism ▪ Cost efficiency	▪ Interference to historical architecture

Suggestions	♦ Interaction with human and technology (communication) ♦ Subjectivity of history	♦ Accessibility	♦ Inclusivity ♦ Preservation of the current legacy

Table 55. *The comparison of codes about Smart Statue (04SS) in Exhibition 1, 2 and Workshop 3*

The analysis of the exercises from the three events shows a few shared or similar codes, positive and negative. First, on the positive side, in Exhibitions 1 and 2 and Workshop 3, it was acknowledged that the Smart Statue could positively impact the promotion of local history. In the meantime, the three events highlighted its benefits differently, such as encouraging tourism (Ex1), improving accessibility (Ex2), and making the place more attractive (Wr3). Notably, in Exhibition 1, the code was developed regarding expectations of interaction between humans and technological agents such as AI, which has yet to be explored. The expectations include the view that humans will interact with autonomous agents like humans, such as having a chat.

On the other hand, to some extent, there are codes related to the concerns about the subjective nature of history in Exhibition 1 and Workshop 3. The codes indicate the risk of implementing the technology, which could interfere with the importance of historical figures or their architectural value. Furthermore, regardless of the potential benefits of the sculpture describing local history, past events in diverse contexts may result in varying interpretations of history, which may cause controversy. In addition, different codes are highlighted. In Exhibition 1, connected to the theme of interaction between humans and technology, a theme of experiencing frustration was developed. This code indicates that when technology malfunctions, people will get frustrated with the technological failure. Linking to this theme, Exhibition 2 also pointed out unpleasant feelings the autonomous agent can cause, including fear. In addition, other codes were developed in Exhibition 2, including cost efficiency, vandalism, and noise pollution.

In the three events, some suggestions were made to improve accessibility and inclusivity, such as including language choices. As discussed, the subjectivity and importance of history are highlighted in Exhibition 1 and Workshop 3. In particular, Workshop 3 recommended preserving the current historical legacy by requiring minimum interference with the present statute. These diverse codes are marked by different groups participating in the respective events, offering a range of aspects and insights on Smart Statue. Significantly, the policymakers' view in Workshop 3 diverged from the two Exhibitions, highlighting the importance of history and preserving historical values. The PSD activities in this research brought attention to this viewpoint, which could provoke meaningful discussions concerning the extent to which tradition and history should be protected and preserved from the digital transition. Also, this analysis indicates that the public and local authorities may have varying degrees of acceptance of implementing a technology.

	Exhibition 1	Exhibition 2	Workshop 3
Positive side	• Noise pollution • Crowd dynamics	• Noise pollution • Improving environment	• Noise pollution • Safe and quite space
Negative side	▪ Privacy violation ▪ Vulnerable users ▪ Decision making (criteria)	▪ Transparency ▪ Surveillance ▪ Creating new culture ▪ Environmental pollution	▪ Privacy Violation ▪ Limited freedoms for the public ▪ Safety ▪ Temporary solution
Suggestions	♦ Third place	♦ Air pollution	

Table 56. *The comparison of codes about Nanobots (06NB) in Exhibition 1, 2 and Workshop 3*

Second, the themes based on feedback regarding Nanobots (06NB) at the events are presented in **Table 56**. At the three events, it was commonly recognised that Nanobots would significantly reduce noise pollution, and different codes were featured. Exhibition 1 suggested another positive use of Nanobots, controlling crowds in public spaces, while Exhibition 2 and Workshop 3 focused on the result of implementing Nanobots, such as improving the environment and making places safe and quiet.

On the negative side, a disadvantage of implementing Nanobots was related to privacy, as highlighted in Exhibition 1 and Workshop 3, in contrast to the emphasis on transparency in Exhibition 2. Also, codes related to surveillance and public freedom are present in both Exhibition 2 and Workshop 3. These topics featured through the PSD methods are essential to discuss prior to deploying technologies. Additional codes that have been categorised include risks for vulnerable users, concerns regarding the establishment of decision-making criteria regarding the extent to which noise levels in Exhibition 1 contribute to the development of a negative technology usage culture, environmental pollution in Exhibition 2, which endangers safety, and the notion that this would be a temporary solution in Workshop 3.

Overall, the analysis indicates that each event contributes to developing a variety of technology-related topics that policymakers may find beneficial to consider before formulating policies. Furthermore, meaningful perspectives were revealed by the PSD activities and methods in this study, such as the conflict between historical tradition and digital transition, as well as and public freedom surveillance. This result indicates that policymakers could benefit from the diverse outputs that PSD activities could produce if they were organised with various locations and audiences.

10.4. Findings of comparative analysis

After conducting the comparative analysis, the researcher identified three key findings. First, a place has a common image, which constructs a sense of place. On the other hand, participants describe different aspects based on their various disciplines, experiences, and professions. This finding links to the literature review regarding place, which states a place is a way of understanding for individuals. Thus, PSD activities should be designed to capture these plural views of place. Second, generational differences and longer living experiences may cause the difference in PSD outputs. In particular, the younger generation is more familiar with utilising digital devices and is interested in digital technologies. This distinction relates to the fact that when planning PSD, various ways of interaction for participants should be considered to include a wide range of participants. This requirement is also linked to the challenge discussed in Workshop 3: Policymakers need to integrate more younger adults into policymaking. Third, PSD can provoke technology-related discussions that will benefit policymakers in pre-policymaking and during policymaking stages. Thus, PSD activities should be organised in various locations to encourage diverse participation.

10.5. Summary of Chapter 10

This chapter has presented similarities and differences in exercise outputs across the stages. The researcher compared the workshop exercises conducted in Stages 1 and 2, and then the public exhibition exercises in Stages 2 and 3. The workshop exercises include Method 1 Place Mapping and Method 2 *What-if* Questions and Method 3 Speculative Brainstorming. The exercises for the public exhibition consist of Method 5 Storyboard Critiques, which specifically address Smart Statue and Nanobots.

Based on the analysis, the three key findings were featured: (1) a place can be described with its shared image but also viewed in different aspects because of participants' educational backgrounds, occupations, and lived experiences; (2) In particular, differences in generations and time spent in place cause different outputs of PSD activities, and (3) diverse topics related to technology implementation were discussed during PSD in this research, which could be valuable for policymakers to integrate in policymaking processes.

The following chapter will present a discussion examining PSD from various angles. This chapter will synthesise the research gaps and insights identified in the literature review and findings throughout this study, including the contextual pilot studies and primary research. Then, it will demonstrate nine critical points of discussion. The discussion includes (1) the importance of collective efforts, (2) the value of speculation and imagination, (3) the requirements of PSD, (4) the trainability of participants, (5) the various roles of designers and researchers in PSD, (6) a scope of participants, (7) multiple approaches for engagements, (8) adaptation of place-based approach in PSD, and (9) the relevance of PSD in policymaking.

Section 5. Discussion and Conclusions

This section consists of two chapters: discussion and conclusion. **Chapter 11** will provide a discussion based on the findings and insights throughout the study, including the literature review, the contextual pilot studies, and the primary research. Then, **Chapter 12** will conclude this thesis by highlighting the answers to the research questions and contributions, stating the study's limitations, and providing recommendations for further research.

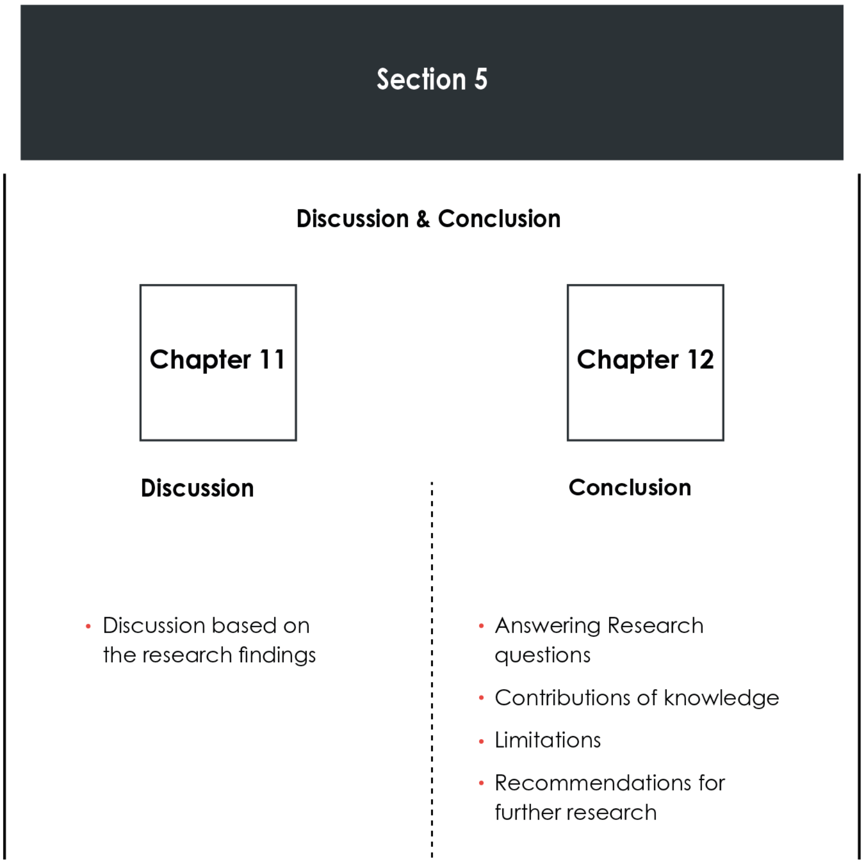

Figure 86. *The overview of Section 5*

11. Discussion

The literature reveals the benefits of imagination and speculation in anticipating unexpected futures (in **Part 2.4.6**). In the design field, speculative design has been acknowledged as a future-oriented practice that envisions alternative futures. At the same time, there are new attempts to combine speculative design with participatory approaches to involve people without design or technology expertise but with lived experiences. However, this is still an emerging area, so more exploration is required (in **Part 2.4.8**). In policymaking, policymakers have to deal with challenges to be prepared for unforeseen situations, develop plans, and meet the needs of the public. For instance, in Workshop 3, these challenges were highlighted, and they struggled to imagine the future because of their position and role in the council. It would lead to limited views on how to be prepared for unexpected events. Another work of literature (in **Part 3.6**) also points out the gap between policies, the rapid growth of digital technology, the 4IR, and the urgent need to keep pace with its speed. Moreover, it was revealed that inclusive approaches to public spaces are critical to dealing with the challenges (in **Part 4.2**).

Based on the gaps identified from the literature review, this research has focused on the main gap and attempted to explore how to involve non-design or non-technology experts in speculating and designing the future of connected public places. Thus, this research employed PSD as a way for participants to understand complex connected technology and engage in speculative design processes. The study also aimed to evaluate PSD to support policymakers in navigating unseen futures driven by emerging technology. PSD is a combination of speculative design and participatory design. This combined approach enables individuals who are non-designers or non-experts to be at an early stage of creating design fictions and prototypes. Based on the research findings, the researcher argues that this early involvement is significant as inputs of speculative design to reflect a broad spectrum of creativities and perspectives by participants. In addition, they can broaden their perspectives on emerging digital technology and critically reflect on it during the involvement of PSD.

Previously, **Chapters 7** to **9** provided an overview of the research activities, including data collection, analysis, and findings. **Chapter 10** then provided a comparative analysis of the same methods used in the different events. In this chapter, nine key points of discussion are based on the findings from **Chapters 7** to **9**. These points include:

1. The importance of collective efforts in constructing imaginary futures for places.
2. The value of speculation and imagination for placemaking and emerging technology
3. The necessary elements for PSD from the participants' perspectives.
4. The potential for training individuals in PSD.
5. The roles of designers and researchers in PSD.
6. Identifying who should be involved in PSD.
7. Exploring multiple approaches to engaging people in PSD.
8. The significance of adopting a place-based approach in PSD.
9. Understanding the relevance of PSD in policymaking.

Before diving into the discussions, it is essential to acknowledge the scope of engagement in this PSD research. The reasons behind this acknowledgement are to distinguish this research from traditional speculative design projects and to offer a context for understanding the discussions that emerged from this research. This research utilised the framework of four levels of engagement and eight categories of participation proposed by Farias, Bendor, and Van Eekelen (2022) as detailed in **Part 2.4.8**.

Sallow → Deep								
Level of engagement	Non-participation	Involvement		Collaboration			Leadership	
Category of participation	Spectatorship	Reflection	Inspiration	Generative reflection	Shared creativity	Shared authorship	Initiative	Ownership
Description of participation	Non-designers view or interact with the finished speculative design.	Non-designers discuss the finished speculative design with designers after viewing or interacting with them.	Non-designers inspire designers before the speculative design process begins.	Non-designers respond to speculative designs during the design process and their comments and feedback on the design.	Non-designers brainstorm with the designers before and/or during the design process.	Non-designers produce speculative designs alongside the designers.	Non-designers initiate the speculative design process and have the opportunity to influence its direction.	Non-designers maintain ownership over the process by shaping goals, procedures, outcomes, and dissemination.
				The scope of this research				

__Figure 87.__ The scope of this research mapped the levels of engagement and categories of participation from deep to shallow (adopted from Farias, Bendor and Van Eekelen, 2022)

For the engagement level, this research can be landed in the middle of the level of collaboration. This level includes categories of participation from shared authorship and generative reflection. For instance, in Stage 1 of the primary research, the influence of non-designers can be mapped between those categories. At this point, although the researcher played the role of a speculative designer to curate the entire design process, her involvement was minimised to influence the design outputs less. Instead, the researcher added more roles than the designer, such as a facilitator, to provoke participants' imagination and discussions. At this point, the participants, as non-designers, could have shared creativity and authorship by brainstorming their ideas and developing storyboards. In the exhibition of Stage 2, the participation of non-designers was for generative reflections. The visitors responded to the speculative prototypes generated in Stage 1 and provided feedback to inform further design iterations.

While Farias, Bendor, and Van Eekelen (2022) identify distinctive engagement levels and participation categories, this study proposes that there is a transition during the speculative design process between shared creativity and authorship. During the workshops, participation categories were shifted from shared creativity to authorship. When they brainstormed their ideas during the speculative brainstorming method, it could be mapped for shared creativity. Then, it was moved to shared authorship when they shaped a prototype and built its storyboards. Based on this reflection, the following discussion focuses on PSD at the collaboration level, ranging from generative reflection to shared authorship.

11.1. The importance of collective efforts in constructing imaginary futures for places

This research employed PSD as a methodological framework to ensure collectiveness in speculative design. After conducting this research, the researcher assures the importance of collectiveness in constructing speculative futures. In particular, from existing literature, the need for collective efforts was highlighted to deal with wicked problems in the 4IR and the concept of place as a way of understanding and social space. The following paragraphs will examine the relevant argument and pieces of evidence from the literature and this research.

First, the 4IR has caused wicked problems requiring a comprehensive and collective approach. As identified in the literature review in **Chapter 3**, industrial revolutions in history caused substantial changes, including opportunities and challenges in society. The historical events are characterised by introducing and adopting of new technologies that increase productivity and efficiency while causing complex social issues such as inequality. For instance, adopting AI and robotics in workplaces is a double-edged sword. While they can boost productivity and efficiency to benefit humanity significantly, they can unexpectedly disadvantage by replacing human roles in industry. In social science, in response to this transition, collective intelligence is considered a means to navigate wicked problems. Salminen (2012) points out that while a certain level of diversity is advantageous in the scientific areas, diverse perspectives could be confusing without a systemic structure to coordinate inputs from different disciplines. Despite this risk, collective and collaborative approaches are still valuable as they allow people to understand intricate technologies and perspectives from others. They can also articulate their concerns and current challenges while overcoming constraints and limited awareness (Salminen, 2012).

The evidence to support the need for a collective approach is also found in this research. The researcher observed that different disciplines offer distinct perspectives to interpret technologies and speculate how they could be used from the two workshops in Stage 1. This difference highlights the potential of the collective approach. The questionnaire results revealed that the participants in Stage 1 were university students who were gaining academic knowledge. However, they may not have an in-depth understanding of connected technology. However, there was a different focus on speculative ideas between Workshop 1 and Workshop 2 participants from other disciplines, Design Management and Arts Management and Architecture. While the Design Management and Arts Management students ideated concerning products and services, considering ethical considerations, the architecture students addressed environmental issues. This observation indicates the need for more diverse perspectives to shape the future of a place.

The second reason for the collective approach required can be found in the context of the place. The literature on the place and placemaking approaches (**Chapter 4**) reveals that physical environments and intangible elements, including human activities, construct places. Places are distinguished from landscapes because humans inhabit and attribute meanings to them. They influence individuals to build a way of understanding encompassing emotional connection and various experiences in their surroundings or interactions with others. In literature, humanistic geographers employ concepts such as place identity, sense of place and place attachments to indicate cognitive and emotional factors. Moreover, other literature suggests places as social spaces which allow human beings to facilitate activities and form communities. Significantly, public spaces, including parks, plazas, and cafes, form shared identity and social connections. Thus, it is evident that places contain diverse invisible elements from people's lives and experiences beyond merely nature or the built environment. These elements reflect the dynamic and complexity of places that should be understood through collective efforts.

The existing practice of placemaking is to understand places in collective and collaborative approaches. It includes diverse stakeholders to reshape the physical built environment to achieve community well-being in the areas. Furthermore, advancing digital technology has led to an emerging practice, digital placemaking, which enables communities to engage in placemaking via digital technology. However, this new practice faces criticisms, such as overlooking historical significance and excluding communities without digital connectivity. Another challenge in digital placemaking is that implementing digital technology increases the complexity of places, such as new digital infrastructure, data storage, and cybersecurity. In literature, a transdisciplinary approach is explored in placemaking to deal with these challenges. Also, participatory design and action research are suggested to increase inclusivity in the process. Therefore, this research proposes PSD as a collective and collaborative approach that can generate multiple views of individuals and their visions toward public spaces. This approach enables us to outline and understand intangible elements, such as various perspectives and realities the public illustrates. The primary aim of PSD is to understand the dynamics of places rather than providing infrastructure solutions, as Mattern (2003) stated.

This research also provides supportive evidence for the necessity of collectiveness. Stages 1 to 3 of the study revealed that different workshops produced shared and distinct perspectives on a location. This is due to the participants' backgrounds, disciplines, interests, and age groups. For example, all workshop participants recognised Dalton Square as a historic green space, but each group had a unique viewpoint. First-year undergraduate students focused on the theme of nightlife. At the same time, Workshop 3 participants, consisting of policymakers and residents, highlighted noise pollution based on their personal experiences, which had not been mentioned in the previous workshops. These diverse perspectives underscore the importance of involving a wide range of individuals in placemaking to acknowledge and embrace diversity.

11.2. The value of speculation and imagination for placemaking

Speculations with collectiveness hold significant value for several reasons. In this research, diverse members of non-experts, including university students, participated in designing speculative prototypes and speculating their alternative futures. The researcher argues here these speculations may not become a reality; nevertheless, they serve important purposes. First, the speculations can promote critical thinking within an educational context. Critical thinking is a crucial life skill that involves continuous reflection and questioning in all aspects of one's life (Arend, 2009). This research asked participants in Stage 1 to consider the *what-if* questions and speculate the negative scenarios. In Stage 2, the exhibitions presented negative occasions, which helped the visitors see if the prototypes worked differently. These measures enabled the participants to think critically about the alternative scenarios. Moreover, there are testimonials from the participants after the activities. They stated this potential of mutual learning by commenting that engaging in the speculative process helped them raise their attention to technology and critically examine its associated issues.

Second, PSD offers a space for mutual learning, which is recognised as an essential element in participatory design. Mutual learning helps establish mutual respect and understanding among different groups (such as users and designers in participatory design). The guiding principle for achieving this understanding is mutual learning, which recognises that individuals are the domain experts with the most knowledge about the activities where the system will be integrated (Bratteteig *et al.*, 2012). Within this learning space, participants can also acquire knowledge about complex technologies and engage in speculative activities to explore their interests collaboratively. In this research, as the participants in Stage 1 worked in a small group, they had a secure space to discuss their ideas, thoughts, and experiences for speculating. As the future is not defined, the participants had to fill that space with their imagination based on their previous experiences and existing knowledge. Potentially, this space can be extended by involving technology experts and policymakers with the public.

Third, in connection with the second point, speculations in group dynamics can be helpful to bring collectiveness. According to Balcom Raleigh and Heinonen (2019), collective speculations enable participants to better imagine uncertain futures by understanding others' diverse viewpoints and knowledge sources by working as groups. This process allows the individuals to foster critical thinking and creativity. In the group aspect, it generates a wide scope of ideas and increases the considerations of the people influenced by the discussed ideas. Including diverse perspectives can ultimately facilitate more inclusive decision-making and innovative solutions. Also, collective imagining unveils possible yet unclear futures and offers fresh views beyond the constraints of current understanding and technologies (Balcom Raleigh and Heinonen, 2019).

Based on the abovementioned values, the researcher states that collective speculations are valuable exercises for places and placemaking practices. The exercises enable one to explore multiple views from people in the place, create a comprehensive picture of people with this exploration and then make better decisions for the place. In literature (**Chapter 4**), places influence individuals to construct a way of understanding the world and emotions and also allow them to communicate and socialise with others. Thus, when they engage in the process of speculation and imagination about the place, they can have an opportunity to include their insights, lived experiences and expertise in building speculative futures. Also, during the discussions, they can understand others' perspectives and discover overlooked communities or issues. Eventually, this collective process can shape a holistic view of that place. In the context of place-based technology implementation, once technology is integrated into a place, it may lead to unintended consequences on the environment, biodiversity, people, and the economy. Such integration can make it difficult to undo the changes it brings. Therefore, it is essential to invest time and effort through collective speculation in thoughtful decision-making to carefully evaluate technological interventions' potential impacts and benefits by exploring plural views of the place.

11.3. What participants bring to PSD

Based on what was learned from this research, the researcher highlights several prerequisites and considerations for participants before planning and conducting PSD activities. First, PSD requires less professional design skills from participants to create speculative artefacts. The research participants were asked to express and describe their feelings, experiences, and ideas using hands-on tools through writing and drawing. These skills required are not to make objects professionally, such as 3D modelling. The minimum requirements are because PSD aims to leverage participants' lived experiences, understanding and skills to articulate their ideas. Integrating individuals' inputs is essential from the early stage of PSD, which aligns with the primary motivation of participatory to democratise decision-making.

On top of that, individuals' creativity and imagination are necessary in PSD. As discussed in **Parts 2.2.1** and **2.2.2**, design problems are often complicated, so creativity is required to develop innovative solutions. According to Sullivan and Schuh (2015), creative thinking indicates abilities to create ideas, work with uncertainty, use intuition, imagine, connect meaningful insights, and combine them. Middleton (2005) argues that visual illustrations are essential design factors that contribute to constructing a framework for creative solutions. In other words, the nature of design is related to creative thinking, which is used to ideate, deal with ambiguity, make connections, and imagine achieving its goals. Following the model proposed by Farias, Bendor, and Van Eekelen (2022) (**Figure 87**), the creativity element, shared creativity, is featured as one of the participation categories in the collaboration level of PSD. This stage engages actively with non-designers in the early stages of speculative design to turn reflective thinking into shared creativity. In this stage, the participants can employ their creativity and share it to think about different possibilities, such as brainstorming. Eventually, shared creativity enables non-designer participants to be empowered with increased agency.

Moreover, creativity and imagination are closely related. Both are often considered similar abilities of humans. However, according to Manu (2006), the district difference is that creativity is the ability to create innovative solutions by using existing resources, while imagination is to conceive new solutions that are unnecessary with pre-existing foundations. Imagination is vital in solving problems, designing, and planning (Kind, 2020). Although PSD does not aim to develop solutions, imagination is a significant element of PSD in speculating the near future, which has not yet happened. For example, speculative prototyping requires participants' imagination to assume non-existent technology and its experiences.

Critical thinking is necessary from participants as the concept of PSD is rooted in critical and speculative design. As argued by Malpass (2013), essential critical design examines how hypothetical design outputs would influence and challenge the dominant social, cultural and ethical contexts. Critical designers employ the practice of investigating broad contexts to analyse designed concepts and artefacts critically. The design outputs are often presented as fictional scenarios or objects to help people reflect and explore the potential consequences. Showing them results in discomfort to viewers, blurring the line between reality and fiction. Based on critical design practices, PSD requires participants to think critically to challenge their prototypes and build critiques of them. Criticism as constructive feedback is crucial in PSD to open the spaces for other views and to examine overlooked scenarios such as ethical considerations, potential risks, and weaknesses. Furthermore, through critical thinking, participants can obtain an in-depth understanding of the speculation context, such as technology implementation in this research context. They can have an opportunity to investigate what technology can do and how it can impact the broader range of society, culture, and ethics.

Apart from an individual's skills and experience, notably, the level of willingness among participants to engage in speculative thinking played a significant role in shaping the outputs of PSD activities. For instance, in Stage 1 of this primary research, the researcher observed that when the group members were less motivated or did not actively engage, the group produced fewer ideas or less relevant ideas compared to groups with higher motivation. The individuals' motivation to participate is a potential challenge for PSD facilitators. The facilitators should pay particular attention to crafting prompts and approaches for participants to motivate or recruit them with the willingness to be involved.

11.4. Can individuals be trained for PSD?

The abovementioned elements prompt the fundamental question of whether an individual can be trained to practice critical and speculative design practices. Based on the findings and observations throughout the research process, The researcher argues that people can learn and acquire skills and practices relevant to PSD, such as creativity and imagination.

As explored above, creativity is a vital ability in the field of design and PSD. According to Buchanan (2001), although creativity is often considered a natural talent, it can be practised and fostered through education. Cooper and Press (1995) argue that design students should be encouraged to seek inspiration from diverse sources, test ideas, develop solutions and be open to failures. Creativity in design enables designers to connect different skills and utilise them effectively. Imagination can also be viewed as a trainable skill, a crucial aspect of PSD to speculate futures. Kind (2020) argues that an individual with a high level of imagination can perform beyond the standard level of performance in an activity. In her argument, individuals with an allocated task become skilful, reaching maximum performance as they work and train. However, skilled individuals can improve their performance by practising imaginative capabilities. Furthermore, imagination is related to human mental processes such as daydreaming, immersing themselves in fiction or experiments, and empathising with other's emotions and opinions. Therefore, individuals can be trained for speculative design practices while utilising their creativity and imagination to experiment, test their ideas, and create fictional stories and objects. The objective of the exercises is to provoke debates and discussions rather than develop novel solutions. The practices can contribute to a more thoughtful and meaningful approach to placemaking and policymaking connecting with the objectives of PSD.

Despite agreeing with the argument that individual motivations and willingness are essential for PSD, the limitation is acknowledged, which is their desires and attitudes may not be trainable. However, the research argues that setting the atmosphere and environment is essential for speculative activities. Similar to the training context, continuous exposure of speculative activities to the public can improve awareness of the transition and related issues. At this point, the value of the PSD approach is to generate the space for experiential learning and raise awareness of technology that does not yet exist. During the workshops, the participants actively connected and combined their experiences and imaginations for the future. This process allowed participants to understand and be aware of issues around connected technology. Demonstrating an example of the existing bin with a sensor was a starting point to encourage and involve speculation. The researcher observed that the students paid more attention at that moment than before. Several students also commented that they were surprised by the example and realised the changes were already happening in their ordinary place. They stated that the speculative process helped them become more aware of technology and its issues. This reflection indicates that the public may not notice or be aware of technology implementations in public spaces without efforts from technology practitioners, policymakers, and urban planners.

11.5. The roles of designers and researchers in PSD

In this PSD research, the researcher adopted more dynamic and flexible roles than speculative designers. In conventional speculative design practices, researchers or speculative designers observe conversations and discussions of participants after provocations. However, this research reveals that multiple roles emerged in organising activities and encouraging and interacting with the participants at the beginning of speculative design. The following demonstrates the diverse roles played by the researcher throughout the study and discusses the requirements for researchers and designers in PSD. **Table 57** shows the various roles the researcher has played throughout the research from Stage 1 to Stage 3.

Stage	Activity	Level of collaboration with the participants	Researcher's detected role	Tasks
Pre-PSD Stage 1	Workshops 1 & 2		Researcher	• Researched about the contexts
			Speculative designer	• Defined the scope of futuring • Defined the contexts • Defined the challenges • Defined the participants
During PSD Stage 1		Shared authorship and creativity	Facilitator	• Introduce contexts and challenges • Interact with participants • Promote participants with questions • Challenge participants about their designs
After PSD Stage 1/ Pre-PSD Stage 2	Exhibitions 1 & 2		Speculative designer	• Selected ideas • Merged some similar ideas • Supplemented descriptions
			Graphic designer	• Designed posters and promotional materials • Collaborated with the 3D artist
			Curator	• Curate an exhibition • Communicate with external partners to organise
			Brand manager	• Develop marketing strategy how to promote
During PSD Stage 2		Generative reflection	Observers	• Observed how the visitors reacted to the exhibited items • Interact with the visitors

Table 57. *The multiple roles of the researcher in this research*

In the preparation stage, the researcher primarily examined the context for speculation. In this research, she conducted a literature review to explore the opportunities and challenges related to 4IR and connected places. This exploration became a foundation for formulating PSD activities and prompts. This **researcher's** role may still be needed in traditional speculative design, or research outputs as a source of inspiration would be required for speculative designers. Then, the role of the **speculative designer**, which is slightly different from traditional speculative design practices in the PSD context, is highlighted. The role was minimised at this point compared to the conventional speculative designers. This role is featured to set boundaries for speculation, such as defining future scope, contexts, and design challenges. For instance, as a speculative designer, the researcher suggested that participants speculate ten years ahead and consider the context of connected places and challenges related to the policy. The inputs provided by the designer could influence the participants' experiences and the outcome of prototyping activities.

During the workshops in Stage 1, the researcher played the role of **facilitator** to encourage participants to assume they were designers and to create shared authorship by letting them work together. The facilitator presented the contexts and challenges of the workshop based on the result of the pre-PSD stage. It included the real-world example of the bin with sensors in Market Square, Lancaster. By presenting the actual case, she could draw more attention from the participants and even observe their reactions to shocks and surprises. During the activities, the facilitator walked around the tables to engage with the participants by asking them to explain their ideas and sometimes prompting challenging questions to promote critical thinking. She had to observe them to catch moments when participants seemed lost and unclear with the activity. This observation allowed her to intervene and suggest alternative perspectives and approaches the participants would not take into account.

After Stage 1, a graphic designer was needed to work with an external 3D artist. The collaboration with the artist was to refine the outputs of Stage 1 workshops. The researcher selected the prototypes that would be exhibited and iterated them into the exhibition format, such as posters and 3D-printed models. The support of the 3D artist was essential in this process to produce a 3D model of each prototype based on the storyboards. His imagination and 3D modelling skills also led to the different interpretations of the prototypes. For example, the idea of Dr Pigeon was initially described as an organic form; however, it was visualised as a futuristic drone shape in this process. As a result of Stage 1, 22 prototypes were developed, and each prototype included two storyboards describing both positive and negative scenarios. Out of these, six prototypes were chosen based on selection criteria: whether the students gave consent to the researcher and whether it illustrated multiple devices and systems. Similar ideas, such as the Smart Bin idea, were merged to reinforce the contents of the prototypes. This task of selecting items for the exhibitions is combined with the responsibilities of a curator, which will be discussed further in the following explanation.

The role of **curator** was required to plan public exhibitions. It was crucial to define the exhibitions' locations, time, audiences, and contents. In this research, the researcher, as curator, decided to present a single public space out of four, Dalton Square. Focusing on one public space was with the consideration of simplifying information for visitors. This square was selected because several participants described it as having various activities and events. The space has been utilised for different purposes, such as holding local farmers' markets during the pandemic and installing ice-staking rinks during winter. This versatile space use could help audiences imagine other occasions in place. Another decision the curator made was to refine the prototypes in a more accessible and inclusive manner. For instance, the outputs of Stage 1 were on the hands-on materials. So, the handwriting of the participants needed to be digitalised to improve readability. In addition, terminology was carefully chosen, and technological features were described in plain language. For instance, instead of IoTs or connected places, the term *smart* was used in the exhibition title and descriptions, even though it is still ambiguous and might be familiar to the public. Also, the curator designed a journey of the exhibitions, deciding how to unpack the background and story and in which order would follow to present the prototypes to audiences. It was essential to reflect on the audience's position, what type of information they would expect, and how they would perceive it.

Furthermore, during this stage, the researcher acted as a **brand manager**, considering the exhibition a brand and planning marketing strategies to prompt the events. The responsibilities encompassed understanding the exhibition theme and items and developing a colour scheme and a logo reflecting the understanding. Setting strategies to promote the events was crucial, including selecting channels and platforms. These events were promoted via social media, such as Twitter on the university library account and the Imagination Research Centre on Twitter, a blog post on the Imagination website, and printed posters and postcards. Applying for the ESRC Festival of Social Science was another strategy that offered national promotion. These efforts involved multiple visitors who had found the exhibitions in different channels.

During the exhibitions in Stage 2, the visitors participated in generative reflection (**Figure 87**), in which they responded to speculative prototypes and provided feedback, while the researcher remained an **observer**. She carefully monitored and recorded how the visitors reacted and interacted with the prototypes and tools. The visitors' behaviours varied towards the tools and the exhibited items. For instance, some were happy to write their comments, while others preferred to read the posters and other's comments. Their diverse opinions led the researcher to gain meaningful insights into the different perspectives and potential to be considered before technology implementation. PSD practitioners and researchers should consider multiple and effective ways of capturing their responses. On some occasions, the researcher was more than an observer with an opportunity to explain the objectives of the exhibitions to the visitors, like an elevator pitch. This explanation from the researcher could influence the audiences, guiding their attention towards the purpose of speculations and raising awareness of the related issues. Thus, researchers and designers who plan PSD activities should be well-prepared for their presentations and be open to interacting with the public instead of remaining a sole observer.

The role transition presented in this research reflects on Chopra *et al.*'s (2022) claim that designers and researchers still play a valid role in shaping the PSD process even though the role of designing speculative artefacts is passed on to the participants. By adding to their argument, the research argues that diverse roles can emerge in the PSD processes during the study more than an observer, and they can influence the result of the activities, such as the interpretation of 3D artists and selection criteria of the research. Thus, designers and researchers should reflect on the positionality before and after PSD activities. This reflection considers the research team members' backgrounds, positionalities, community relationships, and contextual and cultural understandings. Such considerations can ensure flexibility for the PSD planners to respond critically and thoughtfully to the roles, responsibilities, and risks of their role or previous position as experts, which could influence the outputs (Chopra *et al.*, 2022; Light and Akama, 2012).

11.6. Identifying who should be involved in PSD

As suggested in sociotechnical imaginary studies, smart cities are often considered sociotechnical imaginary, presenting a desirable vision offered by technology and science. The initiatives of the imaginary are facilitated through the formulation and implementation of policies and regulations. Sadowski and Bendor (2019) argued here that it should be examined the beneficiaries of smart city initiatives because these initiatives may favour particular groups. This argument led to the question in this research about who should be involved in the discussions and the shaping of the collective vision throughout the process.

Similarly, in the literature regarding speculative design, there is a continuous discussion regarding who the agency is of projecting speculations. In particular, applying the famous diagram, the futures cone, casts doubt on its applicability in dynamic and contextual realities. The limited scope of the starting point in the cone is criticised by Tonkinwise (2014). He points out the assumption behind the cone, which is a single point in time placed at the apex of the cone. However, people are individuals placed in different places rather than a single point. Coulton, Burnett and Gradinar (2016) suggest extending the futures cone by including the realm of the past. They argue that speculative designers should continuously explore what desirable is rather than relying on the exclusive focal point of the design process from the cone. Dunne and Raby (2013) argue that a preferable future should be defined by groups ranging from companies, cities and societies. These arguments demonstrate the need for collectiveness and collaboration in designing artefacts, stories, and futures to reflect people's desires and aspirations.

By reflecting on both aspects of sociotechnical imaginary and speculative design, the researcher states that PSD is a suitable approach to comprehensively understand preferable futures by involving more participants. In particular, Simon's (1996) definition of design is: *"Everybody designs who devises courses of action aimed at changing existing situations into preferred ones."* Design is a fundamental human skill. At the same time, the term *preferred ones* indicate that a particular group of individuals continuously require and desire to make changes through design. The question of who the group is still relevant to be asked approaching PSD. In the realm of PSD, individuals are considered designers with lived experiences and the capability to transform existing situations into preferred ones. This approach highlights that design is not limited to a few professionals but can be an inclusive process involving various lived experiences.

In the context of a place, it is essential to acknowledge that places, particularly public spaces, are reflected in individuals' worldviews and emotional connections. They are also social spaces that promote activities among people and form communities there. Thus, engaging with residents in a place is valuable input for PSD to understand the dynamic and complex nature of the place. This call for engagement is not only because of their lived experiences but also their desires and visions, which can contribute to discussions for the place's future. In Stage 1 of the primary research, although the participants were limited to the students who may not be professionals, their perspectives towards the place generated intriguing prototypes, leading to interesting and meaningful conversations in Stages 2 and 3. The student involvement was still valuable in representing the city's often overlooked and invisible population. Notably, the first group of students with international backgrounds could produce prototypes, which led to rich discussions even though they had fewer living experiences in the city. Therefore, planning PSD should ensure the recruitment of a wide range of individuals to inform policymaking by revealing aspects that policymakers, researchers, and designers may have overlooked.

11.7. Exploring multiple approaches to engaging people in PSD

To embrace inclusivity and diversity in speculative design processes, PSD requires multiple approaches to interact with various participants. The researcher faced several challenges in conducting this research by involving and interacting with the participants. In particular, in the stage of designing speculative prototypes of Stage 1, the researcher, as a facilitator, observed some participants' fear regarding the skill of designing and prototyping speculative artefacts. The participants took a passive attitude when drawing storyboards because they believed they did not have enough skills to draw or express themselves. The challenge in this regard may vary when involving broader and more diverse members of communities. In Stage 3, the policymakers faced the challenge of imagining or speculating what emerged from their professional positions. They stated that it is difficult for them not to think about relevant regulations and rules within the

Councils when imagining and ideating future technologies. These insights indicate the need to consider appropriate facilitation strategies when engaging the public in the early stage of speculative design to encourage their imagination and ideation.

Moreover, the incorporation of diversity is necessary not only in the design of speculative prototypes but also in the process of recruiting participants and engaging with them. Moving to Stage 2, which engaged with a broader range of participants, the researcher had to plan how to reach audiences for the public exhibitions carefully. The considerations included deciding suitable venues and dates, providing a provocative and intriguing description of the events and using multiple channels to promote the events, such as utilising social media and making printed materials. For instance, Exhibition 2 attempted to reach a broader range of audiences beyond the university communities. It was scheduled during the half-term break, expecting more family visitors with children. Also, it was held between Wednesday and Thursday because there is a local farmers' market in front of the venue every Wednesday, so increased footfall was expected in the city centre. These efforts attracted numerous visitors and collected diverse participants' responses, including insights not featured in Exhibition 1.

In general, during the exhibitions, when showcasing the prototypes, several occasions arose to capture a diverse range of individual responses effectively. As described earlier, participants had different behaviours when interacting and engaging in the event. Some visitors preferably had conversations with the researcher, while another group was happy to write comments. Others just looked at the prototypes without leaving any comments. In Exhibition 2, a wide range of age groups was successfully recruited, involving children and older adults, unlike Exhibition 1, which engaged with university students and workers. The researcher observed the varying interactions of the hands-on tools, such as posters and 3D printed models, based on the age groups. For instance, the storyboards were helpful for children to understand as their parents could read the stories and ask their opinions. Along with the posters, 3D-printed models captured their attention, allowing them to touch and visualise the placement of futuristic technology. However, interestingly, the absence of the prototype, Nanobots, also helped them understand the molecular scale. In addition, elderly visitors were less interested in writing their comments on sticky notes but preferred having conversations. Based on these observed interactions, the researcher highlights that PSD planners should consider multiple ways of interaction to capture diverse insights from participants.

11.8. The synergy of adopting a place-based approach in PSD

The incorporation of PSD and place-based approaches demonstrates a mutually beneficial connection. From the literature, it is essential to embed collectiveness and collaboration in placemaking for public spaces. In particular, during the discussion with the policymaker in Stage 3, it was featured that diverse stakeholders share responsibilities and ownership of public spaces. This is why policymakers should be flexible and open to collecting and examining public opinions before implementing changes. The participants discussed the challenge that arose from the ambiguity of ownership and the different levels of attachment people have toward public space. As explored in Chapter 4, public spaces are considered a third place where people spend less time compared to their homes or workplaces. This characteristic contributes to forming various degrees of ownership, which can result in unexpected issues.

This study observed the potential opportunity for PSD methods regarding the challenge of ambiguous ownership and varying place attachment. For instance, place mapping and speculative prototyping could gather individuals' experiences and feelings within a particular place. By understanding a holistic picture of the site, policymakers and place managers can develop tailored solutions that address local issues. In the workshops in Stage 1, participants' experiences, emotions, and observations were essential to develop ideas relevant to the ongoing problems in the place. For instance, the concept of the Smart Light prototype developed in Workshop 1 represented the participants' emotions toward the area. They described the site as too dark to feel safe at night, so their feeling led to the proposal of smart lighting to enhance safety. In the exhibitions, some visitors agreed with this idea, acknowledging its benefit on women's safety at night. As this example shows, the speculation and development of prototypes concerning a particular place are highlighted as reflective and relevant to individuals' experiences and needs of that place.

The research tested the relevance between place identities and speculative prototypes from Workshops 1 and 2 in Stage 1. When the researcher selected six prototypes for the exhibitions in Stage 2, some ideas were relocated to Dalton Square, although they were designed for other places. This change allowed the researcher to evaluate to which extent the prototypes aligned with the place identities. As examined with the concept of Smart Mirror, the visitors strongly disagreed with the technology, considering it inappropriate to harm the place identity of Dalton Square, a historical area rather than a business district. Interestingly, this concept was initially designed for Market Square, surrounded by local shops and restaurants. The responses differed on whether this concept had been presented in a high street area. On the contrary, the Smart Statue, designed for Dalton Square, was selected as the most desirable technology. The visitors expressed their excitement about this prototype with the expectation of meeting their needs to know more about the place and its local history. They also expected that this interactive statue would reshape Dalton Square's identity to be more attractive to visit and even educational for children.

This research also discovered that in addition to the place identity and experiences, individuals' emotional attachment can influence planning, designing, and maintaining public spaces. The observations from Stage 3, precisely the speculative brainstorming exercise, indicate that the policymaker participants as residents encountered challenges in generating innovative ideas because of their strong emotional attachment to Dalton Square. It was rooted in their memories and experiences, making it difficult to envision any changes to the place. Interestingly, in responding to the attachment, one participant suggested the creation of an anti-technology area, representing a contrasting approach to implementing technological advancements.

Based on this finding, the researcher argues that applying the notion of place as a foundation enables participants to identify local issues and needs through their lived experiences and emotions in the place. Understanding a place through the dwellers is a starting point for developing more inclusive, democratic, and bottom-up approaches, unlike adopting top-down and generic approaches from the central governments. As empathised in literature, each place is characterised by distinctive identities formed by geographic features, history, heritages, people and their current practices and cultures. Ignoring these diverse elements of the place leads to the failure to respond to the needs and develop suitable policies for a place. Instead, it would cause more wicked problems, mainly caused by digital technology's imperceptible and invisible nature. Thus, the researcher claims PSD is a valid approach in policymaking that includes diverse voices from the residents and understands multifaceted elements of place. Integrating place-based processes requires engaging in speculative prototyping specific to a particular place. This holistic approach enables the inclusion of diverse perspectives in speculative prototyping to emerge from the geography, culture, local history and lived experiences of the residents in that place.

11.9. Understanding the relevance of PSD in policymaking

This research's workshops and public exhibitions reveal that the PSD approaches offer an opportunity to collect public responses and build a comprehensive picture of technology implementation. The importance of PSD activities is highlighted to provide a creative way of engaging with the public. For instance, Exhibition 2 engaged several participants with children, allowing them to learn about technology and express their opinions. This experience can make the young participants more interested in the area and involved in policymaking. Thus, the researcher claims that these creative means can be more advantageous than traditional consultation approaches that tend to ask listed questions to community members.

The researcher also argues for the potential of PSD in policymaking as a way of communication and collaboration within organisations. During Workshop 3, the policymakers acknowledged the complex and contextual nature of policymaking processes, which are like a black box and difficult to explain in plain language. A valuable participant insight was articulated by speculating alternative scenarios of the prototypes. When the Workshop 3 participants compared two prototypes of installing the Smart Statue and sensors in a bin in Dalton Square, they reflected the level of controversy and complexity depending on whether personal data was collected. This insight proves that speculative prototypes contribute to reflecting on their practices and judgement criteria in policymaking.

The participants indicated this complexity also emerges from current organisational cultures and policymaking practices. Dealing with this black box requires flexible collaborations among departments. With the challenge of Smart Statue, the participants anticipated several departments they might need to work with together, such as Planning Policy, Public Realm, Legal Service, Information Government, and Art and Culture departments. They also revealed that several tasks must be considered during policymaking, such as obtaining planning permissions, checking ownerships, assessing building classifications, collecting information and recommendations, and delivering reports to support decision-making. Feedback management and continuous evaluation are essential in the stage of after-policymaking. These tasks are highly relevant to the nature of complex policymaking, and they require thorough considerations from policymakers and officers to ensure effective policy implementation.

Fostering PSD practices in public organisations can improve communication by visualising and materialising conceptual technologies. This approach can help policymakers better understand technologies and their impact on the public, even when some speculations are unlikely to be realised. The participants considered it can be helpful for policy writers to understand multiple scenarios they have to consider by speculating alternatives with other departments and creating visual outputs to share with them. Regarding public engagement and communication, the participants stated that PSD would be valuable in approaching the public more playfully and creatively. PSD activities can encourage individuals to introduce new technology and to involve various age groups of the public in policy planning.

To summarise, introducing PSD to policymakers can be an opportunity to tackle the challenges they currently face, such as engaging the public and keeping informed of advanced technologies. This research presents the potential of PSD, enabling one to envision and prepare for future possibilities caused by emerging technology while communicating with other departments within the organisation visually and inviting a wider group of the public. By leading to public engagement and speculation, PSD promises to formulate more inclusive policies to shape better public spaces utilising digital technology.

11.10. Summary of Chapter 11

This chapter has unpacked nine points based on the findings from previous chapters. This research is positioned in collaboration level of engagement from the model defined by Farias, Bendor, and Van Eekelen (2022). Thus, the nine points reflected in the participation range from shared authorship, shared creativity, and generative reflections. They cover the need for collectiveness, the significance of speculation in place, necessary elements from participants, trainability of participants, diverse roles that emerged in PSD, range of participants, various approaches to engage, incorporation of placed-based approach and the relevance of PSD in policymaking.

The findings mentioned previously indicate the value of PSD, showcasing its suitability in dealing with challenges and wicked problems arising from 4IR technologies in places. Moreover, they illustrate the effectiveness of participant involvement in the stage of speculation and provocation and designing speculative prototypes. Significantly, participants' inputs, such as creativity, imagination, and critical thinking, are valuable in PSD and linked with their lived experiences and needs in places. On the practical side, PSD requires multiple roles to run several activities, which can also influence diverse approaches to engage with a wide range of participants. As previously discussed, the results indicate that the concept of PSD is crucial in effectively navigating the intricacies of contemporary technical and social landscapes. In particular, it revealed the potential for policymakers to enhance public engagement and communication within an organisation.

Based on this discussion, the following chapter will conclude by addressing the research question, providing a summary and reflection on the findings, and suggestions for future research.

12. Conclusion

The study aimed to identify how individuals without speculative design or technological expertise can speculate and design the future of public spaces in the context of connected places. The vision of connected places here is near-future technology, which will likely be realised as part of the Fourth Industrial Revolution but has yet to be there, like a *never-seen elephant*. With this aim of the research, the researcher formulated the main research question:

- *How can non-design or non-technology experts participate in speculating and designing the future of digitally connected public spaces?*

Based on the main research question, the sub-research questions were as follows:

- *How can speculative design processes be utilised to involve the members of the public?*
- *How can collective insights into place and technology be used to inform policymakers?*

For the first sub-research question, this study revealed that several speculative design practices with participatory settings, including PSD, have been identified through the literature review presented in Chapter 2. This finding resulted in this study employing PSD, demonstrated in Chapters 7 to 8. This study demonstrated that PSD is a valuable approach for engaging non-experts to highlight the current value of lived experience and overlooked challenges and create meaningful dialogues regarding the place and emerging technologies. Concerning the second sub-question, this study discovered evidence from the literature review presented in Chapters 3 and 4 regarding the challenges of adopting the 4IR, understanding places for policymakers, and the requirements of imagination and collectiveness towards the obstacles. Then, the question was addressed in this research through Stage 3, demonstrated in Chapter 9 by revealing the values of PSD in policymaking from the discussion with local policymakers.

This research utilised PSD as a communal space for people to gather and share their insights and imagination around near-future technology (*the never-seen elephant*) and possible scenarios. This research revealed that understanding a place requires collectiveness from people, and drawing their observations, experiences, and emotions can complete a comprehensive view of a place. Moreover, the results of this research indicate that technology's advantages and disadvantages can be imagined and interpreted in various ways. While PSD can be helpful to foster critical thinking and awareness of emerging technology and create a mutual learning space, it significantly benefits from participants' insights. The contributions include critical thinking, imagination, and creativity connected to their personal and spatial experiences. Thus, planning PSD requires careful consideration of the requirements of participants. Furthermore, this research unveiled that the nature of policymaking is context-based, which causes complexity in the process. At this point, PSD is recognised by policymakers as a valuable means to understand the context, enhance internal communication and foster public engagement in urgent and intricate topics.

Contributions to knowledge

This thesis has demonstrated PSD as a novel approach to engaging with individuals without expertise, assisting them in understanding near-future technology and sharing their imagination through materialising it. This approach supplements the current criticism of conventual critical and speculative design practices and top-down approaches regarding implementing connected places initiatives. By inviting broader audiences to the creation of speculative prototypes and the discussion, this thesis has presented the possibility of collaboratively created prototypes, which could provoke a wide range of topics and issues in discussions, later recognised as valuable inputs for policymakers. Thus, this thesis highlights the significance of bringing collectiveness to address wicked problems raised by technology and the synergy of applying place-based approaches in PSD to create a holistic view of a place. Moreover, this thesis contributes to demonstrating the benefits and opportunities of PSD in policymaking. This research developed and tested a new PSD process and method that is a valuable approach in policymaking. The study discovered that PSD can be useful for policymakers, especially early in and throughout the policymaking process. Since there is an ongoing challenge for policymakers to engage with young populations in their consultation, PSD is potentially a creative engagement approach to communicate with the public. PSD is especially helpful for them raising awareness of urgent areas of technology implementation. In addition, as a visualisation practice, PSD can be beneficial in visualising conceptual speculation, ideas, and processes in policymaking, which is helpful for policymakers to understand.

This thesis has also contributed to identifying several challenges PSD faces in its larger-scale implementation. The scope of recruitment should be considered to generate more inclusive but more diverse scenarios of the future to reflect on a place and their lives, including invisible values, overlooked issues and upcoming challenges driven by emerging technology. However, managing the relationships and expectations of participants can be challenging for PSD planners on a larger scale of implementation. In the practical aspect, many responsibilities are required to carry out the process of PSD effectively, including those of a traditional designer, brand manager, curator, and facilitator. These diverse positions might be financially challenging to put together the PSD team and promote teamwork to maximise PSD's outputs. Moreover, in reality, for policymakers, adopting PSD may be difficult due to their limited finances and lack of staff.

Limitations and suggestions for further research

This investigation was limited because the doctoral research was initiated at the beginning of the COVID-19 pandemic. The COVID-19 restrictions influenced the research design and limited the recruitment of the participants. In particular, university students were the only participants in Stage 1 of the primary research, which was the core of the PSD process, enabling participants to speculate different scenarios and prototypes that became the inputs of the further stages. The researcher argues that the recruitment in the speculative prototyping workshops is still valid for discussing non-experts' involvement in speculative design practices. However, she also acknowledges that its scope is restricted to reflecting the general public's desires, wishes, and fears in imagining different scenarios about the future of public spaces with digital influence. Moreover, the discussion with policymakers in Stage 3 did not involve the views of policymakers from diverse departments who might have different points of view on PSD.

In order to enhance understanding of the implications of PSD, further research should engage with a diverse range of communities and policymakers and investigate how the contributions from these groups impact the PSD process and its outputs and further explore how and where PSD can contribute to policymaking to build a better future.

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Appendix

Publications

Cooper, R., Mullagh, L., Jacobs, N. and **Kwon, N.** (2023) UNITED KINGDOM: A Case Study of Lancaster. In: Cities Under COVID-19: A Systems Perspective. Springer. pp. 219–233.

Jacobs, N.J., **Kwon, N.** and Mullagh, L. (2022) CREATIVE DESIGN METHODS FOR IOT DATA ETHICS IN HYBRID SPACES. AoIR Selected Papers of Internet Research.

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Participant information sheet

Collaborative speculations for placemaking and future places

For further information about how Lancaster University processes personal data for research purposes and your data rights please visit our webpage: www.lancaster.ac.uk/research/data-protection

I am a PhD student at Lancaster University in Design, and I would like to invite you to take part in a research study about collaborative speculative design for future places in Lancaster. Please take time to read the following information carefully before deciding whether or not you wish to take part.

What is the study about?

This study explores how design can enable communities to understand the impact of the fourth industrial revolution (4IR) in public places and how speculative design can be used by the public to prototype future sites collaboratively.

Why have I been invited?

I have approached you because I am trying to understand how students studying design can speculate about near futures. You have been invited as you are a student on LICA420 Research Methods; your experiences and knowledge of design can offer essential insights for this research. I would be very grateful if you would agree to take part in this study.

What will I be asked to do if I take part?

Before the workshop: You will be asked to fill in a short questionnaire of connected environments. The questionnaire aims to assess how much you know about sensor technologies and the Internet of Things (IoT). The outcomes of the questionnaire will be used to design further details of the workshop.

This will take place during the week 8 Seminar. I would like to use what you produce during the seminar and your forum task.

After the workshop: If you consent, your final prototype (narrative or storyboard) and the description from the forum task may be showcased in a public exhibition, the following research project stage, to collect the public's responses.

What are the possible benefits from taking part?

You will not get any personal benefits from this research.

Do I have to take part?

As the workshops designed with the module convenor will be integrated with the university curriculum, you will not be able to withdraw from the activities as these are part of your learning experience. However, you can decide not to share your data (i.e., drawings and notes). If you choose not to share your data, this will not affect your studies and how you are assessed on your course.

What if I do not want to take part?

If you decide not to participate in the exhibition, you can still participate in the workshop for your learning session, but the researcher will not collect their data. That also means your prototypes will not be photographed nor collected for the exhibition. If you decide not to take part, it will not negatively affect your assessment for the course.

What if I change my mind?

If you change your mind, you are free to withdraw at any time during your participation in this study. If you want to withdraw, please let me know, and I will extract any ideas or information (=data) you contributed to the study and destroy them. However, it is difficult and often impossible to take out data from one specific participant when this has already been anonymised or pooled together with other people's data. Therefore, you can only withdraw up to six weeks after taking part in the study. Also, if you decide to withdraw your data, it will not negatively affect your assessment for the course.

What are the possible disadvantages and risks of taking part?

It is unlikely that there will be any significant disadvantages to taking part.

Will my data be identifiable?

After the workshop, only I, the researcher conducting this study, will access the ideas you share with me. I will keep all personal information about you (e.g., your name and other information about you that can identify you) confidential; I will not share it with others. Furthermore, I will remove any personal information from the written record of your contribution. All reasonable steps will be taken to protect the anonymity of the participants involved in this project.

How will we use the information you have shared with us and what will happen to the results of the research study?

I will use the information you have shared with me only in the following ways:

I will use it for research purposes only. This will include my PhD thesis and other publications such as journal articles and conference papers, and I may also present the results of my study at academic conferences and share them with policymakers to inform future policy areas.

The workshop outcomes will be presented in a public exhibition in Lancaster. The final artefacts you created during the workshop will be anonymised. However, if you consent, your name will be shown as a list of students who participated in the project. I will ask your permission to get your name associated with the exhibition.

How my data will be stored

Your data will be stored in encrypted files (that is no-one other than me, the researcher will be able to access them) and on password-protected computers. I will store hard copies of any data securely in locked cabinets in my office. I will keep data that can identify you separately from non-personal information (e.g., your views on a specific topic). In accordance with University guidelines, I will keep the data securely for a minimum of ten years.

What if I have a question or concern?
If you have any queries or if you are unhappy with anything that happens concerning your participation in the study, please contact:

Ph.D. Candidate	
Nuri Kwon	**n.kwon1@lancaster.ac.uk**
Supervisors	
Rachel Cooper	**r.cooper@lancaster.ac.uk**
Marianna Cavada	**m.cavada@lancaster.ac.uk**
Naomi Jacobs	**naomi.jacobs@lancaster.ac.uk**

If you have any concerns or complaints that you wish to discuss with a person who is not directly involved in the research, you can also contact: Alan Marsden, Head of Department, Lancaster Institute for the Contemporary Arts, Lancaster University, Lancaster, LA1 4YW, Tel: +44 (0)1524 593246, email: a.marsden@lancaster.ac.uk**.**

This study has been reviewed and approved by the Faculty of Arts and Social Sciences and Lancaster Management School's Research Ethics Committee.

Thank you for considering your participation in this project.

Exihibition Posters

DALTON SQUARE 2032

Beyond the SMART City

BACKGROUND

Would you like to see what the iconic Dalton Square in Lancaster would look like in 2032? This exhibition presents the future of Dalton Square as a **SMART** place, including sensor technology, the Internet of Things, wearable technology, Artificial Intelligence (AI), etc.

The six **SMART** products or services prototypes presented here for Lancaster in 2032 were designed by MA Design Management and BA Architecture students from Lancaster University. The prototypes of products, services, or systems do not exist in the present, but may in the near future. The students designed the objects by imagining, '**what if everything was digitally connected?**' and '**what if everything collected data?**' These imaginary future objects enable us to not only experience the future city of Lancaster as a '**SMART**' place but also to reflect on how **SMART** technology could shape and generate potential issues in our everyday lives.

Throughout the storyboards of each technology created by the students, you will see what these prototypes are, how they work and what might happen if they work differently than expected. Furthermore, they enable you to ask and answer questions about your own views on these technologies.

DESIGNERS

MA Design Managment

Student 1	Yuhan Li
Student 2	Xinmeng Lu
Student 3	Tarunikka Premnath
Student 4	Deng Songying
Student 5	Ruiqi Gao
Student 6	Subhrata Sinha
Student 7	Kate Ashworth
Student 8	Rensu Dong
Student 9	Zhijian Cai
Hester	Yajie Zhong
Mark	Benjamin Slack
Scarlett	

BA Architecutre

Student 1	Priya Handa	Freya Gallagher
Student 2	Tyrese Gayle	James Kerr
Student 3	Kardo Kader	Jayne Devers
Student 4	Ryan Want	Eddie Iroh
Student 5	Anthony Hanoon	Davyd Tolkach
Kai Colemon	Libby Barnes	
Shizah Javed	Jess Cammack	
Daniel Rendina	Callum Sedeman	
Celyn Millington	Megan Smith	
Mark Steven Permision	Anna Grosu	
Enzo Matto	Jack Jeffrey	
Isabella Jones	Sakchhi Bhndari	

Pepe Maron

Huge nerd. Fantasy and science fiction fan. Hobbyist photographer and recently a hobbyist 3D "artist" (if I may use that word). Also exploring AI-generated images (and AI in general). I hope my refrigerator and vacuum cleaner will vouch for me when AI takes over the world.

Nuri Kwon

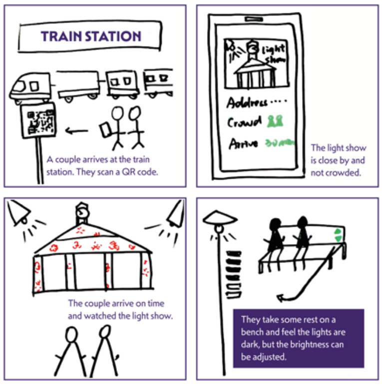
Nuri is a PhD Candidate at ImagainationLancaster, exploring the fourth industrial revolution's technological impact and digital influences on society and public spaces. Her research interest focuses on how to design future connected places utilising speculative design and participatory methods.

01 SMART Light

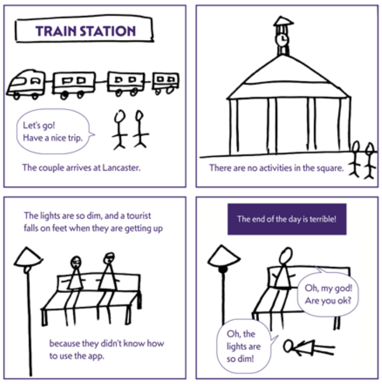
SMART Light is an advanced way to control lights in Dalton Square.

- contains software that **connects to an app** so people can adjust to dim or brighten the light when there are nearby
- has sensors that identify day and night so **automatically brighten the lights** according to the time
- **detects the movements of the public** and brightens more when people are nearby

The Story of SMART Light



What if it works DIFFERENTLY than what you expected?



Are you happy to have this technology in Dalton Square?

YES	NO
Could you tell us why you will be happy to have this technology?	What are you concerned about this technology?

What would you like to change/add to this technology?

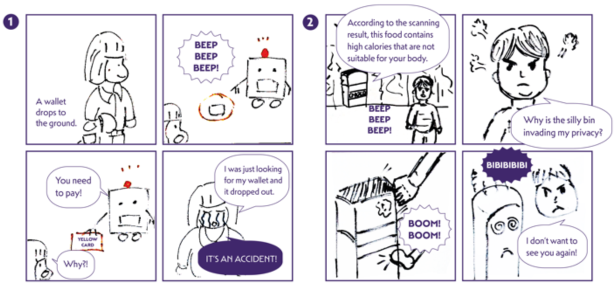
02 SMART Bin

SMART Bin is an intelligent robot to manage waste in Dalton Square.

- provides you **analytic information** based on what you throw it into; for instance, advice on diet and nutrition
- gives **penalties and fines** to people who throw away trash illegally

The Story of SMART Bin

What if it works DIFFERENTLY than what you expected?



Are you happy to have this technology in Dalton Square?

YES	NO
Could you tell us why you will be happy to have this technology?	What are you concerned about this technology?

What would you like to change/add to this technology?

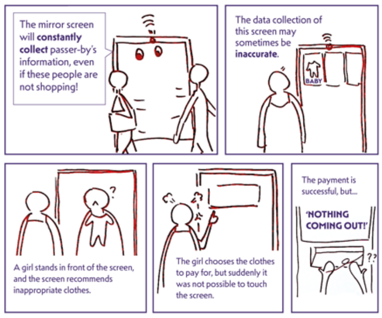
03 SMART Mirror

This **SMART** Mirror might look like a regular mirror but has an electronic display behind the glass.

- **collects information** from a camera, sensors, and your wearable devices and mobile phones
- **analyses your shopping habit and styles** and suggests products
- shows **your reflection with virtual images** of items such as clothing and accessories
- has a touch screen which enables you **to interact with the virtual items**, to check the prices and to purchase the items
- provides **promotions** from local businesses and notifications of local events

The Story of SMART Mirror

What if it works DIFFERENTLY than what you expected?



Are you happy to have this technology in Dalton Square?

YES	NO
Could you tell us why you will be happy to have this technology?	What are you concerned about this technology?

What would you like to change/add to this technology?

04 SMART Statue

This is an interactive **SMART** Statue located in the middle of Dalton Square.

- has a conversation with visitors
- tells you about local history as well as weather, local news, events

The Story of SMART Statue

What if it works DIFFERENTLY than what you expected?

Are you happy to have this technology in Dalton Square?

YES	NO
Could you tell us why you will be happy to have this technology?	What are you concerned about this technology?

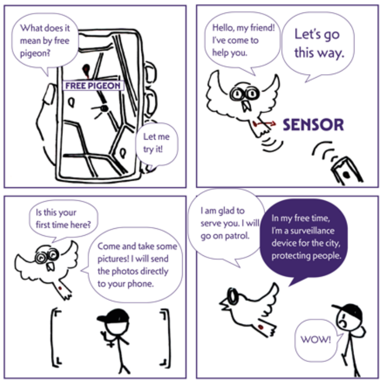
What would you like to change/add to this technology?

05 Dr PIGEON

Dr Pigeon is a drone for surveillance as well as local guide.

- first-time visitors can book Dr Pigeon for a **guided tour**
- **patrols local area** to support local polices
- does not make any noises

The Story of Dr PIGEON



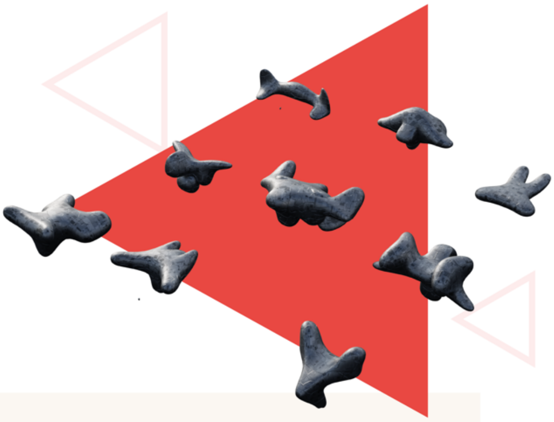
What if it works DIFFERENTLY than what you expected?

Are you happy to have this technology in Dalton Square?

YES	NO
Could you tell us why you will be happy to have this technology?	What are you concerned about this technology?

What would you like to change/add to this technology?

06 NANOBOTS



Nanobots are invisible, working at the molecular scale.

- checks **noise level** in the area and sends the information to the control centre
- **cancels noises in the public space** according to a decision of the control centre

The Story of NANOBOTS

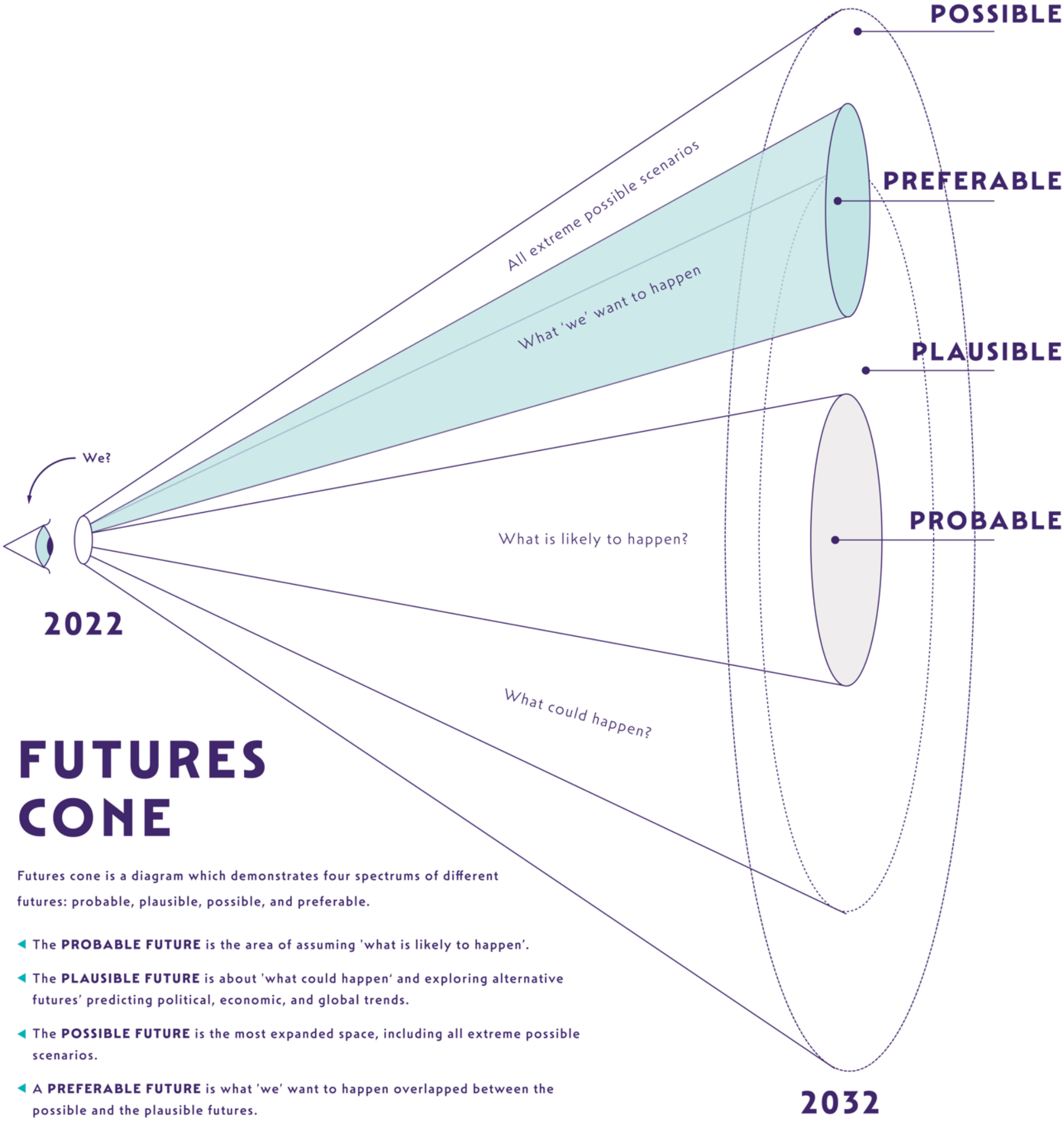
What if it works DIFFERENTLY than what you expected?

Are you happy to have this technology in Dalton Square?

YES	NO
Could you tell us why you will be happy to have this technology?	What are you concerned about this technology?

What would you like to change/add to this technology?

WHAT IS THE MOST PREFERRED TECHNOLOGY FOR DALTON SQUARE IN 2032?



FUTURES CONE

Futures cone is a diagram which demonstrates four spectrums of different futures: probable, plausible, possible, and preferable.

- The **PROBABLE FUTURE** is the area of assuming 'what is likely to happen'.
- The **PLAUSIBLE FUTURE** is about 'what could happen' and exploring alternative futures' predicting political, economic, and global trends.
- The **POSSIBLE FUTURE** is the most expanded space, including all extreme possible scenarios.
- A **PREFERABLE FUTURE** is what 'we' want to happen overlapped between the possible and the plausible futures.

Transcript of Workshop 3

Speaker 1 Participant 1

Speaker 2 Participant 2

Speaker 3 Participant 3

Speaker 4 Facilitator 1

Speaker 5 Facilitator 1

Speaker 6 Facilitator 1

PART 3 STAGE 1---PRE-POLICYMAKING

00:00:01 Speaker 1

That nature, because of the number of houses that run by.

00:00:03 Speaker 1

There. What did they do?

00:00:05 Speaker 1

They built more houses on it.

00:00:07 Speaker 2

So you didn't even take into consideration, yeah.

00:00:11 Speaker 1

You know, and I went to several men give up several of my evenings because I wanted it to be a nice space.

00:00:17 Speaker 1

We were being invited to give our say, which often you're not in developments like that. So I thought it would be a shame if we don't turn up and tell them what we want.

Speaker 2

Exactly

00:00:28 Speaker 1

So whether I assume something changed in the company's circumstances between asking and finishing, because build more houses gives you more money, if that's what they want to do to begin with, what you just done at the one wasting time and money in the consultation and but still.

00:00:42 Speaker 2

But it could have changed that though, wouldn't it? How can we build these houses? Yeah, for you. Can it? Like they could? They could.

00:00:50 Speaker 1

Or who they built what they've built flats and still less space for playground. So they're still getting an income. But you know there, there, there, there could have been other they they just didn't.

00:01:00 Speaker 1

Yeah, I.

00:01:00 Speaker 4

Have a question though, it's a little bit off topic where we are talking about but then you mentioned earlier.

00:01:05 Speaker 4

About the restriction area, is that happening in the pre policy? Prep? Or, yeah. Like what? How?

00:01:12 Speaker 1

You mean like if it's? If it's a A Grade 2 listed structure that you can't change.

00:01:15 Speaker 4

Yeah. When? When is that happening in this timeline?

00:01:20 Speaker 1

Definitely prove with the planning permission. We have planning permission says I would think where they would go. No, you're not.

00:01:28 Speaker 1

I don't really. That's not side of it, but I'm pretty sure it was a grade.

00:01:31 Speaker 1

Two listed building.

00:01:33 Speaker 1

The proves to jump through in terms of planning permission are a lot more. It probably would be for the Council to say, actually, no, that's a Grade 2, so you can't do X.

00:01:47 Speaker 1

Y&Z.

00:01:49 Speaker 1

You have to limit.

00:01:50 Speaker 1

It to.

00:01:50 Speaker 2

This is where we need Susanna.

00:01:51 Speaker 2

And Hardy, who were meant to be like here. There are from planning policy side.

00:01:53 Speaker 1

You can't ask for pre application advice before you put in the planning application and that cost you money because the design. Yeah, you can't put.

00:01:54 Speaker 3

Yes, yeah.

00:02:05 Speaker 1

In a pre application advisory, I'd say we're thinking about doing this. Do you think it would pass?

00:02:10 Speaker 3

I mean, I'm guessing the City Council owns that statue statue.

00:02:15 Speaker 2

Yeah, I think so. The land, yeah.

00:02:17 Speaker 1

But how? How do you pavements?

00:02:21 Speaker 3

Yeah, because that would be the other thing that that's a huge thing, isn't it as well, you know, before you do something, who owns it, you know, because you have to get, first of all, you would have to get regardless of the planning side. If you've gotta get permission off your owns it and then.

00:02:29 Speaker 2

Yeah, yeah.

00:02:35 Speaker 3

If it's a council, that would be.

00:02:38 Speaker 3

You'd assume, then, that it wouldn't be staff that made the decision you assume would be councillors that would, you know.

00:02:45 Speaker 2

Yeah, they would.

00:02:45 Speaker 3

That that more than that.

00:02:45 Speaker 2

They would make a decision. We could only advise.

00:02:48 Speaker 3

Yeah, yeah, absolutely. You know. Yeah, yeah, yeah.

00:02:48 Speaker 1

That's it. That's that's the other thing with any policy we can come up with any sort of idea or recommendation or say this should happen. That should happen.

00:02:58 Speaker 1

in some respect, not, not in every area of work, but in certain areas of work. Planning being one of them, licencing being another.

00:03:02 Speaker 3

Yeah, just.

00:03:06 Speaker 1

Where we just put the report together, our staff who are qualified to know what they're doing right and reward recommend an XY&Z and councillors can go. Yeah, the councillors can just decide they don't agree with what you've said.

00:03:17 Speaker 3

That's that.

00:03:18 Speaker 3

But that's where that consultation come in, cause you'd assume that part of the consultation, the Councils that represent, yes, yeah, you know they will, they will take the views of members of the public, wouldn't they?

00:03:24 Speaker 1

Yes, that area. Yeah, that's that's true. Yeah. You would be asking the councillors and.

00:03:29 Speaker 3

That's it. Yeah, that's it. Yeah.

00:03:32 Speaker 1

Do you think this is likely to pose? Yeah. Do you have any concerns? Yeah.

00:03:33 Speaker 3

Yeah, yeah, yeah. And they'd be putting their opinions through. Yeah. Yeah, yeah, yeah, that's it. It's. Yeah, I I could not be.

00:03:42 Speaker 3

Key place to start is does whoever role on it and there that's that's the starting yeah.

00:03:46 Speaker 1

That's where you need to start. Who owns it? I know.

00:03:48 Speaker 1

Who owns it?

00:03:51 Speaker 2

But I don't know about that.

00:03:53 Speaker 3

Ownership, yeah.

00:03:54 Speaker 3

I mean, we've like Lancaster on ice.

00:03:59 Speaker 1

Ohh yeah yeah the.

00:04:00 Speaker 1

The the I do know the contract.

00:04:02 Speaker 1

It is done by us.

00:04:03 Speaker 3

So maybe we owns it, yeah.

00:04:04 Speaker 1

So maybe probably do most well know of Dalton Square then? Because yeah, the company you know, get attached to the borough who probably put on the ice we it's definitely contract between us and.

00:04:06 Speaker 3

Yeah, yeah.

00:04:11 Speaker 3

Yeah, yeah, yeah.

00:04:13 Speaker 3

Yeah. Yes, it must be. You would've thought the statute be different ownership.

00:04:20 Speaker 3

To the to the rest of the square, but.

00:04:23 Speaker 4

Yeah, interesting. I mean, it's still public space, but we need to think about the ownership in public space exactly.

00:04:28 Speaker 3

Yeah, absolutely. Yeah. Yeah, completely. That's what the councillors do. So. So although technically the public space, I don't know.

00:04:35 Speaker 3

What about politically on the legislation? Stuff, but with it being a public space it is.

00:04:38 Speaker 3

Basically indirectly you can say it's owned by the people Lancaster vote, but what the people in custody they're.

00:04:45 Speaker 3

To councillors to make decisions, you know, to make those calendar decisions, absolutely, yeah.

00:04:49 Speaker 1

If somebody has to maintain in the public space, so it's like Williamson's Park was gifted to the people of Lancaster, but somebody has to maintain that and the City Council's taking that responsibility.

00:04:53 Speaker 3

Yeah, that's it. Yeah, yeah, absolutely, yeah.

00:05:00 Speaker 1

Therefore, you, even though you're a member of the public of Lancaster, you own it, you cannot change anything about Lancaster City councils.

00:05:06 Speaker 3

No, that’s it.

00:05:09 Speaker 1

Yeah, consent, because somebody has to take ownership and management of a public space.

00:05:10 Speaker 3

So yeah.

00:05:13 Speaker 3

Yeah, yeah, absolutely, yeah.

00:05:18 Speaker 1

But did any public space amendments would definitely lead to pre consultation? Wouldn't you know, like, again, if we were to do anything Williamsons park change in any which way.

00:05:27 Speaker 3

You know, I don't know. We plan it is it? Who owns it? Do they have to put the planning permission in or not? I don't know. Yeah. So they so.

00:05:34 Speaker 2

Oh well, no. I keep reading here like the architects, I'm just saying.

DURING POLICYMAKING ---

00:05:36 Speaker 6

I see what you mean. I mean, what happened later here, like, during the policy making, how how is that process?

00:05:37 Speaker 3

Black box, black box? Yeah. I mean, first of all it depends on what conditions were put in place at?

00:05:57 Speaker 3

This point, whether or not you.

00:05:59 Speaker 3

Even get to this.

00:06:00 Speaker 3

Stage, you know whether or not you know after consultation, it said no, we don't want it, you know.

00:06:01 Speaker 1

Well, yeah.

00:06:06 Speaker 3

Yeah, it's sort of.

00:06:08 Speaker 3

I think one will lead one.

00:06:09 Speaker 3

Will lead on from the other one you know.

00:06:11 Speaker 1

I would say you're getting into the more technical legal aspects when you're during policy making. What does existing legislative tell us? We should be doing not be doing? Yeah. Drawing up contracts and ensure that.

00:06:20 Speaker 2

Yeah. OK. Like plan and policy and and public realm because really they would be.

00:06:27 Speaker 2

Working on that.

00:06:31 Speaker 2

Planning policy to put the policy together, but public realm cause they would all be about the maintenance of it and OK.

00:06:39 Speaker 4

So public realms. It's a group of people, very.

00:06:42 Speaker 2

Yes, so they they are the officers that look after all our open spaces. So like the promenade, all the parks, the parks, the like the bins, everything like that

00:06:57 Speaker 1

I would say also then the legal team to advise on contracts and and work.

00:06:59 Speaker 3

Yeah. All right. OK.

00:07:05 Speaker 4

So basically here is more kind of collaborative work within the City Council for probably even beyond.

00:07:09 Speaker 2

I think.

00:07:11 Speaker 2

Yeah, it could be beyond because.

00:07:12 Speaker 1

Could be, yeah.

00:07:14 Speaker 1

In some some respects it depends on what we're doing. Yeah, sometimes the county council

AFTER POLICYMAKING ---

00:07:18 Speaker 3

I think just with it being the statue as well. I just think the interest in it will be.

00:07:26 Speaker 1

Yeah, controversial. You'll you'll find it in the papers on social media if we announce. Will be huge. Controversial.

00:07:26 Speaker 3

Yeah. Yeah. Absolutely. Yeah, absolutely.

00:07:31 Speaker 1

Something like that.

00:07:33 Speaker 1

Everyone be giving their two pennies worth in the main petitions sent in to say, do not touch our queen, you know.

00:07:33 Speaker 3

Yeah, it would be. Well, that's.

00:07:36 Speaker 3

Yeah, yeah, that’s the other thing isn't.

00:07:41 Speaker 3

You know, that's the other thing, if if.

00:07:43 Speaker 3

Sort of like, you know, did go to that.

00:07:46 Speaker 3

You know at that stage you might not even get get much better. You know, it just might be.

00:07:49 Speaker 1

Yeah, it may not go beyond that if there's really, if there's massive public loss of that, that very ideal though.

00:07:52 Speaker 3

Yeah, yeah, yeah.

00:07:58 Speaker 2

I think you guys would be brought into it too, only because they'd be data somewhere.

00:08:04 Speaker 3

Depends what it would do if just information.

00:08:05 Speaker 1

It's probably not probably not personal data, but it's a question worth asking for. Any team. People need some to come and ask us.

00:08:11 Speaker 3

Yeah, yeah, yeah, absolutely, yeah.

00:08:14 Speaker 1

Yeah, if we're considering, that's just going to give information about the weather or history or whatever, but like.

00:08:23 Speaker 2

The model what do you call a non yeah, yeah.

Nanobots

00:08:27 Speaker 1

Yeah, we we have, we've all agreed to keep them for James Bond.

00:08:33 Speaker 3

Yeah, yeah, yeah. I mean that technology probably doesn't quite exist in at the moment anywhere.

00:08:44 Speaker 5

But if you think about the different technology, not necessarily, nanobots, it could be something that blocks the noise. Yeah, something that could be a massive speaker, but it's blocking the noise. Yeah, right. We have noise cancelling headphones 10 year time. Probably have something.

00:08:57 Speaker 3

Yeah, yeah, yeah.

00:09:00 Speaker 1

Yeah, yeah, yeah. I think most people agree that Council and irritating noise, that's a good idea. Well, it's then the idea of the recording or keeping what you actually were saying the limit.

00:09:10 Speaker 3

Yeah, yeah, yeah.

00:09:14 Speaker 1

You know, protest, that goes for common issue.

00:09:17 Speaker 3

What is irritating noise, though? That's the question itself, isn't it? Because very, very well. Any like you look at like anything environmental, so like someone puts in a noise complaint about something.

00:09:19 Speaker 1

Wow, this is that subjective, isn't it?

00:09:30 Speaker 3

It's very it's it's very subjective. It's it's to what extent that's, you know, having a detrimental effect on.

00:09:36 Speaker 3

On your life.

00:09:38 Speaker 5

Well-being, it's it's there's no sort of.

00:09:40 Speaker 1

Yeah. Yeah. I'm wondering at this point too, if if there's another local authority.

00:09:42 Speaker 3

There's no there's no legislation that would solve the.

00:09:47 Speaker 3

Knowledge of what is and. Yeah, so I think.

00:09:49 Speaker 3

That would probably.

00:09:50 Speaker 9

So that that, that.

00:09:51 Speaker 5

Would be needed in that case, like if we are trying to make a policy of implementing a really like technology, it's like what what kind of legislation actually?

00:09:57 Speaker 3

Absolutely. Yeah. Well, it.

00:10:00 Speaker 3

Absolutely, yeah, yeah, absolutely. Because that would be the thing with that. Like there's no and there isn't because it's subjective. It's different for every person to look. Some somewhat part is irritating, someone else wouldn't.

00:10:14 Speaker 3

And yeah, how do you sort of quantify and it's and then it's working out, you know what's reasonable? What's?

00:10:20 Speaker 3

Yeah, all that sort of stuff. I mean, there's some like legislatures are building well, not legislation, but the guidance around buildings is that they're building noise and construction. Now it's, you know, it's quite, you know, it's it's quite exist, but yeah, yeah, yeah, yeah, that's the yeah.

00:10:31 Speaker 1

Oh yeah, I mentioned before the rules several times. You're not supposed to start before 8:00 AM with the noisy stuff they constantly did.

00:10:39 Speaker 2

Yeah. Yeah. Or on Sundays and things, you've.

00:10:42 Speaker 3

Yeah, that's. Yeah.

00:10:43 Speaker 1

Always and after.

00:10:44 Speaker 1

A certain time of day I can't remember.

00:10:45 Speaker 1

What the end date was, but the pre 8:00 o'clock starting with the pneumatic drill was not fun. Yeah.

00:10:45 Speaker 2

OK.

00:10:53 Speaker 1

Just think of something else there, you know.

00:10:54 Speaker 1

Is there another local authority somewhere the country's already done something similar. Can we learn from their project?

00:11:01 Speaker 1

That's that's quite.

00:11:02 Speaker 1

Often how we.

00:11:02 Speaker 1

Do things.

00:11:04 Speaker 1

Who else has done this and done it? Well, that's that's still up.

00:11:05 Speaker 3

Yeah, yeah, yeah.

00:11:08 Speaker 2

So after policy making, we would want to. I'm guessing we'd want to showcase that.

00:11:13 Speaker 5

Would. Ohh.

00:11:16 Speaker 1

Have a whole big media come, you know, event to launch it, a launch event event, yeah.

00:11:22 Speaker 5

The Prime Minister announced the Eden project all those kind of things right?

00:11:26 Speaker 4

Cut the ribbons and.

00:11:27 Speaker 1

Get more get more photographs done

00:11:33 Speaker 1

Yeah, you definitely want to make it.

00:11:35 Speaker 1

Like a tourist attraction, wouldn't you?

00:11:36 Speaker 1

You know, you'd want people to know it exists, to encourage them to visit the town. I'd imagine that's part of the idea behind it. It's to increase tourism.

00:11:46 Speaker 1

But maybe feedback as to how you did the. Did the locals like it is anything they want changed?

00:11:51 Speaker 2

About yeah. How do you how do?

00:11:53 Speaker 2

You gather feedback.

00:11:55 Speaker 1

It's it's almost.

00:11:56 Speaker 2

Or or monitor the use of that evaluation, yeah.

00:11:58 Speaker 1

It's sort of similar to the original.

Speaker 6

It’s continuous evaluation

00:12:01 Speaker 3

I just say yeah, future, yeah.

00:12:04 Speaker 1

Sort of similar to the pre consultation, we ask people what they'd like to see maybe afterwards something similar, you know.

00:12:10 Speaker 1

Did you think how do you think it looks? Are you using it? Is it useful?

00:12:16 Speaker 5

So we can say that this is an entire policy making process, obviously a fictional one. But what I can see here is that we have communities here and we have community here. This happen like more.

00:12:27 Speaker 1

It's just the more technical specification stuff to make a policy to make an idea a policy. I suppose you have to, you have to. The technical, legal parts of it, right, don't you?

00:12:37 Speaker 3

Yeah, yeah.

00:12:41 Speaker 4

So, shall we move to the next?

PART 3 STAGE 2------------------------------Implementing Design Methods and Actvities

00:12:42 Speaker 2

Oh Another one

00:12:43 Speaker 4

Yeah, well, next one, so.

00:12:46 Speaker 4

You know, we tried today different bits and bobs methods that I used it throughout this process, participatory speculation. So I made few stickers put the names on it ike an activity, one workshop was basically more like a related to prototyping exhibition, public exhibitions and different methods. You know place mapping you used the tracing paper to draw about the place.

00:13:09 Speaker 5

The first one.

00:13:10 Speaker 4

The first one and then.

00:13:11 Speaker 4

I throw you the what if question to make you speculate. And then brainstorming, you draw what you want based on what you've questions. And sorry we didn't do it because of the time limits today but imagine that you kind of view that kind of storyboard by yourself as an activity and with the Community participant they.

00:13:31 Speaker 5

The community so participant.

00:13:34 Speaker 4

Do it together.

00:13:36 Speaker 4

As you noticed the the some of the drawing has a different style because the students they draw together, they agree with the story and then that was a part of the approach.

00:13:45 Speaker 4

And then critiques about the storyboard, you saw the storyboard and then you comments on it. You don't like it. You know what you like it. And the prototypes that you can see the.

00:13:56 Speaker 4

You know, intangible idea, but in a tangible form. So I want you to look at look at those methods and then kind of map in this process where you can possibly use it maybe.

00:14:10 Speaker 5

And if if you don’t think you can use it if you you feel.

00:14:13 Speaker 5

Like you know, I wouldn't.

00:14:16 Speaker 4

Sounds fine. Yeah, we've got to do this.

00:14:25 Speaker 1

You're making all our dreams come true think outside of the box.

00:14:31 Speaker 2

Can you tell why I enjoy working with imagination?

00:14:37 Speaker 1

Some papers. Stickers.

00:14:41 Speaker 4

Actually, it's lots of fun to make the material for the workshop. For me, putting different colours and.

00:14:48 Speaker 2

What we're doing, seeing which bits of these which which?

Or if you think you can use.

00:15:42 Speaker 4

It multiple times there are more stickers.

00:15:47 Speaker 1

Well, look, we'll.

00:15:48 Speaker 5

Show you that I can put mine.

00:15:50 Speaker 5

In this one here.

00:15:54 Speaker 1

Just like.

00:15:55 Speaker 5

Yeah, yeah.

00:15:58 Speaker 1

The workshop.

00:16:06 Speaker 9

We planned it for more people so they have even more stickers.

00:16:15 Speaker 1

Just a long time since someone let me spend the morning with Post-its and pens and stickers.

00:16:43 Speaker 3

So place mapping, you know, it's all under these.

00:16:44 Speaker 3

OK.

00:17:13 Speaker 2

Prototypes. So yeah, to me, I see that.

00:17:16 Speaker 2

As the end product.

00:17:17 Speaker 2

Like not the end product, but something to show.

00:17:17 Speaker 1

Oh, you see, I think I see.

00:17:20 Speaker 1

I get your point, but I I see it as part of the consultation, here's what it would look like. People you can have both. Yeah.

Speaker 6

You can have both.

00:17:22 Speaker 2

Yeah, yeah. Part of the consultation. Yeah. Yeah. You can tackle. Yeah.

00:17:31 Speaker 5

And you can you can ask people to make their own prototype to show their ideas. I mean, that's how we design. Usually we have prototype could be a simple sketch in a piece of paper.

00:17:39 Speaker 4

Actually that happened with the storyboards.

00:17:41 Speaker 5

And then we end up with something more advanced that could be a 3D model it.

00:17:45 Speaker 5

Could be something like that.

00:17:46 Speaker 5

It could be that.

00:17:47 Speaker 5

Type of image.

00:17:49 Speaker 5

Or it could be a high fidelity kind of prototype that could really be the bin, for example here. But we can we can even interact with it, yeah.

00:17:56 Speaker 2

Because like the shows, the showcase could be the prototypes, it doesn't actually.

00:18:00 Speaker 2

Have to be.

00:18:02 Speaker 2

The like it all in place it could be.

00:18:04 Speaker 3

Yeah, yeah.

00:18:06 Speaker 2

This is what we've got and we need to raise money for it or or something like, you know, we get.

00:18:08 Speaker 1

Yeah. Yeah. And based on what you iron out here, the prototype of that end could look different than the prototype here. So that might have to, yeah.

00:18:17 Speaker 5

Yeah, definitely, definitely. And that's the idea of prototyping in design is that it's very iterative. So that's why we start usually with kind of low fidelity, one that really easy to fix if I if I Draw Something here and you don't like, I can draw it again and within 5 seconds, if I come up with something more.

00:18:34 Speaker 5

More details it would take maybe a week.

00:18:35 Speaker 4

3D printer, yeah.

00:18:39 Speaker 6

You can print it out and then.

00:18:42 Speaker 6

You know, make tweaks and then print another one there is no like.

00:18:43 Speaker 5

Yeah, yeah.

00:18:44 Speaker 4

Yeah, that's true.

Speaker 1

You're not starting all over again. Yeah, yeah.

00:18:45 Speaker 6

Yeah, exactly.

00:18:50 Speaker 4

I want I was a bit curious about the speculative brainstorming part.

00:18:57 Speaker 5

Yeah, there is one.

00:18:58 Speaker 1

Here. Mm-hmm. I put it in the next one because when you're trying to write a policy, that's the sort of thing you need to be thinking about. Yeah.

00:19:09 Speaker 4

Different occasions.

00:19:12 Speaker 1

To make sure that every angle is covered in the legislative part of it.

00:19:19 Speaker 1

So yeah, you have to kind of preempt things that may change or you know, particularly if you're trying to write a watertight piece of legislation that's going to exist forever, you have to kind of preempt various other changes and things that might happen.

PART 4---

00:19:35 Speaker 4

Umm, because I I was just imagining that our speculative design can be just used for the very beginning of the policy making stuff. I just speculated by myself, but I think that's very good insight.

00:19:48 Speaker 4

Actually this activity leads to the next question, which is the final bit of our workshop I wanted to ask you, like, what kind of challenges you would have if you are going to use this particular method like, OK, we're going to write the policy or we're going to make the policy. the real challenges you have within the organisation.

00:20:09 Speaker 4

Or communication with the public.

00:20:11 Speaker 1

Would be resources is always our biggest challenge, isn't it? In terms of money and staff, you know, staff time and whatever money it may cost to do, engage consultants and things, that's always the biggest constraint for anything the Council wants to.

00:20:15 Speaker 4

OK.

00:20:27 Speaker 2

Do to do it.

00:20:28 Speaker 2

Properly the consultation properly, I think so.

00:20:31 Speaker 2

Like, we're not necessarily able to do it ourselves properly.

00:20:37 Speaker 1

Because of such a collaborative thing among different parts of the Council. It's not a quick process either.

00:20:43 Speaker 1

Don't start this today, thinking you'll be sold up in six months. You know and I think the the cost.

00:20:48 Speaker 1

Process getting from idea to policy to you know implementation.

00:20:51 Speaker 3

Yeah, yeah. And just the timing, making sure.

00:20:56 Speaker 3

The right relevant.

00:20:57 Speaker 3

People have been consulted as well, you know, no.

00:20:58 Speaker 1

Yeah, yeah, yeah.

00:21:00 Speaker 3

You know, no one's been left out because that's.

00:21:02 Speaker 1

Yeah. And the one thing that you can't ever predict is what will the public hmm bring up, bring to your attention.

00:21:10 Speaker 1

What ideas will they come with? What will they think that's the.

00:21:12 Speaker 1

One thing you can't make guess is that it might go down well or might not.

00:21:17 Speaker 1

But there will be a lot of curveballs in the consultation process that may require further thinking.

00:21:22 Speaker 2

I think it goes back to your point earlier about how the Council, like the Community consultation, is done, and if it, if you're listened to. So I think an important part is.

00:21:35 Speaker 2

Like you said, we don't can do you know? Yeah. Make ensure that we truly do take in what people are saying.

00:21:44 Speaker 1

Particularly when it comes to public spaces, because we do feel we own that space like in the beginning I was very much like, but I loved all of course it don't change it, there'll be a lot of people that feel that way, yeah. You know, because we do feel like it's ours. So if you're going to start messing with it and changing it, people will want to hear and they'll want to know that. You've heard them.

00:22:03 Speaker 2

Yeah. When is it would be completely different if it was an empty space like a new like I don't know like decorating

00:22:16 Speaker 1

You know, you ask people. Yeah, we're thinking of doing this with this space. You know, it's not a public space most.

00:22:21 Speaker 1

People do. Yeah, whatever. You know, don't care.

00:22:25 Speaker 1

Yeah, there's no point asking the public if you're not going to take their opinion on board. Otherwise, just a waste of money.

00:22:30 Speaker 1

And time, isn't it?

00:22:34 Speaker 1

And people will feel ownership of that particular area.

00:22:41 Speaker 4

So what kind of policy area could affected by this kind of if we hypothetically say we can use this method in in the policy making process like a speculative design or in a participatory method like, what kind of?

00:22:59 Speaker 4

Policy would be affected.

00:23:01 Speaker 4

Like area where.

00:23:01 Speaker 5

Where you can use them.

00:23:03 Speaker 4

Can you use this?

00:23:04 Speaker 4

Like digital technology or place planning or?

00:23:08 Speaker 2

I think it would be in the place making.

00:23:14 Speaker 2

Or like the the conservation heritage site.

00:23:19 Speaker 2

And also maybe like arts and culture.

00:23:24 Speaker 2

I never knew that.

00:23:24 Speaker 2

Maybe we should.

00:23:27 Speaker 2

Because because it is to do like if we're talking about Dalton Square.

00:23:34 Speaker 5

Yeah, but what about fold off? This could have been about maybe not even technology or something, or not even place.

00:23:43 Speaker 5

You think this we can do something similar to using quite similar method, another type of policy.

00:23:48 Speaker 1

Yeah, I think it's the same process.

00:23:52 Speaker 2

You would hope it would be well, yeah.

00:23:54 Speaker 2

Thanks. Is there any area?

00:23:57 Speaker 6

In the policy that you think.

00:23:59 Speaker 6

That that could benefit particularly from this that maybe is tough to do at the moment and this might help with.

00:24:11 Speaker 3

I think it has to be. Well, it's hard and I don't think that like with policy and like any area, there's not. I don't think there's gonna be one-size-fits-all.

00:24:20 Speaker 3

Because I think.

00:24:24 Speaker 3

Because like this, you know. So. So here's the example, yeah.

00:24:28 Speaker 3

Do something the statue in Dalton Square. I think the sort like there be lots of.

00:24:33 Speaker 3

People that you know will need to be consulted. Lots of.

00:24:37 Speaker 3

You know the sort of, you know, it's just just with the nature. But you know it's it's it's.

00:24:43 Speaker 3

Yeah, you know the natural walk.

00:24:45 Speaker 3

You know what this is talking about? It's huge, really. But but we, you know, the probably be smaller stuff like like for example putting sensors in bins.

00:24:55 Speaker 3

Well, it's quite fine. It makes complete sense. You know, it's not introducing, you know, a bin is not historically, you know rather than.

00:25:05 Speaker 3

Things so you know, you wouldn't necessarily need to do workshops and things like like just be like it's gonna save loads of time. People don't have to check bins all the time. Yeah.

00:25:05 Speaker 1

That's right.

00:25:13 Speaker 1

Which is exactly what happened. And then we just announced it on the website.

00:25:16 Speaker 1

That it was done.

00:25:16 Speaker 3

Yeah, absolutely, yeah.

00:25:16 Speaker 1

But nobody was nobody.

00:25:20 Speaker 1

Say they still don't.

00:25:21 Speaker 1

Because I think literally the only mention of it was on our website to say it had.

00:25:24 Speaker 3

That's. Yeah. Yeah, yeah, absolutely.

00:25:25 Speaker 1

Been done so unless you're sat at home reading Lancaster Council's website.

00:25:29 Speaker 3

Absolutely, yeah, yeah, absolutely. But The thing is with that is like, yeah, exactly. That's it's no no personal data being collected.

00:25:33 Speaker 1

Well, it hasn't intruded in anyone.

00:25:39 Speaker 6

But someone come along and like, what's that? What's doing? Yeah.

00:25:42 Speaker 6

Worrying about it could be.

00:25:43 Speaker 6

Listening. Yeah, well.

00:25:45 Speaker 1

That's that's the down side. It's it could cause unnecessary worry.

00:25:49 Speaker 3

That's the thing. I mean, that's the.

00:25:51 Speaker 3

Thing isn't it? But but.

00:25:52 Speaker 3

But as a councilor, you'd like to think we're approachable and people can just, like, say, I've noticed this. Please can you give me some information about it?

00:25:58 Speaker 1

So we'll we'll get it in, we'll get an e-mail going and notice this.

00:26:01 Speaker 1

And this in the bin, what’s that? Don’t like it.

00:26:01 Speaker 3

Yeah, yeah, absolutely, yeah.

00:26:04 Speaker 2

Is there any policy around.

00:26:06 Speaker 2

Saying there's anything, I know that.

00:26:08 Speaker 3

We can't, we we sort of so, so on the approach we take, I mean there's obviously the legal element of the DPI, isn't there?

00:26:15 Speaker 3

So that's I mean that's where when we get requests for it, that's where Irish point.

00:26:20 Speaker 3

People. Yeah. So not like a stand alone policy for.

00:26:23 Speaker 3

No, no, no.

00:26:23 Speaker 1

That issue but the normal processes and procedures we have would apply. So somebody's planning on a project that would involve sensors, any phone collection, collection of data, they'd have to come by my office.

00:26:36 Speaker 3

OK. Yeah, absolutely. But yeah, and that's it.

00:26:41 Speaker 1

They should they.

00:26:42 Speaker 1

Should by my.

00:26:43 Speaker 3

Office. Yeah. Yeah, yeah, absolutely.

00:26:48 Speaker 6

Secondly, you came to The Walking event. You didn't think that we had?

00:26:49 Speaker 1

Yeah, yes, yes. Nice.

00:26:53 Speaker 1

Food. Yeah, I was at. I was at the castle. Yeah, yeah.

00:26:54 Speaker 1

So. So do you know how this?

00:26:56 Speaker 1

Is going to do you know how?

00:26:58 Speaker 1

This is gonna go.

00:26:58 Speaker 1

All remember the first event cause of the lovely weather, the 2nd event.

00:27:01 Speaker 1

Is of the lovely food and the third event of the lovely food.

00:27:07 Speaker 1

Stick in my mind.

00:27:08 Speaker 6

Yeah, yeah.

00:27:08 Speaker 1

And I know you want me to.

00:27:09 Speaker 1

Go off and think about all of this.

00:27:12 Speaker 3

That's it. But yeah. Yeah. For me, they'll be. They'll be things that you know, you do need to do.

00:27:16 Speaker 3

There's a there's a lot that is doing, but there's other things. Yeah, it's not. I don't I.

00:27:21 Speaker 3

Don't think there.

00:27:22 Speaker 3

Is for a policy. There is it.

00:27:22 Speaker 1

It does depend entirely on the project whether you have to follow the hostage or not.

00:27:23 Speaker 3

And it does. Yeah, yes, absolutely.

00:27:28 Speaker 6

We did come out of that workshop with the kind of set of things that could go on policy.

00:27:36 Speaker 2

Yeah, yeah.

00:27:39 Speaker 6

At some point be good to maybe you know, follow that up. It sounds like it's not much specifically right now, yeah.

00:27:42 Speaker 3

Yeah, yeah, yeah, yeah.

00:27:49 Speaker 3

Yeah, yeah. It's like tonnes of examples where there would have been, there wouldn't be much.

00:27:56 Speaker 3

You know, I mean it.

00:27:57 Speaker 3

All depends on the installations. One thing.

00:28:00

You know.

00:28:01 Speaker 3

Sort of the planning side of it and.

00:28:03 Speaker 3

Things like that.

00:28:03 Speaker 3

But like like for air quality centres for.

00:28:05 Speaker 3

Example. Well, they're not collecting anything that peak then it's no personal data that they're collecting.

00:28:11 Speaker 3

It makes sense. You know, we, the Council do, does air quality monitoring at the moment, not necessarily smart sensors, but you know.

00:28:18 Speaker 3

You know we.

00:28:19 Speaker 3

Probably we test you if you know it's.

00:28:20 Speaker 1

I think I think it's possibly going to become, yeah, more, more like all this all us to do that collection because.

00:28:28 Speaker 3

Yeah, yeah.

00:28:29 Speaker 1

Do you think about that recent case that that little girl who died? Yeah, because of pollution in London. I I can see those policymakers making a policy that insists that we do local collection of air quality so that we can then plan.

00:28:30 Speaker 3

Yeah, yeah.

00:28:38 Speaker 5

Yeah, yeah.

00:28:45 Speaker 3

Yeah, exactly. Yeah. Yeah. Well, then we that, that that so that a process like this where you do stuff like workshops, prototyping and stuff, it probably will, you know probably just be asking experts where is the best place for these sensors. You know where they needed and probably just, you know, provided the infrastructure is there to install them.

00:29:12 Speaker 6

Well, yeah. But I was gonna say as well. I mean, if you did go.

00:29:15 Speaker 6

Through this process or.

00:29:16 Speaker 6

Something like because we we had our senses.

00:29:18 Speaker 6

On the walk and we did, we did.

00:29:21 Speaker 6

Publicly we did a couple of public engagement ones. Remember the public and there was some really interesting discussions about, for example, well, OK, the air sensors are there. But how did we like, what if the data isn't accurate that they?

00:29:34 Speaker 6

Yeah, things that are being done at the sitting on where they get put is really important. Yeah, what they say and then.

00:29:38 Speaker 3

Yeah, absolutely. Absolutely yes.

00:29:44 Speaker 6

Like you know, if they're they're next to shops or people's houses, is that gonna change?

00:29:48 Speaker 3

Yeah. Yeah, absolutely. Yeah, yeah.

00:29:49 Speaker 1

You have you have to rely on the experts to give you that advice as to where the best place you know. Yeah, you have to just trust them.

00:29:54 Speaker 6

Yeah, but again, a policy might have to say,

00:29:57 Speaker 6

We need to consider there's.

00:29:58 Speaker 3

Perhaps yeah.

00:29:59 Speaker 6

This this process of speculating saying well, what if something wrong that intentionally.

00:30:02 Speaker 3

Yeah. Yeah. But I mean, the sense that there are air quality sensors, they're they're not smart, they're not smart set, they're they're not smart in as much as they're not what your class are smart in.

00:30:12 Speaker 5

This, but you know if you have a look around.

00:30:15 Speaker 5

The city centre in various places, you you might see a little test tube in a in a thing which is an air quality. It's basically an.

00:30:20 Speaker 1

We've got a anpr camera.

00:30:23 Speaker 5

Yeah, yeah, yeah.

00:30:24 Speaker 1

That the point of that is to collect data on congestion and it's mostly looking at how many buses and waggons and things go past.

00:30:27 Speaker 3

Yeah, yeah.

00:30:33 Speaker 1

But that again, that is something we've to we have to, we're obliged to do so we have plenty of data and we send it off to whoever we send it to.

00:30:42 Speaker 3

I'm not sure, so yeah.

00:30:44 Speaker 1

Government we collecting data and send it to them.

00:30:48 Speaker 2

What happens to companies then? So I'm thinking like football data in Spain.

00:30:52 Speaker 2

So there was.

00:30:54 Speaker 2

We had a recent meeting, maybe last year sometime and a company came to us and could tell us exactly where where people were coming from and where they were spending their money. And it's all through. It was like through visa wasn't were you in that.

00:31:03 Speaker 3

Yeah. Yeah, yeah, yeah, yeah.

00:31:06 Speaker 1

I was going.

00:31:10 Speaker 1

To say, well, it'll be through.

00:31:12 Speaker 3

I wasn't in it, but that's tat's the one we were talking earlier.

00:31:15 Speaker 3

Yes, you know, if you've got free apps on your phones and things like that, that's that's, that's that's probably where that's probably why you've got certain apps you're free.

00:31:18 Speaker 2

Yeah. What it was through mobile data, right?

00:31:21 Speaker 1

OK, that's it you show your location data on your mobile phone flex where you've been?

00:31:26 Speaker 3

Yeah, that's how.

00:31:27 Speaker 3

We have developed the money. Yeah, absolutely.

00:31:27 Speaker 1

But yeah, right, because because nearly everyone pays electronically these days, there's a record.

00:31:31 Speaker 3

Yeah, yeah, yeah, yeah.

00:31:33 Speaker 3

Yeah. It's like if you have, you know, if you have an app and you need any GPS switch and stuff and that's, you know, yeah, you.

00:31:38 Speaker 3

Know maps some small using this data to.

00:31:41 Speaker 1

Yeah, but it is not very accurate, cause mine sometimes ask me how was a pub or a shop?

00:31:49 Speaker 1

And I'm like, I wasn't even near it.

00:31:52 Speaker 1

So it's not, you know, it’s not accurate.

00:31:54 Speaker 3

Yeah, that's true.

00:31:56 Speaker 6

That's it. Yeah, we gonna make decisions based on that inaccurate data.

00:31:58 Speaker 1

Yeah, yeah. I mean, I've lost somewhere nearby. You know, it's not completely me enough. Yeah, I've not been.

00:32:05 Speaker 3

Yeah. Yeah, absolutely. Yeah. Yeah, it's, it's it's it's. Yeah.

00:32:08 Speaker 5

Yeah, but what I hear is also kind of strangulate the people that are using the same Internet connexion with the same IP. So like for instance, maybe it wasn't you, it was maybe your your.

00:32:17 Speaker 5

Your son was around that area and bought something and it would like for.

00:32:20 Speaker 3

I I I I play location is very yeah it's it's not it's not very accurate.

At all. It's it's for it's for countries. So for example, they'll be able to IP, you can probably pin it down to a country, but a location within that country is very, very, very, very.

00:32:33 Speaker 5

OK. All right.

00:32:37 Speaker 3

Yeah. Yeah, that's that's that's the big two option with IPS, yeah.

00:32:44 Speaker 4

Shall we wrap up. Very interesting.

00:32:46 Speaker 5

So what do you think about the method in general or kind of?

00:32:52 Speaker 3

Makes sense. Yeah, it's also, it's good to get people thinking in. It starts. So it's good. Like why to get the you know, it's not like so rather than just start like going you know, watching this, this this sort of thing. Yeah, it's good sort like exercises to get the brain working and there before moving on to.

00:32:54 Speaker 1

Yeah, makes sense.

00:33:09 Speaker 1

I think the more what I actually come up with, the more your brain starts thinking about other things and you.

00:33:13 Speaker 3

Yeah, that's it. Yeah. Yeah, yeah, yeah.

00:33:15 Speaker 4

Know kind of nice brain exercise.

00:33:18 Speaker 1

Kickstart Chin to you know.

00:33:20 Speaker 1

Thinking more about us, yeah.

00:33:20 Speaker 3

Yeah. And just previously you asked very different like, here's your engine people towards expressing the different ideas where everyone is out, you know, everyone has the yeah, yeah.

00:33:32 Speaker 1

But I also think that's for any confusion that will add to the value of the responses you get. You'd have that different generations, you know, cause it's quite possibly they will see it very differently, particularly when it's all about technology. Yes, you've got a very different ideas.

00:33:39 Speaker 3

Yes, yes, yeah.

00:33:48 Speaker 2

Well, there's there's been another project hasn't known.

00:33:50 Speaker 2

Like the place making with young adults one.

00:33:52 Speaker 2

Yeah, because and that came about from planning policy. They find it hard. Well, it's not that it's hard to engage with different generation like different age people, but they find it tends to be like, more like mostly retired people are older. They would take part in planning.

00:34:12 Speaker 2

Consultations they were trying to do something to make cheques to the younger.

00:34:13 Speaker 3

Yes. Yeah.

00:34:16 Speaker 1

You said that's part of the reason I purposely made the point of going to that development constitution because I thought the other people will be represented.

00:34:24 Speaker 1

There will be retired people have nothing else to do in it. Even so, while I was, you know.

00:34:29 Speaker 1

Getting from work, make tea. Get to have meat and I could have done the whole. Yeah, I felt it was.

00:34:33 Speaker 1

Important for that reason, yeah. Have a representation on it.

00:34:38 Speaker 1

But yeah, I do think you know, particularly when it comes to technology, there is a bit of a generation.

00:34:44 Speaker 1

There may be a generational split as to what your feelings and thoughts on.

00:34:47 Speaker 2

It are. Yeah, because it's scary like.

00:34:49

Right.

00:34:50 Speaker 2

I'm not very technical.

00:34:53 Speaker 4

Actually, when I put an exhibition in the museum, many elderly people also came to they were just passing by, but they're watching carefully, but they didn't interact because they I don't want to. I don't want it basically.

00:35:05 Speaker 4

Well, yeah. I mean, I understand that's why we put it.

00:35:11 Speaker 2

Yeah, it's a word for everyone.

00:35:14 Speaker 2

Well done

00:35:15 Speaker 4

Thank you. Thank you for participating. I know you guys are super busy. Thank you very much.

00:35:21 Speaker 4

For your time with everything.

00:35:25 Speaker 1

Thank you very much.