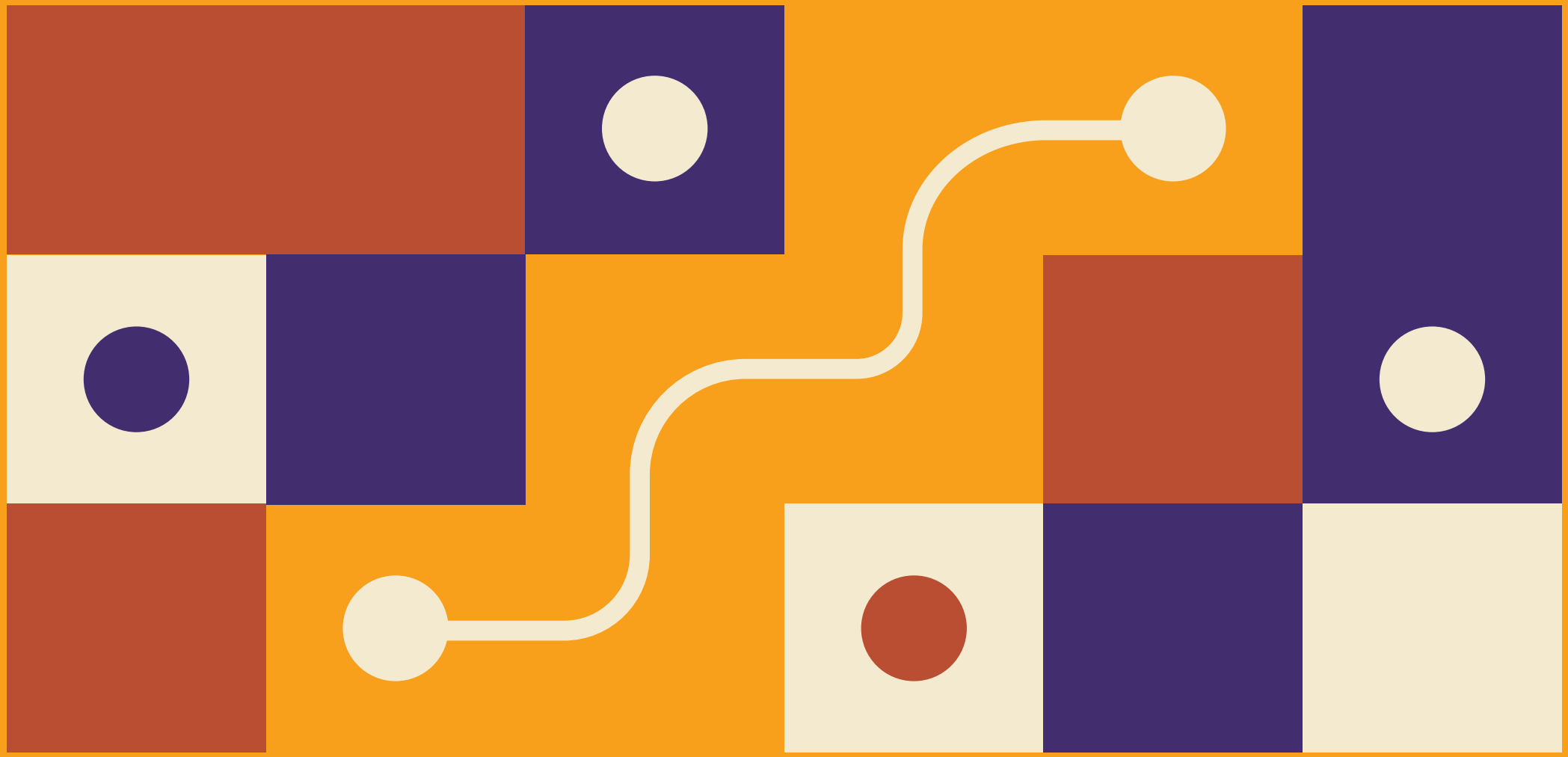


into the unknown.
designing wayfinding & exploration experiences for newcomers in complex urban spaces.

A QUT Industrial Design Capstone Research Report | Written by Michelle Fortune

hokiih.

executive summary.

This project examines how newcomers and occasional visitors navigate unfamiliar outdoor urban spaces, revealing the behavioural, cognitive and emotional factors that shape wayfinding and exploration. Existing research shows that poor wayfinding can heighten stress, confusion and reduced spatial confidence, especially for users with limited familiarity or accessibility needs.

As urban environments grow more complex, traditional signage and digital navigation tools each present limitations: static signage often lacks interactivity, while digital apps can narrow spatial awareness and reduce engagement with the environment. Benchmarking highlights a clear market gap, with few public-facing artefacts offering both high interactivity and high effectiveness, signalling an opportunity for hybrid, phygital solutions.

Primary research reinforces these insights. Users consistently prioritise orientation and destination clarity, rely strongly on landmarks for spatial grounding, and blend digital and physical cues when navigating. While digital apps are preferred for efficiency, physical signage and environmental cues remain essential for reassurance and micro-navigation. Participants also expressed strong interest in interactive features, suggesting that engaging elements can motivate exploration across different user types. Expert interviews further emphasised progressive disclosure, simplicity, durability and inclusive design as critical considerations.

Overall, the report identifies a need for wayfinding interventions that reduce cognitive load, strengthen environmental clarity and support exploration. Opportunities lie in integrating physical and digital systems, utilising landmarks, introducing more interactive cues and adopting universally accessible design approaches to build a holistic intervention that supports confidence and boosts user experience.



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Authenticity Statement

This is to certify that to the best of my knowledge, the content of this report is my own work. This report has not been submitted for any subject or for other purposes. I certify that the intellectual content of this report is the product of my own work and that all the assistance received in preparing this report and sources have been acknowledged.

AI Use Statement

I have utilised Generative AI in this report (Copilot) to assist in various ways. The way I have used AI mainly includes proofreading texts and correcting grammatical and spelling errors. It was also utilised in transcribing the audio recordings collected from interviews (refer to section 2.2).

Michelle Fortune | N11487241 | 09/26

1

project overview.

1.1 Introduction
1.2 Background
1.3 Benchmarking

1.1 Introduction

into the unknown:

designing wayfinding & exploration experiences for newcomers in complex urban spaces.



Wayfinding is the process of using spatial and environmental information to determine one's location and navigate through an environment to reach a destination (Goldenberg et al., 2026; Lynch, 1960). Poor wayfinding can contribute to stress, frustration, confusion, anxiety, and feelings of being unsafe, while also hindering efficient movement and even compromising safety in dire situations (Goldenberg et al., 2026; Swann et al., 2026).

Challenges, Limitations & Opportunities

Support wayfinding and encourage exploration.
Outdoor urban spaces, such as public precincts and city centres, present wayfinding challenges due to their vast open areas, constantly changing weather conditions, visual clutter, diverse infrastructures and confusing urban layouts. These factors increase the complexity of interpreting and navigating the environment and can contribute to cognitive and sensory overload (Swann et al., 2026).

Newcomers and occasional visitors are particularly vulnerable to these challenges due to limited familiarity and underdeveloped mental maps of the space which increases their cognitive load and reinforces negative emotions and experiences (Ghamari & Sharifi, 2021), Additional barriers related to language, cognition, vision, or physical mobility may further affect their ability to navigate and explore unfamiliar spaces (Ghamari & Sharifi, 2021; Swann et al., 2026).

Existing wayfinding tools present limitations. Static signage systems, while durable and consistent, risk becoming outdated and offer limited interactivity, which can compromise user trust and reduce effectiveness (ScreenCloud, 2025). On the other hand, digital GPS apps provide direct turn-by-turn information but may discourage newcomer's ability to build mental maps and spatial confidence due to reliance (Dahmani & Bohbot, 2020; Miola et al., 2024).

Supporting users in interpreting and navigating these evolving urban spaces aligns with UN's Sustainable Development Goal (SDG) 11, particularly Targets 11.3 and 11.7, which promote inclusive urbanisation and accessible, safe, and inclusive public spaces (UN, 2026). Additionally, Wayfinding extends beyond signages and apps, it can involve environmental cues such as landmarks, paths, colour, lighting, spatial features, or digital technologies (Lynch, 1960; Eptura, 2025). This presents an opportunity for industrial design to support not only navigation but also build user confidence in spatial understanding

Aim

This project investigates the behaviours, needs, and challenges of newcomers and occasional visitors navigating unfamiliar outdoor urban spaces. The findings will inform design approaches that support wayfinding and encourage exploration.

the double diamond.

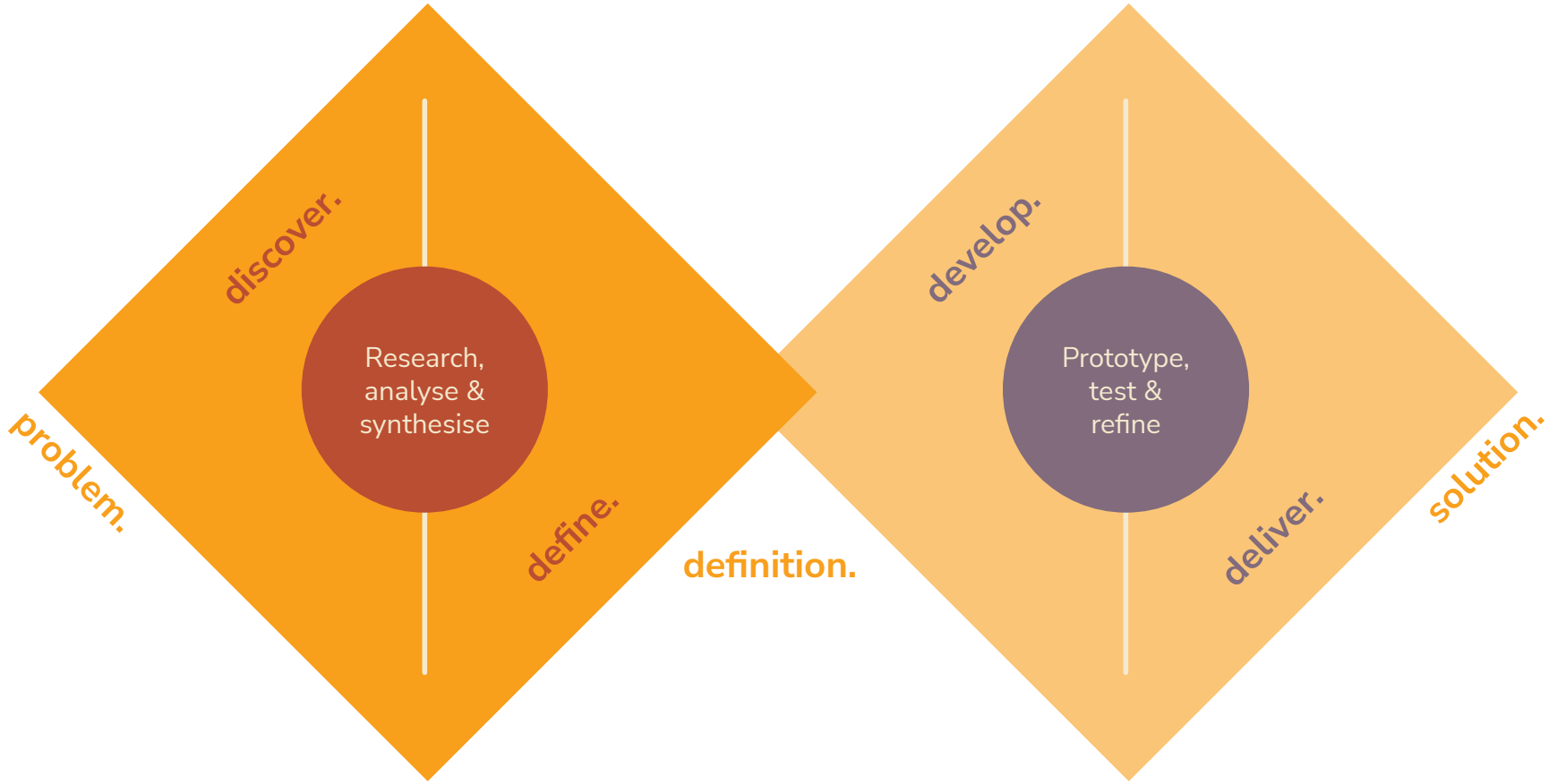
This project will follow the Double Diamond design framework published by the British Design Council in 2005 combining divergent (expanding outward) and convergent (narrowing inward) thinking.

Week 1-9

Discover & Define:
Design research & direction of concepts. This report sits withn these phases.

Week 9-14

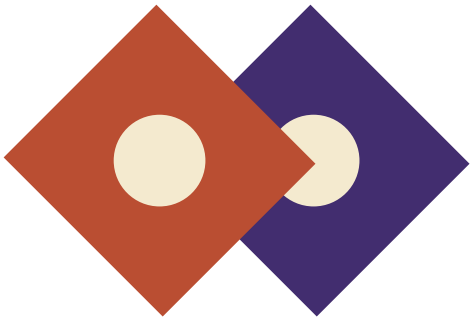
Develop & Deliver:
Design development & refinement. These are the next phases following this report.



1.2 Background

According to Environmental Preference Theory, people are more likely to explore environments that feel coherent, legible and safe (Appleton, 1975; Kaplan & Kaplan, 1989). When these qualities are lacking, spaces can induce anxiety, disorientation and overwhelm, reducing exploration, engagement and willingness to return (Swann et al., 2026). As cities become denser and multilayered, newcomers increasingly experience these challenges due to higher cognitive load, difficulties forming mental maps, interpreting environmental cues and locating destinations (Byrne, 2017; Swann et al., 2026). This indicates an opportunity for interventions.

Wayfinding, as a process, can be divided into four key phases: orientation, route decision, navigation and destination recognition (Arthur & Passini, 1992). Orientation provides the foundation for understanding one's surroundings, while route decision can create high cognitive load when choices are ambiguous or poorly designed, which could present potential points for intervention (Schwering et al., 2017).



Traditional & Exploratory Wayfinding

Traditional wayfinding primarily addresses these needs by providing direct and efficient information through signage and maps (CivicBrand, 2026). However, an emphasis on predetermined routes may limit opportunities for newcomers to develop cognitive maps and engage with their surroundings.This has encouraged greater interest in exploratory wayfinding, which complements navigation with curiosity, discovery and forming spatial familiarity (CivicBrand, 2026). By incorporating placemaking principles, it can create environments that feel engaging and safe while strengthening connections between people and place (Kamruzzaman et al., 2025; PPS, 2007). Integrating traditional and exploratory approaches may therefore provide a more holistic solution for dense urban environments.

Spatial Blindess

This balance is particularly relevant as digital navigation becomes increasingly dominant. Over-reliance on GPS can reduce spatial awareness and the formation of cognitive maps by shifting users towards passive, stimulus-response navigation (simply reacting to commands such as 'turn left') (Dahmani & Bohbot, 2020; Miola et al., 2024), creating "digital tunnel vision" that limits awareness of surrounding information (Huston & Hamburger, 2025).

Emerging Technologies & Practices

Emerging technologies, including AR, AI-assistance and 'phygital' (physical-digital) solutions, offer opportunities to combine digital guidance with physical environmental cues, supporting both navigation and exploration while avoiding cognitive overload (Niantic, 2026; RTF, 2025; 22Miles, 2025). Additionally, current sustainable design practices through the use of durable materials, modular design and energy-efficient technologies could also be incorporated (Mima, 2026).

Summary

Overall, the research identifies a need for wayfinding approaches that not only help users reach destinations, but also supports spatial learning, comfort and engagement with place. Integrating traditional and exploratory wayfinding could help newcomers navigate complex urban environments while building familiarity and confidence. Emerging technologies, phygital solutions and sustainable practices are aspects that could be considered when innovating interventions to support the long-term viability of these interventions.

1.3 Benchmarking

Overview

Benchmarking is crucial in the design development process to understand existing solutions and identify market trends and gaps (Meeker & Thornton, 1995). Solutions beyond static signages and digital kiosks were investigated which includes traditional artefacts, apps, personal smart equipment and other adjacent innovations that could inspire the direction of the project. This process aims to build an understanding of the current landscape and different approaches that already exists in relation to navigation and wayfinding which will uncover both favourable and unfavourable features that could be adopted or improved.

Benchmarking Attributes

28 products across five product categories were benchmarked against eight attributes derived from industry research (Table 1). Refer to Appendix A for the extended benchmarking table.

Category	Universal Accessibility	Cost	Feedback Modality	Aesthetics & visual clarity	Interactivity	Durability	Usability / Ergonomics	Effictiveness of use	Maintenance/ Repariability
Definition	The artefact's ability to be utilised across a wide range of user groups with varying needs.	The cost of the artefact.	The effecitvness of the artefact in delivering navigaitonal cues via different sensory channels (visual, auditory, haptic, multimodal)	The look, feel and clarity of the artefact and the infromation it provides.	How interactive and engaging the artefact is for users.	The artefact's resistance againt continuous use overtime and agaisnt enviormental elements.	The user experience and how intuitive the artefact is.	How well the artefact is able to assist user in the way they were intended to.	Maintenance consideration and how easily repairable the artefact is.
Scale breakdown	1: Least , poorly caters to only the general public | 5: Most, caters to diverse user needs excellently	1: High cost | 5: Low cost.	1: Low, No channel/ Single channgel but low clarity | 5: Multimodal & high clarity.	1: Poor in Aesthetic & clarity | 5: Excellent in Aesthetic & clarity.	1: Not interactive, static | 5: Highly Interactive, two-way exchange.	1: Low Easily damaged | 5: Resilient.	1: Lowest, least intuitive & user friendly | 5: Highest, very intuitive & user friendly.	1: Least effective | 5: Highly effective.	1: Unrepairable | 5: Very repairable.

Table 1. Benchmarking Attributes

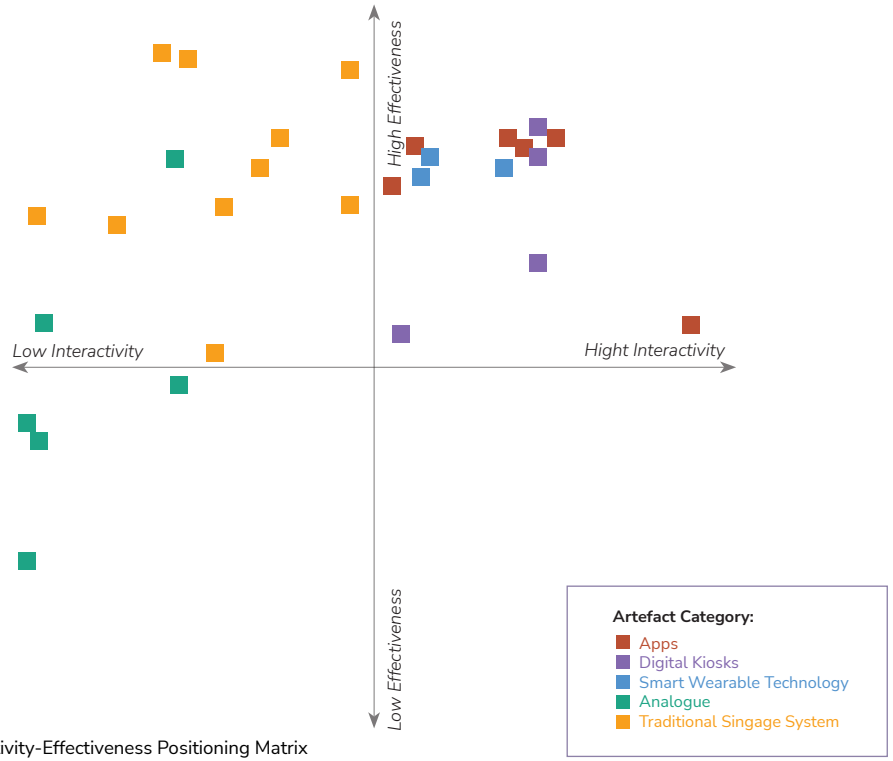


Figure1. Interactivity-Effectiveness Positioning Matrix

Opportunities & Gaps

Figure 1 shows the 28 artefacts plotted against an 'Interactivity-Effectiveness' positioning matrix. Most artefacts clustered in the high interactivity-high effectiveness quadrant are digital including apps, kiosks and smart wearables. Traditional signage and analogue artefacts found in the built environment sit mostly in the middle to lower interactivity quadrant. Despite this, many traditional signage artefacts still score equal to, or even higher than, other solutions in terms of effectiveness while remaining largely static. This suggests that these systems could be strengthened through digital or interactive enhancements. More broadly, the matrix reveals a gap in public environmental navigation whereby very few artefacts in the public space deliver both high interactivity and high effectiveness, indicating a strong opportunity for intervention.

1.3 Benchmarking

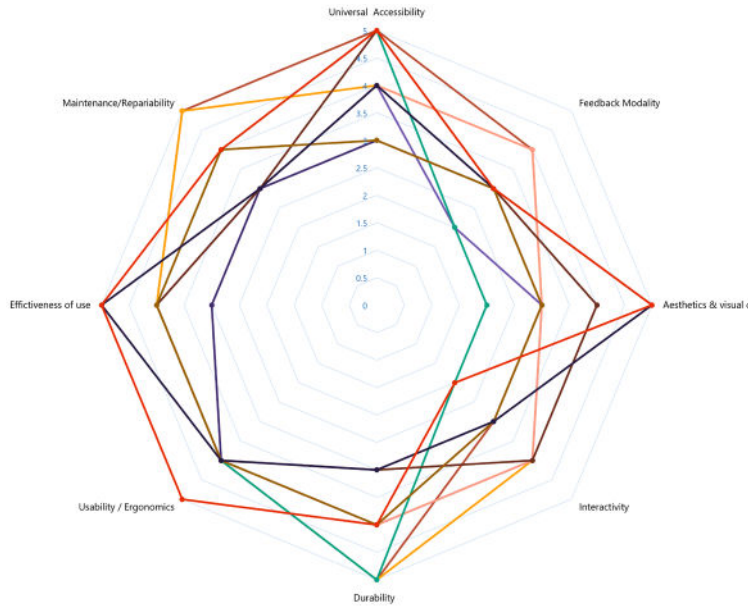


Figure 2. Combined Radargraph of Top 10 Artefacts

Figure 2 and 3 shows a deeper analysis of the top 10 artefacts. The radar charts reveal a clear divide between environmental and digital navigation artefacts. Environmental solutions such as the signage family, 3D tactile map and Braille trails perform strongly in durability, accessibility, and aesthetics and visual clarity, yet consistently lack interactivity and multimodal feedback. In contrast, digital artefacts (BindiMaps, Google Maps, the INMO GO3 AI Smart glasses and Wayband) excel in those traits and effectiveness of use but lack in either aesthetics and visual clarity, usability and/or maintenance and repairability. No artefact performs well across all criteria, which highlights a gap in the market for a solution that blends the strengths of traditional signage and digital tools. A hybrid approach could offer robust, accessible guidance while also providing the interactivity and multimodal support found in digital systems.

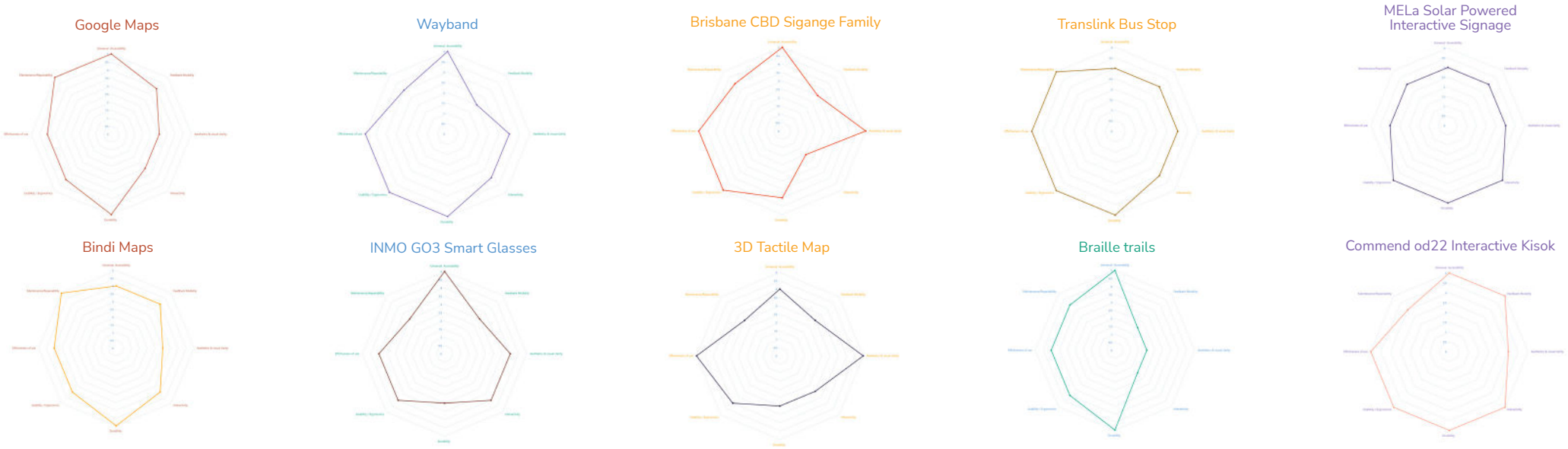


Figure 3. Individual Radargraphs of Top 10 Artefacts

1.3 Benchmarking

Figure 4 presents a ‘Cognitive Load–Guidance Specificity’ positioning matrix of the top 10 artefacts, revealing that effective wayfinding should prioritise high guidance specificity while minimising cognitive load. Although digital solutions can provide highly specific guidance, their complexity may increase users’ cognitive demands. Therefore, the design intervention should leverage technology selectively, prioritising decision-making by communicating only the information necessary for immediate spatial awareness and navigational decisions. This approach aims to provide relevant guidance without overwhelming the user.

Market Summary

Existing solutions are divided between durable but static environmental artefacts and highly interactive yet cognitively demanding digital systems. Digital kiosks and apps offer live updates, multimodal feedback and technologies such as NFCs, AR and conversational AI, but rely heavily on touchscreen interactions and personal devices. Analogue and traditional signage provide intuitive orientation, aesthetic cohesion and a reliable “point of truth,” yet suffer from outdated information, limited interactivity and maintenance challenges. These patterns reveal a clear opportunity for a hybrid, phygital artefact that delivers precise, low-effort, universally accessible guidance while retaining the robustness and place making qualities of environmental signage.



Figure 4. Cognitive Load - Guidance Specificity Matrix

2

research analysis.

2.1 General Research

2.2 Research & Analysis

2.1 General Research | Methodology

Secondary research was undertaken in section 1 where academic literature, industry reports, market data and other relevant sources were reviewed. Insights from the secondary research aim to provide a foundation of existing knowledge and to highlight gaps in current interventions, revealing areas that could be further explored via conducting primary research (Kelly et al., 2024). It also directly informs the formation of subsequent survey and interview questions that were deployed, ensuring it is grounded within pre-existing knowledge while still allowing space for additional insights to reveal (Kelly et al., 2024).

Primary Research Methodology

The primary research utilised a convergent mixed-method design across different stake-holders where qualitative and quantitative data collection and analysis are conducted in the same phase to produce a comprehensive and balanced perspective
(Hecker & Kalpokas, 2026). Semi-structured inter-views and an online survey with a mix of closed- and open-ended questions were the two methods utilised (Hecker & Kalpokas, 2026). Methodological triangulation, which involves combining different tools for data collection, and data triangulation, which involves comparing finding across multiple sources or datasets, were both applied (Denzin, 2012). This triangulation ensures a comprehen-sive understanding of the research problem and enhances the overall validity and strength of the findings (Denzin, 2012).



Method 1 Overview:

Survey

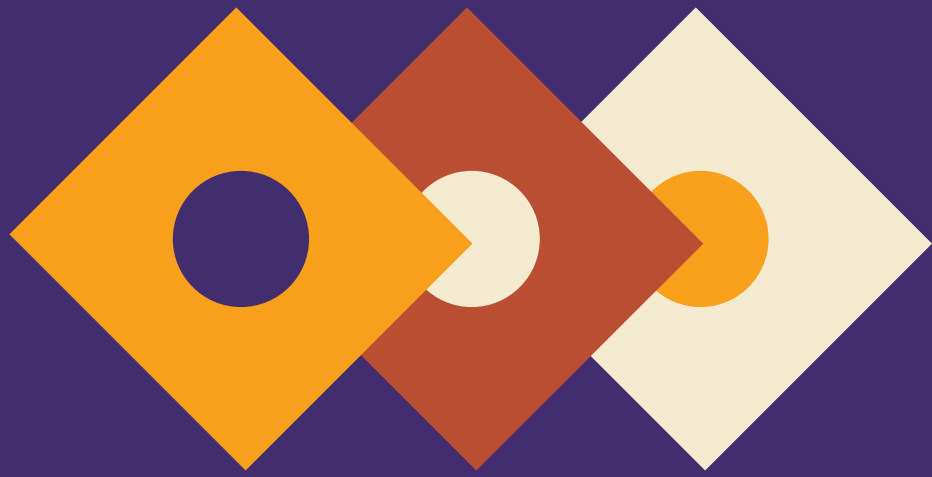
Survey allows for a broad reach of target participants and benefits participants through its convenience of responding at the participant's personal time and pace (Regmi, 2016). The survey was conducted via Qualtrics over a period of two-weeks and utilised a mix of social sampling, where posts are generated across various social media, and direct recruitment (Regmi, 2016). For the purpose of clarity and grounding, the survey stated Brisbane CBD and Southbank as representative sites for 'Urban Outdoor Environments' in this research.

It included 7 short-answer questions and 17 quantitative response questions which generated over 57 responses. The survey questions were designed to start with simpler questions before building up to short answer responses, which prompt the participants gradually enter the right headspace and provide initial ideas to inform more intricate responses (Regmi, 2016).

Method 2 Overview:

Interview

Semi-structured interviews (SSI) provide a flexible framework of core questions while building rapport and allowing the freedom to probe deeper into expert insights and experiences (Kakilla, 2021). The SSI included 8 core questions and involved five industry experts across the field of wayfinding design, environmental graphic design and architecture. The recruitment was conducted through direct approach via Email and Linkedin. The interview questions were aimed to understand current industry practices, challenges of the user group and consideration on existing solutions which would be triangulated with the survey responses (Denzin, 2012).



Method 1 Limitations:

Survey

The primary limitation comes from utilising social sampling via social media platforms. This may elicit selection bias and may not be fully representative of the wider populations (Arias et al., 2023). Therefore, the findings may be more indicative of a user group instead of being generalisable (Arias et al., 2023).

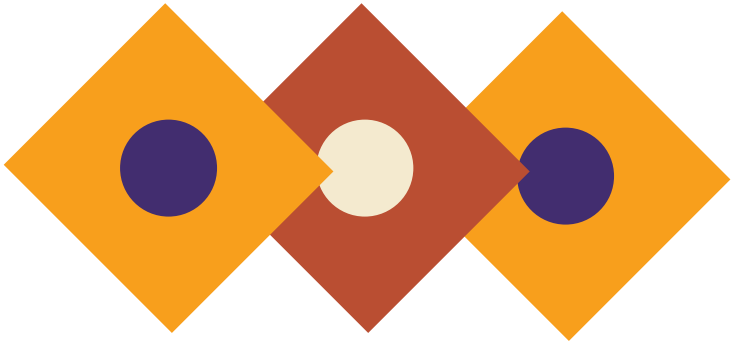
The participants were requested to 'recall their first time experience' in relation to exploring the stated urban spaces which could introduce recall bias (Levine & Safer, 2002).

Additionally, the inclusion of 7 short answer responses provided depth to the overall data but also becomes friction for certain participants as evident through several response drop-offs when these questions were encountered.

Method 2 Limitations:

Interview

SSI may introduce the risk of interview bias where the researcher may influence responses through leading questions, tones and reactions (Adams-Quackenbush et al., 2019). The flexibility of structure may also create challenges in comparability between responses (Kakilla, 2021).



Qualtrics was utilised to convert raw data into visualisations such as bar graphs and pie charts which are utilised to analyse findings. Qualitative responses were exported to Taguette where coding was done manually to uncover underlying themes and patterns. This section will discuss the key insights derived. Refer to Appendix C to view extended survey questions and responses.

Reliance on Digital Apps

Approximately 69% of participants (Q5) reported that they primarily rely on digital navigation apps (e.g., Google Maps, Apple Maps) when exploring unfamiliar outdoor urban spaces. However, a bivariate comparison (Figure 5) between Q5 (preferred navigation tools) and Q7 (actual reliance on physical signage) reveals a deeper overlapping behavioural insight: although users primarily prefer digital navigation apps, they still rely on physical signage with 67% of participants still relying on physical signage at least sometimes which could indicate that environmental cues remain essential for reassurance and micro navigation.

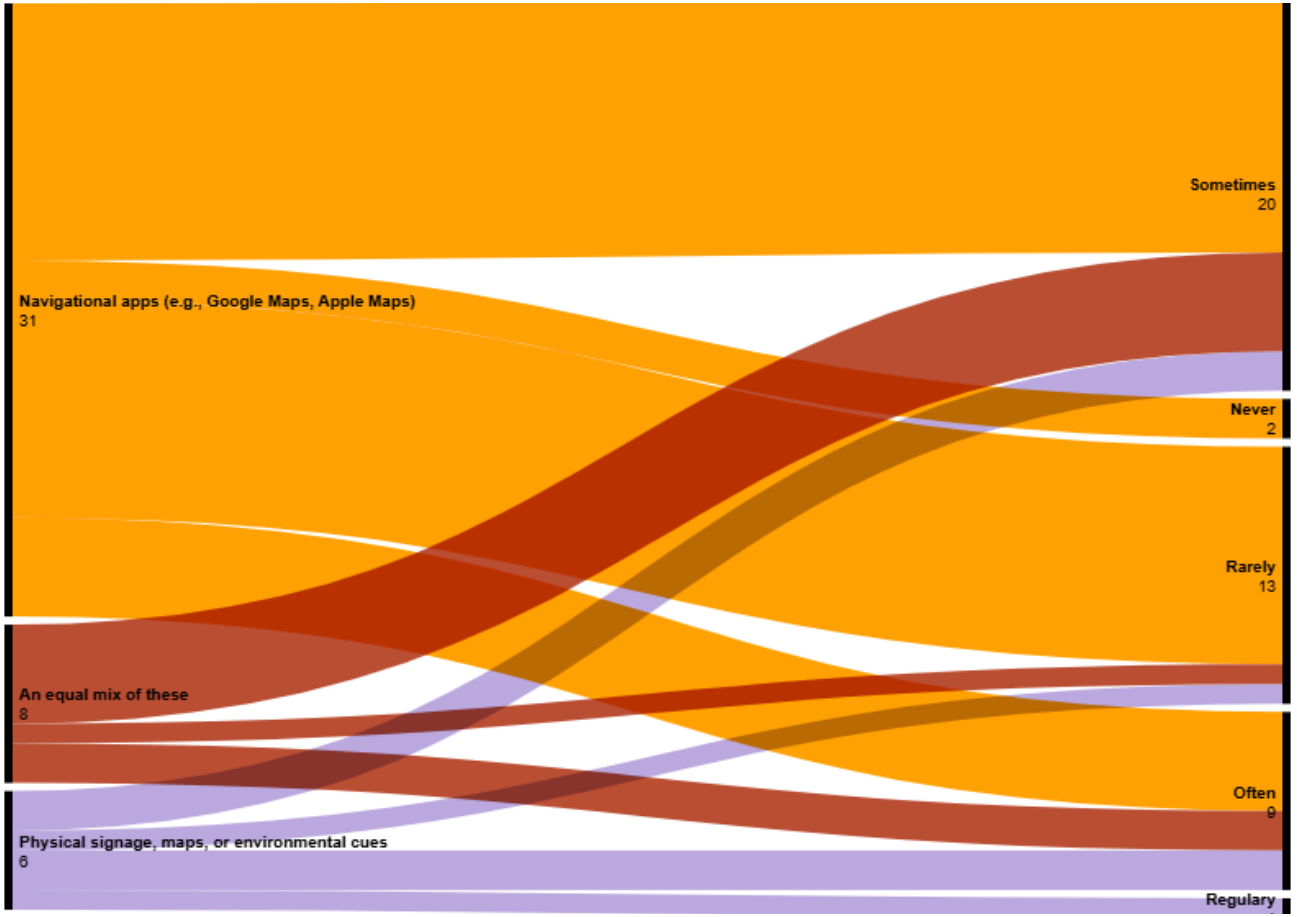


Figure 5. Sankey diagram of Bivariate Analysis between Q5 & Q7

Gap between digital and physical

Thematic analysis comparison was conducted to questions 17-20 that enquires about common environment based and digital based interventions. This key themes are presented as below.

Q17-18: What do you like / not like about using digital solutions (such as GPS apps and digital kiosks) when exploring and navigating such spaces in general?

Q19-20: What do you like/ not like about using analogue signage/maps when exploring and navigating such spaces in general?

Analogue solution

Positive feedback: Easy and direct confirmation for overall layout and key information, not internet or tool needed, users report having better spatial awareness, trusted point of truth, tactile interaction, engaging design.

Negative feedback: may be outdated, no real-time update, distances between signs can result in being lost, complexity

Digital solutions

Positive feedback: Accurate, simple and direct understanding, provides an ETA and suggestion, ability to have a bird's eye view on surroundings.

Negative feedback: Internet lag affects user experience, not accurate for very small streets, not always updated, detracts focus from the actual space.

User Behaviour in Understanding Space

Analysis of Q11 and Q15 indicates a relationship between the information users seek and the tools they rely on when navigating unfamiliar outdoor urban spaces. Users most often look for orientation (20%) and how to reach their destination (21%). Familiar landmarks (28.1%) play an important role in supporting users' need to understand their position within the space. Following this, signage/ maps account for 19.3% of reliance for spatial information.

Q11: When visiting new outdoor urban spaces (like Brisbane CBD or Southbank) for the first time, how do you explore and what do you rely on to find your way.

Q15: When visiting outdoor urban spaces for the first time, what information do you tend to seek out first?

Exploration and Interaction

Analysis on Q9 and Q22 show that while respondents were split between being goal oriented (29%), exploratory (27%), or a mix of both (36%), most participants expressed a strong willingness to explore further when interactive or engaging features were present. 51% rated 8, 9, and 10 for Q22, indicating that interactive elements may increase the motivation to explore across all user types.

Q9: When visiting new outdoor urban spaces (like Brisbane CBD or Southbank) for the first time, do you tend to be: goal oriented, open to exploration or a mix of both.

Q22: Would interactive or engaging features make you more likely to explore such spaces further as a newcomer or occasional visitor? (1-10)

The interview was recorded via Otter.ai and UniScribe was utilised as a backup to generate written transcripts. These were exported to Taguette where coding was done manually. A total of 82 raw codes were derived which were then refined to 38 codes and classified under 7 themes shown in Figure 6. Microsoft Excel was utilised to manually sort data, quotes and generate visualisations. Refer to Appendix D to view extended interview questions and transcripts.

Maps, Orientation & Information Clarity

Orientation and immediate understanding of surroundings were identified as key priorities when entering new spaces as users tend to seek safety before engaging in other actions. Maps and landmarks were particularly mentioned several times in playing a strong role to guide users to orientate. Clear, legible information is emphasised by interviewees as crucial, especially within decision points. There was consistent mention of Information having to be selectively and strategically shown or 'progressive disclosure' as stated by an interviewee. Simplicity and legibility were emphasised to offer a quick understanding of space and prevent cognitive overload (such as through simpler maps and avoiding large information bodies). Different inputs of information overtime will support the user group in building a mental map.

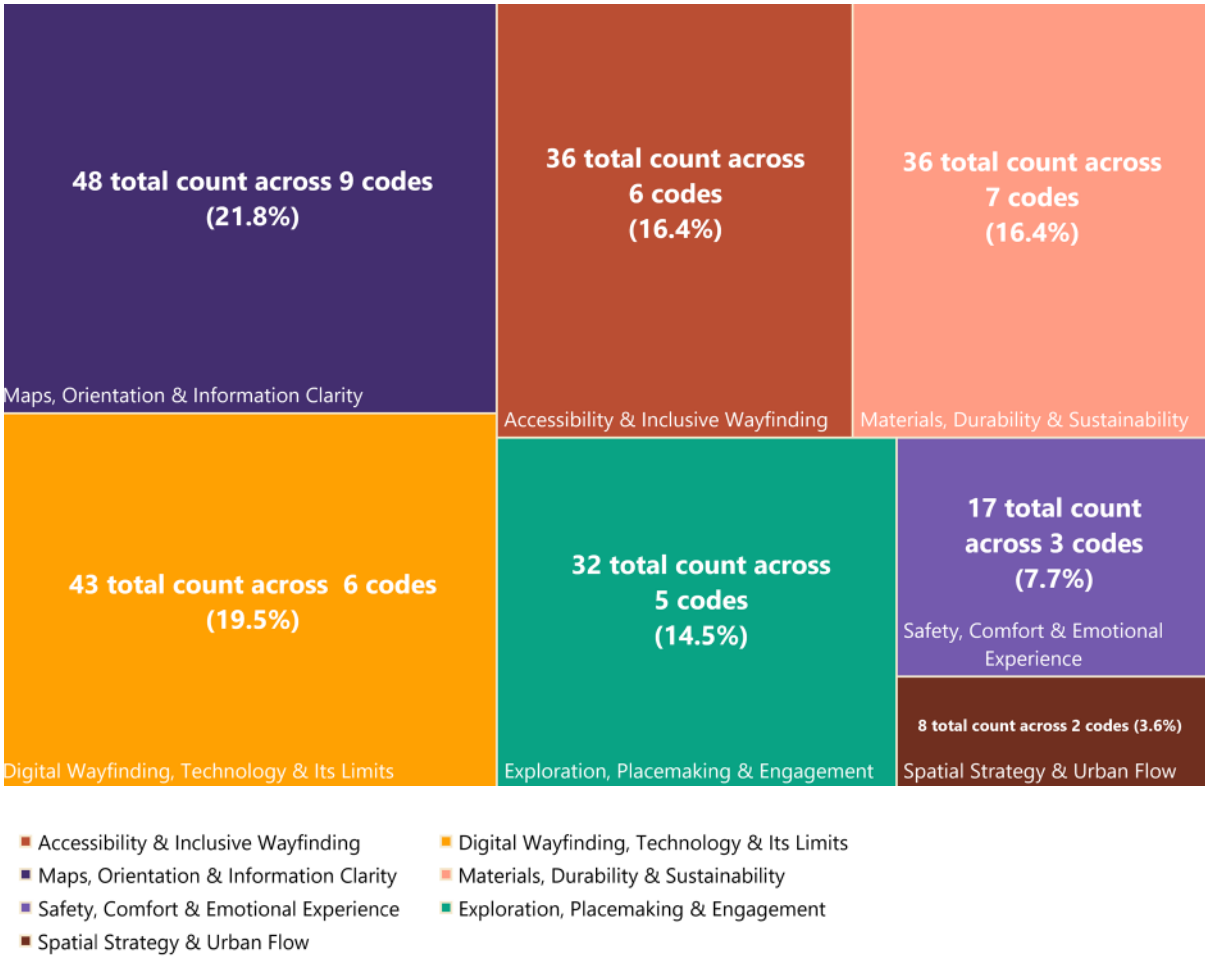


Figure 6. Thematic Analysis Treemap

" People try to make sense of their surroundings all the time for safety, for navigational purposes. It's the first thing that any human does to kind of try to understand where they are. "

Digital Wayfinding Technology & its Limits

Digital navigational apps are deemed as highly useful, especially in addressing accessibility and some apps, such as What3words, are even incorporated in industry into static signage as an enhancing feature. Although utilising digital apps on phones brings comfort and stems from daily habit and convenience, it was also mentioned by several interviewee to cause detachment with surrounding environment, regardless of whether users are new to the space or frequent them more often. Digital systems in the built environment have limitations if infrastructures were to be damaged or power is lost. AR specifically was mentioned across several interviewees as an emerging technology being explored which bridged the physical and digital space.

“The dream is when the physical system works seamlessly with the digital.”

Materials durability & sustainability

Selecting the right materials for specific outdoor conditions is important to ensure durability for environmental interventions such as signs. Consideration towards, vandalism, entrapment and consistent lighting is also disclosed by different interviewees. Sustainability comes from ensuring durability, manufacturing with modularity in mind and designing the form to be timeless in the first place. In real-world projects, budget and safety risk mitgations tend to dictate the final outcomes.

Exploration, placemaking & engagement

Landmarks are numerously mentioned by every interviewee as being a key feature in anchoring, orientating and encouraging exploration within users. They can range from public art to any distinct spatial feature and can function as a placemaking tool which makes a space memorable.

Accessibility and inclusive wayfinding

Accessibility requitements differ depending on location. Generally, user with visual, audio and physical challenges alongside multilingual backgrounds were most commonly mentioned by the interviewees.



3

discussion & design.

3.1 Discussion

3.2 Design Implication

3.3 Conclusion

3.1 Discussion

The primary research strengthened the findings derived within the literature review and secondary research while also uncovering several deeper nuances within existing research.

Orientation and Route Decision as Critical Points

Initial literature review uncovered orientation and route decision as the two starting phases in wayfinding to understand and navigate spaces. Primary research via surveys indicates that understanding 'where I currently am within the whole space' alongside 'how to get to my specific destination' are the two highest voted response from participants. This could indicate 'orientation' and 'route decision' as potential areas for designing interventions. Additionally, it points is backed by the thematic analysis on interviews where orientation is emphasised as a crucial step in supporting spatial awareness and establishing a sense of safety for users before even navigating or exploring further.

The importance of Landmarks

Landmarks were quotes in Lynch's 1960's The Image of the City as one of the five key elements (other four includes paths, edges, districts and nodes) that support spatial understanding and in forming coherent mental maps. Primary research reveals a strong emphasises on this element compared to the other four in association with navigation and exploration. Survey users selected landmarks as a secondary reliance aside from digital navigation tools, ahead from signages and path.

The survey and interview analysis indicate landmarks as the first element users rely on when lost and the first element users integrate into their memory within new spaces. Landmarks, ranging from distinct trees to public art, anchor and attracts users to explore as derived.

Interactivity

The benchmarking process revealed an interesting insight regarding the interactivity of existing solutions. Environmental signages are mostly static and minimal in interaction, whereas digital signages and kiosks often only offer predictable and standard interaction through touchscreen monitors. Digital apps and smart wearables currently offer the most interaction which could contribute to user's preference for them as shown in surveys. This insight matters as survey respondents have mentioned not engaging extensively or utilising solutions beyond digital maps due to limited interactivity of the other options, lowering their interest to explore..

Bridging the physical and digital

Current solutions are often purely physical (signage and maps) or completely digital such as apps. Digital kiosks exist however the survey indicates users disinterest in engaging with them which could present an opportunity for improvement and customisation.

Initial literature mentioned lower spatial awareness overtime when utilising digital maps which is backed by the primary and secondary research revealing similar insights, creating a reliance. Though effective, the use of direct turn-to-turn commands deters user from further exploration. Analysis from the survey reveals users' tendency of cross-checking digital information with physical cues and elements in space, this opens an opportunity in designing solutions that bridges these two sides, especially with current AR exploration and ongoing utilisation of NFCs and QR codes to create 'phygital' solutions.

3.2 Design Implication

Through the discussion in section 3.1, several design implications were derived which be leveraged and considered in future design interventions:

1.Prioritise Orientation for Immediate Spatial Clarity

User consistently seek orientation as a first step within new. Therefore, interventions could prioritise this phase by providing clear cues or simplified spatial overviews. Providing clarity at entry and decision points assists in reducing cognitive load, supports feelings of safety and sets a foundation for spatial understanding.

2.Blend Physical and Digital (Phygital) Interactions

A gap exists between static signage and highly interactive digital tools. Therefore, blending physical clarity with selective digital augmentation or integration (e.g. AR, NFC or other dynamic/digital layer) can improve usability without overwhelming users.

3.Use Landmarks as Core Navigational and Exploratory Tools

Landmarks are the most relied-upon environmental cue and strongly supports spatial memory. Designing distinct, memorable anchors or incorporating them into design interventions can improve orientation and encourage exploration.

3.2 Design Implication

Through the discussion in section 3.1, several design implications were derived which be leveraged and considered in future design interventions:

4.Increase Interactivity to Motivate Exploration

Over half of the respondents indicate interest in exploring more with the presence of interactive elements. Introducing playful, tactile or dynamic features can increase engagement within spaces. This insight was also met positively by industry experts as well.

5.Reduce Cognitive Load Through Progressive Disclosure

Strategic and selective information disclosure is to be considered. Structuring information hierarchically and revealing it progressively helps prevent overwhelm and supports mental map formation.

6.Universal Design Principle

Users with visual, cognitive, mobility, or language barriers face additional challenges. Therefore, adopting a universal design approach such as through designing multimodal cues including tactile, auditory, visual, and multilingual friendly options (such as pictograms) ensures broader accessibility and aligns with SDG 11 mentioned earlier.

Through the discussion in section 3.1, several design implications were derived which be leveraged and considered in future design interventions:

7.Durable and Sustainable design via modularity

For solution intervention in the built environment, there are risks of being outdated or difficult to maintain, especially considering weather or vandalism concerns. Designing with modularity, durable material selection yet still maintaining robustness ensures long term viability and easy update.

conclusion.

The research demonstrates that effective wayfinding in unfamiliar outdoor urban spaces relies on more than simply directing users from point A to point B. Newcomers and occasional visitors require clear orientation, intuitive environmental cues and supportive information structures to feel confident, safe and willing to explore. Both the literature and primary research highlight the importance of landmarks, progressive disclosure and reducing cognitive load, while also revealing the limitations of current tools. Static signage lacks interactivity, and digital apps can diminish spatial awareness. Survey findings show that users blend digital and physical cues, relying on apps for efficiency but turning to signage and landmarks for reassurance and micro-navigation. Interviews also further emphasise the value of clarity, legibility and multimodal communication, particularly for users with diverse accessibility needs.

Together, these insights point toward a clear design direction: interventions should integrate the strengths of physical and digital systems, enhance environmental clarity, and introduce interactive or engaging elements that motivate exploration. In addition to this, by adopting inclusive, durable design principles, future design interventions can better support spatial learning and comfort.

4

references.

4.1 References

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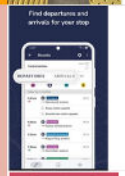
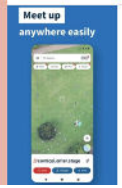
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appendices.

5.1 Appendix A |
Additional Benchmarking Content

5.1 Appendix A | Additional Benchmarking Content

Full Benchmarking Table

Product Code	Product Name	Category	Image	Key Features	Primary Material	($AUD) Cost (estimate)	Link to source			Cost	Universal Accessibility	Feedback Modality	Aesthetics & visual clarity	Interactivity	Durability	Usability / Ergonomics	Effectiveness of use	Maintenance/Repairability	Overall [out of 45]		Orientate	Route-planning	Navigate	Destination Recognition	Encourage Exploration
Product 1	Sundial	Analogue		Utilising Sun's position to cast a shadow from the gnomon 'handle' part. The shadows can determin local solar time, find cardinal directions and estimate latitude. Assist ancient navigation.	Stone(marble & granite) and metal (bronze & brass)	$300-500	https://maxpolyakov.com/brief-history-of-the-origins-of-navigation/				1	1	3	1	5	2	2	4	19						
Product 2	Hiking Compass (A-10 NH Compass)	Analogue		Marked lines and arrows with magnetic needles and bearings that rotate to indicate direction. Has a magnifying glass and often used with printed maps.	Magnet, plastic, metal	$24	https://www.greenbelly.co/pages/how-to-use-a-compass			4	2	1	3	2	4	3	3	4	26						
Product 3	Braille Trail	Analogue		Pavements made of tiles with dotted (warning blocks) or dashed (directional) pattterns.	Concrete, stainless steel, hard-wearing polymers and polyurethane.	$20-40 / paver	https://blindglobetrotters.com/tactile-paving-how-blocks-with-dots-help-provide-street-sense-for-the-blind/				5	2	2	2	5	4	4	4	28						
Product 4	Translink	Apps		Mainly to show the transport routes (ferry, bus, trains) | Supports route planning for future trips	Software	N/A (Free for User)	https://translink.com.au/plan-your-journey/translink-app				4	2	4	4	5	4	4	5	32						
Product 5	Bindi Maps	Apps		Mainly for indoor use and caters primarily for visual impaired users | Utilises IoT hardwares (beacons) and smartphone sensors to give an indoor map | Offers step-by-step audio guidance.	Software	N/A (Free for User)	https://bindimaps.com/				5	4	3	3	5	4	4	5	33						
Product 6	What 3 Words	Apps		Every 3 metre square of the world has been given a unique combination of three words. Used for e-commerce and delivery, navigation, emergencies and more.	Software	N/A (Free for User)	https://what3words.com/				4	2	4	3	5	4	4	5	31						

Full Benchmarking Table

Product 7	Google maps	Apps		Shows maps of anywhere on earth. Utilises AI-powered assistance for searching and immersive guidance | AR overlay direction feature | Live updates of delays and traffics for transport users | Voice activation and guidance	Software	N/A (Free for User)	https://maps.google.com/				4	4	3	4	5	4	4	5	33		
Product 8	Pokemon Go	Apps		It is actually an AR game but it show s layout of actual maps and takes user to explore landmarks around the area. | Draws from Open Street maps (OEM) and GPS of phones | the entire globe is broken down to S2 cells to control 'pokemon' spawns | loacl landmarks are derived from existing databases and player submissions. | AR overlay of pokemon to actual space (Phygital)	Software	N/A (Mostly Free for User)	What is the Map View? — Pokémon GO Help Center https://share.google/KbSCTOsgZTLTN95hV				3	3	4	5	5	3	3	5	31		
Product 9	PAM	Apps		Mainly for indoor sports events or festivals, it helps people navigate large, complex venues like stadiums, university campuses, and shopping districts | Can be accessed via links, QR codes or NFCs	Software	N/A (Free for User)	https://pam.co/				4	3	4	4	5	4	4	5	33		
Product 10	Vismi Interactive Kiosk	Digital Signage/Kiosks		Interactive standard display often used indoors. | Touchscreen allows user to input information | Lower height and bent at bottom to allow for accessibility and ergonomic considerailton fo users interacting.	Carbon steel sheets, ABS composite shell for smooth finish which can be painted, CNC aluminium frame fro screen and strengthened glass with oolephobic coating (finger-resistant) with touch screen sensors (10-point multi touch sheet) under	$4500-$7800	https://www.visimidigital.com/products/indoor-digital-signage/interactive-kiosk-various-colour-options-available				4	3	4	4	4	4	4	3	30		

Full Benchmarking Table

Product 11	MELa 3215 Solar Powered LED with Interactive Signage Display	Digital Signage/Kiosks		IP65/66 weather resistant, interactive touchscreen and has lighting which imporee visibility. | Tempered glass to protect against vandalism and solar power allows the kiosk to work 24/7	Galvanised steel internal frame, tempered vandal proof glass/transreflective that uses the sun to illuminate the screen as well, poycarbonate or acrylic light diffuser, silicone internal sealing, photovoltaic canopy and battery	$6,850	https://mediamea.store/products/mela-3215-led-street-lamp-post-outdoor-interactive-digital-signage-display-totem-with-embedded-i5-pc-10-points-pcap-touch-screen-and-hd-camera				3	3	3	4	4	4	3	3	27						
Product 12	Commend: od22 interactive voice commend kiosk	Digital Signage/Kiosks		High-end outdoor interactive kiosk | Provides real-time update on schedules, wayfinding assistance, emergency call for tourists and residents | Multilingual support, Conversational AI to guide quesitons and Audio technology with loop amplifiers for hearing impairment to ensure clear communicaiton in noisy enviornments | voice enabled	Aluminium, LED touch screen,	$8000-$15000	https://www.commend.com/en/products/intercom-stations/interactive-kiosk-od22/				4	4	3	4	4	4	4	3	30						
Product 13	Reimon: Milano Dual Digital Kiosk	Digital Signage/Kiosks		Dual interactive touschreen with differing height allows for accessibility consideration. |Prints out ticket and has QR code scans	Fabric covering, Internal metal framing, Internal computer hardware, display monitors	$11000-$18500	https://www.youtube.com/watch?v=Mq3YPJLBvOw				4	3	4	3	4	4	3	3	28						
Product 14	Wayband: vibrating navigaiton wristband	Smart Wearable Technology		Bluetootch connected, magentically charged and water resistant. It guides through vibrsation and parir with an app in your phone. Works by vibraitng when user deviates from general right direction towards desitnaiotn	Fabric band, plastic/metal buckle, sensors	$375-$750	https://haptic.work/wayband			2	4	2	3	3	4	4	4	3	29						
Product 15	Ashirase: Wearable for Shoes	Smart Wearable Technology		Clips on your shoe tongue and utilised intuitive virbraiton throguh the feet to provde dierecitonal guide.	Silicone foot strap, eletronic main pod from ABS plastic (injeciton molded), internal sensors and battery	$400	https://www.ashirase.com/global			2	4	3	4	3	4	4	4	3	31						
Product 16	Smart Glasses: INMO GO3 AI Smart Glasses	Smart Wearable Technology		AR overlay shows visual real-time arrows ad text direction, voice activated assistance and guidance and realt time translation integreation	thermoplastic polymer carved with CNC machining, glass lens	$760	https://www.inmoxr.com/collections/go			1	5	3	4	4	3	4	4	3	31						

Full Benchmarking Table

Product 17	Printed Maps	Analogue		Traditional printed maps of a specific location | gives overview but not very specific. | Grids in maps can be difficult and overwhelming to read for new suers	Standard or laminated paper	$10-30	https://hemamaps.com/collections/maps				5		2		1		2		1		2		2		3		1	19
Product 18	Toposcope	Analogue		Orientation table ofr graphic display placed often at a high vantage point to show direciotn, name and distance of notable landmarks	Metal (bronze, brass, stainless steel), Slate or granite, Conrete or brick	$3000-$10000 (Depending on custom project)	https://www.fermanaghomagh.com/services/community/completed-programmes/fermanagh-omagh-lag-local-action-						3		1		4		1		5		3		3		4	24
Product 19	Identification Sign	Traditional Signage Systems		Branded bright colours that attracts and communicates clearly | Minimal written content meant to identify space | Often has more opportunity of creative designs that fit the space	Aluminium panel, Acrylic (maybe) and digital printed vinyl, limestone cladding	$15000-$30000	https://www.armsign.com.au/town-entry-signage?utm_source=Pinterest&utm_medium=organic						3		1		5		1		5		4		3		3	25
Product 20	Identification Sign: Translink's Bus Stop	Traditional Signage Systems		Uses E paper which reuiqres low energy input allowing real-time update of schedules. | Comes with NFC and/or QR codes for further informational update (phygital) | 24/7 Wireless telemetry that allows informaiotn update	Painted aluminium bar, Aluminium sign panels, protective glass and E-paper, NFC chip	$8500-$13500	https://www.businews.com.au/tmr-completes-statewide-solar-powered-e-paper-bus-stop-rollout/						3		3		3		3		4		4		4		4	28
Product 21	Interpretive Signs	Traditional Signage Systems		Descriptive and educational. It provides informaiton about what is in the soace such as descirption, history and such. Has opportunity for micro-itneractions to enagage users | often have blocks of text which could limit multibakcground users from accessing the ifnormaiotn	Timber, Resin, Aluminimum brakcet, Graphics	$4800-$10000	https://www.3d-incrust.fr/mobilier/signaletique-ludique/32						3		1		4		2		4		3		3		3	23

Full Benchmarking Table

Product 22	Regulatory: Trail post	Traditional Signage Systems		Standad and internationally recognised pictorgrams are utilsie| Size and contrast is very important as safety and regulation needs ot be communciated | often cuopled with concise text as added layer of infromation| braille can be utilised as well	Interal steel frame, ACM (cheper) or Aluminium panel with powder coated or painted finish, cast vinyl decals	$3500-$7500	https://www.behance.net/gallery/31112429/Burgess-Park?utm_source=Pinterest&utm_medium=organic	4	1	4	1	5	4	4	3	26
Product 23	Informational: 3D Tactile Maps	Traditional Signage Systems		Tactile map that utilises contrasting colours and braille. | Beyond just 3D outlines of the overall lspace, forms of landmarks are created to allows visually imparied users to understand the landmark beyond just words/braille.	3D rpinted/ CNC-milled from industrial grade impact resitant polymers. | Powder coated metal (thermaformed) | Metal frame | printed graphics	$25000-$45000	https://tactilestudio.co/achievements/luma-arles-sensory-station-tactile-device/	4	3	5	3	3	4	5	3	30
Product 24	Informational: Flat Diagrammatic map	Traditional Signage Systems		Schematic maps that shows current location and localotn relative to it istead of complex maps | Has direcitonl informaton as well | contrast, legibiltiy and typography is important (expecially indicating "you are here") | Yellow contrast against space to signal it is an informaiont point| QR code to scan for audio (phygital)	folded aluminium panels, digitally printed graphcis	$500-$850	https://au.pinterest.com/pin/123145371056570160/	4	2	4	2	4	4	4	3	27
Product 25	Direcitonal: Fingerpost	Traditional Signage Systems		High rise placement of fingerport and colour contrast pulls in user's eye.| Clear direction points allows for quick informaiotn understanding	Galvanized steel post, Aluminium panels	$1700-$3400	https://diadem.co/projects/marram-baba-merri-creek-parklands/	3	1	4	1	5	4	4	3	25

Full Benchmarking Table

Product 26	Directional: Colour coded floor/wall graphics	Traditional Signage Systems		The distinct colour, arrow and typography on the floor/wall guides users directly to where the need by simply following the path, cutting away confusion	Industrial grade, floor vinyl with digitally printed graphics	$70-$120 per linear meter	https://au.pinterest.com/pin/21926907602469960/							4	2	4	2	3	5	4	3	27
Product 27	Signage Family: Brisbane City	Traditional Signage Systems		Comprised of 2 types: Fingerpost sign (directional) and Monolith (informational and identification) . | Contrasting colour against the space signals its presence and use| consistent branding between the sign family and across the entire site indicating the space is part of one unit (i.e. Brisbane CBD). Benefits in stronger informaiton communicaiton and creates trusts for users navigaitng aorund | multilingual wording and pictograms |	Galvanied metal frames, Folded and powdercoated/ polyurethane paint aluminium panels, cast vinyl/UV-printed printed graphics	N/A (Based on project)	https://dotdash.com.au/work/multilingual-brisbane-city-wayfinding/							5	3	5	2	4	5	5	4	33
Product 28	Signage Family: World Square Sydney	Traditional Signage Systems		Comprised of several types including: Finger post (directional), Red wrap-around pillar sign (identification), Floor graphics (directional), Information al signs. | All follow consistent branding in colour, assets and typography which dictates the scope and boudnary of the place when implemented around the site. | Consistent messaging for users and lowers congitive load due to visual pattern recognition| Scalable long term | Incorporates modular design with future update in mind	Aluminium panels, brushed sainless steel,floor printed graphics, tempered glass, UV curable ink/ premium cast vinyl for graphics	N/A (Based on project)	https://dladem.co/projects/world-square/							5	3	5	2	4	5	5	4	33

