Exploring Smart Heritage in an Urban Context with the Case Study of Chinatown Melbourne

by

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Abstract

Smart Heritage, derived from the Smart City concept, is an emerging field. While most research focuses on standalone applications and conceptual understandings, limited studies have explored the enablers and challenges of implementing Smart Heritage strategies in urban heritage contexts. Existing urban heritage assessment frameworks often place the concept of urban identity at the core of heritage significance. However, there is limited understanding of how urban identity is integrated into Smart Heritage. Consequently, this thesis explores how urban identity is mapped in urban heritage precincts and how these precincts can incorporate Smart Heritage strategies to improve cultural sustainability. This is illustrated through a case study of Chinatown Melbourne.

The methodology framework of this thesis involves four key phases. First, the precinct's heritage identity and spatial attributes are evaluated within its urban context. The thesis then examines how attributes of urban identity are considered in existing heritage assessment frameworks. It also investigates how best-practice Smart Heritage projects incorporate urban identity into their applications. In the final phase, the thesis identifies potential enablers and challenges of Smart Heritage implementation in Chinatown Melbourne, particularly regarding its urban identity. Quantitative and qualitative data were collected through mixed methods, including case study analysis, literature and archival review, field observation, space syntax analysis, and interviews.

The findings reveal that while top-down interventions have shaped Chinatown Melbourne's urban identity, integrating community-driven, bottom-up strategies is essential for preserving cultural authenticity and enhancing Smart Heritage initiatives. The potential of Smart Heritage in Chinatown Melbourne lies in utilising its unique spatial and cultural characteristics to reinforce its identity as a vibrant multicultural hub. However, enablers such as community engagement and technological integration need to be balanced against

challenges like sourcing funding, maintaining cultural integrity and navigating diverse stakeholder interests.

This thesis provides both theoretical and practical implications. Decision-makers engaged in urban heritage precincts can benefit from the transferable results and the methodological framework, using them to assess the feasibility of implementing Smart Heritage transitions. These findings are informed by in-depth understanding of urban characteristics, spatial attributes, urban identity, and the specific case study of Chinatown Melbourne. Future research should focus on exploring methods to increase community participation and evaluating the long-term impacts of Smart Heritage strategies on cultural sustainability, visitor engagement, and identity preservation.

Declaration of Authenticity

'I, Shiran Geng, declare that the PhD thesis by publication entitled Exploring Smart Heritage in an Urban Context with Chinatown Melbourne as a Case Study is no more than 100,000 words in length including quotes and exclusive of tables, figures, appendices, bibliography, references and footnotes. This thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work'.

'I have conducted my research in alignment with the Australian Code for the Responsible Conduct of Research and Victoria University's Higher Degree by Research Policy and Procedures.'

'All research procedures reported in the thesis were approved by the Victoria University Human Research Ethics Committee. The application ID is HRE22-190.'

Signature:

Date: 05/11/2024

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List of Publications

Based on the research reported in this thesis, the candidate has produced the following papers, which have been published or accepted in various international journals and peer-reviewed conferences.

Journal Articles

1. Geng, S., Chau, H. W., Jamei, E., & Vrcelj, Z. (2022). Understanding the street layout of Melbourne's Chinatown as an urban heritage precinct in a grid system using space syntax methods and field observation. *Sustainability (Switzerland)*, *14*(19), 12701. https://doi.org/10.3390/su141912701
2. Geng, S., Chau, H.-W., Jamei, E., & Vrcelj, Z. (2023). Urban Characteristics, identities, and conservation of Chinatown Melbourne. *Journal of Architecture and Urbanism*, *47*(1), 20–34. https://doi.org/10.3846/jau.2023.17383
3. Geng, S., Chau, H., Jamei, E., & Vrcelj, Z. (2023). Understanding place identity in urban scale Smart Heritage using a cross-case analysis method. *International Journal of Tourism Cities*, *9*(3), 729-750. https://doi.org/10.1108/IJTC-10-2022-0244
4. Geng, S., Chau, H., Jamei, E., & Vrcelj, Z. (2023). Unpacking shifts of spatial attributes and typologies of urban identity in heritage assessment post COVID-19 using Chinatown, Melbourne, as a case study. *Architecture, 3*(4), 753–772. https://doi.org/10.3390/architecture3040041
5. Geng, S., Chau, H., Jamei, E., & Vrcelj, Z. (2024). Demystifying the Use of Open-Access Data in Smart Heritage Implementations. *Tourism and Hospitality. 5*(4), 1125-1150. https://doi.org/10.3390/tourhosp5040063
6. Geng, S., Chau, H., Jamei, E., & Vrcelj, Z. (2024). Enablers and challenges of Smart Heritage implementation – the case of Chinatown Melbourne. *Smart and Sustainable Built Environment.* Accepted.

Conference Papers

1. Geng, S., Chau, H. W., Jamei, E., & Vrcelj, Z. (2024). Exploring the use of open access data in Smart Heritage – Using Chinatown Melbourne as a case study. *International Conference of Smart and Sustainable Built Environment (SASBE 2024).* Accepted.
2. Geng, S., Chau, H. W., Jamei, E., & Vrcelj, Z. (2024). Deciphering Smart Heritage: current technologies and best practice strategies. *47th Australasian Universities Building Education Association Conference (AUBEA 2024)*. Accepted.

Details of Included Papers: Thesis by Publication

No.	Chapter	Paper Title	Publication Status	Journal Title and Details (Scimago Journal Ranking)
1	Chapter 3	Urban Characteristics, Identity and Conservation of Chinatown Melbourne	Published.	Journal of Architecture and Urbanism (Q2) Impact Factor: 0.6
2	Chapter 4	Understanding the Street Layout of Melbourne's Chinatown as an Urban Heritage Precinct in a Grid System Using Space Syntax Methods and Field Observation	Published.	Sustainability (Q1) Impact Factor: 3.6
3	Chapter 5	Unpacking Shifts of Spatial Attributes and Typologies of Urban Identity in Heritage Assessment Post COVID-19 Using Chinatown, Melbourne, as a Case Study	Published.	Architecture
4	Chapter 6a	Understanding the Role of Place Identity in Urban-Scale Smart Heritage Using a Cross-Case Analysis Method	Published.	International Journal of Tourism Cities (Q1) Impact Factor: 3.3
5	Chapter 6b (Conference 1)	Deciphering Smart Heritage: Current Technologies and Best Practice Strategies	Accepted.	47th Australasian Universities Building Education Association Conference (AUBEA2024)
6	Chapter 7a	Enablers and Challenges of Smart Heritage Implementation – the Case of Melbourne Chinatown	Accepted.	Smart and Sustainable Environment (Q1) Impact Factor: 3.4
7	Chapter 7b	Demystifying the Use of Open-Access Data in Smart Heritage Implementations	Published.	Tourism and Hospitality Impact Factor: 0.5
8	Chapter 7c (Conference 2)	Exploring the Use of Open Access Data in Smart Heritage – Using Chinatown Melbourne as a Case Study	Accepted.	International Conference of Smart and Sustainable Built Environment (SASBE 2024)

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Date: 05/11/2024

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Chapter 1 Introduction

1.1 Urban Identity, Urban Heritage and Cultural Sustainability

In the field of heritage studies, decision-makers often develop conservation strategies based on the cultural significance of heritage using value-based frameworks (Reher, 2020). A value-based approach primarily involves recognising and enhancing cultural significance, which is often interpreted as heritage values (Fredheim & Khalaf, 2016; Mason, 2002). Cultural significance is a well-established concept recognised by the Burra Charter, a 'doctrinal treaty' originally developed to guide conservation practices in Australia, which has since gained international influence (*Australia ICOMOS Burra Charter*, 2013). The Burra Charter defines cultural significance as being 'embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places, and related objects' (The Burra Charter, 2013). Cultural values are frequently seen as the primary reason for considering a heritage site to be significant (Veldpaus et al., 2013). Official heritage conservation guidelines place particular emphasis on the concept of place identity and its inherent cultural significance, recognising it as an essential aspect worth preserving.

Research affirms that the concept of a 'sense of place' is deeply embedded in conservation guidelines and heritage assessment frameworks (O'Connor, 2000). The Burra Charter defines a place as 'sites, areas, land, landscapes, buildings, or groups of buildings, and may include components, contents, spaces, and views' (The Burra Charter, 2013). Alongside economic, environmental, and social sustainability, cultural sustainability is recognised as the fourth pillar of sustainability (Birkeland, 2008; Soini & Birkeland, 2014). In alignment with UNESCO's guidelines, achieving cultural sustainability in the heritage sector involves maintaining and enhancing the place identity of heritage sites (UNESCO, 2023).

Cultural sustainability in urban heritage precincts can be achieved by adopting a holistic approach that integrates heritage conservation with active community engagement. This

involves not only the preservation of tangible elements, such as buildings, landmarks, and public spaces, but also the protection and promotion of intangible aspects like cultural practices, traditions, and social activities that define the character of the precinct (Birkeland, 2008; Throsby, 2017). A key component of cultural sustainability is ensuring that the local community has a central role in decision-making processes. The lived experiences, values, and evolving needs of the community should guide the management of heritage sites to ensure that they remain relevant and reflective of both historical significance and contemporary realities (Snis et al., 2021). This requires creating adaptive frameworks that allow heritage sites to evolve while maintaining their core cultural and historical attributes. By promoting inclusive dialogue and considering the multifaceted needs of urban precincts, heritage conservation efforts can ensure that these areas remain culturally vibrant and relevant, adapting to urban growth. Managing tourism and commercialisation is also vital in maintaining the identity of urban heritage (Ding, 2017; Michelson & Paadam, 2016). Thoughtful strategies need to balance the economic benefits of tourism with the need to preserve the authenticity and cultural significance of the precinct. A sustainable approach recognises that heritage sites should evolve while continuing to serve as meaningful spaces for both the community and visitors, ensuring their long-term viability.

The term 'urban identity,' derived from place identity, often refers to the place identity of an urban fabric (Gospodini, 2004; Salah Ouf, 2001; Ziyaee, 2018). Dating back to the 1950s, research on this concept emerged as modernist planning and architectural approaches led to cities adopting uniform and repetitive characteristics (Davison, 2013). This uniformity in built environments contributed to a perceived loss of place identity (Manahasa & Manahasa, 2020). Concepts that emerged as a response to this perceived loss of distinctiveness are considered the origins of urban identity. Some of these ideas are still used as alternative terms for place or urban identity today. As Cheshmehzangi (2020) summarises these concepts include terms such

as ‘sense of place’ or ‘image of the city’ (Lynch, 1960), ‘placelessness’ (Relph, 1976), ‘genius loci’ (Norberg-Schulz, 1980), ‘townscape’ (Cullen, 2012) and ‘place identity’ (Canter, 1977; Hummon, 1986; Proshansky et al., 1983). Since then, the concept of urban identity has been extensively reviewed across various disciplines, including architecture, urban planning, human geography, urban anthropology, and environmental psychology (Hauge, 2007). Contextually, this thesis situates the discussion of urban identity in an urban heritage context, with Chinatown Melbourne serving as the key case study.

1.2 Smart Heritage

The concept of Smart Heritage has emerged from the broader discourse surrounding Smart Cities. Smart Heritage connects tangible and intangible heritage with its visitors through both physical and virtual experiences (Lupo & Özdil, 2013; Vattano, 2014). In essence, Smart Heritage aims to create digital linkages between institutions, visitors, and heritage assets across various built heritage sites, encompassing both tangible and intangible cultural dimensions. It adopts participatory and collaborative strategies to make cultural information more accessible to the public, thereby enhancing interpretation opportunities and digital curation. Batchelor et al. (2021) define Smart Heritage as the intersection of the Smart City and Heritage disciplines, integrating autonomous and automated technologies with innovative approaches and subjective interpretations of historical contexts. In this perspective, smartness and heritage are interwoven, forming interconnected theoretical constructs within Smart Heritage. As the concept is relatively new, many heritage-focused projects were initially categorised under the Smart City or Smart Tourism frameworks, often involving urban-scale initiatives centred around built heritage sites. Accordingly, this thesis explores place identity within these urban heritage projects and explores potential transitions to Smart Heritage.

1.3 Chinatown Melbourne - the Case Study

Like many countries with a rich history of immigration, Australia is home to numerous distinctive ethnic enclaves that are key heritage sites, particularly following the removal of the White Australia Policy (Anderson, 1990; Jones, 2005). Chinatown Melbourne is one of the oldest and most well-known ethnic precincts located in the city centre. It was originally established in the 1850s by Chinese immigrants who settled in the area during the gold rush period (Cannon, 1993; Yeen, 1986). The precinct is bounded by Swanston, Lonsdale, Exhibition, and Bourke Streets. Over the past 170 years, Chinatown Melbourne has undergone significant transformations in response to shifts in the political landscape, racial attitudes, demographic changes, and economic and cultural perceptions, which have shaped the precinct's function and character over time (Anderson, 1990; Chau et al., 2016; Yeen, 1986). According to Chau et al. (2016), the area developed from a lodging district perceived as 'worthless' and associated with 'sinister and illegal activities' to a furniture production hub, a wholesale fruit market, and, eventually, a celebrated multicultural enclave known for its Chinese cuisine and cultural tourism, attracting both locals and visitors. This evolution reflects the changing architectural and urban features of the area as well as the influence of targeted planning and conservation policies.

Currently, many of the buildings in the area are recognised as having heritage significance. At the local level, the council uses Heritage Overlay controls to protect buildings and precincts with local heritage value, requiring any renovations to comply with the council's regulations through the planning permit process. At the state level, seven buildings within the precinct are listed on the Victorian Heritage Register, identifying them as some of the state's most significant heritage sites. Of these, three buildings facing the main street are directly linked to the precinct's Chinese cultural heritage through their functions and features. The 1985 Action Plan significantly shaped the planning approach for the precinct, with many of its

proposed principles implemented between 1985 and 1988 and still in practice today (*Melbourne City Council*,1985). Following the changes implemented in the precinct according to the Action Plan, Chau et al. (2016) argue that Chinatown Melbourne's value goes beyond historical preservation or city branding. It has become a symbol of cultural pluralism in Australia, challenging past discrimination and segregation while resisting the pressures of a homogenised and globalised cityscape. While it remains a symbolic centre for the Chinese community, its identity has increasingly shifted towards tourism, with the precinct now seen by the council as a tourist destination rather than a cultural hub. Mak (2009) further contends that the precinct has become more of an area shaped by council and commercial interests and has not fully reclaimed its potential as a cultural centre or an authentic expression of Australian-Chinese identities.

Prior to the pandemic, Chinatown Melbourne thrived with a vibrant mix of Chinese and non-Chinese activities that drew visitors from diverse cultural backgrounds. However, the COVID-19 pandemic, coupled with the precinct's focus on tourism, led to a sharp decline in business activity and visitor numbers since 2020 (Yang & Fang, 2020). Like many other Chinatowns around the world, this precinct is now facing an identity crisis in the wake of the pandemic, raising concerns over whether its strategy as a tourist destination is sustainable (Dansie, 2022; Hartke, 2022). The issue is not just whether the precinct serves as a cultural centre or a tourist attraction, but also determining the most appropriate form that this attraction should take. In response to the pandemic, the city council has implemented various revitalisation strategies, such as dining and entertainment discounts and art exhibitions, to breathe new life into the city centre (*Victoria State Government*, 2022). Nevertheless, the precinct's identity crisis remains unresolved, as its future direction and role continue to be debated.

Cultural identity in Melbourne's Chinatown can be understood through both tangible and intangible elements, which are inherently fluid and evolve over time. Tangible elements include the precinct's architectural heritage, such as traditional Chinese facades, heritage-listed buildings, gateways, and the distinctive street layout. Public spaces, including laneways and courtyards, provide essential settings for both heritage conservation and contemporary community activities (*Melbourne City Council*,1985). These physical structures serve as enduring symbols of Chinatown's identity, yet they are continually reinterpreted as the precinct adapts to urban environments. The intangible elements of Chinatown's cultural identity are equally dynamic. These include social and cultural practices, such as festivals like Chinese New Year, traditional business operations, and community gatherings. These living traditions ensure that the precinct's identity is not static but continuously shaped by the practices and values of its community. As the local community continues to evolve, the cultural expressions that define Chinatown's role within the broader city also shift and adapt.

As this thesis explores, the cultural identity of Chinatown Melbourne is fluid, requiring a flexible approach that balances the preservation of tangible heritage with the adaptation of intangible cultural practices. Stakeholder engagement is critical in this process, as it ensures that the precinct's identity reflects both its historical significance and its current present role as a vibrant, multicultural urban precinct. Recognising the fluidity of cultural identity enables the precinct to remain relevant while reflecting its rich history.

1.4 Research Aim and Research Question

This study aims to explore how urban identity is mapped in urban heritage precincts and how these precincts can incorporate Smart Heritage strategies to enhance cultural sustainability, using the case study of Chinatown Melbourne. To achieve the main research aim, the study first focuses on understanding the case study from an urban identity perspective, accomplished through a series of investigations into its urban history, characteristics, and

spatial qualities. Additionally, the thesis examines existing heritage assessment frameworks to determine whether they adequately capture the key aspects of urban identity. Building on these understandings, the thesis then addresses the Smart Heritage aspects, primarily focusing on current best practices, the role of identity in these practices, and the use of existing open-access data. The thesis engages stakeholders to evaluate whether the implementation of Smart Heritage is feasible for enhancing the urban identity of the case study and, ultimately, its cultural sustainability.

The aims of the research are as follows:

1. To provide an overview of the case study from an urban heritage perspective by examining the precinct's urban history and characteristics.
2. To further investigate the spatial qualities (street network, visibility relationships, and the relationship between streets and buildings) and characteristics of the case study, which are often neglected in existing heritage value frameworks.
3. To explore how heritage assessment frameworks can be adapted in the post-pandemic context to sustainably reflect the identity of the case study as an urban heritage site, with a particular emphasis on spatial considerations.
4. To scrutinise the role of identity within current Smart Heritage frameworks.
5. To assess the currently available open-access data for the case study and how these datasets can be employed in the Smart Heritage context.
6. To evaluate how Smart Heritage can influence an urban heritage precinct's identity and to scrutinise the enablers and challenges of such implementation.

This research will first present a comprehensive understanding of the case study, Chinatown Melbourne, from an urban identity perspective. These findings will contribute to broader discussions around urban heritage identity within the field. Additionally, the examination of Smart Heritage will help establish preliminary frameworks and explore how it

can be applied to global case studies. Integrating these insights, the thesis offers practical recommendations for the case study, assessing Smart Heritage's viability in enhancing urban identity and fostering cultural sustainability in heritage precincts. Following the main research aim, the study is driven by the following specific research questions, each tied to different aspects of the investigation and aligned with individual chapters of the thesis:

1. How is urban identity represented and perceived in Chinatown Melbourne, and what historical and spatial attributes contribute to its current heritage status? Related to Chapter 3, this question explores the historical and spatial dynamics shaping Chinatown Melbourne's urban identity.
2. What spatial attributes and relationships within Chinatown Melbourne are overlooked by current heritage assessment frameworks, and how can these be integrated to better reflect the precinct's identity? Investigated in Chapters 4 and 5, this question assesses the adequacy of existing frameworks and suggests improvements focusing on spatial considerations.
3. In what ways can Smart Heritage frameworks be adapted to incorporate and enhance the urban identity of heritage precincts like Chinatown Melbourne? This question, central to Chapter 6, scrutinises the current role of identity within Smart Heritage frameworks and seeks adaptable practices for integration.
4. How can open-access data be utilised within Smart Heritage strategies to enhance cultural sustainability and identity recognition in Chinatown Melbourne? Addressed in Chapter 7, this question examines the practical use of open-access data within Smart Heritage applications to bolster cultural sustainability.
5. What are the potential impacts of Smart Heritage strategies on the cultural sustainability and urban identity of Chinatown Melbourne, and what challenges and enablers affect their implementation? Also in Chapter 7, this question evaluates the effectiveness and

challenges of implementing Smart Heritage strategies in enhancing urban identity and cultural sustainability.

Each question aims to deepen the understanding of Smart Heritage integration within urban heritage precincts, contributing to both theoretical insights and practical strategies for enhancing cultural sustainability.

1.5 Thesis Layout and Methodology Framework

This thesis is structured into eight chapters, each building upon a staged and mixed methodology designed to address the complexities of investigating Smart Heritage integration, urban identity, and cultural sustainability within the context of Chinatown Melbourne.

Chapter 1 introduces the key concepts of this research, including urban identity, urban heritage, Smart Heritage, and cultural sustainability, along with the research aims. Chapter 2 reviews the existing literature, organised into three primary themes, including urban heritage and urban identity, the case study of Chinatown Melbourne, and Smart Heritage. This literature review is structured into seven categories under these themes, covering heritage assessment, urban identity in heritage assessment, the components of urban identity, the relationship between urban identity and cultural sustainability, emerging trends in heritage conservation, Smart Heritage, and the Chinatown Melbourne case study. This chapter identifies limitations in current research and concludes with recommendations for future studies.

Chapter 3 lays the foundation for the case study analysis by presenting a comprehensive overview of Chinatown Melbourne's urban history and unique characteristics from an urban heritage perspective. This stage of the research utilises qualitative methods, such as archival research and literature review, to establish the contextual background necessary for assessing the precinct's transformation and urban identity. Challenges encountered in this stage, such as the subjective nature of historical narratives, are acknowledged, with strategies adopted to gather a variety of data where possible. Chapter 4 expands on the understanding established in

Chapter 3 by introducing quantitative spatial analysis through methods like space syntax analysis. This shift to mixed methods enables an objective examination of spatial characteristics, including connectivity, visibility, and spatial intelligibility within the precinct. Field observations are incorporated to balance quantitative spatial data with the cultural dynamics observed on-site, addressing limitations in spatial analysis's ability to fully capture the lived experience and non-heritage values associated with these spaces.

Chapter 5 examines existing heritage assessment frameworks through a thematic approach that combines spatial and cultural dimensions, emphasising the need for adaptations to these frameworks in the post-pandemic context. This stage highlights the tension between established heritage frameworks that prioritise tangible elements and the emerging need to account for intangible values, such as community identity and spatial experience, in existing urban heritage assessments.

Chapter 6 explores the concept of Smart Heritage, examining current best practices and the role of urban identity within this emerging field. This chapter discusses how smart technologies and data could support heritage conservation, providing dynamic, real-time insights that enable responsive urban management while supporting cultural sustainability. The chapter also addresses methodological challenges, as the field of Smart Heritage spans both heritage studies and smartness, which traditionally operate in separate domains. The research navigated these challenges through cross-case analysis, drawing from global best practices in Smart Heritage to identify adaptable strategies for Chinatown Melbourne.

Chapter 7 synthesises the findings from previous chapters, engaging key stakeholders, including representatives from the City of Melbourne, heritage and built environment professionals, and Chinatown community organisations, to assess the feasibility of Smart Heritage implementation in the precinct. This qualitative method provided an in-depth

understanding of both the opportunities and challenges of adopting Smart Heritage within a culturally rich, urban heritage site. Additionally, the chapter evaluates the availability and potential application of open-access data for Chinatown Melbourne in a Smart Heritage context, proposing methods to align local needs with global best practices.

Chapter 8 concludes the thesis by summarising the major findings and contributions, addressing both theoretical and practical implications. It also critically reflects on limitations, particularly in integrating quantitative spatial analysis with qualitative cultural insights, and considers their impact on research outcomes. Recommendations for future research in the fields of Smart Heritage, urban identity, and sustainable heritage practices are presented, offering directions that extend beyond the case study and contribute meaningfully to broader discussions on sustainable urban heritage.

1.6 Research Significance

1.6.1 Emerging Issues in Chinatown Melbourne as an Urban Heritage Precinct

Chinatown Melbourne, as an urban heritage site with an ethnic enclave background, has experienced rapid development and gentrification (Byrne, 2016; Chau, 2016). The COVID-19 pandemic has negatively impacted heritage sites and the tourism industry, including Chinatown Melbourne. Consequently, urban heritage sites have undergone unavoidable changes to their urban characteristics and identities, which existing frameworks often struggle to accurately reflect (Kaymaz, 2013; Psarra, 2018; Stephenson, 2008; Ziyaee, 2018). Elements such as the street network and grid system are not yet fully considered when addressing the heritage issues of the precinct. Local business owners argue that the local council should consult the community in future events related to identity development (Yang, 2021). Moreover, issues related to the top-down approaches that have characterised the precinct's urban evolution remain inadequately discussed.

Chinatowns around the world have reportedly been experiencing identity crises. This challenge to urban identity requires greater attention in the post-COVID era, particularly as the precinct undergoes rejuvenation. The last version of Chinatown Melbourne's planning guideline was established in 1985 and has not been adapted to address the ongoing transformations in the area. A current analysis is needed to understand the precinct's existing urban identity and its future development requirements as an urban heritage site. By gaining a comprehensive overview of this issue and the precinct's identity—particularly at an urban scale—heritage issues such as the misinterpretation and misrepresentation of architectural styles, planning traditions, and management practices can be more effectively addressed. This thesis provides transferrable results applicable to other urban heritage precincts facing similar challenges.

1.6.2 A Newly Established Field – Smart Heritage

To balance heritage preservation, adaptation, and development, heritage and identity-related strategies should be shaped through collaborative dialogue that involves stakeholders and policymakers (Li & Qian, 2017; Plevoets & Sowińska-Heim, 2018). Many contemporary heritage strategies aim to facilitate platforms for such dialogue. Smart Heritage aims to offer enhanced solutions in this area by digitally connecting institutions, visitors, and heritage objects, thereby fostering interactions across various built heritage sites (Lupo & Özdil, 2013; Vattano, 2014). However, numerous uncertainties need to be addressed to determine the feasibility of this concept and to provide a more comprehensive understanding through practical examples, which will be explored in this thesis.

Although the body of research contextualising smartness has expanded rapidly in recent years, many studies still lack a robust theoretical foundation (Gupta & Hall, 2020). This thesis categorises the objectives and strategies of Smart Heritage initiatives to clarify how they can enhance urban heritage sites, with particular emphasis on spatial attributes. Thus, the findings

of this thesis can inform policymakers about whether, and to what extent, Smart Heritage solutions could be integrated into urban heritage contexts to strengthen urban identity and enhance cultural sustainability.

1.6.3 Transferable Methodology Framework

As part of the research framework, this thesis will employ space syntax to analyse the spatial attributes of the selected case study. This tool uses spatial integration, axial mapping, isovist, and visibility graph analyses to generate data on integration, visibility, and connectivity in different environments (Alkymakchy et al., 2012; Barkat et al., 2019; Eldiasty et al., 2021; Garau et al., 2020; Geng et al., 2020; Xu et al., 2020). By combining different spatial and shape analysis methods, existing studies suggest that quantifiable assessments of spatial attributes can capture elements related to spatial identity at an urban scale (Cheshmehzangi, 2014; Laskari et al., 2008; Phetsuriya & Heath, 2021; Psarra, 2018; Ziyaee, 2018). However, one limitation of these quantifiable methods using space syntax approaches is their inability to fully capture the intangible aspects of spatial experience (Laskari et al., 2008; Phetsuriya & Heath, 2021). To address this, the study proposes using a combination of qualitative and quantitative methods to assess both tangible and intangible factors in urban identity assessment. By doing so, limitations inherent in qualitative and quantitative approaches can be minimised. For instance, space syntax data will be compared with field observations to understand both the theoretical spatial qualities and the actual use of spaces when assessing spatial attributes. By applying and validating these methods in the context of Chinatown Melbourne, this research can contribute methodologically to urban heritage-related studies.

1.7 Researcher Positioning in the Context

This research is situated within the complex and inherently political context of heritage conservation and urban precinct representation. Urban precincts, particularly those that are culturally significant, are shaped by power dynamics involving government bodies, heritage

authorities, commercial interests, and local communities. These competing interests influence decisions on which heritage aspects are preserved, how precincts are utilised, and whose narratives are prioritised.

As an immigrant to Australia from China, I bring a personal connection to the cultural dynamics of heritage precincts like Chinatown Melbourne. This background allows me to engage with the topic not only as a researcher but also as someone who resonates with the cultural identity of diasporic communities. I critically engage with the diverse perspectives involved, seeking to balance the top-down influence of official heritage frameworks with the bottom-up contributions of the local community. My approach is informed by a deep understanding of the multifaceted forces that shape the use and management of urban precincts, particularly in heritage contexts like Chinatown Melbourne. By foregrounding community voices and advocating for inclusive decision-making processes, I aim to foster a more equitable and representative approach to heritage conservation in the urban setting.

This positioning reflects my advocacy for ensuring that urban heritage precincts remain not only sites of historical preservation but also vibrant, dynamic areas that resonate with the needs and values of the communities they represent. In doing so, I recognise the fluid nature of cultural identity and the evolving role of ethnic urban heritage enclaves, while critically addressing the power structures that influence these spaces.

Chapter 2 Literature Review

To address the research aim, the literature review framework has been developed to encompass the concepts listed in the table below. The literature review begins with an exploration of conceptual frameworks related to heritage assessment and urban identity. It then examines various assessment methods, particularly focusing on identity and spatial components. Building on this conceptual understanding, the chapter discusses how cultural sustainability can be considered a practical outcome of enhancing urban identity based on existing frameworks. In hopes of enhancing such cultural sustainability, the literature review explores emerging trends in heritage conservation, including Smart Heritage, a novel concept derived from the Smart City paradigm. To fulfil the research objective of evaluating the potential implementation of Smart Heritage concepts, the literature review also extends to an analysis of Chinatown Melbourne as an urban heritage precinct. The chapter concludes by identifying areas for further research to inform subsequent investigations.

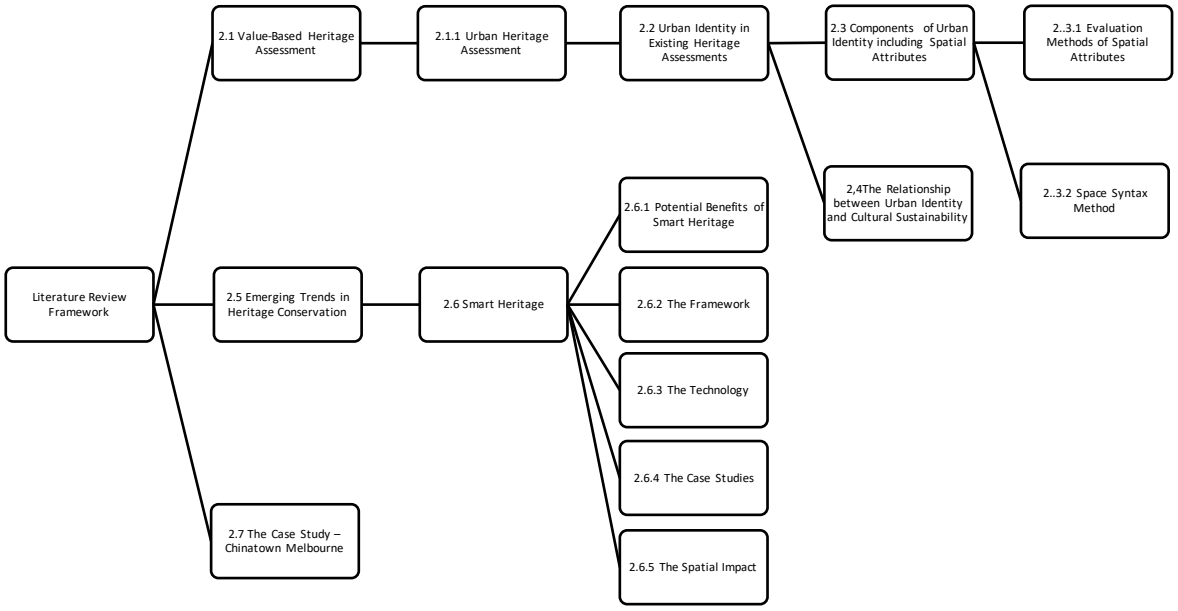

Figure 1. Literature Review Framework

2.1 Value-Based Heritage Assessment

Over the past century, cultural heritage protection has evolved to encompass broad definitions that include both tangible and intangible attributes. In the heritage discipline, conservation solutions are often guided by value-based frameworks that emphasise the cultural significance of heritage sites (Reher, 2020). This approach seeks to recognise and enhance heritage values, which are central to defining cultural significance (Fredheim & Khalaf, 2016; Mason, 2002). The Burra Charter, an influential conservation treaty originating in Australia, acknowledges cultural significance as being inherent in 'a place's fabric, setting, associations, and related objects' (*Australia ICOMOS Burra Charter*, 2013). Consequently, cultural values are commonly cited as the primary reason for considering a heritage site significant (Duval et al., 2019). The term 'attribute' is often used to describe the qualities and characteristics that symbolise cultural value (UNESCO, 2030). However, many scholars in the field contend that more systematic methods and tools are needed to effectively monitor and assess the attributes that define the cultural significance of heritage sites (Fredheim & Khalaf, 2016; Roders & Bandarin, 2019; Roders et al., 2013; Tutchener et al., 2021).

Since the early 1900s, value-based approaches have become a predominant perspective in heritage conservation discourse, viewing conservation as a 'dynamic process of change management' (*Australia ICOMOS Burra Charter*, 2013). Fredheim & Khalaf (2016) point out that value-based approaches have been applied to various types of cultural heritage, including urban and rural landscapes (Mason, 2002; Stephenson, 2008), historic buildings (Stubbs, 2009), archaeological and historic objects (Russell & Winkworth, 2009), and archaeological sites (Teutonico & Palumbo, 2002). These approaches emphasise the importance of understanding how to evaluate heritage. A statement of significance is usually formalised to outline these values, leading value-based assessments to focus on what is deemed valuable about heritage. Heritage can be considered significant for a range of reasons, and existing research has

proposed a diverse array of potential heritage values (Fredheim & Khalaf, 2016). The examination of published heritage value typologies reveals that values-based theory is built on an incomplete understanding of heritage values. While a growing number of typologies indicate an increased focus on critical reflection, many lack thorough consideration of their implications for information gathering and conservation practice. Such lists of heritage values, known as value typologies, are commonly used in heritage and conservation policy assessments. Some value typologies include both their values and attributes, while others list only the values.

However, value-based approaches and their associated typologies have been subject to criticism (Poulios, 2010; Rudolff, 2006; Walter, 2014). Some researchers argue that these approaches often fail because decisions are made based on an incomplete understanding of heritage and its values, even when extensive lists of attributes are provided (Fogliatto et al., 2019; Linaki & Serraos, 2020; Mrak, 2013; Stanik et al., 2018). This trend has led to criticisms of established typologies for favouring outdated interpretations, highlighting the need for a critical review of values-based heritage discourse (Fredheim & Khalaf, 2016). As a result, many scholars have proposed multi-criteria frameworks. Some studies suggest that a comprehensive understanding of heritage value should be captured using more flexible and adaptive aspects of value and value typologies (Fredheim & Khalaf, 2016). For example, Fredheim & Khalaf (2016) propose a three-step value typology framework, suggesting that associative, sensory, evidentiary, and functional values may be the only four aspects necessary for assessing heritage. Other researchers adopt a thematic approach that focuses on addressing specific value themes rather than attempting to capture all values. This perspective is supported by studies arguing that efforts to categorise all values are likely to fail (Rudolff, 2006). Examples of these themes include aesthetic (Dyke, 2013), economic (Dümcke & Gnedovsky, 2013), social network (Djabarouti, 2020), and historic (Macdonald & Ostergren, 2011).

2.1.1 Urban Heritage Assessment

Variegated types of heritage require customised assessment frameworks. Existing research emphasises the need to adapt assessment frameworks and value typologies to suit the specific characteristics of various heritage sites, including those in urban contexts. The term 'urban heritage' was first introduced by Gustavo Giovannoni in 1931, when he advocated for heritage protection at the urban scale (Veldpaus et al., 2013). He described a historic city as both a monument and a dynamic, living fabric. In 1972, during the World Heritage Convention, UNESCO introduced a category for cultural properties called 'groups of buildings.' Since then, UNESCO has promoted a holistic approach to urban heritage that extends beyond the physical environment to encompass social, economic, and functional dimensions.

In the *Encyclopedia of Global Archaeology*, Karlström (2014) defines urban heritage as 'the layers of historical, physical remains that constitute contemporary urban areas,' which include built heritage elements with architectural and historical value, such as churches, city walls, palaces, and institutional buildings. Some interpret urban heritage as considering the city itself a form of heritage, representing a distinctive cultural property often associated with neighbourhoods, centres, and historic cities. Urban heritage is both tangible and intangible, encompassing the cultural practices of the communities residing in these areas and the less tangible elements that shape the space and built environment (Phetsuriya & Heath, 2021). This thesis refers to urban heritage as urban landscapes, such as historic centres and neighbourhoods, which hold heritage values derived not only from historic built forms but also from the evolving uses of these spaces within the contemporary urban context. The thesis primarily focuses on the built environment aspect of these urban heritage sites, with an emphasis on spatial attributes and their relationship to urban identity.

UNESCO's World Heritage Centre plays a leading role in heritage conservation, along with three advisory bodies: ICCROM (International Centre for the Study of the Preservation

and Restoration of Cultural Property), ICOMOS (International Council on Monuments and Sites), and IUCN (International Union for Conservation of Nature). In recent World Heritage Committee meetings, there has been increasing concern over heritage sites in urban contexts (UNESCO, 2020). There is a recognised need to refine the methodologies used to identify and evaluate the impacts of changes on properties within dynamic urban environments. Heritage Impact Assessments (HIA) have been iteratively developed to support decision-making processes in urban heritage conservation, drawing on various value typologies established by ICCROM, ICOMOS, and IUCN. Ongoing revisions of the Impact Assessment methodology are being carried out collaboratively by ICCROM and IUCN, alongside the World Heritage Centre and ICOMOS. During the January 2020 meeting of the World Heritage Committee, it was highlighted that a clear definition of urban identity attributes is necessary, along with a methodology to manage changes and new developments within and around urban heritage contexts. This meeting resulted in the development of an indicative typology of Urban Heritage Identity Attributes, which includes broader context, urban elements, monuments/buildings, and intangible cultural heritage elements, serving as a foundation for this thesis (refer to Table 1).

However, as noted in the literature review, attempts to capture all values and attributes have been critiqued for being impractical, overly complex, and unable to be fully inclusive (Rudolff, 2006). Moreover, some scholars argue that as heritage becomes more complex, the conventional distinctions between tangible and intangible, as well as cultural and natural heritage, may no longer be adequate or sustainable (Borrelli & Davis, 2012; Burke & Smith, 2011; Fredheim & Khalaf, 2016). Rather than categorising values as tangible or intangible, this thesis adopts a thematic approach that focuses on the spatial attributes of urban identity at the urban heritage scale. Unlike conventional thematic approaches that attempt to capture all values by expanding value typologies to a high level of detail or complexity, this research examines

the interplay between spatial attributes and the urban identity aspects of urban heritage. Given the scope of this study, the emphasis shifts from cataloguing tangible and intangible attributes to spatially representing these values, rather than attempting to encompass every attribute detailed in the table below.

Table 1. An indicative typology of urban identity for urban heritage proposed during the World Heritage Committee meeting (UNESCO, 2020)

Wider context	**Urban elements**	**Urban elements continued**	**Monument/buildings**	**Elements of intangible cultural heritage**
Skylines Valleys Hills Natural features Interaction with the environment Hydrology Topography Views and vistas Spatial patterns Orientation (e.g. To seaside, mountains, river fronts) Origin of city plan	Axes City walls Streetscapes (street sections) Festival routes Markets Architectural identities Historical layers Public spaces Distribution of open spaces Vistas and views Panorama view Stairways Street furniture Urban water systems and water elements (fountains, ground tanks, canals, cisterns, *ghat*) materials and building techniques Ground paving textures Height Density Land-use pattern	Spatial organisation Plot size and proportion Street patterns (width) Economic activities Social inclusion Local communities and social groups Migrant communities Rhythm- the marking of time Interface Active streets Circulation patterns Sounds Smells Public/ private interface Activities Street vendors/ cafes Flora and fauna Spiritual dimension Industrial dimension Building crafts infrastructure	Scale Materials Building techniques Form Plot setbacks Colour Textures Craftsmanship Design qualities/ ornamentation Height (already in operational guidelines) Relationship to green Volume Relationship of build and open spaces	Festivals Dance Music Markets Community congregation Sense of ownership Spatial practices Social mix Cultural diversity Spirit of place

2.2 Urban Identity in Existing Heritage Assessments

As discussed in Chapter 1, research on urban identity dates back to the 1950s, an era characterised by modernist planning that led to cities adopting similar and repetitive features (Davison, 2013). This uniformity in urban environments often resulted in a weakened sense of place identity (Manahasa & Manahasa, 2020). In response, concepts aimed at addressing the loss of distinctive place characteristics have become foundational in the study of urban identity. Recognising the complexity of urban identity, Cheshmehzangi (2020) describes it as a 'socially constructed relationship between a human and their space, space and its elements, and elements with one another.' He further suggests that urban identity can be analysed and contextualised at different spatial levels through a four-tier framework that includes global, urban, environmental, and personal perspectives. Cheshmehzangi (2012) explains that urban identity at the urban setting scale is often expressed through visual cues such as spatial form and architectural style, which contribute to a distinctive sense of place.

Early foundational literature in this field, such as Kevin Lynch's work, refers to Little Tokyo in Los Angeles as a 'strong ethnic concentration, probably known to many people…as only a subsidiary portion of the city's image.' Lynch (1960) acknowledges that built cultural heritage sites with distinct urban identities can be influenced by the 'intrusion' of another culture, creating a sense of incongruity, as seen in sites like Chinatown and Little Tokyo. For example, migration introduces foreign cultural elements, thereby impacting the urban identity. Both historic and contemporary buildings are suggested to shape 'place identity' at an urban scale (Al-Zoabi, 2004; Boussaa, 2017; Gospodini, 2004; Ma & Xiang, 1998; Manahasa & Manahasa, 2020). Rudolff (2006) also argues that attempts to define typologies that capture the entire range of values may be overly rigid and impractical. These studies provide the theoretical framework for this thesis, which aims to explore urban identity at the urban setting

scale by implementing Smart Heritage strategies to address the spatial attributes of the case study.

Official heritage conservation guidelines also acknowledge the significance of urban identity and its associated cultural values. The Burra Charter (2013), established by ICOMOS, defines cultural significance as encompassing 'aesthetic, historic, scientific, social, or spiritual value for past, present, or future generations, embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places, and related objects.' A place is defined as including 'sites, areas, land, landscapes, buildings, groups of buildings, and may incorporate components, contents, spaces, and views.' O'Connor's (2000) study indicates that the concept of a 'sense of place' is deeply embedded in heritage assessment frameworks within Australian heritage conservation guidelines, such as the Australian Heritage Commission Act 1975 (later amended to the Australian Heritage Council Act 2003), the Guidelines for the Assessment of Place for the National Heritage List (2009), and the Burra Charter (1979, amended in 2013) (O'Connor, 2000). The Guidelines for the Assessment of Place for the National Heritage List emphasise the comprehensive nature of place assessment by using evaluation criteria such as aesthetic, scientific, historical, and social significance, which together further define cultural significance. According to the Burra Charter (2013), the first step in planning and managing a place of cultural significance is to 'understand the place' before proceeding to the next steps, which involve 'developing policy' and 'managing in accordance with policy.' This thesis aligns its theoretical and conceptual framework with the stages and definitions presented in these guidelines.

Despite the recognition of urban identity and its cultural significance in Australian conservation guidelines, there are no established frameworks specifically for assessing the urban identities of heritage sites. Although the official criteria are inclusive, covering both built and natural cultural heritage, there is no standardised method for evaluating urban identity.

Most guidelines rely on descriptive text to convey cultural significance. Therefore, methods from architectural and planning perspectives could be utilised to better analyse the urban identity of built cultural heritage. Although various heritage value typologies have been developed by official organisations and scholars, urban identity is often intertwined with other attributes rather than treated as a distinct category.

2.3 Components of Urban Identity including Spatial Attributes

Researchers have offered various conceptual understandings of urban identity. Kaymaz (2013) suggests that urban identity can be evaluated from spatial, social, cultural, and economic perspectives. Ziyaee (2018)'s literature review highlights Relph's (1976) framework of place identity, which consists of three main components: physical features and appearances, activities, and meanings and symbols. Ziyaee (2018) focuses on the physical dimension of urban identity, proposing that it can be understood through the interplay of various urban elements, such as streets, squares, buildings, public spaces, urban furniture, and sculptures.

Many scholars incorporate both tangible and intangible characteristics into their frameworks for analysing urban identity. In *The Image of the City* (1960), Lynch outlines three dimensions, identity, structure, and meaning, that together create what he calls 'imageability.' He identifies five elements that contribute to a city's imageability: paths, edges, districts, nodes, and landmarks. Although Lynch's research primarily focuses on physical elements, he acknowledges the significance of meanings and emotions, which are intangible. More recently, Ziyaee (2018) introduced a matrix that combines factors of place identity with characteristics of cultural landscapes to develop an analytical framework for examining place identity from both physical and non-physical perspectives. Ziyaee's matrix informs the methodology of this thesis, where the hybridisation of these attributes has been utilised to establish an urban identity typology. Punter (2007) and Montgomery (1998) also explore how the sense of place is shaped in urban public spaces. Punter identifies physical settings, activities, and meanings, while

Montgomery categorises key elements that influence people's perception of place, such as forms, activities, and images. Carmona (2010) similarly suggests that physical and non-physical aspects of urban identity are often interconnected.

Intangible aspects of urban identity are also crucial in establishing place identity within urban areas (Relph, 1976; Ziyaee, 2018). The Historic Urban Landscape approach, for instance, considers spatial organisation and connectivity as fundamental factors in understanding the intangible dimensions of urban heritage (Jigyasu, 2015). Rapoport (1970) argues that people interact with their environment based on perceptions of its meaning, suggesting that urban identity is influenced by the emotions and experiences evoked by physical spaces. Although spatial attributes are often grouped and categorised under different themes (e.g., components within the 'form' theme in Montgomery's framework or the five elements of imageability in Lynch's framework), it is evident that these attributes have an impact on urban identity from both tangible and intangible perspectives. In other words, urban identity is multi-dimensional, with spatial characteristics playing a central role. These impacts can result from tangible changes, such as alterations in spatial configurations, or from intangible changes, like shifts in spatial experiences. Developing a typology of spatial attributes or characteristics—both tangible and intangible—specific to urban identity within urban heritage contexts can be a future research area. Spatial attributes often are subsumed under broader typologies, limiting the potential for creating a focused conservation assessment. By distinguishing spatial attributes as a separate category, it becomes possible to formulate more precise solutions for conservation and management strategies.

2.3.1 Evaluation Methods of Spatial Attributes

Pietrostefani & Holman (2020) argue that urban heritage is deeply rooted in local history, both conceptually and spatially, which inevitably influences its interpretation within planning practices. They note that urban heritage is likely to evolve over time and across

different contexts, further contributing to its complexity. To address the complex research question concerning the spatial attributes of urban identity, common evaluation methods include quantitative, qualitative, and mixed-method approaches. Some studies provide insights into how quantitative spatial analysis can be beneficial in the urban context. Saad's (2017) study develops a descriptive and quantitative inventory of urban spaces, considering factors such as 'space typology, geometric characteristics, size, and geographical distribution.' By testing the inventory with the historic city of Cairo, Saad (2017) argues that such a framework should help identify some aspects of spatial identity. A study by Laskari et al. (2008) investigates whether and how quantifiable spatial attributes, as conveyed in floor plans, can depict elements associated with the experience of place identity. Their study identifies two groups of methods for quantifying spatial attributes, including space syntax methods and methods that aim to quantify qualitative, semantic features of shapes that enable the classification of building plans. The study incorporates a case study to test both groups of methods. Furthermore, Dadashpoor et al. (2017) create a methodology to analyse various dimensions of spatial configuration in urban systems in Iran. The study explores five key dimensions: 'centrality and dominance of vertices, network cohesion, network strength, network symmetry, and communities and levels.' These elements are systematically described and made quantifiable through index values, allowing for mathematical measurement and analysis.

Other studies have incorporated qualitative methods to break down the spatial attributes of urban identity. From a methodological perspective, a study in 2011 also indicates that the analysis of scaled drawings, 3D models, and maps makes it possible to perceive the spatial qualities and conceptual original construction techniques (Hamamcioglu-Turan & Akbaylar, 2011). Their research claims that digitisation of the heritage site, geometric, visual, and architectural evaluation should be incorporated into heritage assessment. When studying a

heritage shopping street in Amsterdam, Zukin (2012) employs qualitative methods such as interviews, online and archival data, and observations to evaluate how feelings of identity are formed in urban areas. Michelson & Paadam (2016) identify multiple interrelated spatial dimensions that contribute to the symbolic capital of historical sites featuring Hanseatic medieval architecture. Research by Parsaee et al. (2015) propose a conceptual model called the semiology approach, which views the architectural system as a network of signs. The approach includes two key aspects: architectural mechanism and social/cultural background. Within the architectural mechanism aspect, spatial organisation and physical structure are the focuses. From a literature review, Parsaee et al. categorise the analysis of architectural spatial organisation into several types, including spatial organisation (elements in the building), spatial organisation (urban), space sequence, functional zoning, private and public analysis, circulation system, and behavioural pattern. Kuvač & Schwai (2017) also examine three categories involved in constructing spatial identities: spatial context (including physical and natural structures, connection to the historic part of the neighbourhood, and relationship to the city), participation in processes (such as engagement in local politics and planning, neighbourhood design, and housing unit design), and social activities (use of public spaces, quality of life, and place attachment).

Similarly, Zhao et al. (2019) analyse the physical and spatial environment of George Town by examining its historic urban morphology. Their study categorises urban morphologies based on different time periods and then illustrates the evolution of George Town's urban form through a chronological comparison. In the study by Yan et al. (2019) investigate the spatial characteristics of Eaves Gallery, a type of traditional Chinese dwelling, by analysing field distribution patterns, spatial combinations, spatial scale, and functions to inform future renewal policies. Their research integrates both quantitative analysis of building and street dimensions with qualitative data collected through field observations and desktop research. Another study

by Wang & Gu (2020) explore changes in the spatial patterns of the historic city of Pingyao, asserting that the historic urban landscape can be understood through its urban morphology. They conclude that a city's dynamic identity and character are reflected in the structures and places of historic urban landscapes, which can be analysed through their historical contexts and transformations. Using a mixed-method approach, Fu et al. (2021) establish a spatial database of a traditional Chinese village in Hunan by employing GIS, RS, and GPS technologies. They first use an architectural evaluation method to assess the exterior quality of traditional residences, then establish an indicator system and apply an entropy weight method to score these values, systematically demonstrating how the indicators reveal the spatial patterns and value of these traditional dwellings.

2.3.2 Space Syntax Method

Space syntax is a theory of urban planning and a tool for spatial analysis that emerged in the 1970s and 1980s. Unlike earlier studies focused on geometric shapes and dimensions, space syntax adopts a topological approach, emphasising the structural relationships between spaces rather than their geometric properties. This method examines the global interconnectivity of spaces within a built environment, highlighting how spatial configurations influence movement, visibility, and social interaction. By focusing on the functional and social logic of urban spaces, space syntax provides a non-geometric, structuralist analysis. Key intellectual contributions came from Bill Hillier and Julienne Hanson in *The Social Logic of Space* (1984), along with Robin Evans and Christopher Alexander, who framed the method within a broader structural and topological context (Zhu, 2011). The approach considers the typological and configurational organisation of urban spaces, exploring how the inherent spatial form of a self-organised city can contribute to sustainability (Hillier & Hanson, 1984).

Likewise, Chiang and Deng (2017) explain that the spatial configurations of historical cities, such as axial mapping, global integration, and accessibility values in space syntax, can be used to analyse the characteristics of sustainable urban forms and cultural features. Many existing studies juxtapose heritage sites with space syntax to evaluate the spatial configuration and quality. The application of space syntax to heritage-related questions has a long history (Ferguson, 1996; Letesson, 2013; Smith, 2011; Stöger, 2015). These studies employ space syntax methods to investigate the sociocultural dimensions inherent in spatial systems of historical significance. A literature review by Palaiologou and Griffiths (2019) outline the following categories of space syntax research focused on heritage:

1. Designed Urban Heritage: These studies focus on architecture and planning that shape monumental urban spaces with cultural symbolism (Conroy-Dalton & Bafna, 2003; Hillier, 1989; Köseoğlu & Önder, 2009; Psarra, 2018).

2. Assigned Urban Heritage: This category includes research on historic urban areas that may not be monumental but are designated as heritage by planning laws and protected accordingly (Chiang & Deng, 2017; Karimi, 2018; Kubat et al., 2012).

3. Lived/Emergent Urban Heritage: These studies, which have been a longstanding focus in space syntax research, aim to interpret the collective cultural value and identity of everyday urban spaces (Clark, 2007; Davis & Dino, 2015).

The case study of this thesis corresponds to the second type of study suggested by Palaiologou and Griffiths (2019), which looks at non-monumental urban cultural heritage sites. Exploring the case study on a similar scale, Li et al. (2016) apply space syntax analysis to study tourist space on a historical island in Fujian Province, China. They investigate the relationship between street network integration, the urban fabric, and tourist inclinations. Similarly, Kubat et al. (2012) investigate the pedestrian and vehicular movement patterns in Sharjah's historical

centre in the United Arab Emirates (UAE) based on understanding the spatial configuration through space syntax. Research by Chiang and Deng (2017) incorporate axial mapping, integration, and accessibility analysis to explore spatial accessibility by remodelling historical city gates in Gungnae City, China. They further assert that the identity characteristics of sustainable urban heritage sites and the city's cultural features could be recognised through the spatial configuration of the intended urban space.

Overall, this body of research aims to advance knowledge on the role and scope of spatial agency in shaping and preserving urban identity. In other words, the studies discussed above seek to understand how spatial attributes impact urban identity within the context of urban heritage through the use of quantitative, qualitative, mixed-method, and space syntax analyses. A research gap exists in conveying the effectiveness of spatial analysis for identifying urban identity to relevant practitioners, particularly in formulating constructive typologies for policy development.

2.4 The Relationship between Urban Identity and Cultural Sustainability

The World Commission on Environment and Development's report, Our Common Future, defines sustainable development as development that 'meets the needs of the present without compromising the ability of future generations to meet their own needs' (World Commission on Environment and Development, 1987). The cultural dimension of sustainable development was formally recognised for the first time in the United Cities and Local Government's Agenda 21 for Culture (The Committee on Culture of the World Organization of United Cities and Local Government, 2002). This recognition marked an important step in acknowledging the significance of culture within sustainable development. Consequently, culture was introduced as the fourth column of sustainability, alongside economic, social, and environmental considerations. This addition was largely influenced by Jon Hawkes, who first articulated the concept of culture as a fourth pillar in his book, The Fourth Pillar of

Sustainability: Culture's Essential Role in Public Planning. Hawkes (2001) argues that integrating culture into the theoretical and operational frameworks of public policy offers a wide range of potential benefits.

The primary aim of cultural sustainability is to ensure that cultural heritage can be used and adapted by the current generation without compromising the ability of future generations to understand and appreciate its values and meanings. Thus, cultural sustainability is concerned with maintaining the continuity of cultural values (Pop & Borza, 2019). Todd and Geissler (1999) and Sev (2011) further associate cultural sustainability with the preservation of community identity, traditional practices, belief systems, and the unique values of various communities. UNESCO also views cultural heritage protection as intrinsically linked to cultural sustainability (Loach et al., 2017). According to Wu et al. (2016), cultural sustainability has been explored within the broader context of social sustainability, encompassing themes such as cultural symbolism (Martin et al., 2014; Yung et al., 2014); conservation of local culture and heritage (Hartmuth et al., 2008; Mieg, 2012); promotion of cultural identity (Weingaertner & Moberg, 2014; Yung et al., 2014); preservation of cultural diversity (Hartmuth et al., 2008; Yung et al., 2014) sense of place (Ryan & Wayuparb, 2004; Weingaertner & Moberg, 2014; Yung et al., 2014); collective memory (Yung et al., 2014); neighbourhood attractiveness (Dave, 2011).

As the concept of cultural sustainability continues to develop, researchers are focusing more on exploring practical tools and methods to protect, monitor, and promote cultural assets. Studies suggest that the current focus on measurable values in sustainability rating systems makes it challenging to effectively evaluate the qualitative aspects of heritage properties (Powter et al., 2005). Therefore, it is essential to form new indicators, typologies, and measures for cultural sustainability. Since then, numerous studies have built indicator-based cultural sustainability assessment frameworks, focusing on both qualitative and quantitative tactics.

Similarly, in an urban sustainability assessment tool proposed by Kaur and Garg (2019), cultural sustainability is included as one of the sustainability themes and covers elements, including heritage identity of cultural heritage, heritage conservation, community diversity, cultural and natural assets use, cultural practices, and social and cultural initiatives.

Due to the complexity and intangibility of cultural indicators, most sustainability frameworks in the built environment that concentrate on environmental aspects fail to capture cultural element (Qtaishat et al., 2020). To bridge this gap, Qtaishat et al. (2020) propose incorporating tangible metrics for intangible cultural aspects of vernacular architecture, which can be seamlessly integrated into existing design assessment methods and tools. The study adopts a thematic literature analysis to review existing research in the field and identifies that cultural sustainability can be reflected through indicators such as 'values, customs, belief systems, privacy, flexibility of use, the role of aesthetics, colours, gender roles, cultural relevance, and dwelling functionality.' In their study, indicators such as privacy, flexibility of use, and dwelling functionality are categorised as spatial-related indicators.

Meanwhile, some frameworks have been developed to target specific built environment focuses, such as green building design. Based on a literature review, Wu and Logan (2016) highlight that cultural sustainability is often overlooked in green building programs, which typically rely on technical assessments. They developed a cultural sustainability index framework by reviewing green building communities and examining relevant sustainability indicator systems, ecosystem services, and sustainable planning. The framework includes cultural diversity, identity, vitality, and continuity as key criteria.

Postalc and Atay (2019) assert that the relationship between cultural sustainability and spatial planning can be examined. The spatial criteria indicated in their study diverge from the spatial features introduced by Nasar (1994), as Postalc & Atay's framework is intended to

determine the spatial qualities in which traces of cultural references can be found. Nasar's work on spatial features and criteria primarily addresses the exterior and aesthetic aspects of the built environment. In contrast, the spatial criteria proposed by Postalc and Atay are based on concepts such as spatiality, terminology, morphology, and planimetry at various scales of spatial design, providing guidance for designers to enhance cultural sustainability in built environments.

The literature review reveals that protecting place identity is a critical component of the cultural sustainability of heritage. The process of maintaining place identity can be supported by examining and enhancing the spatial attributes of a site. Frameworks can be developed to address specific built environment topics through a comprehensive review of indicators from both the cultural sustainability field and the targeted subject area (Wu & Logan, 2016). Additionally, adopting a mixed-method approach could contribute to the development of these frameworks, as most existing frameworks are limited to either quantitative or qualitative methodologies.

2.5 Emerging Trends in Heritage Conservation

Conservation involves all the practices undertaken to care for a place in order to preserve its cultural significance, which is typically evaluated through heritage assessments, as mentioned above. As outlined by the Burra Charter (2013), conservation may include the 'processes of retention or reintroduction of a use; retention of associations and meanings; maintenance; restoration; reconstruction; adaptation and interpretation; and commonly involves a combination of more than one of these strategies' (Australian ICOMOS Burra Charter, 2013). Prior literature has examined the implementation of these strategies in case studies worldwide. The role of this thesis is to contribute beyond the established strategies and explore emerging trends in built cultural heritage conservation that may incorporate these methods or introduce new ones. Heritage conservation has continually evolved to respond to

technological, economic, demographic, environmental, and social changes. Currently, key trends in the field include participatory conservation, adaptive reuse, heritage tourism, and the emergence of Smart Heritage as primary areas of development.

For participatory perspective, Bandarin and van Oers (2012) indicate that conservation should adopt a holistic approach, considering many different aspects and voices. Similarly, Dimelli (2019) asserts that urban heritage conservation should follow a governance model that fosters policy development and encourages collaboration between educational institutions and local communities. By adopting participatory processes, place identity can be acknowledged, and cultural heritage can become part of a shared community consciousness. Another perspective centres around the adaptive reuse of heritage sites. In the existing literature, adaptive reuse is primarily discussed in publications dedicated to protecting cultural assets and is approached as a field relating to the restoration of monuments or analysed through the prism of solely architectural issues. Research in this area primarily focuses on identifying design methods that can connect the original structure of heritage sites with their contemporary modifications. A novel concept in this field is the concept of 'vernacular adaptation' for built heritage (Plevoets & Sowińska-Heim, 2018). Additionally, efforts have been made to develop models for adaptive reuse strategies and a comprehensive framework that addresses adaptive reuse as a response to social changes (MisIrlIsoy & Günçe, 2016).

A large body of literature highlights emerging trends in heritage conservation, with many studies focusing on adaptive reuse, participatory strategies, tourism adaptation, and Smart Heritage. Although these trends are gaining traction in Australia, very few studies have contextualised them within the Australian built cultural heritage framework. Further research is required to examine the feasibility of incorporating these trends into Australian heritage sites and their potential impacts on existing cultural practices, inhabitants, and the urban fabric. The following section will review and discuss prior research on Smart Cities and Smart Heritage.

2.6 Smart Heritage

2.6.1 Potential Benefits of Smart Heritage

Many existing studies focus on assessing the potential of adapting Smart City strategies to suit local contexts by customising development approaches based on each city's unique assets and urban identity (Angelidou, 2014; Angelidou et al., 2017; Kitchin, 2015; Paskaleva, 2011). The concepts of Smart Heritage and smart cultural heritage have emerged from the broader Smart Cities discourse. Lupo and Özdil (2013) describe Smart Heritage as an intangible geography of cultural content linked to tangible heritage elements, which can be activated, accessed, and experienced through various technologies, either in person or remotely, by diverse communities of users. Vattano (2014) conceptualises smart cultural heritage as an identity element of a place that can be shared through the use of smart technologies, fostering knowledge exchange and social inclusion to enable full participation in the promotion of cultural heritage. Both researchers view Smart Heritage as a way to establish connections among users through shared digital platforms, between institutions and their visitors, between heritage objects and visitors, and across physical and virtual spaces. In essence, Smart Heritage facilitates digital interaction among institutions, visitors, and heritage objects at various sites, including built cultural heritage (smart cultural heritage).

One perspective within this field suggests that Smart Heritage can provide unparalleled access to cultural artefacts and experiences from anywhere, transforming cultural consumers from passive recipients to active participants (Borda & Bowen, 2017). Griffinger et al. (2007) propose that Smart City strategies can enhance both tangible and intangible cultural assets, making cities more appealing in the tourism and business domain. In this sense, Angelidou et al. (2017) argue against one-size-fits-all solutions when applying Smart City strategies and advocate for customised approaches that cater to the specific cultural assets and urban identities of each site. Additionally, Vattano (2014) also stresses that integrating heritage into

contemporary realities is crucial for advancing urban intelligence and suggests that optimising technology use in heritage management can help reduce maintenance costs. Hollands (2008) notes that ICTs are fundamental to the Smart City concept, as they create networked infrastructures that can drive social and cultural development. Although there is broad consensus on the potential benefits of applying Smart City strategies to heritage sites, much of the existing research is abstract and fragmented. These studies provide insights into how cultural heritage can be conceptualised within the Smart City framework but offer limited guidance on the overall relationship between cultural heritage and Smart Cities, as well as practical solutions and implementation strategies.

2.6.2 The Framework

Since 2018, an increasing number of studies have aimed to establish frameworks for smart cultural heritage. A literature review by Angelidou and Stylianidis (2020) concludes that the first academic publications proposing comprehensive frameworks for integrating cultural heritage within the Smart City context appeared after 2018. For instance, Allam and Newman (2018) introduce the first integrated Smart City framework that includes culture as a fundamental component. In 2019, Kourtit (2019) proclaims the need for establishing intelligent, data-driven cultural policies in Smart Cities.

From an urban planning perspective, a study by Papa et al. (2013) emphasise that urban planning, when guided by a holistic approach to city development, plays a crucial role in aligning and integrating urban policies geared towards establishing a Smart City. However, their study provides limited insights into how urban planners should engage in Smart City development and the spatial impacts, a joint gap found in existing studies. Errichiello and Mirera (2018) suggest that there is limited research on the relationship between cultural sustainability and smart innovations, with a particular scarcity of empirical studies. They propose a framework that connects strategic and practical levels to address cultural

sustainability and examines the role of collaborative structures in fostering smart innovations. Using the MuseoTorino in Turin, Italy, as a case study, they demonstrate that this framework can help identify how social structures contribute to achieving cultural sustainability goals within Smart City approaches. While these studies have proposed integrated frameworks for cultural heritage protection and engagement in Smart Cities, more frameworks combining historical and contemporary characteristics of cultural heritage sites, digital tools, visualisation techniques, and other socio-economic factors still need to be developed.

The literature review indicates that recent studies have focused on establishing frameworks for integrating cultural heritage within Smart Cities. However, gaps remain, especially in urban planning and empirical studies on cultural sustainability and smart innovations with practical applicability. More frameworks are needed to blend historical and contemporary heritage characteristics with digital tools and socio-economic factors. Additionally, more practical case studies are required to test the feasibility of these frameworks.

2.6.3 The Technology

Several studies have focused on proposing innovative technologies for smart cultural heritage. Technologies such as big data management, artificial intelligence (AI), augmented reality (AR), and virtual reality (VR) enable the storage, management, and visualisation of extensive datasets, contributing to the protection of cultural heritage and supporting the sustainable development of its lifecycle conservation. These technologies are argued to improve the cultural heritage ontologies of Smart City initiatives, enabling visitors and citizens to access, experience, and engage with heritage sites, ultimately enhancing sustainability (Angelidou & Mora, 2019; Kolivand et al., 1989; Olshannikova et al., 2015). For instance, Chianese and Piccialli (2014) develop smart cultural heritage architecture and platforms to enhance user experiences at cultural heritage sites in Italy. Koukopoulos et al. (2017) introduce an ICT system that uees crowdsourcing for real-time cultural event management. Valentini et

al. (2018) review advanced technologies and portable device sensors that can monitor and regulate the physical environment of cultural heritage sites and assist in the restoration of artworks. Another study by Apollonio et al. (2012) explores using AI to engage museum visitors, acting as an interactive medium between data and users. Angelidou et al. (2020) summarise that recent research on smart technological applications primarily utilises sensors and other hardware and software for a variety of purposes, such as:

1. Better management of conditions and utilities (temperature, humidity, and lighting)
2. Increasing the attraction of heritage sites
3. Safeguarding and preserving cultural heritage
4. Enhancing the visitor experience

Overall, these technology-driven studies primarily showcase standalone Smart City applications designed to improve site conditions, boost attraction, preserve heritage assets, and enhance user experiences at cultural heritage sites and creative attractions. Reflecting on the argument made by Angelidou and Stylianidis (2020), the need for tailored strategies specific to each heritage site suggests that these isolated applications often overlook the broader context and surrounding environments.

2.6.4 The Case Studies

Some Smart City studies employ case studies to provide site-specific responses and evaluations with linkage to the heritage domain. Through the analysis of 61 applications from 33 Smart Cities, Zubizarreta et al. (2015) reveal that while many Smart City applications are used worldwide, most are tools that do not collectively contribute to city-scale sustainable development. Very few case studies are widely recognised as exemplary Smart City initiatives

Barcelona's Smart City initiative views culture and education as key areas for integration. Similarly, in Amsterdam, Smart City applications related to 'tourism/culture/sports/leisure' make up 26% of the city's overall Smart City services portfolio (Angelidou et al., 2017). In Genoa, Italy, the development of a smart museum and park arena platform was designed to improve heritage visiting experiences and enhance safety in urban spaces (Schaffers et al., 2011). Gold Coast, Australia was awarded an IBM Smarter Cities Challenge Grant, with researchers recommending that the Smart City strategy prioritise the preservation and promotion of cultural and natural assets (Bajracharya et al., 2014). Vienna's Smart City vision integrates innovative applications across various sectors, including culture and leisure. Similarly, Stockholm's Smart City plan recognises all urban assets, including heritage, as contributing to environmental and social sustainability (Angelidou & Mora, 2019). In Heraklion, a range of interactive applications has been developed to enable both physical and digital exploration of the city's heritage and cultural assets. Additionally, cities like Graz (Austria), Budapest (Hungary), and Tarragona (Spain) are actively integrating Smart City initiatives with cultural elements (Zubizarreta et al., 2015).

Developing Smart Cities is a clear objective and future goal of the Australian Government. In 2017, the Department of Infrastructure, Transport, Regional Development and Communications initiated a $50 million Smart Cities and Suburbs program to support innovative Smart City projects that enhance the liveability, productivity, and sustainability of cities and towns across the country (*Department of Prime Minister and Cabinet*, 2017). In the first round of grant applications, 49 successful projects received $27.7 million in Australian government funding, with additional contributions from local government, industry, research organisations, and the private sector totalling another $36 million. These projects focus on areas such as visitor experience, facility and service, public safety, education, public health, and environmental data and measurement. The projects incorporated smart elements like smart

lighting, smart parking, smart energy, smart waste, and smart amenities, using technologies such as the Internet of Things, smartphone applications, 5G, Wi-Fi, sensors, online portals, and CCTV. In 2018, round two of the initiative allocated an additional $21 million from the Australian Government (*Department of Prime Minister and Cabinet*, 2017). A performance framework has also been developed to monitor the progress of these projects by the Australian Government (*Department of Prime Minister and Cabinet*, 2017). The status of each project is indicated on the Department of Infrastructure, Transport, Regional Development and Communications website. Four of these Smart City projects aim to improve the visitor experience, including 'Australia's First Heritage City becomes an Australian Future City in Broken Hill CBD, New South Wales,' 'The Place for People in Palmerston LGA, Northern Territory,' 'Interactive City Management in Melbourne, Victoria,' and 'The Smart Beaches Project in Lake Macquarie, New South Wales'. However, limited reports have since documented the progress of these initiatives due to shifts of development focus by different government cabinet and ministers.

The case studies discussed highlight the benefits of Smart Heritage in individual precincts, demonstrating how technology can enhance preservation, engagement, and cultural sustainability. However, the potential of Smart Heritage extends beyond individual sites, contributing to the management and promotion of wider urban heritage (Clarke et al., 2020; Negri & Lelli, 2022; Riganti, 2017; Song & Selim, 2022; Zubiaga et al., 2019). Beyond individual precincts, Smart Heritage can integrate technology to create cohesive networks between multiple heritage sites within a city. Through shared digital platforms, heritage sites can be connected in ways that enhance visitor engagement, promote tourism, and support cultural sustainability at an urban scale (Boulanger et al., 2020). This allows for a more holistic approach to heritage management, whereby precincts such as Chinatown can be linked with other culturally significant areas, fostering a unified cultural narrative across the city. This

networked approach facilitates integrated tourism strategies, enhances visitor engagement, and promotes a broader understanding of the city's cultural identity (Allam & Newman, 2018; Brusaporci & Maiezza, 2021; Giourka et al., 2020; Riganti, 2017). In this way, Smart Heritage contributes not only to the preservation of individual precincts but to the sustainability of urban heritage as a whole.

Although many applications have been launched worldwide to utilise Smart City strategies in built cultural heritage, almost none of the cases are supported by clearly defined objectives, processes, and tools to enhance cultural heritage through the Smart City route. In the cities mentioned above, smart strategies in cultural heritage sites often appear isolated and disconnected, with applications frequently occurring solely in one museum or one heritage site. In Australia, there is limited research examining the outcomes of the Smart City initiatives undertaken by the Australian Government.

2.6.5 The Spatial Impact

Despite the theoretical studies on Smart Cities and cultural heritage, limited research provides a clear picture of what constitutes a smart cultural heritage site. Most city-scale Smart City initiatives that propose integrating large heritage sites are still in the early stages. Currently, three studies stand out in bridging this research gap.

Sadowski and Maalsen (2020) use three Australian case studies to identify three modes of creating Smart Cities: Corporate Centric, Citizen Centric, and Planner Centric. Their study offers an in-depth analysis of Smart Cities in Australia, considering the existing spatial, cultural, and political contexts, and suggested that additional modes of Smart City development are yet to be discovered. The Planner Centric model, which emphasises the role of local planning authorities in leading the implementation of Smart City strategies, is particularly useful for understanding how spatial planning contributes to Smart City development. Angelidou and

Mora (2019) identify possible classifications and typologies for spatial planning in Smart City development, aiming to clarify how Smart Cities can be developed, addressing the complex and often ambiguous nature of this field. Their study concludes with two typological classification systems: one based on urban characteristics (including urban functions, district character, and technical infrastructures) and one based on project scales (national, regional/metropolitan, and local/municipal). These classifications help define the research scope of this thesis. Borda and Bowen (2017) characterise three smart cultural heritage trends using AR and VR tools: preservation and reconstruction of heritage sites, digital trails, and exhibition tours. Their case studies include historical heritage sites and museum exhibits, but did not cover gentrified urban heritage sites, which could be explored in this thesis. Overall, existing research has not deeply studied the physicality of smart cultural heritage. One notable observation is the blurred distinction between digitalisation and smart cultural heritage. Digitalising existing architecture and urban layouts in heritage sites is merely the foundation; achieving smartness involves the effective sharing of data and fostering user engagement.

In conclusion, although existing literature emphasises the need to integrate the Smart City concept with heritage protection, only a limited number of studies offer a comprehensive framework for cultural heritage within this context. The strategic relationship between smartness and cultural heritage remains vague, with unclear objectives, processes, and outcomes. Moreover, the spatial implications of Smart City strategies on urban cultural heritage sites have not been adequately addressed. While technological advancements have facilitated the protection and enhancement of cultural heritage through isolated applications, the management of heritage within an integrated Smart City framework is still at a nascent stage.

2.7 The Case Study – Chinatown Melbourne

Prior research on Chinese migration in Australia focuses on three critical areas:

1. Chinese Migration History: This includes studies on the gold rush period, post-gold rush migration, and more recent trends (Annear, 1999; Cannon, 1993; Fitzgerald et al., 2004; Huck, 1967; Markus, 1974).

2. Chinese Cultural and Ethnic Studies: These studies examine themes such as politics and property development (Macgregor, 2013; Meng et al., 1879; Tewari & Beynon, 2017; Tung, 2005)

3. Architectural and Urban Studies: This category covers typologies like Chinese temples, joss houses (Chinese ancestral halls or small temples), Chinatowns (mixed typologies), and more recent Chinese settlements in the suburbs(Chang, 1999; Couchman, 2019; Tewari & Beynon, 2018; Wilton, 2019).

While cultural and historical studies will serve as supplementary records for this thesis, the following review focuses on the architectural and urban aspects of Chinatowns and other Chinese communities in Australia. Key documents for the archival review in the first phase of the thesis include the Chinatown Action Plan (1985) by the Melbourne City Council - Victoria Tourism Commission, and several thesis publications from the twentieth century (Choi, 1970). Archives such as Culture Victoria, the Museum of Chinese Australian's Research Library, the Golden Dragon Museum, the Journal of Australian Colonial History, Chinese-Australian Historical Images, the State Library of Victoria, the National Library of Australia, and the archive at the University of Melbourne are also key resources for this study. Several studies have discussed the diversity and cultural identity of Chinatowns in Australia. Collins and Jordan (2009) argue that although Chinatowns exist globally, Australia is uniquely positioned to market its ethnic diversity and multicultural background. For example, Sydney's Chinatown is adjacent to Spanish and Thai quarters, while Northbridge offers a similarly diverse cultural experience. They concluded that ethnic precincts often result from deliberate ethnic place

marketing and urban planning, which sometimes includes a mix of ethnic groups. Ang (2016) notes that Sydney's Chinatown is evolving from a Chinese ethnic enclave to a hybrid and transitional place reflecting Asian-Australians.

Spatial and architectural studies have scrutinised the transformation of Chinatown Melbourne since the gold rush. Chau et al. (2016) examine its evolution from a segregated ghetto to a well-established cultural tourism site. They identify three stages in Chinatown Melbourne's development: the slum stage, a centre for furniture production and fruit wholesale, and its current role as a hub for cafes and restaurants. Chau et al. (2016) argue that Chinatown Melbourne's value lies not only in historical preservation or marketing but in its contribution to cultural pluralism in Australia, challenging both past discrimination and present homogenisation. Their illustrative maps of Chinatown Melbourne from 1880 and 2015 are valuable for spatial functional analysis. Anderson (1990) discusses Chinatown redevelopment schemes in Victoria and New South Wales since the 1970s, focusing on zoning, preservation strategies, and revitalisation. Further research should examine current preservation strategies and assess the spatial impacts of Chinatown redevelopment since the 1970s. Architectural studies have explored Chinese influence on building typologies. (Chau et al., 2018) analyses the Num Pon Soon Society Building and the See Yup Temple in Melbourne and the Kaiping Diaolou in Guangdong province of China. Despite being designed by Western architects, the buildings incorporated Chinese ornamentations, reflecting the migrants' openness to foreign cultures while maintaining their cultural core. Byrne (2020) examines the influence of Chinese migrants on Zhongshan's architecture, categorising typologies such as the stretched traditional house and the mansion house, and highlighting neoclassicism brought from Australia.

Newly established Chinese settlement areas have also been explored. Beynon (2019) explores the integration of Chinese settlements into Australia's architectural identity, using Ballarat and Bendigo as case studies. He argues that Chinese migrants played a key role in

opening these regions to colonial and national authorities through land clearing and settlement. Beynon highlights that Chinese settlement architecture is often overlooked in the British-centric architectural narrative of Australia. He also touches on suburbs with significant Chinese populations, such as Box Hill and Glen Waverley in Melbourne, noting that Chinese-Australian residential architecture is difficult to distinguish from other local architecture. Beynon (2019) concludes that nineteenth century Chinese settlements should be recognised as integral to Australian identity, with their architectural contributions accepted as part of the local built environment. Groves (2011) further argues that the principles of fengshui in joss houses align with postmodern architectural principles, supporting the argument that Chinese migrants' architectural influence is embedded in Australian architecture. While a common identity crisis for Chinatowns around the world existed long before COVID-19. After the pandemic, many studies argue that such concerns in global Chinatowns are becoming more confronting. Chinatown Melbourne is also experiencing this identity crisis, as it is unclear whether the tourist attraction is a sustainable strategy (Dansie, 2022; Hartke, 2022). Future research is needed to scrutinise how this phenomenon has emerged and how potential strategies can be engaged to resolve this.

In summary, while substantial research exists on Chinese migration history, cultural studies, and architectural influence, there is a lack of studies examining the spatial configuration and urban impact of Chinese settlements, such as Chinatowns, using contemporary research methods like space syntax. Most existing studies rely on qualitative methods, highlighting a research gap that this thesis aims to address through quantitative methods.

2.8 Gaps in Current Research and Recommendations for Further Research

While the field of urban heritage has advanced considerably in recent years, several gaps and weaknesses persist that hinder the full potential of heritage conservation strategies.

Firstly, although value-based heritage assessment frameworks have become dominant, there remains a critical lack of frameworks that can address the dynamic and evolving nature of urban heritage. The emphasis on static, tangible elements often overlook the spatial and intangible qualities that are essential for preserving the identity of urban heritage precincts. The existing heritage assessment models, particularly in Australia, fail to offer a comprehensive methodology for evaluating urban identity in a way that accounts for spatial interrelations and the cultural context within which these urban forms exist. These frameworks need to incorporate more comprehensive, spatially nuanced approaches that move beyond simply recognising built forms and instead delve into the interactions and experiences that these spaces evoke.

A second gap is around the understanding of urban identity in relation to cultural sustainability. Current definitions of urban identity are primarily informed by modernist planning theories, which have tended to homogenise cities, leading to a loss of distinctiveness in urban precincts. While recent research has expanded the notion of urban identity to include social, cultural, and spatial dimensions, these frameworks remain underdeveloped in terms of applicability to urban heritage sites, especially those with dynamic, multicultural identities such as Chinatown Melbourne. The emerging complexity of identity crises in heritage precincts, exacerbated by factors like globalisation and gentrification, requires new approaches that integrate cultural diversity, historical narratives, and local community engagement into a cohesive urban identity framework. This gap also highlights the need for methodologies that can assess the impact of urban change on the evolving identity of heritage spaces, rather than relying solely on static preservation models.

The most significant gap, however, is found in the nascent field of Smart Heritage. Despite its promise, Smart Heritage remains a conceptual framework more than a fully realised practice. While much of the discourse focuses on integrating variegated technologies for

cultural preservation, there is a disconnect between theoretical applications and their practical implications for urban heritage. The lack of comprehensive case studies on Smart Heritage implementations in Australian urban heritage sites leaves a critical void in understanding how these technologies can actually enhance cultural sustainability, visitor engagement, and community involvement. Additionally, Smart Heritage initiatives often fail to account for the social dynamics that shape heritage spaces, particularly in multicultural urban settings, where community narratives are just as crucial as physical preservation. Without addressing the relationship between technology and local identity, the potential of Smart Heritage to support both cultural continuity and adaptation remains largely unrealised.

Finally, while there is growing recognition of the importance of community involvement in heritage conservation, the practical strategies to effectively engage local populations in the development and implementation of Smart Heritage initiatives remain underexplored. Engaging communities goes beyond mere consultation; it requires deep, participatory frameworks that ensure that Smart Heritage projects align with the needs and values of the populations they aim to serve. Future research should prioritise methods for ensuring equitable stakeholder participation, making sure that local knowledge, cultural practices, and community identities are meaningfully integrated into Smart Heritage applications.

Overall, while current research has progressed in many key areas, it still exhibits notable gaps in developing applicable frameworks, integrating technology effectively, and fostering community involvement. From the literature review, future studies should aim to address several identified gaps and challenges below:

1. Building on the understanding of existing heritage assessments and discussions around urban identity, future research should address Chinatown Melbourne's current identity

crisis using relevant assessment frameworks. It should explore how potential heritage strategies can mitigate this issue to ensure the precinct's cultural sustainability. In particular, the precinct's urban identity and spatial features remain underexplored and require further investigation.

2. There is a notable lack of research examining the outcomes of Smart Heritage initiatives in urban precincts. Future studies should focus on evaluating the effectiveness of these projects, particularly in terms of cultural preservation, visitor engagement, and community benefits. This could include case studies that analyse the transformation of urban heritage areas like Chinatown Melbourne through the lens of Smart City principles. Comparative studies of Smart Heritage initiatives across different cities could offer valuable insights and help shape the development of best practices.
3. Ongoing research is needed to explore technological innovations and best practices in the field of Smart Heritage. This includes investigating new technologies such as Artificial Intelligence (AI), augmented reality (AR), virtual reality (VR), and the Internet of Things (IoT) to enhance visitor experiences and support heritage conservation efforts. Future research should aim to develop comprehensive frameworks that integrate smart technologies across multiple heritage sites rather than relying on isolated applications. This could involve creating interoperable systems that facilitate data sharing and user engagement across various cultural heritage assets.
4. Engaging local communities in the development and implementation of Smart Heritage initiatives is crucial. Future research should explore strategies for enhancing community participation and ensuring that Smart Heritage projects reflect the needs and values of local populations. Involving stakeholders in the research process through methods such as surveys and interviews could be instrumental in achieving this goal.

In conclusion, future research in Smart Heritage should aim to create a cohesive and integrated approach that effectively utilises smart technologies to enhance cultural heritage conservation, foster cultural identity, and engage communities. This research should also focus on diverse heritage contexts, including urban heritage sites like Chinatown Melbourne. Addressing these identified gaps through more inclusive, dynamic, and integrative research will pave the way for more effective heritage conservation strategies, particularly in culturally complex urban environments like Chinatown Melbourne.

2.9 Concluding Remarks

The literature review in this document focuses on several key themes, including heritage assessment, urban identity, Smart Heritage, and the case study on Chinatown Melbourne. Captured from the literature review, the concept of heritage assessment has evolved significantly, with value-based approaches becoming dominant.

For the urban heritage in domain, tailored assessment frameworks are recommended. The UNESCO World Heritage Convention and the work of several international organisations have listed methodologies for urban heritage conservation. However, there is a need for clearer methodologies to manage adaptative change and development in urban contexts. Research on urban identity began in response to the homogenisation of cities due to modernist planning. Existing research defines urban identity as a multifaceted concept involving social, cultural, and spatial elements. It can be understood through various frameworks, including those focusing on physical features, activities, meanings, and symbols.

The Burra Charter and Australian heritage guidelines emphasise the importance of urban identity in heritage conservation but lack specific evaluation methods. Existing frameworks indicate that urban identity comprises both tangible and intangible attributes. Spatial attributes, in particular, play a crucial role in defining urban identity. Methods to

evaluate these attributes can be quantitative, qualitative, or mixed method, incorporating space syntax and other techniques. The review suggests that a focused approach on spatial attributes could enhance the effectiveness of heritage conservation strategies. It is evident from the review that protecting place identity is a key aspect of the cultural sustainability of heritage sites. The process of maintaining place identity can benefit from examining and enhancing the spatial attributes.

Next, the literature review examines current emerging trends in heritage conservation. A large volume of existing literature highlights these trends, with many focusing on adaptive reuse, participatory strategy, tourism adaptation, and Smart Heritage. Very few studies have contextualised these trends within Australian built cultural heritage. Amongst the emerging trends in heritage conservation, Smart Heritage is one of the key trends. Studies have also highlighted the potential of Smart Heritage implementation and its possibility in enhancing urban identity and cultural sustainability. Much research has gone into the framework and the conceptualisation of Smart Heritage. Current studies help readers understand what cultural heritage represents in a Smart City context and the foundation of Smart Heritage, but they provide little on the overall relationship between cultural heritage sites and the urban context, practical solutions, and implementation strategies. Case studies with Smart Heritage implementations in the Australian context are particular limited.

The literature review also delves into the case study, Chinatown Melbourne. Extensive research exists on Chinese migration history, cultural studies, and architectural influence. These studies accentuate the importance of recognising the contributions of Chinese migrants to Australia's architectural and cultural landscape. However, there is a lack of studies examining the spatial configuration and urban impact. As current research suggest, Chinatowns around the world are experiencing an identity crisis, leading to cultural sustainability issues. Based on

existing literature, this demonstrates a gap in research to see where new strategies such as Smart Heritage can impact the precinct.

Chapter 3 Case Study Chinatown Melbourne

3.1 Introduction

This chapter marks the beginning of this thesis, which examines Chinatown Melbourne's current urban characteristics and its past urban evolution to establish the context of the case study. Understanding and preserving these urban characteristics is crucial for informing the development of Smart Heritage strategies, which aim to balance heritage conservation with future urban development. Establishing this context is essential before exploring Smart Heritage strategies for the precinct in later chapters.

Chinatown Melbourne is one of the oldest and largest precincts among many ethnic enclaves in Australia. From the literature review, existing studies have examined various aspects of the precinct, including its architectural styles and demographic shifts. Despite extensive research on these facets, gaps remain in understanding its urban history and characteristics, which this chapter aims to address.

This chapter employs qualitative methods, including archival records, literature reviews, map analysis, and field observations. These methods collectively provide a multi-dimensional understanding of Chinatown's urban evolution, allowing for a more accurate identification of its key heritage features. This chapter outlines Chinatown Melbourne's key urban developments across seven phases from the mid-1850s to the present, ranging from its origins as a slum to its evolution into a dining district and, ultimately, a multicultural symbol. Radical changes in the precinct's functional purpose, public perception, and planning strategies have occurred, intertwined with migration policies, economic recessions, and cultural movements, all of which have impacted the precinct's urban identity. To portray the precinct's current urban identity, this chapter draws on the Chinatown Action Plan (1985), addressing elements such as the main street, laneways, gateways, and public spaces within the area.

The historical and urban evolution of Chinatown Melbourne suggests that change will be inevitable in its future development. This chapter suggests that adopting an adaptive heritage strategy framework, one that both acknowledges heritage values and characteristics while considering stakeholder demands through a bottom-up approach, is key to the future of the precinct. In alignment with existing heritage conservation frameworks, this chapter aims to provide a holistic understanding of the case study to inform potential heritage conservation strategies and policies. It serves as a critical foundation for the subsequent chapters of this thesis.

The following paper is included in the chapter;

1. Geng, S., Chau, H.-W., Jamei, E., & Vrcelj, Z. (2023). Urban Characteristics, identities, and conservation of Chinatown Melbourne. *Journal of Architecture and Urbanism*, *47*(1), 20–34. https://doi.org/10.3846/jau.2023.17383

3.2 Declaration

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DECLARATION OF CO-AUTHORSHIP AND CO-CONTRIBUTION: PAPERS INCORPORATED IN THESIS

This declaration is to be completed for each conjointly authored publication and placed at the beginning of the thesis chapter in which the publication appears.

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2. CANDIDATE DECLARATION

I declare that the publication above meets the requirements to be included in the thesis as outlined in the HDR Policy and related Procedures – policy.vu.edu.au.

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Signature Date

3. CO-AUTHOR(S) DECLARATION

In the case of the above publication, the following authors contributed to the work as follows:

The undersigned certify that:

1. They meet criteria for authorship in that they have participated in the conception, execution or interpretation of at least that part of the publication in their field of expertise;
2. They take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;

3. There are no other authors of the publication according to these criteria;
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Hing-Wah Chau	5	Critical review of manuscript. Feedback and discussion on research and writing.		4 Nov 24
Elmira Jamei	5	Critical review of manuscript. Feedback and discussion on research and writing.		4 Nov 24
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URBAN CHARACTERISTICS, IDENTITIES, AND CONSERVATION OF CHINATOWN MELBOURNE

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Abstract. Many unique ethnic enclaves have been established in Australia due to the country's rich and diverse immigration history. Chinatown Melbourne is one of the oldest and most iconic examples that date back to the gold rush period in the 1850s. Previous studies have examined many aspects of the precinct, such as its architectural styles and demography shifts. However, there is a lack of research investigating the enclave's urban characteristics and the consequent urban identity. This knowledge gap can lead to unfeasible heritage conservation decisions with a lack of emphasis on the precinct's unique identity. Hence, this study aims to scrutinize the precinct's past urban evolution and its present characteristics to better understand its heritage value and enhance future urban policies. Qualitative data are collected using archival and literature review, map analysis, and field observation. Overall, by elucidating Chinatown Melbourne's urban characteristics and key urban movements, the study depicts the precinct's identity, addressing elements like the main, laneway, gateway, and public space. The output of the research provides insights into how future heritage policies and initiatives can benefit from the case study in enhancing heritage protection and sustaining its urban identity. Further research is recommended to incorporate quantitative research methods and compare results with this study's findings.

Keywords: urban heritage, heritage conservation, urban identity, Chinatown, migration.

Introduction

Like many countries with rich immigration histories, Australia is home to many unique ethnic enclaves, which have become critical heritage focal points, especially after the end of the White Australian policy (Anderson, 1990; Jones, 2005). As one of the oldest among these precincts, Chinatown Melbourne is a well-known ethnic enclave in the city center, initially occupied by Chinese immigrants as a lodging cluster during the 1850s gold rush period (Cannon, 1993; Yeen, 1986). In the past 170 years of Chinatown Melbourne's establishment, due to radical changes in the political spectrum, racial acceptance, population composition, and economic and cultural perception, the key functionality and character of this precinct have gone through many phases (Anderson, 1990; Chau et al., 2016; Yeen, 1986). According to Chau et al. (2016), the precinct has evolved from the inferior lodging center of "worthless" Chinese men coupled with "sinister and illegal activities," furniture production hub, wholesale fruit center to a well-celebrated multicultural enclave offering Chinese cuisines and cultural tourism for both the locals and the visitors. William Howitt criticized Chinese immigrants as "a very worthless class of immigrants" (Howitt, 1858). The functional progression of this area links to the changes in its architectural and urban characteristics and targeted planning conservation policies. Most of the buildings in Chinatown are now considered to have heritage significance to the local area. On the local level, the local government engages Heritage Overlay to protect buildings and urban precincts with local heritage significance, where renovations must comply with the council's requirements through a planning permit. On the state level, buildings highlighted in green in Figure 1 are listed in the State's Heritage Inventory, a list of all known historical archaeology sites in Victoria, which are prohibited from modification (Victoria State Government [VSG], 2022a). Seven buildings on the Heritage Inventory list are listed on the Victoria Heritage Register as the state's most significant heritage places with the highest recognition. Three of the seven buildings, facing the main street, have a direct connection to the ethnic enclave, as they inhabit Chinese-related functionalities.

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Many existing studies address heritage issues in Chinatown Melbourne concerning only individual buildings (Byrne, 2016, 2020; Chau, 2016). However, there is a lack of research providing summaries on the overall identity of Melbourne Chinatown and what constitutes the place from an urban planning point of view. Without a holistic understanding of this question and the precinct's identity, heritage concerns such as misinterpretation and misrepresentation of architectural styles, planning traditions, and decorations can occur. According to Lynch (1960), districts are "the medium-to-large sections of the city, conceived of as having two-dimensional extents, where the users mentally enter inside of" and are recognizable as having common, identifying characters. Always discernible from the inside, these characters are also used for external reference if visible from the outside. The common yet distinguishing characteristics are its physical and functional dimensions. This study focuses on the urban identity of Chinatown Melbourne by examining its physical settings and urban plans (Erdoğan & Ayataç, 2015; Relph, 1976). Such identity can also be found in the social and functional dimensions, including activities that traditionally happen in the area (Zhang, 2006). Hence, it is essential to explicate how the precinct has been used and viewed by locals and the general public. Based on these dimensions, to unveil the past and present identity of Chinatown Melbourne and inform future heritage policies and initiatives, this study seeks to answer three research questions:

- how have Chinatown Melbourne's identities and urban characteristics developed, and what are the driving forces of these developments?
- what are the current identity and urban characteristics of the precinct?
- how can future heritage policies and initiatives benefit from learning the history of the precinct's characteristics and identity shifts?

1. Methods

According to the research aim and questions, the first two objectives are to summarize the precinct's historical urban evolution and examine its current identity. This combination of historical records and contemporary analyses can help fathom the precinct's identity and heritage value and thereby enhance future heritage policies and initiatives bearing on it. Along with the milestone of Chinatown's redevelopment, the 1985 Chinatown Action Plan proposes planning principles (Melbourne City Council and Victorian Tourism Commission [MCC & VTC], 1985). To define the aspects of urban characteristics in this study, authors adopt the elements listed in the Action Plan, which recognizes the main street, major streets, side lanes, open space, parking, building, height, and decorative features as critical attributes of the precinct's urban identity.

Firstly, relying on methods of archival research, correlation with concurrent policies, and cultural movements, this study examines several vital historical phases of Chinatown Melbourne. Then, maps from these different historical stages are compared to analyze the precinct's distinct urban characteristics and identities during these stages, aligning with the cultural turns. To provide qualitative data, archival materials such as migration records, historical photos, maps, and existing literature are obtained from the Museum of Chinese Australian History, the National Library of Australia, the State Library Victoria, and the University of Melbourne. Secondly, as new developments have been erected in the past 36 years after the Action Plan, the characteristics of the precinct have unavoidable modifications. To examine the precinct's current characteristics and reveal changes from the Action Plan guideline, the authors conduct field observation with references to the key elements listed in the original 1985 blueprint (Lucas, 2016). Field notes and photos are analyzed and compared with the findings from archival and map analyses. Drawing from the data and results of the research, the last objective of the study is to address the third research question further and expand into discussions on the following three aspects to inform future decision makings in the precinct:

- the intended urban characteristics and the actual use of space;
- top-down approaches and bottom-up needs of the local communities;
- the relationship between changes in urban characters and heritage preservation.

Overall, this study engenders new insights into the precinct's heritage value and identity building, as these discussions have remained marginalized in existing research.

2. Results

2.1. The urban evolution of Chinatown Melbourne

It is fundamental to look at the precinct's history to recognize urban characteristics and the urban identity of Chinatown Melbourne. With the original Hoddle Grid marked out in 1837 by surveyor Robert Hoddle, the orthogonal major grid, accompanied by subdivided plots with narrow laneways, divides most of Melbourne city's blocks, including Chinatown (Mundell, 2019). On an urban scale, Chinatown Melbourne has been modified several times since the 1850s due to different political climates and functional needs, which made it a highly adaptable precinct in terms of its functionality (Beynon, 2019; Jakubowicz & Moustafine, 2010; Jones, 2005). These functional changes are often not self-managed but affected by political decisions, and planning strategies made compulsively by the government. To help visualize this precinct's urban history and its current heritage protection levels, a list of heritage buildings and a timeline of Chinatown Melbourne's functional changes are provided in Tables 1 and 2, and a series of maps in Figures 1 to 6. These changes are inevitable consequences of the migration policy, discrimination acts, and the shifting dynamics of Chinese demographics, contributing to planning and conservation decisions

Table 1. Buildings in the Victorian Heritage Register

No.	Address
1	200-202 Little Bourke Street, Num Pon Soon Society Building
2	112-114 Little Bourke Street, Sum Kum Lee Little Bourke Street
3	119-227 Exhibition Street, 84-98 Little Bourke Street, Her Majesty's Theatre
4	190-192 Bourke Street, Former Bank of New South Wales
5	196 Little Bourke Street, Chinese Methodist Mission Church
6	180 Russell Street, Total House
7	134-144 Little Bourke Street, Former Hoyts Cinema

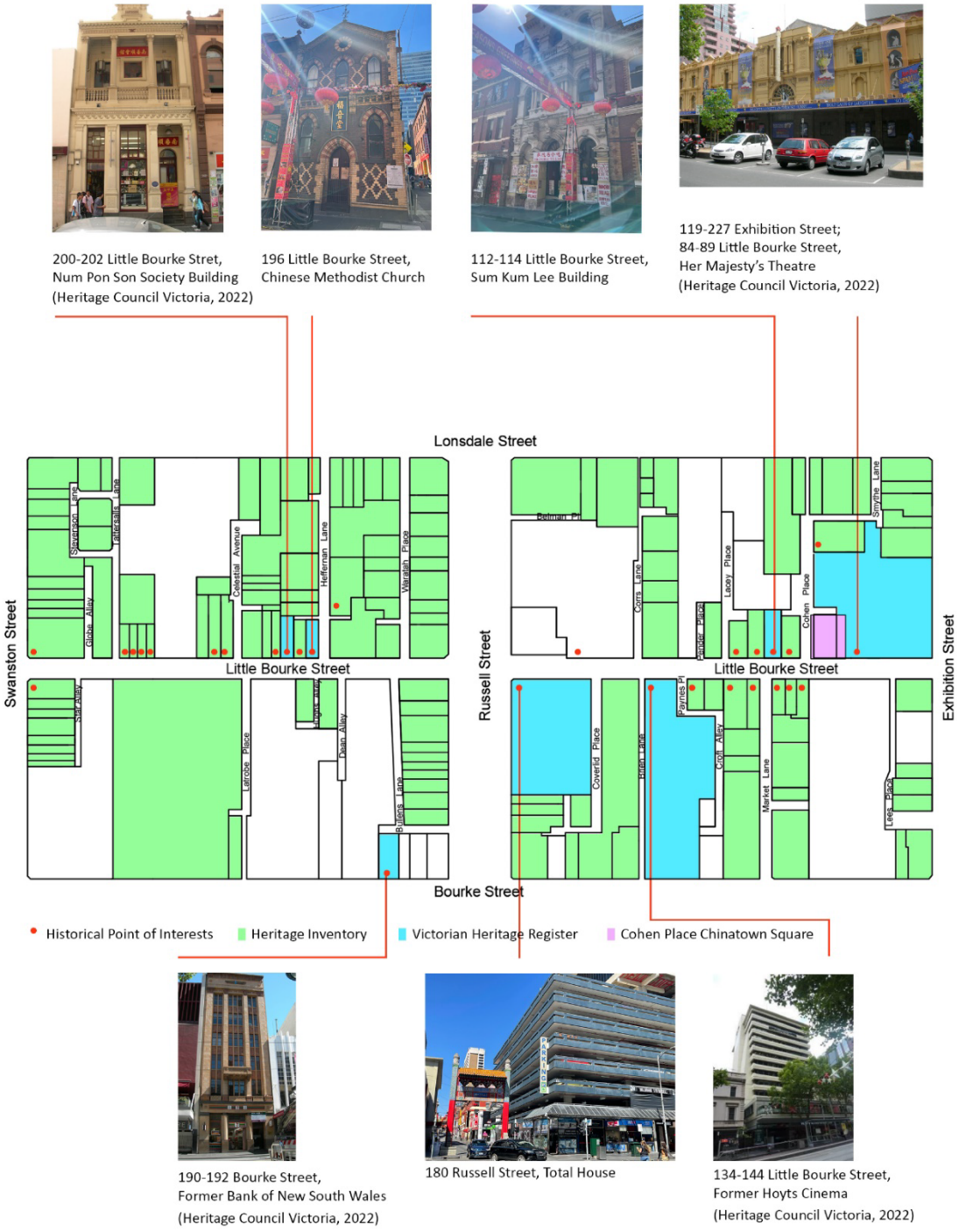

Figure 1. 2022 heritage inventory and heritage register in Victoria (source: authors)

Table 2. A timeline of Melbourne Chinatown's functional changes

Time period	Boundary of the precinct	Major planning and policy influences	Main functions of the area	Perception from the public
Phase One Mid 1850s	Around the interaction of Bourke and Swanson Street	Influenced by the Hoddle Grid; Self-formed and managed	Lodging house, provision stores, candle and opium factories	A fearful slum (McConville, 1985; Anderson, 1990 and Chau et al., 2015) Not a slum but a community in Cohen Place (Young, 2000)
Phase Two 1860s–1910s	In between La Trobe Street, Bourke Street, Spring Street and Swanston Street	Decline of demand in Mining	Fruit wholesale market and furniture factories	'Chinese quarter'; a notorious district; a threat (McConville, 1985 and Anderson, 1990)
Phase Three 1920s–1930s	Occupying the block formed by Lonsdale Street, Bourke Street, Spring Street and Swanston Street	Influenced by the Anti-Chinese sentiment; the Great Depression in the 1930s	Reduction of shops, shrinkage of area and function	Doomed to extinction (The Melbourne City Council and The Victorian Tourism Commission, 1985 and Anderson, 1990)
Phase Four 1940s–1960s	Occupying the block formed by Lonsdale Street, Bourke Street, Spring Street and Swanston Street; Little Bourke Street as the centre	Influenced by reform of the discriminatory migration and nationality laws	Restaurants and cafes	A place to dine for the westerners (Chau et al., 2016)
Phase Five 1972–1976	Officially occupying the block formed by Lonsdale Street, Bourke Street, Spring Street and Swanston Street; Little Bourke Street as the centre; Formal establishment of Chinatown	Removal of White Australian Policy; Stage One of Chinatown redevelopment	Restaurants and cafes; Marked as a place for tourists	The city's first attempt in developing an ethnic quarter with injections of 'Chinese' characters; a place for tourist (Anderson, 1990)
Phase Six 1983–1988	Chinatown redevelopment continues with a focus on laneways in the area	Stage Two of Chinatown redevelopment; The Chinatown Historic Precinct Act in 1984; The Chinatown Action Plan 1985	Multicultural historic precinct; restaurants and cafes; museum; ethnic activities	An urban symbol of Multiculturalism; a celebrated cultural heritage; ethnic enclave with cultural significance
Phase Seven 1988–Current	Settled with four plots shown in Figure 1; laneways mostly facilitate south-north movement; consolidated	Non-specific strategies; mostly follow the general city planning and heritage protection strategies such as heritage overlay and heritage registration	Multicultural ethnic enclave	Occasional mis-cultural interpretations (Yang & Fang, 2020)

(Jakubowicz & Moustafine, 2010; Wang et al., 2018). The changes can deliver an overlook of how the precinct was perceived and its subsequent urban identity. According to the sequence of Chinatown Melbourne's development maps (Figures 2 to 6), such linkages are evident (Table 2). The boundary of the precinct once peaked in the 1910s before declining to the current boundary (Figure 3). Before the impact of the anti-Chinese sentiment and the Great Depression in the 1920s and 1930s, the urban layout of the enclave was established mostly under self-management (Bowen, 2011; Chau et al., 2016).

Studies point out that the location selection of the first lodging house and the early development of the enclave along Little Bourke Street was highly organic, which resulted from the close family and tribe ties possessed by the first group of migrants, who were often from the Sze Yap region in Guangdong, China. Chau et al. (2016) state that once a Chinese person had settled in Little Bourke Street, others wished to live in proximity for social bonding. Soon after the low-rent lodging house started to appear on the street, shops, gambling houses, opium shops, and brothels also emerged. Although these functions in the enclave do not justify the government's racially discriminatory attitudes, they added to Chinatown Melbourne's overall negative image at the time (Fitzgerald, 2007). In the book the Outcasts of Melbourne, McConville describes Chinatown as a "slum" (Davison et al., 1985). However, there have been ongoing debates on the accuracy and comprehensiveness of the "slum" statement about the precinct at the time (Young, 2000). Soon after the 1880s, with the decline of gold mining, Chinese migrants established furniture-making factories and wholesale fruit markets in the precinct, which peaked around the 1910s in terms of the precinct's size (Bowen, 2011).

Figure 2. Map of Chinatown 1888 with Chinese functions annotated (source: authors)

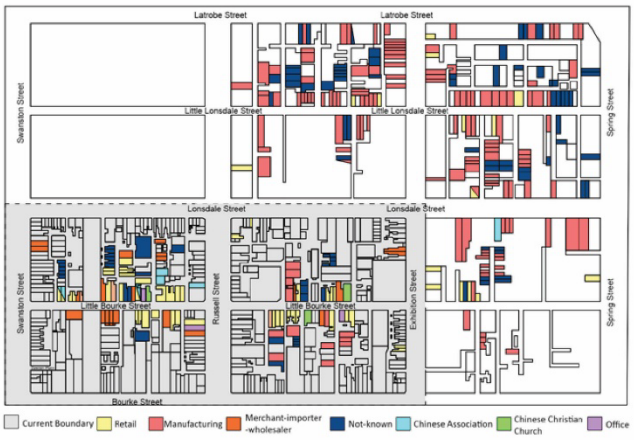

Figure 3. Map of Chinatown 1910 with Chinese functions annotated in comparison with the current precinct boundary (source: authors)

Figure 4. Map of Chinatown 1948 with Chinese functions annotated (source: authors)

Figure 5. Map of Chinatown 2015 with Chinese functions annotated (source: authors)

Figure 6. Map of Chinatown 2022 with Chinese functions annotated (source: authors)

Due to the passing of an Immigration Restriction Act that legalized the anti-Chinese sentiment, the Chinese population in Melbourne decreased dramatically after 1901 (Anderson, 1990). Consequently, by the 1930s, together with the Great Depression, Chinatown Melbourne had shrunk to only a few shops along Little Bourke Street. Various studies reveal that along with the declination of the precinct's physical size, both the government and the public had highly negative perceptions of the precinct at the time (Beynon, 2019; Blake, 1975; Davison et al., 1985). Business owners in Chinatown, particularly restaurant owners, also began to branch out to suburban areas during the 1930s (Nichol, 2002). The discriminatory migration law and municipal regulations ceased in the 1940s. Shortly after, with reformed work practices and trade union rules, Chinatown Melbourne slowly grew back again. The enclave soon regained its livelihood by providing dining services with authentic Chinese cuisine to westerners and tourists (Chau et al., 2016; Mak, 2009). To help visualize the changes, the Mahlsteft maps, VicPlan, and maps produced by Chau et al. (2016) were utilized to mark the typologies of "passing overlays when buildings were built, altered, and demolished" in Figures 2 to 6. According to the mapping analysis, an extensive number of small plots were amalgamated to form blocks occupied by new buildings with large footprints during this period. Blake (1975) also indicates that before the reform in the 1940s, Chinatown Melbourne also partially occupied the two blocks north of its current location. As a result of the block consolidation and shrinking of the area, the present boundary of Melbourne Chinatown rendered slowly occupying the block formed by Lonsdale, Bourke, Exhibition, and Swanston Street, with Little Bourke Street being the central vein. The abolition of the discriminatory White Australia policy in 1972 and the notion of cultural pluralism marked a critical turning point in the history of Chinatown Melbourne (Anderson, 1990; Ang, 2014; Satzewich, 1989; Seitz & Foster, 1985). As a result, the government selected Chinatown as a symbol of ethnic diversity and an object of civic pride, which planners celebrated as they brought cultural pluralism on board. Wong (2018) denotes that despite the unsupportive opinion held by some cultural activities and local Chinatown residents, the city council established the Chinatown Special Advisory Committee to help "enrich and revitalize" the area.

The Redevelopment of Melbourne Chinatown is divided into two stages; Stage One commenced from 1972 to 1976, while Stage Two began in 1983 and lasted until 1988. In Stage One of the redevelopment, according to the Melbourne City Town Clerk, the key goal was to "inject Chinese characters" into the area and generate a "characteristic Chinatown atmosphere" (Anderson, 1990). To realize this vision of "Chineseness," four archways and clusters of Chinese-style lantern lights were erected across Little Bourke Street. City Mayor Walker sent project architects to China to learn from the original materials and styles to create the most original gateways and decorations. Ironically, later in the modification proposal of gateways in Melbourne's Chinatown, Guo et al. (2008) affirm that the original gateways styles share some characteristics of the tomb gateways in the Ming-Qing dynasty. As the local council and planners were unaware of the unsuitable gateway styles at the time, Stage One of the revitalizations had already been criticized for embracing cultural inclusion through exclusive planning strategies that reminded the local Chinese of their turbulent past of racial and cultural discrimination (Wong, 2018). The government developed special committees, such as the Victorian Chinatown Project Study Committee to fight against the redevelopment plan and the second stage in the making. Despite all the opposing voices, Stage one was completed in 1976. However, the Stage Two of this development proposal, led by Mayor Walker, was terminated.

In 1983, the issue of renovating and upgrading Chinatown reappeared. Stage Two of the redevelopment was proposed again, but to sensitively dignify the Chinese's contribution while adding to the Australian ideal of "multi-culturalism." Anderson (1990) criticized the project as still subtly carrying the concept of incorporating some essential "Chineseness" and marking the clear boundary of space. Ang (2016) also criticized the term "Chineseness" by suggesting the term as an object of commodification, where ethnic identities are alleged sources of exchange value through cultural branding. Similarly, using Chinatown Brisbane as an example, Ip (2005) expresses his negative opinion by arguing that the term is used to sell Chinatown as a cultural landmark to non-Chinese with its' exotic and ethnic characteristics in western society. In February 1985, the Chinatown Historic Precinct Act 1984 came into effect, which specified Chinatown's physical existence and boundaries and empowered the City Council to issue direction to owners on the external appearance of heritage buildings on-site to ensure the precinct's character stays coherent (Anderson, 1990; Jones, 2005). Along with the Victorian heritage registration and heritage overlay, the long-term impact of this legislation seems positive, as most of the heritage facades are being well-protected. Then in the Chinatown Action Plan 1985, prepared by the Melbourne City Council Victorian Tourism Commission, essential principles to revitalize the precinct included:

- activating small laneways along Little Bourke Street;
- promoting incidental open spaces;
- establishing the Museum of Chinese Australian History and further exploring Chinese-style decorative elements.

The 1985 Action Plan plays a vital role in the current planning of Chinatown Melbourne, as most of the proposed principles were realized from 1985 to 1988 while still being practiced today (MCC & VTC, 1985). Post the changes made to the precinct according to the Action Plan, Chau et al. (2016) later comment that the value of Melbourne Chinatown's existence is now not merely a way of historical preservation or a marketing strategy for city branding. It is a genuine contribution to cultural pluralism in Australia against discrimination and segregation in the past and the homogenized and globalized cityscape in the present. Although still being a symbolic center to the Chinese community, in the minds of the council, the tourist dimension came to dominate Chinatown's identity. Mak (2009) asserts that the precinct has increasingly become a creature of the council and commercial interests, and it has not regained its function as a cultural center or as the expression of Australian-Chinese identities that it could have been. Before the pandemic, the precinct once prospered with a mix of Chinese and non-Chinese functions that attracted numerous visitors from muti-cultural backgrounds (Figure 6). However, due to the pandemic and the precinct's focus on being a tourist destination, a decline in Chinatown Melbourne's occupancy and business has occurred since 2020 (Yang & Fang, 2020). According to the field observation, the pandemic affects both Chinese and non-Chinese-related businesses. Some have closed down, leaving some empty shopfronts waiting for new rentals along the street. Now, like many other Chinatowns post-pandemic, Chinatown Melbourne is experiencing an "identity crisis," as it is unclear whether the tourist attraction is a sustainable strategy (Dansie, 2022; Hartke, 2022). For many planning authorities, the context of such ethnic enclaves is less about the precinct being a cultural center or a tourist attraction but about what form this attraction should take. After the end of the pandemic, the city council has initiated many strategies to revitalize the city area, including dining and entertainment discounts and art exhibitions (VSG, 2022b). However, the precinct's "identity crisis" is yet to be deciphered.

2.2. Current urban features and principles

2.2.1. Main Street: desirable congestion

Long before Chinatown Melbourne received any catered urban planning strategies, the Hoddle Grid was laid out in Melbourne and is still in use today (Freeman & Pukk, 2013; Mundell, 2019). Major streets, including Swanston Street, Russell Street, Exhibition Street, Bourke Street, and Lonsdale Street, which form the boundaries of Chinatown, are all designed to be around 30 meters wide. Intersecting streets such as Little Bourke Street are approximately 10 meters wide. These streets divide Melbourne Chinatown into four major blocks, each around 100 meters by

200 meters, with Little Bourke Street as the central street (Dovey et al., 2018; Freestone, 2010). In the 1985 Chinatown Action Plan, under the key urban principles for Little Bourke Street, one statement highlights that the building forms and streetscape should be like a "valley form," with its central axis being Little Bourke Street. When viewing the precinct from a sectional perspective, the main street and the buildings along the streets create a "valley form." With such a "valley form," the laneways direct pedestrians into the main street, while the main street holds most of the pedestrian and traffic flow and creates a "desirable congestion."

Based on the supporting principles, the 1985 Action Plan also implies that the buildings facing Little Bourke Street need to be strictly controlled regarding their height and external appearance to retain the original scale and character assets (MCC & VTC, 1985). The existing low-medium building height, the main street width, the narrow laneways, and the ratio between them are key attributes of such a "valley form" streetscape proposed in the Action Plan. The guide does not depict the main street as a grandeur central street for only pedestrians and sightseeing. Instead, it argues that the apparent congestion created by pedestrians and vehicles constitutes the intrinsic and essential character of the street.

Before the 1984 Chinatown Historic Precinct Act and its subsequent 1985 Action Plan, buildings on Little Bourke Street had to be set back by around 1.4 meters from the original alignment in response to the Melbourne Widening of Streets Act 1940 to widen certain footways in the city area. However, to maintain the "desired congestion" and heritage features of buildings along the street, the 1940 Act was repealed by the Chinatown Historic Precinct Act 1984, which ceased the setback of buildings. The "desired congestion" also needs to maintain the comfort and safety of pedestrians and balance the needs of traffic, deliveries, shops, and restaurants. To achieve such balanced congestion, instead of setting back buildings, one of the principles of treatment to the main street entails that reducing the carriageway, on-street parking, and non-essential traffic can facilitate the footpath widening.

There are many widened pavement segments on Little Bourke Street from the Swanston Street entrance to the Exhibition Street entrance (Figure 7). Such widening creates a narrow main street with compacted functions. However, the widening is not continuous along the main street, with occasional widened segments. Permanent widening of the pavements creates mostly walkways for pedestrians (Figure 8), entrance areas for shopfronts, and on-street parking (Figure 9). Some temporary widenings are used as outdoor seating areas for restaurants in response to pandemic-related actions with no patterns (Figure 7). As the irregular footpath expansion pattern forms, the carriageway width changes, causing traffic congestion on the main street. Despite the narrow main street and its sporadic width, the provision of on-street parking and seating area, the wider walkable footpath, and the one-way car-

Figure 7. Widening of the pedestrian walkway on Little Bourke St (source: authors)

Figure 8. Widening for pedestrians only (source: authors)

Figure 9. On-street parking zone (source: authors)

riageway have contributed to the congestion of the main street (Matan & Newman, 2012; Whitfield, 2015). As the Action Plan proposes, congestion is maintained on Little Bourke Street. However, whether the current congestion level is "desirable" for carriageway traffic is undetermined (Ellis et al., 2016; Wang & Yang, 2019).

2.2.2. Side lanes and consolidation of parcels: laneway culture

Laneway culture is unique to the urban landscape of Melbourne city; Chinatown necessitates the same urban character with no exception (Mundell, 2019). Laneways in Melbourne work as a network that navigates pedestrians and serves as a critical contributor to the city's overall iden-

tity (Bate, 1994). Like elsewhere in the city, Chinatown's latent circulation pattern facilities mainly the north/south pedestrian movement and the east/west traffic. The Chinatown Action Plan 1985 highlights that "a shift in the perception of Chinatown" marked the retreat from delineating Little Bourke Street as the key strip and the laneways as subsidiary spaces. Chinatown is not the only topic that received a change of perception by the public; laneways in Melbourne and the graffiti art attached also went from being considered a sign of depravity to hidden treasures to a part of the city's identity (Dovey et al., 2012; Mundell, 2019; Poulton, 2011). Graffiti forms a part of Melbourne city's place identity and its unique laneway culture. Dovey et al. (2012) argue that graffiti in Melbourne's laneways takes both positive and negative symbolic meanings, resembling both street art and vandalism. The relation of graffiti to place identity affirms Lefebvre's theory on the reciprocity between sociality and spatiality (Lefebvre, 1991; Dovey et al., 2012). In the case of Melbourne, the laneway culture and the embedded graffiti are intertwined with both the urban morphology and cultural identities. Graffiti is often engendered from intersecting and conflicting intents to protect urban character and place identity. It may seem disruptive and pollutant to the coherence of streetscape and buildings. However, with such an urban spatial practice, neighborhoods and the locals can express their identity characteristics freely, forming a new "sense of place" and resulting in new place identities. Nowadays, the inner city's graffiti-covered laneways act as one of the city's premier tourist attractions and a part of the laneway culture, which is essential to the city's identity.

The occupancy of laneways has a prolonged history in Chinatown Melbourne (Dovey et al., 2018). A study by Nichol (2002) uncovers the history of Chinese restaurants in Melbourne, including the former Wing Ching restaurant, which was constructed in 1891 with a few other cafes and restaurants in Heffernan Lane. Despite the planning principles of Melbourne CBD's Hoddle Grid, block consolidation and heritage control also play a role in forming the current laneway layout of the precinct (see Figures 2 to 6). A Nolli map analysis of the enclave by Chau et al. (2016) showcases the sequential laneway reduction by consolidating small plots as the land value increased while laying a foundation for the mapping analysis in this study. The mapping analysis also illustrates that more east/west laneways with close ends had been erased than the north/south ones in Chinatown, as the permeability of the east/west movement relies mainly on Little Bourke Street. Chau et al. (2016) and Moreau (2015) assert that these close-ended laneways cease traffic flow but increase privacy. Reducing the amount of these east/west laneways also echoes the area's functionality change. Using Cohen Place as an example, Young (2000) points out that three families living in the area as long-term residents formed a close-net community between 1880 to 1900 (Young, 2000). However, as the second phase of Melbourne Chinatown's redevelopment emphasis, Cohen Place is now presented as a major cultural hub, where a heritage precinct with a cultural museum is located. Parts of the Cohen Place plot and east/west close-ended laneways have been amalgamated to form a square that marks the Cohen Place precinct's entrance (Figure 10). The function of Chinatown was a residential area with lodge hubs where those close-end laneways secured intimacy and privacy (Moreau, 2015). As commercial-focused zones require loading bays, the close-end laneways no longer fit the area's adapted functional needs.

From the Action Plan and current maps of Chinatown Melbourne, 24 laneways are identified, including twelve open-end and twelve close-end laneways (Table 3 and Figure 11). According to the Action Plan, seven laneways, all running in the north/south direction, are labeled as laneways that prioritize pedestrian movement (MCC & VTC, 1985). Twelve laneways provide services priority for businesses in the precinct, including mostly loading bays, back gates, and services; meanwhile, four other laneways are mixed-function laneways that fulfill demands by both pedestrians and services. According to the field observation, Chinatown laneways' current functional usage aligns with the 1985 Action Plan. However, a contrast was observed between the livelihood and condition in laneways with different functions. Laneways that prioritize only pedestrians, such as Tattersalls Lane, Market Lane, Heffernan Lane, Corrs Lane, and Cohen Place, accommodate a range of functionalities, such as the museum, restaurant, and bar. On top of serving the pedestrians, these laneways often accommodate outdoor seating for restaurants, provide a visual connection between main streets, and form decorated pathways to key attractions such as the Chinese Museum in Cohen Place. Contrasting to the vibrancy of those laneways that prioritize pedestrians, laneways for services in Chinatown mostly do not have any crowd or decorative features and design. Most service laneways present no visual content despite some graffiti, such as Stevenson Lane (Figures 12 and 13) and Hughs Alley (Figure 14). Rubbish bins, exposed buildings services, and parking with low-level pedestrians take up most of the service lanes.

Figure 10. Cohen Place Square – Gate 5 (source: authors)

Table 3. Laneways in Melbourne Chinatown according to Chinatown Action Plan and Field Observation

No.	Name	Open-end or close-end	Main function priority	Treatment mentioned in the Action Plan
1	Stevenson Lane	Open	Mixed	No
2	Globe Alley	Close	Service	No
3	Tattersalls Lane	Open	Pedestrian	Yes
4	Celestial Avenue	Close	Mainly pedestrian; partly service	Yes
5	Heffernan Lane	Open	Pedestrian	Yes
6	Waratah Place	Open	Mixed	Yes
7	Belman Place	Close	Not Mentioned	Yes
8	Corrs Lane	Open	Pedestrian	Yes
9	Pender Place	Close	Service	No
10	Lacey Place	Close	Service	Yes
11	Cohen Place	Open	Pedestrian	Yes
12	Smythe Lane	Open	Service	No
13	Star Alley	Close	Service	No
14	Latrobe Place	Open	Mixed	Yes
15	Hughs Alley	Close	Service	No
16	Dean Alley	Close	Service	Yes
17	Bullens Lane	Open	Service	No
18	Golden Fleece Alley	Close	Service	No
19	Coverlid Place	Close	Mixed	Yes
20	Brien Lane	Open	Mainly pedestrian; partly service	Yes
21	Paynes Place	Close	Service	No
22	Croft Alley	Close	Service	No
23	Market Lane	Open	Mainly pedestrian; partly service	Yes
24	Lees Place	Open	Service	Yes

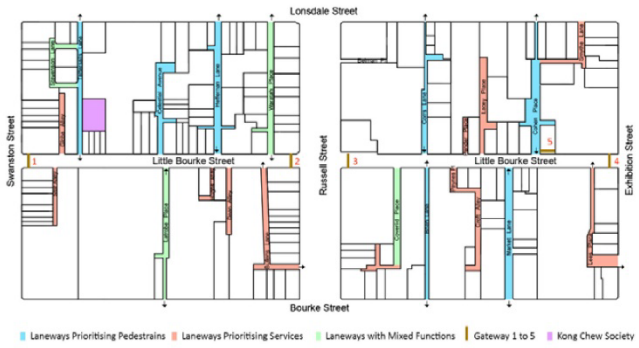

Figure 11. Map of Chinatown 2022 with laneways and gateways annotated (source: authors)

Despite the occasional graffiti and pavement painting, no other visual treatments or designs were observed in these service lanes above. Mixed-use laneways such as Celestial Avenue and La Trobe Lane are decorated with temporary signages to harmonize service use and pedestrian engagement (Cartiere & Tan, 2020). Restaurants in these lanes utilize eye-catching Chinese-style signages to energize the streetscape.

Laneways have been a feasible solution for building a coherent dialogue between commercial pressure and historic preservation (Freeman & Pukk, 2013; McCartney et al., 2019; Mundell, 2019; Poulton, 2011). The 1985 Action Plan states that the "Chinese uses" of buildings and

Figure 12. Stevenson Lane 1 Graffiti (source: authors)

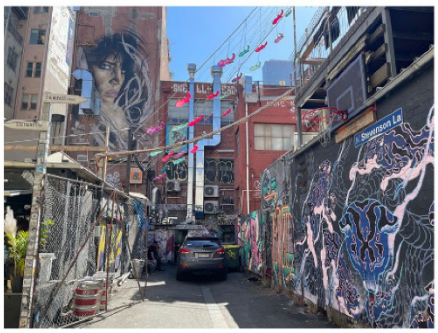

Figure 13. Stevenson Lane 2 mixed usage (source: authors)

Figure 14. Hugh Alley Graffiti (source: authors)

the "Victorian fabric" make the area distinct. The term "Chinese uses" describes the traditional use and the functional zoning of shopfront houses in Guangdong Province, particularly the Sep Yep region, the hometown of many early migrants (Byrne, 2020). Commercial use and heritage preservation are in harmony with shops or restaurants occupying the ground level, while the upper floors remain intact. At the same time, laneways offer space for services and delivery to these shops.

2.2.3. Gateway

Unlike some previous approaches used to suppress the cultural identity of Chinatown Melbourne in the past stages, Chinese-style gateways are the results of incorporating and celebrating its cultural background for the precinct branding and identity development in a top-down manner (Hudson et al., 2017). Along Little Bourke Street, four gateways were erected in 1976 (Figure 11), redesigned in 1985, and modified in 2008, marking the intersections of Little Bourke Street (Figure 15 to Figure 18), Swanston Street, Russell Street, and Exhibition Street (Anderson, 1990). Upon consultation with experts in traditional Chinese gateways, the local government modifies these four gateways from having a Ming-Qing dynasty tomb gateways appearance to having more vibrant and festive colors. It is worth noting that the modifications of the gateways in 2008 utilized removable metal sheets with color prints resembling a temporary nature. Guo et al. (2008) conclude that the functions of these newly modified gateways include urban decoration and cultural symbols, a local landmark for festival occasions, and attraction for tourists nationally and internationally. These sheets are still in use today, as the locals and the experts view the decorated gateways as a cultural representation of more prosperity compared with the original tomb-style gateways (Guo et al., 2008). Another gateway locates parallelly to Little Bourke Street (Figure 10), highlighting Cohen Place and the museum's entry (Figure 11). This gateway was a gift from Jiangsu Province to the State of Victoria in 1979, celebrating the sister-states relationship. Unlike the four gateways sectioning Little Bourke Street, the Gateway (Lingxing gateway) outside Cohen Place is a replica of the Chaotian Palace gateway in Nanjing. The Palace was initially built in the Ming dynasty for cultural ceremonies, so its gateway was selected as the model with cultural meaning for the replicated gift (Wang, 1987). Today, these permanent gateways are essential to the precinct's identity. They not only act as decorations but also resonate with the precinct's spatial layout and cultural background. Geng et al. (2022) argue that the gateways stand at key intersections of the precinct to enhance a sense of continuity along the main street. For instance, at the intersection of Russell Street and Little Bourke Street, the two gateways mark the extension of the precinct beyond Russell Street with four lanes, which sections the precinct in half (Geng et al., 2022). These gateways serve as spatial signages for pedestrians to identify the boundary of the precinct.

2.2.4. Public and green space

As narrow laneways with the desired congestion are core to the precinct's identity, Cohen Square complexifies the spatial layout and the subsequent identity. The 1985 Action Plan advocates that public space is required in Chinatown, and it seems fitting to have the only one close to the museum in Cohen Place (MCC & VTC, 1985). On top of the usual functionality of open spaces, the proposed open space in Chinatown is also set to be responsible for cultural events, being a welcome gateway for the museum and signifying the location of the Cohen Place cultural hub. This proposed square is designed to be a central focus of Chinatown. The Action Plan asserts that open space should be kept small and compact in the context of laneway networks. The Plan outlines that small node-like public spaces should complement the desired pattern for Chinatown Melbourne with narrow laneways. The Action Plan indicates that the assertion was based on empirical evidence, but there is a lack of references provided. Although there is no clear numerical ratio given, the assertion made in the Action Plan has been widely supported by various urban theorists (Gehl, 2013). Using a laneway in Perth as an example, Gehl (2013) points out that small spaces and short distances resemble a warm and intense city environment, where buildings, landscapes,

Figure 15. Gateway 1 – Swanston Street entry (source: authors)

Figure 16. Gateway 2 – Russell Street west entry (source: authors)

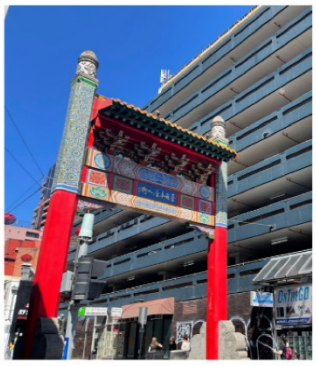

Figure 17. Gateway 3 – Russell Street east entry (source: authors)

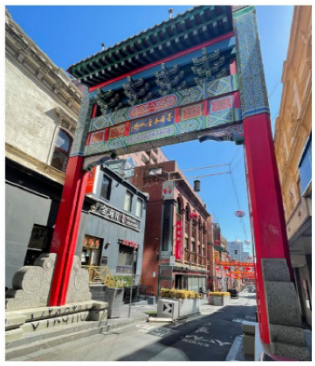

Figure 18. Gateway 4 – Exhibition Street entry (source: authors)

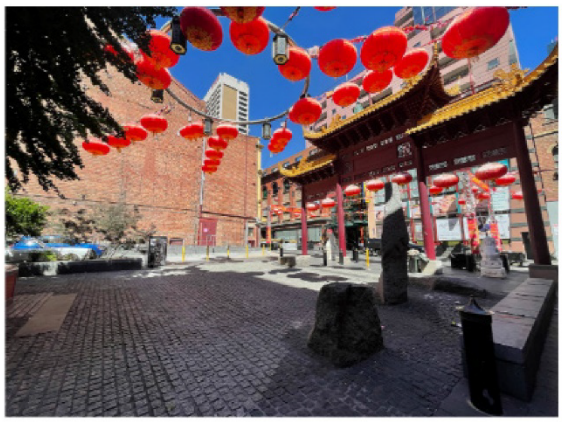

Figure 19. Cohen Place square during festivals with decorations in Jan 2020 (source: authors)

and activities can be experienced with great intimacy. On the contrary, city areas with large built-ups that are widely spread can convey coldness, impersonality, and formality. To achieve warmth and intimacy between people and the space, proposing a compact square that does not disturb the current streetscape with low-medium-rise buildings and narrow laneways that still provides some different spatial experiences is a desirable solution (Matan & Newman, 2012). Next to the entry point of Cohen Place, a traditional Chinese gateway marks a small square, which creates a cultural complex rather than a laneway with a uniform width (Figure 19). Chau (2016) suggests that this square is a key gathering point when celebrating Chinese festivals. Having Cohen Place serving as the only public space in the already tightly arranged space can accommodate the occasional festival needs. During the field observation, only hospitality workers occupied the square during their break in a non-festive period. Aligning with the Action Plan, green space is not the focus of the precinct's identity development; limited green spaces exist in the area. Similarly, the emphasis on public amenities in the precinct was set to focus on those with a decorative nature, mostly addressing the signage design with Chinese characters and visual elements. Under such guidance, erecting more public amenities and green spaces in the precinct will transform the urban identity instead of preserving its current form.

3. Discussion

By examining Chinatown Melbourne's urban evolvement, this study argues that the precinct's urban characters lay the foundation of its identity. Radical changes in the precinct's functionality, public perception, and planning strategies occurred due to various factors, such as migration policy, economic recession, and multicultural movement, which led to subsequent identity changes. Such shifts in Chinatown Melbourne have mostly been non-organic but consequential from the abovementioned factors. The top-down decision model and its results in a heritage precinct led to the discussion on the reciprocity between identity shifts and urban characteristics (Plevoets & Sowinska-Heim, 2018). Although the scale of Chinatown Melbourne has decreased to the current four plots from a much greater area, the surviving precinct has gradually gained recognition of its heritage value (Blake, 1975). This study finds that most of Chinatown Melbourne's urban characters still follow the strategies listed in the Chinatown Action Plan 1985, part of the second redevelopment stage (MCC & VTC, 1985). In the post-pandemic era, revisiting the precinct brings insight into the intended urban characteristics and the actual use of space. Although the area is mainly recognized and protected as a heritage precinct, most strategies are based on prohibiting renovations at a building scale. Limited strategies on an urban scale, such as those suggested in the 1985 Chinatown Action Plan, are currently provided by Heritage Victoria. Drawing from the data and the analysis, the following discussion provides some insights into developing heritage strategies for the urban scale enclave, focusing on three key aspects.

3.1. The intended urban identity, characteristics, and the actual use of the precinct

As the main street of Chinatown Melbourne, Little Bourke Street has been planned to accommodate the high demands of pedestrians and traffic while maintaining the "desirable" congestion (MCC & VTC, 1985). Its narrow street width, set back of buildings, and extension of footpaths have been executed to help sustain such congestion. With these strategies, the main street width presents no pattern but irregular segments of offset. In the post-pandemic era, the street is often congested with a prospered streetscape, high traffic, and pedestrian flow. However, with the high traffic level in Melbourne, the line between "desirable" and "non-desirable" congestion in the precinct is blurry with no clear guidance. This raises a discussion between the intended and the actual use of the precinct. An updated guide on the planning and identity of the precinct is needed to redefine goals set in the 1985 Action Plan to meet the adaptative demands. More empirical parameters in the heritage guideline can help better define these goals, particularly those related to transportation and traffic congestion (García et al., 2012). Studies have suggested that sensory technologies and empirical measures can enable close monitoring of traffic flow and walkability (Chiang & Deng, 2017; Zhang et al., 2019). Another example of such a phenomenon is Cohen Place square; the lack of occupancy of Cohen Place square presents a mismatch between the intended use and the actual use. The Action Plan proposes that Cohen Place square is the only public place in the precinct for gathering and cultural activities. While serving as a key landmark and an occasional gathering space during festival celebrations, the Cohen Place square does not seem occupied during the field observation. To harmonize between heritage preservation and spatial practicality, heritage and identity-related strategies should derive from a collaborative dialogue, including its stakeholders and policymakers (Li & Qian, 2017; Plevoets & Sowinska-Heim, 2018). As the demography of Chinatown's visitors went through radical changes after the

1985 Action Plan, these strategies are also facing undeniable shifts. With the proximity of two universities to the precinct, international students and tourists are rejuvenating the precinct in the post-pandemic era (Barraclough, 2022; Saunokonoko, 2022). However, the characteristics and identity set in the 1985 Action Plan are outdated in the sense that the ongoing shifts in demography and needs are not actively being addressed. Such rigidness in the guideline results in a mismatch between the intended and actual use of the space and the current demand of its users.

3.2. Top-down approaches and bottom-up needs of the local communities

Whether the existing top-down decision-making model results in obsolete planning and heritage strategies is questionable. Gateways in the precinct are a vital part of the area's urban identity from the 1985 Action Plan and the observation (Guo et al., 2008). They help direct visitors and symbolize the area while making it stand out among the nearby concrete built-ups. These gateways and many other approaches implemented during the precinct's development are examples of how cultural and political influences can indeed determine a precinct's identity development. As seen in the urban evolution of the precinct and the current temporary decorations, the authors of this study find that the direction of the precinct's identity building is constantly shifting due to the political and cultural environment in a top-down decision model (García et al., 2012; Ruzzier & Petek, 2012; Murillo, 2017). Unlike the permanent gateways, some decisions can be culturally unsuitable due to the singularity of such a decision model. For instance, as part of a cultural celebration event for the full moon's rise (RISING Melbourne) in May 2021, blue and white lanterns (Figure 20) were installed in Chinatown. In Chinese culture, blue and white lanterns are usually installed in mourning halls during funerals to express grief over one's death, which is culturally interpreted as a lack of prosperity and festive meanings (Wolf, 1970; White & Leung, 2015). The installation in Chinatown received numerous complaints from local business owners, declaring that the city council was ignorant of Chinese cultural traditions and caused damage to the precinct's Fengshui (Yang, 2021). Although these installations are only temporary and not a part of the urban characteristics of preserving nature, they reflect the potential adverse outcome of the top-down decision model in building the precinct's identity. Engaging the local business owners and the greater Chinatown community may minimize the potential singular effect of a top-down identity development model (Hudson et al., 2017; Ruiz Pulpón & Cañizares Ruiz, 2020). The local business owners also argue that the local council should consult the local community in future events related to identity development (Yang, 2021). A bottom-up model may assist the authorities in implementing more customized planning and decorating strategies for the precinct with a better understanding of the embedded cultural background.

Figure 20. Blue and white lantern – temporary decorations for RISING events in May 2021 (source: authors)

3.3. The relationship between changes and heritage preservation in the precinct

Although the top-down approaches lay the foundation of the identity and planning decisions made to the precinct, the results reflect that some spontaneous alterations to Chinatown Melbourne still occurred. For instance, laneways have been crucial for the urban identity of Melbourne city, which Chinatown is an unneglectable part of (Mundell, 2019). Although possessing the same laneway culture, Chinatown's laneway set-up is unique as many functional priorities are intertwined, including those for pedestrians, services, and mix-use. Most pedestrian laneways have open ends and present high visual quality with eye-catching signage, minor services exposure, and some outdoor seating. These laneways also facilitate south-north movements of the precinct and are packed with restaurants, bars, and cultural activities. Mix-use laneways showcase an opportunity for service laneways' adaptations. With the effective use of graffiti and Chinese-style signage design as decorations, the mix-use laneways present a cohesive balance between pedestrians and services. Such spontaneous changes in the laneways have led to a positive perception by the visitors and the local community. Looking at the gateway decorations, the adaptation of laneways, and other temporary features that have been widely accepted by the local community, both top-down and bottom-up decision models lead to changes in the urban characteristics and identity of the precinct (Hudson et al., 2017; Ruiz Pulpón & Cañizares Ruiz, 2020). As the precinct is constantly evolving with its user profile, the pattern of use, and identity pursues, changes in its urban characteristics are unavoidable consequences. Apart from fathoming the precinct's past and current urban characteristics, which this study provides, forming an adaptive guideline that can facilitate multi-dimensional changes in the precinct's future identity is equally important (Gertner, 2011; García et al., 2012; Ruzzier & Petek, 2012). As seen in Chinatown Melbourne, the line between what is to be preserved and what is to be adapted in an urban heritage precinct should be drawn from the collaborative input of the authorities and the local communities.

Conclusions

Chinatown Melbourne's urban identity has undergone numerous radical changes due to non-organic cultural and identity shifts set by the authorities. By exploring the precinct's urban history, this study scrutinizes the evolution of the precinct's urban identity through seven key phases, ranging from the "slum" lounging house area and fruit wholesale market to the current heritage ethnic enclave. With these urban characters, the "valley-like" precinct genuinely contributes to Australia's cultural pluralism and functions as an iconic urban heritage zone in harmony with the busy cityscape. The current urban identity of the precinct is primarily built upon the pursuit of the original Chinatown Action Plan 1985 with some modifications. Such characteristics that form a major part of the urban identity include a narrow main street with "desired" congestion, a "valley-like" precinct with strong laneway culture, four major plots sectioned by Chinese-style gateways, and a small public space. With its unique urban characters, the precinct is now a multicultural enclave with various functionalities, including entertainment, hospitality, and some cultural activities that suit visitors and locals. Recently, lockdowns during the pandemic impacted the precinct, and now it is revitalizing with the incoming flux of visitors and international students. During this critical moment, a framework for the precinct's identity development is essential to lessen the potential adverse effect of an "identity crisis", evident in Chinatowns around the world. Changes in urban characteristics mostly result from the council's top-down decisions, aligning with the shifts in the precinct's set identity. However, the government implemented some unsuitable decorations and character changes without thoroughly understanding the local community's cultural background and demands. Drawing from the history of the precinct, changes are unavoidable to the precinct's future. An adaptive guideline that acknowledges the heritage value and characteristics while incorporating the stakeholder's demands in a bottom-up manner and cultural background is necessary for the precinct's future development.

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Chapter 4 Spatial Understanding of Chinatown Melbourne

4.1 Introduction

The previous chapter provided a fundamental understanding of the precinct from an urban history and urban characteristics perspective. Building on this context, this chapter focuses on the spatial characteristics that is a part of Chinatown Melbourne's urban identity. It also proposes a methodological framework for future studies examining heritage precincts from a spatial perspective.

The discussion around the spatial characteristics of heritage precincts has been marginalised in existing research. The literature review concludes that studies in this area often provide a limited understanding of urban features without exploring the relationship between spaces within heritage precincts and their unique spatial layouts. Therefore, this chapter delves further into the spatial qualities and characteristics of the case study to unveil a new layer of understanding that is often overlooked in heritage value frameworks. Three key research objectives are achieved in this chapter: understanding the case study's street network, investigating visibility relationships within the precinct, and scrutinising the relationship between streets and buildings in the area.

This study uses qualitative and quantitative data to develop a methodological framework encompassing four analytical scales: macro, semi-urban, micro, and human. Key methods include space syntax analysis and field observation, with parameters such as connectivity, mean depth, integration, intelligibility, visibility, intervisibility, topological depth, and use of spaces within the precinct. Each scale offers a distinct perspective. For instance, macro-scale analyses provide a broad urban view, while micro-scale analyses reveal the relationship between individual heritage structures and their immediate surroundings.

The findings provide insights for future heritage policies, presenting a framework that integrates spatial values into urban heritage decisions. This chapter reveals that, at a macro scale, there are significant differences in connectivity, mean depth, and integration between the main streets and laneways within the precinct. At a semi-urban scale, most laneways are visually deep and hidden, exhibiting low visual integration and small isovist areas. At a micro-urban scale, the case study shows low topological depth between private and public spaces at ground level, which is advantageous for commercial activities. The precinct's urban liveliness, based on intervisibility and constitutedness analyses, is found to be highest along Swanston, Little Bourke, and Russell Streets. Human-scale field observations were conducted to validate these findings derived from the space syntax analysis.

By examining the development of the spatial characteristics of the case study within the context of the Hoddle Grid system, this chapter provides a holistic understanding of the case study from a spatial perspective, which can benefit future heritage decision-making, including the potential implementation of Smart Heritage strategies. Another key implication of this chapter is the transferable methodological framework, which can facilitate future research on other heritage precincts. This chapter builds upon the findings of the previous chapter. Together, these two chapters provide a holistic and in-depth understanding of the case study from its urban and spatial contexts, consequently presenting the case study's urban identity from multiple dimensions.

The following paper is included in the chapter;

1. Geng, S., Chau, H. W., Jamei, E., & Vrcelj, Z. (2022). Understanding the street layout of Melbourne's Chinatown as an urban heritage precinct in a grid system using space syntax methods and field observation. *Sustainability (Switzerland)*, *14*(19), 12701. https://doi.org/10.3390/su141912701

4.2 Declaration

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DECLARATION OF CO-AUTHORSHIP AND CO-CONTRIBUTION: PAPERS INCORPORATED IN THESIS

This declaration is to be completed for each conjointly authored publication and placed at the beginning of the thesis chapter in which the publication appears.

1. PUBLICATION DETAILS (to be completed by the candidate)

Title of Paper/Journal/Book:	Urban Characteristics, Identities, and Conservation of Chinatown Melbourne
Surname: GENG	First name: SHIRAN
Institute: Institute for Sustainable Industries and Liveabl	Candidate's Contribution (%): 89

Status:

Accepted and in press:	☐	Date:	
Published:	☑	Date:	20/01/2023

2. CANDIDATE DECLARATION

I declare that the publication above meets the requirements to be included in the thesis as outlined in the HDR Policy and related Procedures – policy.vu.edu.au.

	[redacted]	05 NOV 24
	Signature	**Date**

3. CO-AUTHOR(S) DECLARATION

In the case of the above publication, the following authors contributed to the work as follows:

The undersigned certify that:

1. They meet criteria for authorship in that they have participated in the conception, execution or interpretation of at least that part of the publication in their field of expertise;
2. They take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;

3. There are no other authors of the publication according to these criteria;
4. Potential conflicts of interest have been disclosed to a) granting bodies, b) the editor or publisher of journals or other publications, and c) the head of the responsible academic unit; and
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Name(s) of Co-Author(s)	Contribution (%)	Nature of Contribution	Signature	Date
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4.3 Understanding the Street Layout of Melbourne's Chinatown as an Urban Heritage Precinct in a Grid System Using Space Syntax Methods and Field Observation

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Understanding the Street Layout of Melbourne's Chinatown as an Urban Heritage Precinct in a Grid System Using Space Syntax Methods and Field Observation

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Abstract: Melbourne's Chinatown is the oldest in Australia. A large amount of research on this unique ethnic enclave has been conducted to elucidate its formation history, heritage significance, cultural influence and architectural features. However, the discussion of the precinct's spatial characteristics remains mostly marginalised. As a heritage precinct in the centre of an urban grid form, the precinct offers a unique spatial experience to its visitors. To better fathom the street layout of the area, three objectives are addressed in this study, including understanding: (1) the precinct's street network in the grid system, (2) the visibility relationship within the precinct and (3) the relationship between buildings and streets. A joint methodology framework is established to fulfil the research objectives by incorporating space syntax methods and field observation. The findings facilitate policymakers and planners in understanding the precinct's unique street layout and making relevant preservation decisions. Further studies are encouraged to scrutinise other spatial and urban characteristics of the precinct and test the proposed methodology.

Keywords: urban heritage; heritage conservation; space syntax; urban morphology; Chinatown; spatial analysis

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1. Introduction

Chinatown is often regarded as a settlement or an ethnic enclave for Chinese migrants. In Australia, the history of Chinatown can be traced back to the gold rush period in the 1850s, when many Chinese gold seekers arrived and resided in major cities such as Melbourne [1]. As the oldest in Australia, Melbourne's Chinatown is located on Little Bourke Street in the city centre. As seen in Figure 1, the boundaries of Melbourne's Chinatown precinct are formed by Swanston, Lonsdale, Exhibition and Bourke Streets. The Victorian Heritage Register identifies three levels of protection from the state level (highest level of heritage significance) to a local level, namely the Victorian Heritage Register, Heritage Inventory and Heritage Overlay [2]. As depicted in Figure 1, most of the urban fabric within Melbourne's Chinatown is recognised with heritage significance by Heritage Victoria, which establishes the precinct as a key urban heritage site in the centre of Melbourne. Anyone can nominate a place to be a part of the Victorian Heritage Register. The nominated places are evaluated using the Heritage Council's assessment criteria to examine their importance to the history and development of the State. For a place to be considered, at least one out of eight criteria must be met, including:

1. Importance to the course, or pattern, of Victoria's cultural history;
2. Possession of uncommon, rare or endangered aspects of Victoria's cultural history;
3. Potential to yield information that will contribute to an understanding of Victoria's cultural history;
4. Importance in demonstrating the principal characteristics of a class of cultural places and objects;

5. Importance in exhibiting particular aesthetic characteristics;
6. Importance in demonstrating a high degree of creative or technical achievement at a particular period;
7. Strong or special association with a particular present-day community or cultural group for social, cultural or spiritual reasons;
8. Special association with the life or works of a person, or group of persons, of importance in Victoria's history.

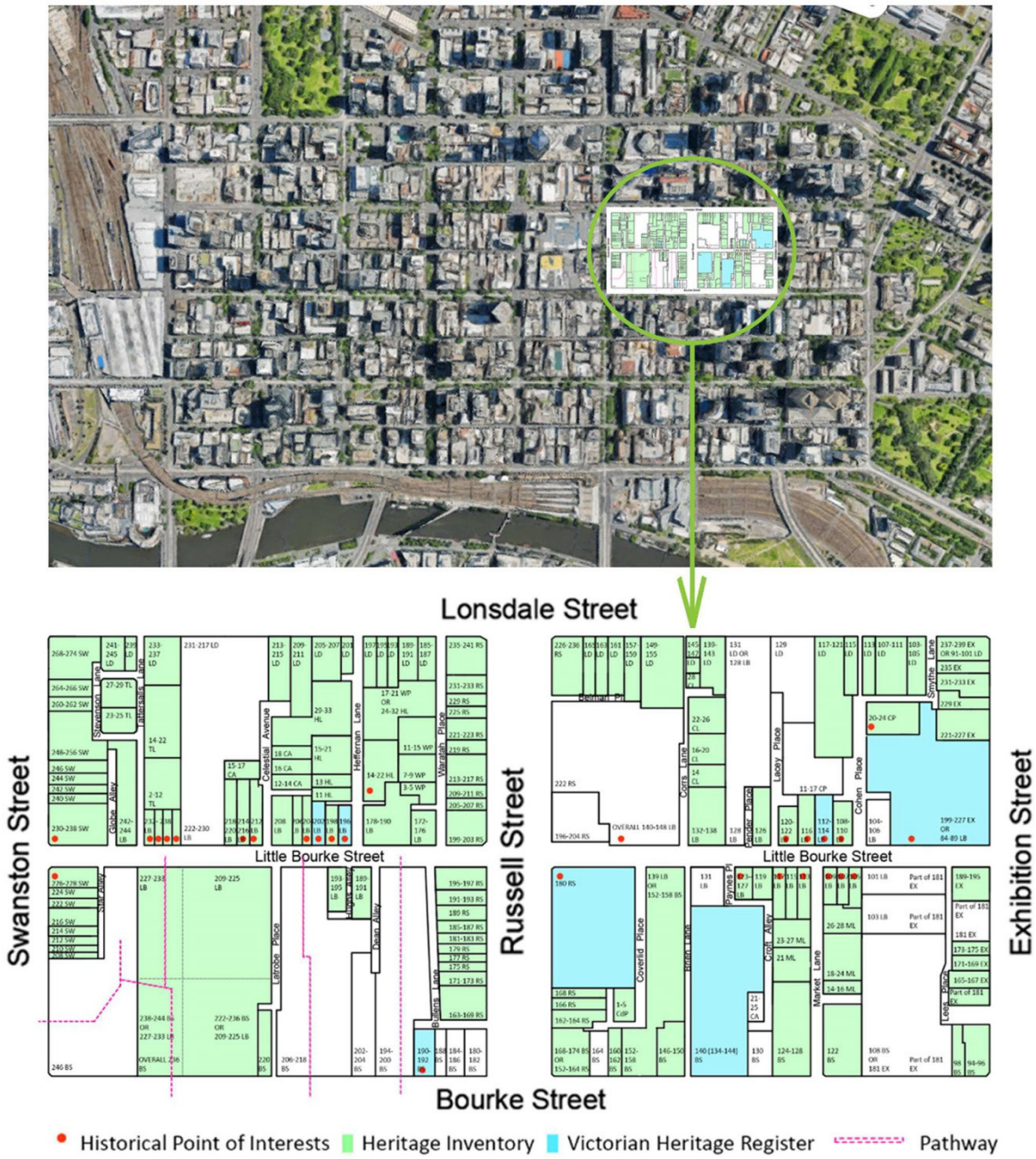


Figure 1. Map of Chinatown drawn by author [3].

Places not meeting the state-level criteria by the Heritage Council of Victoria may be qualified as locally significant (Heritage Overlay).

As a key ethnic enclave with rich heritage value, a large volume of qualitative research can be acquired on associated topics such as the migration history of Chinese ethnic groups in Australia [4–9]. As a heritage precinct situated in the grid form of Melbourne's city centre, it offers a unique spatial experience to visitors. However, the discussion of the spatial and

urban characteristics of the area that constitutes such an experience has primarily remained marginalised. Only a few existing studies have addressed elements of the area's spatial and urban characteristics, such as critical zoning [10], socio-economic features [11] and Chinese urban and architectural influences [12–19]. The lack of understanding of the precinct's street network and its interaction with the grid system is inevitable. As the precinct currently serves as an urban heritage tourist attraction under the Victorian Heritage Register, spatial features and the subsequent experiences for visitors are critical aspects to consider. To better serve the precinct as an urban heritage attraction, the street network in the grid system and the relationship between buildings and streets on the ground level become crucial factors to understand. These factors can directly impact the visitor's experience in the precinct, which involves mostly ground-level interactions. To enrich the spatial understanding of this heritage precinct and its spatial interaction with visitors, the study also aims to examine the visibility of spaces within the precinct. Therefore, this study postulates three key research objectives:

1. Understanding the street network of Melbourne's Chinatown in the existing grid system;
2. Examining the visibility relationship within the precinct;
3. Understanding the relationship between buildings and streets within the precinct.

With the understanding of these above-mentioned spatial characteristics, the study aims to broaden the current urban morphological analysis around Melbourne's Chinatown and provide suggestions to enhance the ground-level visitor spatial interaction within the precinct, serving as a crucial urban heritage in the city's grid network. Currently, the concept of cultural sustainability is addressed as the fourth pillar of sustainability among economic, environmental and social sustainability [20,21]. In the heritage discipline, the concept often emphasises retaining and improving the cultural significance and place identity of heritage sites. Fathoming the above-mentioned spatial characteristics can also benefit the preservation of the current urban identity and enhance cultural sustainability as an urban heritage precinct.

To fulfil the research objectives, this study incorporates space syntax methods with field observation to gain both qualitative and quantitative evidence. A joint methodological framework is developed to better provide insights into the objectives [22,23]. Space syntax deviates from classical urban morphology because it utilises an open space system to practice a form of spatial representation [24]. The juxtaposition of space syntax methods and heritage-related questions has an enduring history, mainly in evaluating the spatial characteristics and exploring the sociocultural dimensions embedded in spatial systems of historical significance [25–37]. A literature review by Palaiologou and Griffiths (2019) explicates three case study scales in research papers evolving space syntax and heritage study, including monumental urban spaces, non-monumental but protected by planning law and lived/emergent historical urban areas [38]. This study corresponds to the second type of urban heritage scrutinised by Palaiologou and Griffiths (2019). To facilitate further testing of the methodological framework of this study, this study categorises the objectives and the subsequent multidimensional methods into four scales, including macro, semi-urban, micro and human scale. Following the methodology and findings, discussions and recommendations can ultimately assist with preserving the precinct as a key urban heritage site in Australia. Further studies are encouraged to use the proposed transferable methodology in examining other urban heritage sites from other cultures.

2. Materials and Methods

This study incorporates spatial analyses on four scales, including three existing space syntax analyses and field observation as joint methods [39–41]. To enrich the comprehensiveness of space syntax results, the field observation method is utilised. Parameters of each space syntax are selected to suit the three research objectives. Table 1 provides an overview of the variables in each step of the proposed methodological framework [39–41].

Table 1. Methodology of the study.

Step	Spatial Scale	Method	Analysis Variables/Parameters within Methods
1	Macro-scale	Space Syntax analysis with depth map: Axial analysis	Connectivity Mean depth Integration Intelligibility
2	Semi-urban scale	Space Syntax analysis with depth map: Visibility graph analysis (semi-urban scale)	Isovist Area Visual Integration Visual Step Depth Metric Step Depth Angular Step Depth
3	Micro-scale	Spatial Relationships Between Buildings and Streets (ground-level)	Topological Depth Entrance Density Intervisibility, Constitutedness
4	Human-scale	Field Observation	Use of Spaces Street Layout

2.1. Human-Scale: Field Observation

The 1985 Chinatown Action Plan plays a vital role in the planning of the precinct, as most of the proposed principles were realised from 1985 to 1988 while still being practised today [3]. These principles provide suggestions on a range of urban elements within the enclave, including the main street, sidewalk, laneway and open space. As new developments have been erected in the past 36 years, features of the precinct have unavoidable modifications. Based on the key elements listed in the Chinatown Action Plan and the objectives to further understand the precinct's street layout, the field observation is conducted to unveil the context of the case study, human perceptions of the urban complex and to compensate for the potential singularity of space syntax results [42,43]. The focus of the field observation also aligns with the key measurements in the previous three steps (Table 1), mainly focusing on the spatial features from an experiential perspective, including accessibility, visibility, step depth and the use of main streets and laneways. Field observation was conducted in April 2022 to collect qualitative data using field notes and photographs. Observation points are scattered along the main streets and the laneways within the precinct. As the occupancy of dwellings in the area changes frequently, the results from field observation only reflect the uses of dwellings in April 2022. With the lack of official records and frequent changes, findings from this tactic may vary in the future. Photographic sequences and cartography evidence are included to showcase findings from this tactic.

2.2. Macro-Scale: Space Syntax Axial Analysis

The axial analysis was developed based on the space syntax theory by Hillier and Hanson [24,41]. It is often performed to assess the spatial layout represented as an axial map, commonly extracted from urban maps or architectural floor plans. In this study, four key measurements are utilised to attain the macro-scale street characteristics of Melbourne's Chinatown and how it fits in the existing grid system. Table 2 summarises the four measurements, including connectivity, mean depth, axial integration and intelligibility [41,44–46]. Table 2 can benefit future studies with clear identification of the formulas and interpretation of space syntax parameters with respect to the original space syntax methodologies, which are often absent in existing research. Depth map X is used to aid the data extraction, the analysis process and visualisation. Only streets within Chinatown are presented in the space syntax result tables to resonate with the study's scope. However, for the macro-scale analysis, the entire Melbourne CBD is considered in assessing and interpreting the data in Depthmap X. Streets in the precinct are categorised into three types, a, b and c, denoting

laneways, north to south main streets and east to west main streets. Twenty-three 'type a' streets are recorded, while six main streets are classified as 'type b or c'.

2.3. Semi-Urban Scale: Space Syntax VGA (Visibility Relationship within the Precinct)

VGA is commonly executed to examine the visibility relationship between spaces on a semi-urban scale [47,48]. This study uses VGA to test the visibility relationships within the precinct from five key entrances along Little Bourke Street, in order to examine the visibility relationship within the precinct, which is critical as the precinct now acts as an urban heritage serving visitors who are not familiar with the area. This study employs five key VGA measurements, including isovist area, visual integration, visual step depth, metric step depth and angular step depth (Table 3). Further to an existing study by Xu et al. (2020), this study incorporates further analyses on two scales to obtain an in-depth understanding [49].

2.4. Micro-Scale: Spatial Relationships between Buildings and Streets

By addressing the entrance density, constitutedness and intervisibility, this study is the first to analyse Melbourne's Chinatown from the perspective of private–public spatial relationships. Van Nes and Yamu (2021) suggest that the micro-scale urban spatial analyses mentioned above are quantifications derived from Jane Jacob's and Jan Gehl's presumptions about the interrelation between streets, building entrances and windows [39,40,50–52]. In their view, achieving urban liveliness necessitates many entrances and windows facing the streets. Urban liveliness determined through the density, depth, permeability and visibility of entrances along streets can envisage the natural surveillance, street safety and relationship between crime and space of an urban fabric.

Based on this theory, scholars affirm that by studying the street network's spatial structure and the interrelation between buildings and adjacent street segments, one can understand micro-scale urban spatial relationships between private and public spaces [40,50]. Later, several measurements were developed and tested to address how building openings are connected to the street network, the degree of topological depth from private space to public space and the intervisibility between entrances and windows. Key measurements include entrance density, street constitutedness, street intervisibility, and topological depth between private and public street spaces [24,40,50,53,54]. Measurements derived from this tactic are developed mainly to quantify spatial parameters for the building–street interface and how to present degrees of active frontage. Table 4 summarises these variables and their diagrammatic explanations. Field observation is essential in identifying each street's entrances and private–public topological relationships. Van Nes and Yamu (2021) identified some limitations of the urban micro-scale methods, including the difference between urban liveliness during day and night [39]. They recommend further research to use these methods in case studies with different cultural backgrounds, which is piloted in this study with Melbourne's Chinatown.

Table 2. Formulas and spatial characteristics within space syntax axial analysis [24,39,41,44–46,49].

Name of Axial Measure	Mathematical Formula	Explanatory Notes	Spatial Characteristics Interpretation
Connectivity (C_i)	$C_i = K_i$	Connectivity defines the configurations of local structures in street networks; where C_i is the number of axial lines connected to the i-th axial line.	A street with a high connectivity value has many connections to its side streets, whereas a low connectivity value represents few connections.

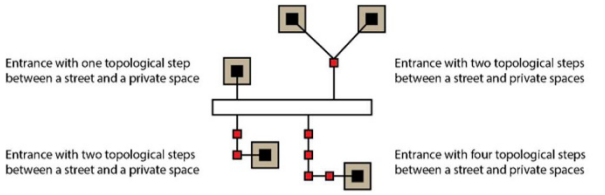
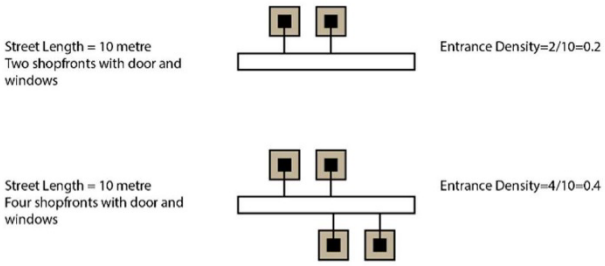
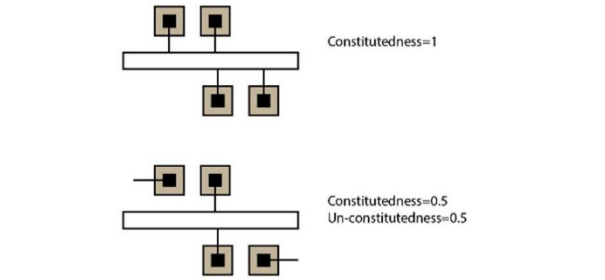
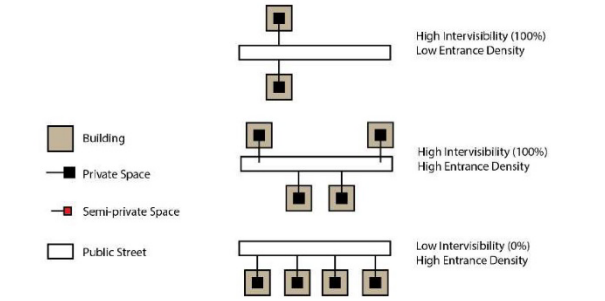
Table 2. *Cont.*

Name of Axial Measure	Mathematical Formula	Explanatory Notes	Spatial Characteristics Interpretation
Mean Depth (MD_i) Total Depth (TD_i)	$MD_i = \frac{1}{(n-1)} \times TD_i,\ i \neq j$ where $TD_i = \sum_{j=1}^{n-1} d_{ij},\ i \neq j$ $MD_i = \frac{\sum_{j-1}^{n-1} d_{ij}}{(n-1)},\ i \neq j$	Mean Depth represents the average distance of the i-th axial line from all the other n-1 axial lines. For two open spaces, i and j, which are said to be at depth d_{ij} (least syntactic steps needed to reach one vertex from the other), TD_i represents the sum of all depths from a given origin.	A system with a high total depth value is often described as a 'deep' system, where more spaces are passed through from a chosen starting point in the system (more steps). Based on total depth, mean depth reflects the average distance of any two points within the system.
Axial Integration (INT_i)	$INT_i = \frac{1}{RRA_i} = \frac{D_i}{RA_i}$ where $RA_i = \frac{2(MDi-1)}{D_i}$ where D-Value $= \frac{2\{n[log_2(\frac{n+2}{3})-1]+1\}}{(n-1)(n-2)}$ $INT_i = \frac{n[log_2(\frac{n+2}{3})-1]+1}{(n-1)(MD_i-1)}$	Integration represents the degree to which i-th vertex is integrated or segregated from an urban system as a whole (global integration $[HH]$) or from a partial system within certain steps away from the i-th vertex (local integration). In most cases, three syntactic steps (radius of three) represent the walking scale within an urban system (local integration $[HH]$R3). RA_i is real asymmetry RAA_i is real relative asymmetry 'Diamond' D-Value is used to normalise graphs that represent architectural or urban spaces.	A street with high integration means the degree of accessibility this street has to all other streets in the system is high, fewer direction changes (syntactic steps) are needed. Global integration reflects the accessibility at a radius of n (n syntactic steps). Local integration reflects the accessibility at a radius of three (three syntactic steps).
Intelligibility (R^2)	$R = \frac{\sum(C_i-\overline{C})(INT_i-\overline{INT})}{\sqrt{\sum(C_i-\overline{C})^2\sum(INT_i-\overline{INT})^2}}$ $R^2 = \frac{\sum(C_i-\overline{C})(INT_i-\overline{INT})^2}{\sum(C_i-\overline{C})^2\sum(INT_i-\overline{INT})^2}$	Intelligibility describes the correlation between connectivity and global integration $[HH]$. $\overline{C}$ is the average of all the connectivity value. $\overline{INT}$ is the average of all the global integration value.	Intelligibility measures if the local spatial structure (number of immediate connections) can help comprehend the entire spatial system (how correlated are the connectivity and global integration).

Table 3. A table of VGA parameters [35,41,46].

VGA Variable	Definition
Isovist Area	Isovist area represents the area of all space visible from a subject point in the plan.
Visual Integration	Visual integration measures the visual distance from all spaces to all others. It tells you how visually connected all spaces are in the footprint.
Visual Step Depth (from five identified view points)	Derived from the definition of Step Depth, visual step depth measures how many 'steps' it takes to cover the entire area, where the 'steps' are measured by how far you can see.
Metric Depth (from five identified view points)	The metric depth to location at any point in the plan is the shortest metric path distance from said point to a single universal sample location.
Angular Step Depth (from five identified view points)	The angular depth to location at any point in the plan is the lowest angular variation in heading accumulated along any path from said point to a single universal sample location.

Table 4. Definition and spatial characteristics within public–private spatial relationship analysis [39–41,50].

Name of Parameter	Definition	Spatial Characteristics	Diagrammatic Interpretation (Drawn by Author)
Topological depth between private and public spaces	Topological depth. Measuring the number of semi-private and semi-public spaces between the private and public spaces under scrutiny.	Degree of urban liveliness Degree of safety Vitality of Streets	
Entrance density	The degree of interface between buildings and streets. Measuring the number of building entrances with adjacent windows facing towards a public space per street segment length.		
Constitutedness	The degree of adjacency and permeability from buildings to the public space. Measuring how buildings' entrances with adjacent windows connect to the street (direct/indirect).		
Intervisibility	'Point-to-point visibility.' Measuring if buildings are directly visible to one another on the same street (entrances that face each other across the streets/entrances that do not).		

3. Results

The following section will present the findings from the space syntax analysis and the field observations. Findings from the first observation (Section 3.1) are first presented to portray the overall visual of Melbourne's Chinatown. Results from the axial analysis (Section 3.2) mainly addressed the first objective, which is to understand the street network of the precinct in an urban grid system. Parameters within the axial analysis include connectivity, integration, and intelligibility. The VGA analysis results (Section 3.3) address the visibility relationships within the precinct. Section 3.4 delves into the relationship between the buildings and streets on the ground level. Together, the result sections showcase more understanding of the street layout of Melbourne's Chinatown in an existing urban grid to better serve the precinct as an urban heritage attraction.

3.1. Results from Field Observation

Before any planning strategies were tailored for Melbourne's Chinatown, the Hoddle Grid was laid out as a foundation for the city's urban planning [55,56]. As seen in Figure 1, major streets, including Swanston Street, Russel Street, Exhibition Street, Bourke Street

and Lonsdale Street, are all planned to be around 30 m wide (one and a half chain). While intersecting streets that divide the blocks, such as Little Bourke Street (Figure 2), are approximately 10 m wide (half chain). These streets split the precinct into four major blocks, each around 100 m by 200 m, with Little Bourke Street as the central street [57]. On Lonsdale, Bourke, Swanston, Exhibition and Russell Streets, mixed-use dwellings often occupy large plots (Figures 3–7). However, hidden dwellings in the laneways facing Little Bourke Street often have much smaller, single-use plots. Figures 1–6 provide information on the four border streets and the precinct's surrounding cityscape. Due to the tram access and subsequent pedestrian flow, Swanston and Bourke Streets are mostly populated with mixed-use and large retail centres (Figures 3 and 6). Common functions of Melbourne's Chinatown include restaurants, cafés and retail. On central Little Bourke Street, a Chinese restaurant is the most common function (Figure 2). As a heritage precinct, a lack of emphasis on cultural functions is identified during the field observation. Buildings under the Victorian Heritage Register (the highest protection and significance level in the State of Victoria) do not accentuate their cultural significance through their current use. Unexpectedly, only three (the Chinese Mission Church, Her Majesty's Theatre and the Num Pon Soon Society) of the seven Victorian Heritage Register buildings within the enclave still possess cultural or religious functions (Figure 1).

Figure 2. Little Bourke Street is the main street of Melbourne's Chinatown.

In Action Plan, the central street is not viewed as a grandeur walkway for sightseeing but a street for pedestrians and vehicles with 'desired congestion' as one of the street's intrinsic characteristics. To maintain the 'desired congestion,' the comfort and safety of pedestrians and the needs of traffic, deliveries and shopfronts, one core principle for the treatment of the main street entails certain sidewalks being widened. As seen in Figure 8, such widening of sidewalks is reflected only during the field observation but not space syntax analysis. The results show that such widening is not continuous along the central street. Irregular patterns of the sidewalks were observed during the field observation. Such an irregular widening was mainly performed to create outdoor seating areas, shopfront entrances, loading bays and some on-street parking. During the observation, the central street was observed to be congested with all the above-mentioned usage of an already narrow street.

Figure 3. Swanston Street entrance of the precinct.

Figure 4. Lonsdale Street side of the precinct.

Laneway culture is unique to the urban fabric of Melbourne, which Chinatown is an essential part of [56]. Laneways in Melbourne work as a network that navigates pedestrians and serves as a critical contributor to the city's overall identity [58]. From the Action Plan and the field observation, a total of twenty-four laneways are identified, including twelve open-end laneways and twelve close-end laneways. Most of the twelve close-ended laneways are used for services (loading bay and back gates) in the precinct. Open-end laneways, all running in the north/south direction, are laneways that prioritise pedestrian movement and commercial activities (Figure 9). In particular, Cohen Place is now presented as a major laneway cultural hub, where the Museum of Chinese Australian History is located. A contrast was observed between the livelihood in laneways. Laneways that prioritise commercial activities and pedestrians are observed to contain a variety of functionalities, such as the museum, restaurant and bar. Among these laneways, Tattersalls Lane, Cohen Place and Market Lane were the most vibrant (Figure 9). Despite its relatively narrow width compared to other pedestrian-friendly lanes, Tattersalls Lane (Figure 9) represents a lively streetscape with restaurants, a cultural society and a popular outdoor bar [59]. Market Lane is mainly

employed as an outdoor seating area for restaurants from the observation (Figure 9) while creating a visual connection between Little Bourke Street and Bourke Street. In Cohen Place, the pathway to the museum is led by the pavement design with traditional Chinese patterns and museum banners along the way (Figure 9), due to the low visibility of the museum from the central street. Contrasting to the vibrancy of those laneways that prioritise pedestrians, laneways for services in Chinatown are not favoured by the pedestrians, such as Hughs Alley, Star Alley and Bullens Lanes (Figure 10). Most of the service lanes were observed to be occupied by rubbish bins, exposed buildings services, and parking with low-level pedestrians. Despite the occasional graffiti and pavement painting, no other treatments on the ground level were observed to add vibrancy to these service lanes.

Figure 5. Exhibition Street side of the precinct.

Figure 6. Bourke Street side of the precinct.

Figure 7. Russell Street side of the precinct.

Figure 8. Sidewalk widening.

The Chinatown Action Plan (1985) asserts that small node-like public spaces are required to complement the desired pattern of the precinct [3]. It argues that open spaces should be kept small and compact in the existing narrow laneway network. However, limited open spaces were observed on the main streets and the laneways, despite one small square in front of the Cohen Place cultural precinct. Moreover, apart from the artificial greenery as a part of sidewalk widening on Little Bourke Street, barely any green space was observed during the field observation.

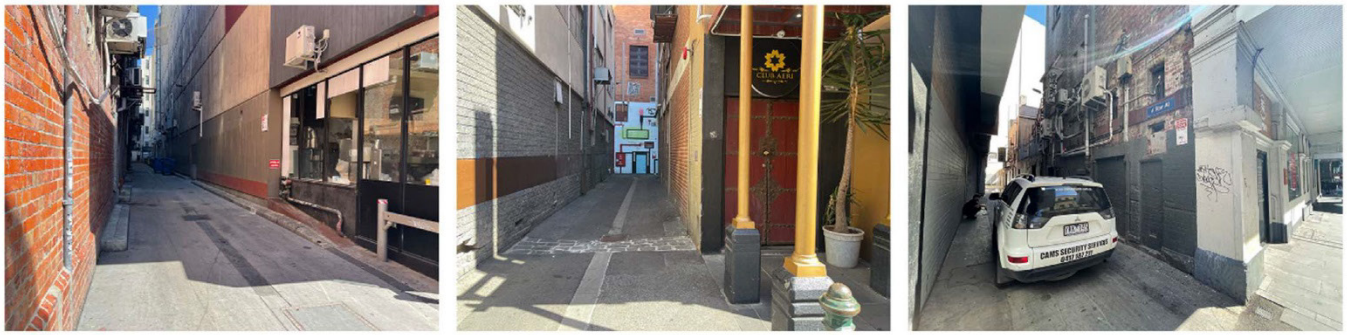


Figure 9. Vibrant laneways: Cohen Place 1, Cohen Place 2, Market Lane and Tattersalls Lane (Left to Right).

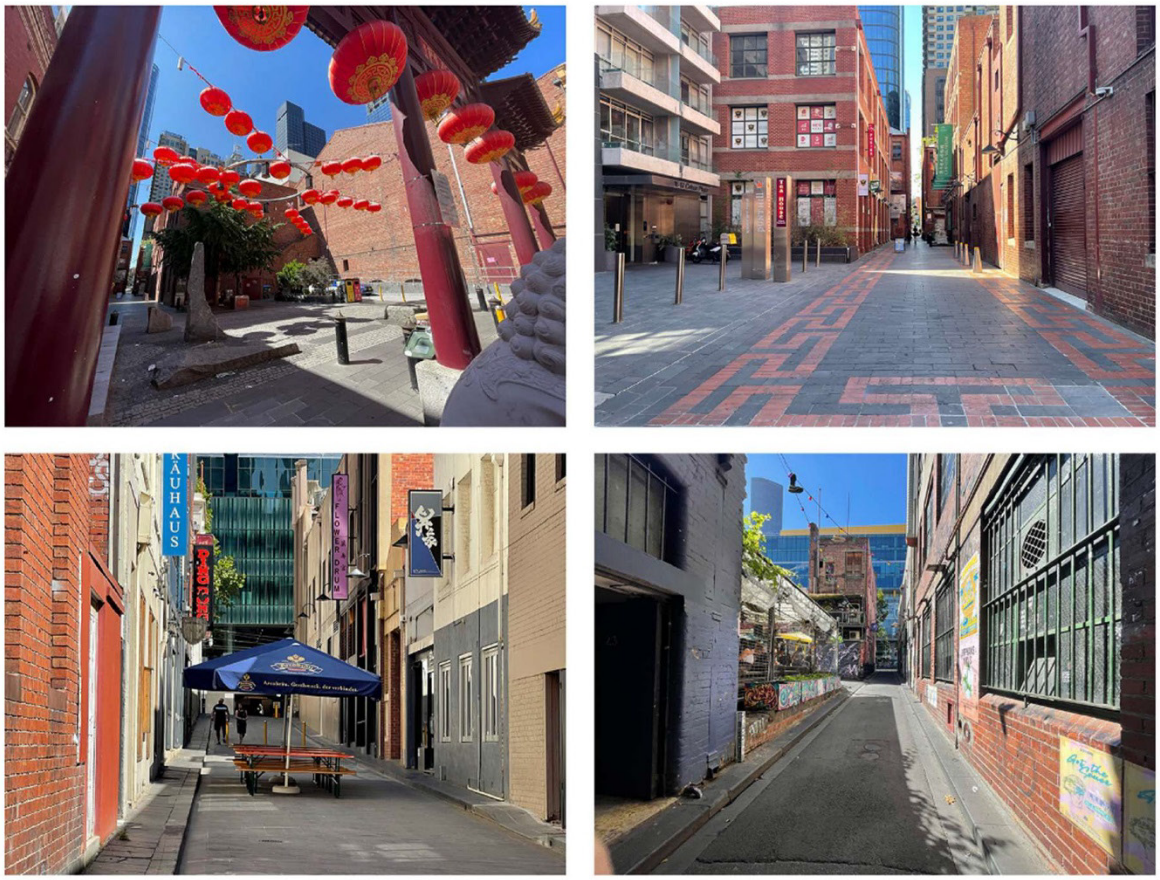


Figure 10. Service laneways: Bullens Lane, Hughs Alley and Star Alley (Left to Right).

3.2. Results from Axial Analysis

3.2.1. Connectivity

Most laneways (type a streets) possess low connectivity values, ranging from 1 to 4. Little Bourke, Lonsdale and Bourke Streets (type c streets) have the highest connectivity values (from 38 to 69), significantly higher than the average connectivity of 8.483 within the precinct. The difference in connectivity between laneways and main streets is significant, which reflects the unique spatial layout of Melbourne's Chinatown. The main streets have a high level of connections with their side streets, making them spatially permeable. With the extreme connectivity difference between main streets and laneways, a spatial boundary is formed by the six main streets. The numerical results in Table 5 are presented as diagrams in Figure 11, where red and blue depict high and low connectivity values accordingly.

Table 5. Results from space syntax analyses.

Street Name	Street Type	Connectivity	Mean Depth	Global Integration [HH]	Local Integration [HH] R3	Entrance Density
Globe Alley	a	1 (min)	3.744	2.255	3.074	0.000 (min)
Belman Place	a	1	3.385	2.594	2.885	0.000
Pender Place	a	1	3.744	2.255	3.074	0.000
Star Alley	a	1	3.744	2.255	3.074	0.000
Dean Alley	a	1	3.744	2.255	3.074	0.000
Lacey Place	a	2	3.739	2.259	3.102	0.000
Smythe lane	a	2	3.918	2.120	2.695	0.000
Latrobe Place	a	2	3.639	2.345	3.314	0.021
Coverlid Place	a	2	3.734	2.263	3.115	0.000
Brien Lane	a	2	3.639	2.345	3.314	0.000
Market Lane	a	2	3.639	2.345	3.314	0.063
Lees Place	a	2	3.739	2.259	3.102	0.000
Hughs Alley	a	2	3.739	2.259	3.102	0.000
Paynes Place	a	2	3.730	2.266	3.114	0.000
Croft Alley	a	2	5.711 (max)	1.313 (min)	0.698 (min)	0.000
Stevenson Lane	a	2	5.606	1.343	0.704	0.000
Bullens Lane	a	2	3.739	2.259	3.102	0.000
Celestial Avenue	a	3	3.734	2.263	3.130	0.067
Heffernan Lane	a	3	3.629	2.353	3.341	0.032
Waratah Place	a	3	3.629	2.353	3.341	0.042
Corrs Lane	a	3	3.629	2.353	3.341	0.021
Tattersalls Lane	a	4	3.620	2.361	3.381	0.053
Cohen Place	a	4	3.625	2.357	3.369	0.042
Exhibition	b	13	2.434	4.316	4.650	0.100
Swanston	b	15	2.408	4.394	4.711	0.140
Russell	b	20	2.387 (min)	4.461 (max)	4.794 (max)	0.235
Bourke	c	38	3.028	3.051	3.615	0.086
Lonsdale	c	42	2.925	3.213	3.792	0.093
Little Bourke	c	69 (max)	2.746	3.543	4.271	0.158 (max)
Average Value	/	8.483	3.611	2.552	3.227	0.040
Intelligibility (correlation between connectivity and integration)			$R = 0.565$		$R^2 = 0.320$	

As Melbourne's Chinatown is a pedestrian-friendly precinct most suitable for walking access with limited parking and car access, the local scale integration and the mean depth value at a walking scale are the focus of this analysis in determining the accessibility and depth of the area [3]. The precinct is not a 'deep' system since the highest (5.711) and the lowest (2.387) mean depth are both within ~50% difference from the average mean depth (3.611). The low mean depth relates to the grid system layout, where most laneways are open-ended, connecting two main streets (north to south). On the contrary, the precinct's layout before the deduction of east to west laneways and cul-de-sacs (dead-end laneways) has a higher mean depth, making the system 'deeper' [3,60]. Many cul-de-

sacs are connected to the main axes. They contribute to the identified variations in the connectivity values, which also have an impact on the intelligibility values.

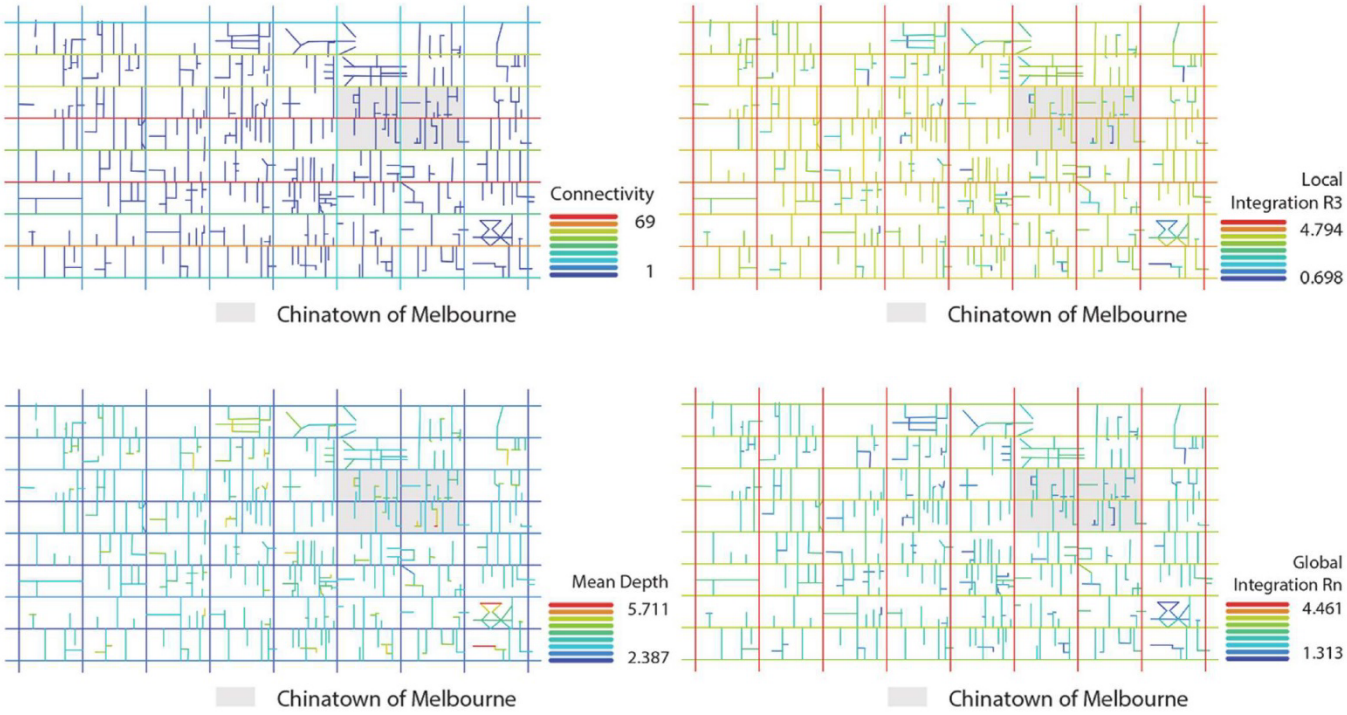


Figure 11. Results from Section 3.2.

3.2.2. Integration

As seen in Table 2, the calculation of integration value (HH) involves the reciprocal of mean depth (MD). An inverse correlation between the two sets of values can be seen in Table 4. For instance, Russell has the lowest mean depth and the highest integration; Croft Alley retains the highest mean depth and the lowest integration. Overall, street types b and c (main streets) have much higher integrations (both globally and locally) than street type a (laneways), making the main streets more accessible than the laneways. With a global integration of 4.461 and local integration of 4.794, Russell Street is the most accessible in the Chinatown precinct. Apart from Croft Alley and Stevenson Lane, most laneways have integration values less than ~50% off the average value (2.552 for global and 3.227 for local). The two laneways have turns, mostly diverging from north to south into the east to west. The turns of these laneways result in more directional changes (syntactic steps), reducing the integrations significantly.

3.2.3. Intelligibility

Intelligibility describes the correlation between connectivity and global integration. It measures if the local spatial structure can help interpret the entire spatial system (Table 2). Through intelligibility analysis, spatial identifiability can be characterised to reveal what one can comprehend from the spatial layout matches or is useful guidance for what one cannot see [44]. The authors first assumed high intelligibility in the precinct, as the Hoddle Grid layout of Melbourne should be easily identified and recognised by people [61,62]. However, the intelligibility results in Melbourne's Chinatown contradict the assumption. In this case, an intelligibility score of 0.32 depicts that the precinct is not highly identifiable. A low intelligibility value (between 0 and 0.5) represents the low correlation between integration and connectivity, reflecting that the local spatial structure does not comprehend the entire spatial system well. R^2 locates at 0.5–0.7 represents good spatial identifiability; R^2 locates at 0.7–1 reflects high spatial identifiability [44,49]. Moreover, the street with the

highest connectivity does not have the highest global and local integration. This shows that the precinct does not necessarily have an apparent central structure, which echoes the Hoddle Grid layout. The system involves six main streets that are all highly accessible and connected with laneways running in the south-north direction. The authors of this study argue that the low intelligibility value is mainly caused by the low connectivity values of the laneways (more than ~50% difference from the average). Findings in the field observation also provide context to this phenomenon. Laneways in the precinct connected to Little Bourke, Swanston, Russell, Exhibition and Bourke Streets do not follow any grid system or alignment. Hence, the layout of these laneways does not necessarily comply with the uniform grid system. The width and depth of each laneway are a result of a rather organic development throughout the precinct's evolvement. From the space syntax results, these laneways are not classified as numerical outliers as there are twenty-three of them in the precinct, while only six main streets are identified. These laneways can be viewed as 'spatial outliers' to the well-established Hoddle Grid. Most scholars and planning policies recognise Little Bourke Street as the central passageway of the 'valley-like' precinct [3,10,11]. However, from the axial analysis, all six main streets have high integration and connectivity, which reflects their accessibility, convenience and public exposure [41]. These results reverberate with the unique Hoddle Grid layout, where most main streets share high spatial importance. Despite not having the highest integration and minimal depth, it is worth noting that Little Bourke Street does have a peak in the connectivity and entrance density analysis.

3.3. Results from VGA

As seen in Figure 12, results from visual integration and visual isovist area analyses depict the overall visibility relationship of the precinct [39,41]. The intersections between Russell Street and the three 'type c' streets demonstrate the largest isovist area and the highest visual integration, implying that the visible areas are the largest at these three intersections (indicated in warmer colour tones in Figure 12). The intersections between the other two 'type b' streets and the three 'type c' streets have slightly smaller isovist areas and lower visual integration (indicated in cooler colour tones in Figure 12). On the contrary, the laneways have small isovist areas and low visual integrations. On the main streets, visual integration values are slightly higher at the laneway intersections, as those points provide more views into the laneways. During the site observation, the views from and to these laneway intersections are also influenced by temporary dining furniture, signage and other service facilities, which are not reflected in the VGA analyses. It is worth noting that some cultural attractions are located on the laneways, including the Museum of Chinese Australian History. The low visibility of these laneways can hinder pedestrians from attending these cultural attractions if spots are not well-known. During the field observation, the authors observed that direction signage is implemented on Little Bourke Street to guide visitors to Cohen Place, where the Museum of Chinese Australian History is located.

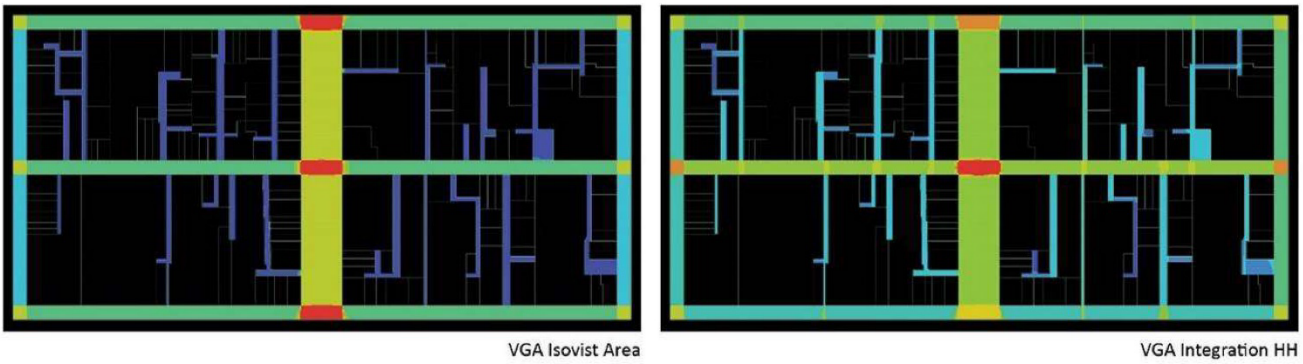


Figure 12. Results from VGA Analysis (Isovist area and Integration HH).

Five main entrances of Chinatown are marked as the most likely first viewpoints for the visual step depth, metric depth and angular step depth analysis. Results from this tactic mainly concern visual depth (presented in Figure 13). Overall, the results from VGA show that the laneways of Melbourne's Chinatown have poor visual connections with all five viewpoints. Compared with the main streets (type b and c), laneways require more visual syntactic steps (visual step depth), longer distance (metric depth) and higher angular variations (angular step depth) to be visible from the five identified viewpoints. The laneways in this precinct are visually 'deep', affecting the vitalisation of the laneways and the dwelling within them. For instance, Cohen Place, the cultural square of Melbourne's Chinatown, is only relatively visible from viewpoint 3.

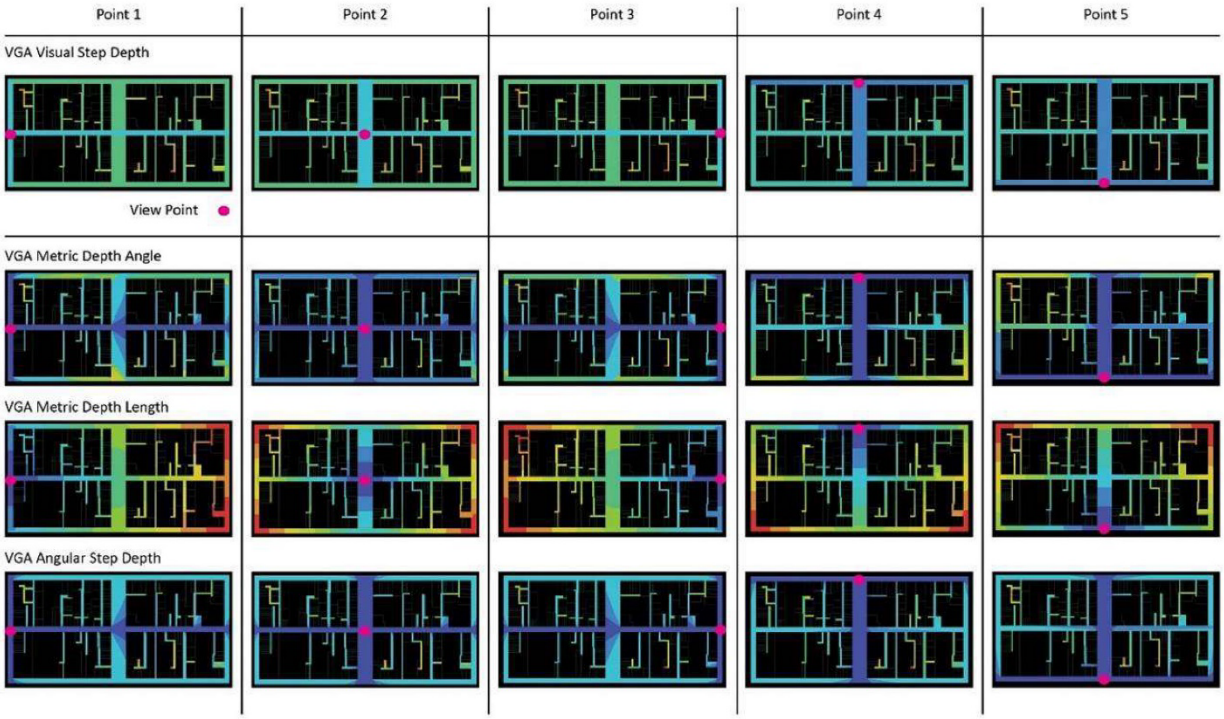


Figure 13. Results from VGA Analysis (visual depth—five entrance viewpoints).

3.4. Results from Spatial Relationship between Buildings and Streets (Ground-Level)

3.4.1. Topological Depth

Melbourne's Chinatown has low topological depth, and pedestrians can enter most shopfronts directly in the precinct with minimal semi-private buffer zones. Only a few outliers have a buffer zone, including one of the few residential towers in the precinct. Although the precinct is extensively protected from heritage overlay, there is no restriction on the residential use of buildings. Despite the gentrification and potentially higher revenue to operate as commercial development, this study argues that the shallow topological depth is another factor in why the precinct is mostly commercialised [63]. Researchers contend that low topological depth and transparent frontage can enhance safety, increase the natural surveillance of an area, and enable people inside and outside a building to see each other [53]. In this case, having a low-topological depth between public and private spaces can benefit commercial activities in the precinct.

Topological depth provides a good indication of the level of natural surveillance and the spatial depth from public to private of Melbourne's Chinatown, which are vital aspects to consider when interpreting the changes in the precinct's spatial layout, usage and identity [50]. However, other factors on various scales have contributed to Melbourne's Chinatown's spatial configuration and functionality; the topological depth between public and private space is not the only one. Results from the previous section indicate that the laneways have relatively high mean depth, reflecting the spaces' privacy. However,

during the precinct's development, the number of east/west laneways has been reduced, which echoes the area's functionality change [60]. Most laneway reduction happened before and during the Chinatown Action Plan (1985) was published to reduce unwanted cul-de-sacs in the precinct. Young's study showcases that a close net community was formed by three families living in Cohen Place between 1880 to 1900 [64]. The Cohen Place area had many more small and narrow lanes running east to west compared to the current layout. Such laneways provided more privacy through a higher mean depth and topological depth. A courtyard-like space was formed near the current Cohen Place and is now presented as a major cultural hub, where a heritage precinct with the Museum of Chinese Australian History is located. During the field observation, the authors found that the original plots of the three families' homes have been combined into one plot, where one of the few residential apartments in the precinct is located. The topological depth of the original layout (before the east/west laneway reduction) was much higher than the current layout (post east/west laneway reduction). However, the current apartment is gated with a high level of surveillance by security cameras, whereas the original courtyard-like layout delivers much better natural surveillance.

3.4.2. Entrance Density

The results from entrance density are first numerically documented in Table 6. According to the original theory and method, entrances with no windows next to them are not marked as entrances in the analysis [39,51]. Figure 14 depicts the existing entrances within the precinct on each street, documented in the field observation. The lengths of streets are uncovered in studies around the Hoddle Grid and maps [65]. Existing studies have provided minimal information on factors to consider when deciding the different colour gradient groups for the entrance density diagram, despite listing out mostly five benchmarks. Three benchmarks are usually provided with two other benchmarks, highlighting the maximum and minimum values. In this study, a standard statistical method—quartiles (Q1, Q2 and Q3) is incorporated to sort the different degrees of entrance density. First, all streets with zero entrance density are grouped into the 'lowest' group. Then, with the remaining numbers, the study identifies Quartile 1 (25%), Quartile 2 (50%), and Quartile 3 (75%) to facilitate the grouping and visualising of the data. Table 6 lists Q1 (0.4210), Q2 (0.6495) and Q3 (0.1000). Through sorting the data with clear benchmarks and data visualisation, entrance density results can be easily interpreted to provide insight into each street's building–street relationship. As seen in the table, five groups are formed, and colours are assigned accordingly. As seen in Figure 14, Swanston, Little Bourke, and Russell Streets have the highest degree of entrance density. Lonsdale, Bourke and Exhibition Streets have a medium-high degree of entrance density. Many laneways in the precinct act as service lanes (observed during field observation) with no entrances with windows. Some laneways, including Celestial Avenue, Market Lane, Tattersalls Lane and Waratah Place, have relatively higher entrance density than the rest. During the field observation, these lanes were mainly populated with restaurants, bars and nightclubs that immerse in Melbourne's unique laneway culture [56,66]. However, Cohen Place, the cultural centre of the precinct, exposes a lower entrance density [3,67]. Authors argue that low entrance density does not necessarily reflect its low urban liveliness but can promote flexible use of space, as there is a lower level of interference to other shop entrances. For instance, Heffernan Lane is often used as a street for night markets. The street is observed to be highly lively during the field observation. The low entrance density of Heffernan Lane makes the space highly adaptive, which subsequently activates the street as it can host different cultural events.

Table 6. Entrance density of streets in the precinct.

Street Name	Street Length (m)	Number of Entrances	Entrance Density	Quartiles	Colour Code Group
Russell	200	47	0.2350		High
Little Bourke	430	68	0.1581		High
Swanston	200	28	0.1400		High
Exhibition	200	20	0.1000	Q3 = 0.1000	Medium/high
Lonsdale	430	40	0.0930		Medium/high
Bourke	430	37	0.0860		Medium/high
Celestial Avenue	60	4	0.0667	Q2 = 0.06495	Medium/high
Market Lane	95	6	0.0632		Medium
Tattersalls Lane	95	5	0.0526		Medium
Waratah Place	95	4	0.0421		Medium
Cohen Place	95	4	0.0421	Q1 = 0.0421	Low
Heffernan Lane	95	3	0.0316		Low
Corrs Lane	95	2	0.0211		Low
Latrobe Place	95	2	0.0211		Low
Globe Alley	40	0	0.0000	Lowest	Lowest
Stevenson Lane	35	0	0.0000		Lowest
Belman Place	40	0	0.0000		Lowest
Pender Place	25	0	0.0000		Lowest
Lacey Place	65	0	0.0000		Lowest
Smythe lane	30	0	0.0000		Lowest
Star Alley	40	0	0.0000		Lowest
Hughs Alley	20	0	0.0000		Lowest
Dean Alley	45	0	0.0000		Lowest
Bullens Lane	100	0	0.0000		Lowest
Coverlid Place	70	0	0.0000		Lowest
Brien Lane	95	0	0.0000		Lowest
Paynes Place	20	0	0.0000		Lowest
Croft Alley	55	0	0.0000		Lowest
Lees Place	100	0	0.0000		Lowest

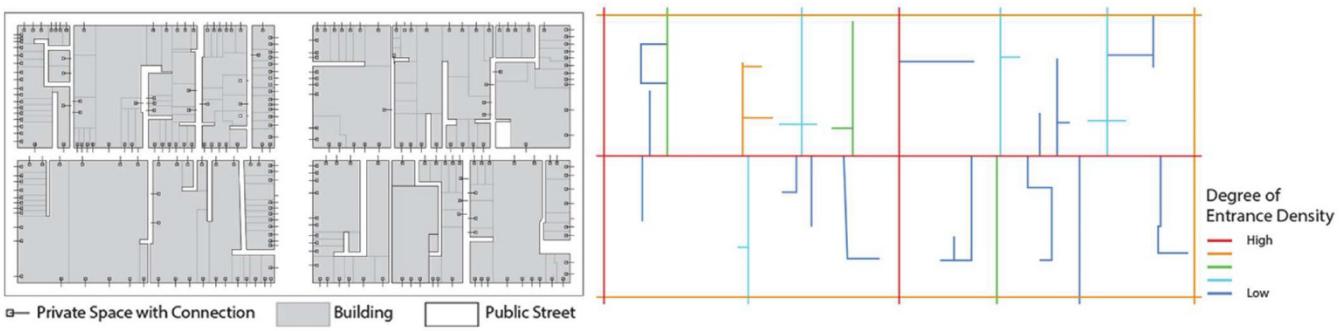


Figure 14. Entrance density diagram of the precinct.

When looking at the results from the axial analysis, entrance density and field observation together, the authors elucidate that streets with high integration and connectivity often have a

high entrance density. However, Bourke Street is an exception in this instance, as few entrances have been recorded on this street. It shows the highest integration and connectivity levels but lower entrance density than the other type b and c streets. During the field observation, the authors observed large window openings on Bourke Street, since many large commercial complexes position their main entrances and displays on this street. Although the entrance density is lower than other main streets (few entrances on this street), each recorded entrance is much larger with transparent windows. Moreover, two tram stops were observed on each side of the street. The street is observed to be highly populated and possesses high urban liveliness and high natural surveillance. This links to one of the other key limitations of the entrance density analysis identified in this study: the lack of consideration of transport stations and entrance/window sizes. Moreover, shopfronts can experience a frequent change of ownership and other adaptations; methods from this tactic can only reflect the characteristics of the space during a short period. As van Nes and Yamu (2021) suggest, results from this tactic should be interpreted with results from other methods [39]. The entrance density does provide an additional level of understanding of the ground-level street network and liveliness, but the limitation of this analysis is also inevitable.

3.4.3. Constitutedness and Intervisibility

According to Hillier and Hanson (1984), constitutedness is about the degree of adjacency and permeability from buildings to public space [24]. In the original theory, buildings only constitute the street if a building can be directly accessed from the street. If buildings are located adjacent to a street, but their entrances can only be accessed indirectly (i.e., through a courtyard), the street is unconstituted. The degree of constitutedness reflects dwellings' connection to the street and their visibility to the street. Again, scholars argue that the vitality of streets in urban areas can be epitomised through such interpretation. In Melbourne's Chinatown, most shops open directly with no buffer zone to the streets. Even shopfronts considered 'hidden' mostly open directly into the laneways [56]. Most of the streets in the precinct have a constitutedness of 1 (Table 4). According to the theory of constitutedness, in streets that are constituted, the stationary activity of people is less likely to occur; more people tend to sit or stand for a prolonged period in unconstituted streets [39,40,50]. During the field observation, the width of these laneways allows very minimal space for pedestrians to sit or stand. Not many pedestrians were observed to utilise these laneways. The observation results contradict the constitutedness theory in this instance. As the width of streets is not considered in the measurement of constitutedness, the authors find the results from this tactic to be singular in the examination of Melbourne's Chinatown.

Intervisibility is measured by calculating the ratio between entrances that face each other across the streets to entrances that do not. The way entrances and windows are positioned facing each other on the street influences the probabilities for social control and street life and control between buildings across street segments [50]. Most of the main streets in Melbourne's Chinatown have high intervisibility. On Little Bourke Street, shopfronts with windows occupy both sides of the streets, making the street highly intervisible and lively with a high level of natural surveillance. However, when looking at the intervisibility of laneways, the singularity of results is again apparent. Four of the five shopfronts with windows on Tattersalls Lane are positioned facing each other, giving the laneway a high theoretical intervisibility. However, due to the narrowness of this laneway and the non-direct visual angle from the shopfronts, it is hard to see activities from each side of the laneway. However, for a wider laneway such as Market Lane, with all six shops facing each other, activities on each side of the laneway become more visible. Authors find the lack of consideration of the street width and the angle of views in intervisibility measurement propagate singular results when testing on laneways. When using intervisibility to reflect spatial characteristics, results must be understood and interpreted with other spatial measurements. In this study, field observation suggests different findings on how intervisible the laneways in Melbourne's Chinatown are than the theoretical intervisibility measurements.

4. Discussion

Further to the understanding of the street layout in the results, the discussion section addresses key findings that can facilitate the preservation of Melbourne's Chinatown and better serve the precinct as an urban heritage attraction.

4.1. Continuity of Little Bourke Street

The section of Little Bourke Street that runs from Swanston to Exhibition Street is the known main street of Melbourne's Chinatown precinct. However, Russell Street dissects the precinct with high connectivity and integration. During the field observation, Russell Street is much wider than Little Bourke Street, which is not recognised in the space syntax axial analysis. To preserve the spatial continuity of Little Bourke Street, four traditional Chinese gateways are placed at the three intersections on this street, which can help pinpoint the key entrances of the precinct and enhance the continuity of the Chinatown fabric along Little Bourke Street [68]. Similar to existing research, the results of this study show that space syntax methods only help understand spatial characteristics of the precinct from floor plans and maps, causing unclear and singular interpretations of the precinct's identity [69]. Therefore, field observation is an essential part of this study to validate findings from space syntax. In studies related to urban heritage sites, previous studies mostly run axial analysis (macro-scale) and VGA analysis (semi-urban scale) parallel to examine the consistency of results from space syntax analysis [36,49]. This study identifies inconsistencies and outliers in results from the four-scale analyses with joint methods. With the introduction of the micro-urban scale analysis and human-scale field observation, the study provides a more comprehensive understanding of the spatial characteristics and identity of Melbourne's Chinatown. The methodology of this study should be tested with other urban heritage sites with different cultural backgrounds.

4.2. Laneways as Spatial Outliers in a Grid System

Many existing scholars argue that Melbourne has a unique laneway culture without clarifying the underlying spatial reasons [55,56,66]. This study offers a spatial interpretation of the uniqueness of the laneway culture through the intelligibility results. The laneways interrupt the highly identifiable Hoddle Grid system as 'spatial outliers' shown in the intelligibility analysis, making it harder to recognise and master by the pedestrians in wayfinding. Based on the results, this study contends that laneways make the overall Hoddle Grid system spatially more engaging and unique through their interruption of spatial regularity [70]. Unlike spaces with a maze effect, in Hoddle Grid, regardless of the location of the laneway, they are always linked to the main streets [70]. Due to the feature of the street layout, laneways in the grid system are creating a good structure system for wayfinding, despite the low intelligibility value. As seen in the field observation results, there are no drastic changes in the structural properties of the precinct and the entire city area. The intelligibility study of Chinatown provides an epitome of wayfinding in the city grid area with non-uniformed laneways. For Melbourne's Chinatown and the entire grid system with laneways across, the low intelligibility caused by the 'spatial outliers' of the laneways is not viewed as a negative aspect that causes uneasy wayfinding. Kaplan (1979) suggests that a more complex urban pattern may improve the pedestrians' experience of the space by slowing down their cognitions [49,70]. Authors of this study argue that despite causing a low intelligibility value, the laneways attaching to the Hoddle Grid system do not necessarily hinder wayfinding but potentially make navigating more engaging, which is a spatial justification of the appealing laneway culture in Melbourne. The semi-urban scale analysis of the topological relationship between private and public space also sheds light on the use of laneways. Heffernan Lane shows that laneways with low entrance density can have a high adaptability and flexibility. As a limitation, this study only involves Melbourne's Chinatown as a case study. Further studies are recommended to examine the correlation between street width and entrance density, intervisibility and functional adaptability, employing more case studies from diverse cultural backgrounds.

4.3. Lack of Cultural Use Buildings

With most of the dwellings in the precinct functioning as restaurants or including at least one restaurant, the precinct is crowded with Chinese cuisine as well as cuisines from other cultures. However, a significant lack of cultural-use dwellings is detected. Moreover, among heritage buildings recognised with high heritage significance by the Victorian Heritage Register, only three involve cultural usage. The Open House of Melbourne initiative annually provides guided tours of some of these buildings [71]. Other cultural events such as RISING and celebrations of Chinese festivals are also introduced to the precinct [72,73]. However, the daily cultural use of dwellings in the precinct is minimal. It is worth noting that the RISING event 2022 took place at the golden square car part, which is not registered with the highest level of heritage significance [2]. Digital technologies are involved in turning the car park into an engaging art venue. The authors of this paper assert that it is worth considering the everyday cultural use of dwellings with or without heritage significance, and the involvement of digital technologies can be advocated to enhance the precinct's cultural identity.

The high spatial depth and the low integration of Cohen Place are other potential points of improvement. On the macro, semi-urban and micro-scale analysis, Cohen Place is identified as having low connectivity, integration visibility and entrance density. These spatial characteristics of Cohen Place make the laneway and the Museum of Chinese Australian History endure low permeability, accessibility, visual connection and subsequent low liveliness. Some spatial strategies are already implemented to vitalise the laneway. During the field observation, a square with a traditional Chinese gateway is observed at the intersection of Cohen Place and Little Bourke Street. The square is the only open space on Little Bourke Street, which acts as a buffer zone for the laneway and can help draw pedestrians' attention. Previous research suggests that this square is often utilised to host key cultural events during Chinese festivals [1,11]. However, the space is not largely occupied during the field observation and has limited seating. Signage is placed on Little Bourke Street to direct pedestrians to the Cohen Place cultural centre. On top of existing strategies, this study suggests the increase in buildings with cultural use can potentially facilitate the formation of a more engaging and connected cultural zone, as opposed to the current standalone museum in a narrow laneway.

5. Conclusions

This study incorporates a four-scale analytical framework to explore the street layout of Melbourne's Chinatown, incorporating field observation and space syntax. On a macro-level, the difference between connectivity, mean depth and integration of main streets and laneways in the precinct is highly significant. A low intelligibility value is scrutinised, resulting in low spatial identifiability. However, the study argues that the low intelligibility is primarily due to the 'spatial outliers' (laneways) in the Hoddle Grid system. With most laneways connecting to the main streets, wayfinding in the precinct is hardly hindered by the low spatial identifiability. The 'interruptive' effect of these laneways in the Hoddle Grid system can be viewed as a spatial interpretation of Melbourne's unique laneway culture, potentially appealing and fun for visitors [44,56,70]. On a semi-urban level, most laneways in the precinct are visually 'deep and hidden' with low visual integration and isovist area. In particular, the cultural centre-Cohen Place in the precinct is visually 'deep' from most entrances, discouraging the encountering of visitors unaware of the location of the Museum of Chinese Australian History. However, some strategies have been implemented to overcome such spatial limitations. Chinese-style gateways act as signifiers of entrances in the precinct, one located outside Cohen Place. However, with the limited number of cultural dwellings in the precinct, the influence of Cohen Place is still limited. From a micro-urban perspective, Melbourne's Chinatown has a low-topological depth between private and public space on the ground level, benefiting commercial activities. Based on the entrance density, intervisibility and constitutedness analyses, the urban liveliness is the highest on Swanston, Little Bourke and Russell Streets. For most laneways with narrow

widths, the findings from field observation contradict the findings from the micro-urban analysis. One laneway with low intervisibility, constitutedness and entrance density was highly adaptable and flexible. As an urban precinct with high heritage values, a lack of cultural use in dwellings is observed, while 'restaurant' is the most predominant function in the precinct.

Three recommendations for future studies are drawn:

1. Further studies are recommended to test the joint method with other case studies within grid systems. This study finds laneways can act as spatial outliers in a grid system. A joint approach can diversify and further interpret the results.
2. Limitations of the micro-urban analysis, such as the impact of width of the street, window size and public transport stop, are identified in this study. Further studies are encouraged to validate the methods with urban precincts inheriting different cultural influences.
3. Inconsistencies are concluded from the field observation and space syntax results. Further studies are encouraged to incorporate human-scale analysis such as field observation or interviews to comprehend space syntax results.
4. As spatial-themed research of the case study remains marginalised, the study encourages future research to examine other urban characteristics of the precinct, such as architectural typology, building characteristics, public spaces, urban policies, mobility and perception of citizens.

Overall, by fathoming the precinct through joint methods, the study insightfully envisages the street layout of this precinct with evidenced-based approaches. Based on the results, suggestions are provided to better serve the precinct as an urban heritage attraction in the existing grid system, preserve its heritage identity and ultimately enhance cultural sustainability.

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Chapter 5 Heritage Assessment Framework, Urban Identity and Spatial Attributes

5.1 Introduction

With a comprehensive understanding of the precinct's urban and spatial dimensions established in previous chapters, this chapter shifts focus to evaluating Chinatown's heritage through current assessment frameworks. The urban and spatial characteristics from Chapters 3 and 4 are pivotal to the analysis in this chapter. To make informed recommendations for the development of the precinct's urban identity, it is essential to understand how current assessment frameworks capture the key elements within this heritage context.

Many studies recognise the importance of assessment frameworks in preserving the identities of urban heritage sites. For Chinatown Melbourne, the COVID-19 pandemic brought unavoidable changes to its spatial characteristics and identity, challenging the effectiveness of existing assessment frameworks. As with other urban heritage sites, Chinatown Melbourne is navigating a post-COVID-19 revitalisation, which brings into question the adequacy of existing assessment frameworks in capturing the precinct's evolving urban identity.

The chapter begins with a review of urban heritage assessment frameworks, covering typologies, spatial attributes, and analytical methods. The research follows the methodology for collecting and assessing evidence to demonstrate cultural significance, as outlined in the *Guidance on Identifying Place and Object of State-Level Social Value in Victoria* under Criterion G by the Heritage Council of Victoria. Chinatown Melbourne serves as the case study to address the research questions, drawing on qualitative data obtained through archival research and field observations.

The findings of this chapter highlight the limitations of current heritage assessment methods, particularly in urban settings, by highlighting the often-overlooked role of spatial attributes in understanding urban identity. The chapter also concludes that the COVID-19

pandemic has exacerbated this identity crisis, exposing the complex interplay between tangible and intangible values within the precinct, such as spatial constraints, architectural elements, and the effects on the hospitality sector.

The results indicate that examining spatial characteristics and their connection to urban identity is crucial for urban heritage sites, particularly those that have been adapted for modern use in complex urban environments in the post-pandemic context. This chapter recommends that future heritage assessments incorporate spatial attributes through a thematic approach tailored to diverse cultural heritage contexts in the post-pandemic era.

This chapter provides an overview of the currently available assessment frameworks for Chinatown Melbourne from an urban identity perspective, incorporating spatial attributes. It further enriches the understanding of the case study and its relationship with heritage assessment, particularly in the post-pandemic context, which is vital for offering feasible recommendations to enhance and revitalise its urban identity in the subsequent chapters of this thesis.

The following paper is included in the chapter;

1. Geng, S., Chau, H., Jamei, E., & Vrcelj, Z. (2023). Unpacking shifts of spatial attributes and typologies of urban identity in heritage assessment post COVID-19 using Chinatown, Melbourne, as a case study. *Architecture, 3*(4), 753–772. https://doi.org/10.3390/architecture3040041

5.2 Declaration

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DECLARATION OF CO-AUTHORSHIP AND CO-CONTRIBUTION: PAPERS INCORPORATED IN THESIS

This declaration is to be completed for each conjointly authored publication and placed at the beginning of the thesis chapter in which the publication appears.

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2. CANDIDATE DECLARATION

I declare that the publication above meets the requirements to be included in the thesis as outlined in the HDR Policy and related Procedures – policy.vu.edu.au.

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3. CO-AUTHOR(S) DECLARATION

In the case of the above publication, the following authors contributed to the work as follows:

The undersigned certify that:

1. They meet criteria for authorship in that they have participated in the conception, execution or interpretation of at least that part of the publication in their field of expertise;
2. They take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;

3. There are no other authors of the publication according to these criteria;
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Elmira Jamei	5	Critical review of manuscript. Feedback and discussion on research and writing.		4 NOV 24
Zora Vrcelj	1	Critical review of manuscript. Final approval of manuscript.		5 NOV 24

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5.3 Unpacking Shifts and Spatial Attributes and Typologies of Urban Identity in Heritage Assessment Post COVID-19 Using Chinatown Melbourne as a Case Study

architecture

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Article

Unpacking Shifts of Spatial Attributes and Typologies of Urban Identity in Heritage Assessment Post COVID-19 Using Chinatown, Melbourne, as a Case Study

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Abstract: Many studies acknowledge the significance of assessment frameworks for urban heritage sites in preserving their identities. Due to the pandemic and its impact on heritage sites and visitors, the spatial features and identities of many heritage sites have undergone inevitable shifts, challenging the current assessment frameworks. As numerous urban heritage sites are being revitalised post COVID-19, this study aims to explore how heritage-assessment frameworks can be adapted during the pandemic to sustainably capture the identity of urban heritage sites, particularly from a spatial perspective. Methodologically, the study first examines existing urban-heritage-assessment frameworks, including typologies, embedded spatial attributes, and analysis methods, through a literature review. The research adopts the methodology framework for collecting and assessing evidence to demonstrate the cultural significance outlined in the 'Guidance on identifying place and object of state-level social value in Victoria' under Criterion G by the Heritage Council of Victoria. Chinatown, Melbourne, serves as the case study to address the research questions, utilising qualitative data from archival review and field observation. The results highlight the shortcomings of current heritage assessments, particularly in urban contexts, emphasising the overlooked importance of spatial attributes for understanding urban identity. This is exemplified by the exacerbated identity crisis in Chinatown, Melbourne, during the COVID-19 pandemic. Therefore, the study recommends future heritage assessments incorporate spatial attributes with a thematic approach tailored to diverse cultural-heritage backgrounds in the post-pandemic era. The study acknowledges the sample size and encourages future studies to test the framework with case studies of varied backgrounds.

Keywords: urban heritage; heritage assessment; urban identity; spatial characteristics; heritage conservation; heritage-value typology

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1. Introduction

Before COVID-19, many urban heritage sites were rapidly developed and gentrified, while preserving the urban identity of these sites can be challenging and may cause damage to the site [1]. COVID-19 has generated adverse effects on heritage sites and the tourism industry. As a result, urban heritage sites have undergone inevitable changes in spatial characteristics and subsequent identities, which existing frameworks often fail to capture. Before the pandemic, many studies proposed multicriteria/multifaced heritage-assessment frameworks for holistic heritage evaluations [2–6]. However, these heritage-assessment frameworks that aim to categorise all values associated with heritage sites often fail to deliver an adaptive and flexible assessment [7,8]. Fredheim and Khalaf (2016) argue that value typologies are adaptable. The value of heritage also resembles mutability, where the baselines of values often shift [9]. As heritage values shift over time, especially in the pandemic era where changes are rapid and complex, it is unlikely that making typologies that aim to cover all themes will ever be sufficient. At the same time, the World Heritage Committee and many scholars in the field argue that it is not appropriate to treat urban

heritage as isolated monuments or groups of buildings. Heritage-value typologies are recommended to cater to urban heritage sites, recognising the Outstanding Universal Value (by the World Heritage Committee) and attributes of urban heritage identity [10]. Each city or settlement should have its list of urban heritage identity attributes that inform the description of local significance and local and regional identity.

The authors of this paper argue that such a challenge in urban identity needs more attention in the post-pandemic era. This study aims to unveil whether spatial attributes should be addressed in heritage frameworks to adapt to post-pandemic heritage sites and how those features can be better incorporated to enhance cultural sustainability. Defining the identity concerns of urban heritage in the post-pandemic period is challenging without understanding how urban-identity-assessment frameworks currently address spatial characteristics. In the literature review, this study begins with exploring how current heritage frameworks address spatial characteristics that form a part of the heritage's urban identity. Chinatown, Melbourne, is incorporated as a case study to scrutinise the changes it underwent during the pandemic as an urban heritage site. This study also provides transferable implications by aligning these changes in the case study with recommendations for future heritage frameworks and suggestions on developing an adaptive typology to reflect urban identity themes.

2. Literature Review

2.1. Heritage Assessment, a Value-Based Approach for Heritage Conservation

Cultural-heritage protection has evolved under broad definitions with tangible and intangible attributes over the past century. Decision-makers often decide on conservation solutions based on the heritage sites' cultural significance, primarily through a value-based assessment [11]. In the context of heritage assessment, a value-based approach is often defined as seeking to recognise and enhance significance, which can be understood as heritage values [7,12]. Keeney's book, *Value-Focused Thinking: A Path to Creative Decision-Making*, advocates for a paradigm shift in decision making, urging for a greater emphasis on eliciting values and actively pursuing goals. The book provides practical frameworks for value-focused thinking, emphasising the importance of clarifying values to generate new alternatives, which also apply to decision making in the heritage context based on values [13]. Cultural significance is a well-acknowledged concept with the Burra Charter, a 'doctrinal treaty' designed initially to convey conservation solutions in Australia, which soon became influential worldwide [14]. Accordingly, cultural significance was accepted worldwide as 'embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects' [15]. Subsequently, cultural values are usually referred to as the reason for considering a heritage site significant [16,17]. The term 'attribute' describes qualities and characteristics symbolising cultural values [18]. However, scholars in the field often argue that there is a need for more systematic methods and tools for monitoring and assessing the attributes that define the cultural significance of heritage [7,17,19,20].

Consequently, value-based approaches for heritage conservation have become dominant in the discourse since the early 1900s, where conservation is viewed as a 'dynamic process of change management' [15]. According to Fredheim and Khalaf (2016), value-based approaches have been espoused to various categories of cultural heritage, including urban and rural landscapes [12,21], historic buildings [22], archaeological and historical objects, and archaeological sites [15,23]. Within the European Green Deal framework, emphasising human-centred adaptive reuse for heritage, Girard and Vecco (2021) discuss the transfer of the concept of intrinsic value from natural ecosystems to cultural-heritage sites. They suggest that integrating anthropocentric instrumental and intrinsic values should be emphasised for assessing and managing cultural heritage [24]. The approaches above induce a spotlight on understanding how heritage is valuable. A statement of significance is often formalised to address the values. Thereby, value-based frameworks often have an uncontested emphasis on what is valuable about heritage. Heritage is deemed to be signifi-

cant for many different reasons and values. A wide range of possible heritage values have been suggested in the existing research. Such lists of heritage values encompassing heritage significance are called 'value typologies', often utilised in heritage and conservation policy assessments. Some value typologies list their values and attributes, while others provide merely the values. For instance, Australia ICOMOS lists aesthetic, historical, scientific, and social as the critical attributes for heritage-value typologies [25]. Robles (2010) suggests that typological, structural, constructional, functional, aesthetic, architectural, historical, and symbolic are the crucial attributes in a value typology [26].

However, such value-based approaches and their value typologies have been criticised [8,27,28]. Some researchers argue that the value-based approach often fails because decisions are made upon an incomplete understanding of heritage and its value [3,4,29]. Many of these scholars then propose multicriteria frameworks. Some studies argue that the full context of heritage value needs to be captured using less definitive and adaptive aspects of value and value typologies [7]. For instance, by establishing a three-step value-typology framework; Fredheim and Khalaf (2016) suggest associative, sensory, evidentiary, and functional could be the four aspects of value needed to assess heritage. Studies also discuss the mutability of values and how shifting baselines might impact heritage assessments. For instance, Spennemann (2022) explores the impact of shifting baselines on community heritage studies, accentuating how individual contributors' biases and experiences can shape the identification and evaluation of heritage assets. The study advocates for a comprehensive approach involving diverse contributors and ongoing reassessment to address potential inaccuracies resulting from evolving perspectives. The role of the assessors and their epistemology of the nomination and valuation in this context is also vital and often missing in the discourse of the studies [9]. Spennemann's research in 2023 examines the suitability of futurist concepts like heritage stewardship. It recommends contemporary heritage to adopt a heritage-assessment model that positions accessors in a strategic foresight-derived future 'reality', enabling the application of standard hindsight-assessment methodology [30].

While other researchers practice a more thematic approach, where capturing all values is not the focus, but instead focusing on tackling a specific value theme through establishing value typologies and developing assessment methods. Studies support the thematic perspective by claiming the destined failure of any attempts to categorise all values [8]. Examples of these themes include aesthetic [31], economic [32], social network [33], and historic [34]. This study aims to explore the possibility of addressing the significance of urban heritage sites by adopting a thematic approach with dedication to a spatial theme which impacts urban heritage's identity.

Urban-Heritage-Assessment Methods

Variegated types of heritage require heritage assessment. Existing studies argue for the need to tailor assessment frameworks and attached value typologies in a site-specific or heritage-specific way, including for urban heritage. Gustavo Giovannoni first used the term' urban heritage' in 1931, campaigning for urban-scale heritage protection [20]. He defined a historic city as a monument and a dynamic living fabric. Then, in the World Heritage Convention 1972, UNESCO (United Nations Educational, Scientific and Cultural Organization) he created a category of cultural properties named 'groups of buildings'. Since then, UNESCO has promoted a comprehensive approach to urban heritage beyond the physical environment and has incorporated social, economic, and functional dimensions [10].

In the *Encyclopedia of Global Archaeology*, it is stated that urban heritage is often defined as the layers of historical, physical remains that constitute contemporary urban areas, that is the built heritage with architectural and historical value or the monuments of a city (churches and other religious buildings, castles, city walls, palaces, and institutional buildings) [35]. Some people also use urban heritage to denote the city as heritage, a unique cultural property mainly associated with neighbourhoods, centres, and historic cities. Urban heritage is both tangible and intangible, including the culture of the people who live in

the areas and places that are less tangible but important for articulating space and the built environment [36]. In this study, urban heritage refers to urban landscapes (historic centre, neighbourhood) with heritage values (cultural significance) from the historic buildings on site and the current use of these spaces that might have adapted to urban life. It is vital to access the spatial aspects of these sites, as they are currently being marginalised. Hence, the study focuses on the built-environment aspect of these urban heritage sites, mainly concerning spatial attributes and associated urban identity.

The UNESCO's World Heritage Centre plays a leading role in heritage conservation, along with three advisory bodies: ICCROM (International Centre for the Study of the Preservation and Restoration of Cultural Property), ICOMOS (International Council on Monuments and Sites), and IUCN (International Union for Conservation of Nature). Increasing concerns about heritage sites in urban contexts have been raised [10]. There is a need to refine methodologies that identify and evaluate changes that impact heritage sites in the dynamic urban context. Iterations of Heritage Impact Assessment have been developed to facilitate decision making in urban heritage conservation based on different value typologies, including ones created and adopted by the ICCROM, ICOMOS, and IUCN. With the ongoing revisions of the Heritage Impact Assessment being carried out by ICCROM and IUCN in cooperation with the World Heritage Centre and ICOMOS, the World Heritage Committee meeting (January 2020) suggested that there is a need to first determine urban identity attributes clearly and to establish a methodology to manage change and new development in and around heritage in the urban context. An indicative typology of Attributes of Urban Heritage Identity was developed in the meeting, acknowledging indicative elements/typologies, including the broader context, urban elements, monuments/buildings, and intangible cultural-heritage elements. However, as indicated in the above literature review, long lists with no theme are suggested as impractical, complicated, and unsuccessful for inclusivity due to their potential failure to capture all values and attributes [8]. It is also argued that heritage is increasingly complex; the traditional tangible/intangible and cultural/ natural heritage divides can be insufficient and unsustainable [7,37,38].

A recent systematic review conducted by Spennemann (2023) contributes to the definition of a 'heritage conservation area', characterising it as a spatially circumscribed collection of heritage assets with a shared theme, allowing for the application of multi-criteria assessment. The study notes that various countries use 'heritage conservation area' under different names, emphasising the common thread of spatially circumscribed and thematic heritage conservation [39]. The review highlights that many overseas jurisdictions predominantly focus on the architectural significance of included buildings, street patterns, and historical dimensions, particularly emphasising the visual appearance of 'heritage conservation areas', including those in the urban setting. Based on the review, Spennemann defines a heritage conservation area as 'an area of land recognised and valued for the collective nature of buildings and elements that distinguish it from other places and its surroundings' [39]. Extracting the essence of Spennemann's study in 2023, the authors of this study aim to examine whether the existing framework can recognise those 'distinct identities' through spatial features, reflected in the case study as an urban 'heritage conservation area'.

2.2. Heritage Assessment: A Value-Based Approach for Heritage Conservation

Research on urban identity can be traced back to the 1950s when modernist planning and architecture led cities to inheriting similar and repetitive characteristics [40]. The repetitiveness of these built environments was often coupled with a sense of losing the place's identity [41]. Hence, researchers in built-environment disciplines began to report on issues involving the identity of cities. Concepts that progress as a reaction to this phenomenon of losing distinctive place peculiarities are often regarded as the origin of urban identity. Many of these concepts are still used as alternative terms for urban identity today [42]. As Cheshmehzangi (2020a) summarises, terms of such connotation

include 'sense of place' or 'image of the city' [43], 'genius loci' [44], 'placelessness' [45], 'townscape' [46], and 'place identity' [35,47–49]. Since then, urban identity has been widely discussed in many disciplines, including urban planning, architecture, human geography, and environmental psychology [50].

Acknowledging the complexity of this concept, Cheshmehzangi (2020a) suggests that urban identity could be defined as a 'socially constructed relationship between human and his space, space and its elements, and elements with other elements'. He also reports that urban identity could be contextualised and delineated in different spatial levels by setting up a four-level framework, including the global, urban, environmental, and personal perspectives. Cheshmehzangi (2020b) employs the framework to Chinatown in Melbourne to explain urban identity in an urban-setting scale [51]. He points out that urban identity at this scale is often achieved through the visual sense, such as spatial form and architectural language, which can formulate a distinctive place. In his view, urban identity on the urban-setting scale often epitomises a particular architectural language, which cannot represent the whole city. Early fundamental literature in this field by Kevin Lynch (1960) also referred to the Little Tokyo of Los Angeles as a 'strong ethnic concentration, probably known to many people. . .as only a subsidiary portion of the city's image'. Lynch (1960) recognised that built cultural-heritage sites with distinct urban identities are often influenced by the 'intrusion' of another culture that may seem out of place, such as the two sites mentioned above. For instance, introducing a foreign culture through migration can impact the urban identity [43]. More specifically, historical and innovative buildings are suggested to affect the 'place identity' on an urban scale [41,52–55]. These studies also indicate an undeniable link between the spatial characteristics of an urban setting and its identity, which is further addressed through the case study in this article.

Official heritage-conservation guidelines also acknowledge the concept of urban identity and its underlying cultural significance, which is worth protecting. The Burra Charter 2013, established by the ICOMOS, defines cultural significance as aesthetic, historical, scientific, social, or spiritual value for past, present, or future generations, which is embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places, and related objects [15]. The place is defined as 'sites, area, land, landscape, building, group of buildings and may include components, contents, spaces and views'. A study by O'Connor (2000) indicates that a 'sense of place' is deeply embedded in the heritage-assessment framework in Australian heritage-conservation guidelines, including the Australian Heritage Commission Act 1975 (amended to become the Australian Heritage Commission Act 2003 and the Guidelines for the Assessment of Place for the National Heritage List 2009) and the Burra Charter 1979 (amended to become Burra Charter 2013) [56]. In the Guidelines for the 'Assessment of Place for the National Heritage List' of the Act, the implicit depth of assessment inherent in each place is reinforced by evaluation criteria such as aesthetic, scientific, historical, and social significance, summarised as 'cultural significance'.

More specifically, in the Burra Charter 2013, 'understand the place' is placed in stage one of the steps in planning for and managing a place of cultural significance before steps two and three, namely 'develop police' and 'manage in accordance with policy'. Although conservation guidelines in Australia recognise the prominence of urban identity and its cultural significance, very few studies have attempted to formulate a framework to examine the urban identities of relevant urban heritage sites. The official criteria are also inclusive and target not only built cultural heritage but also natural cultural heritage. Although the importance of urban identity is reflected in the guidelines, evaluation methods have yet to be specified to standardise the process. Most examples in the guidelines employ descriptive text to highlight their cultural significance. Methods derived from architectural and planning perspectives could be incorporated to thoroughly examine the built cultural heritage's urban identity. Within the heritage-value typologies developed by official organisations and other researchers, urban identity is always underlined and mixed with other aspects. According to Rudolff (2006), defining the typologies to capture a range of values may be unadaptable and inflexible [8].

The above-mentioned systematic review by Spennemann (2023) also considers the two current legal frameworks for heritage protection in Victoria, Australia, including the Heritage Act 2017 and the Planning and Environment Act 1987 [39]. The review exposes that the close connection between buildings and elements in a 'heritage conservation area' generates a meaningful sense of place valued by the community and possessing cultural-heritage significance deemed worthy of preservation. The cultural significance and heritage values of such an area can stem from various factors, including historical origins, subdivision patterns, building materials, styles, age, planting elements, common uses, and layering of historical elements providing evidence of the area's development over different periods. A discussion derived from the above research concerns managing changes that allow for development but ensure it echoes the local streetscape character and respects the area's cultural significance. Spennemann's (2023) study on heritage conservation areas and attributes leads to the next part of the literature review, where more components of urban identity are unveiled.

Components of Urban Identity

Researchers have provided different conceptual understandings of urban identity. Kaymaz (2013) contends that urban identity can be evaluated from the spatial, social, cultural, and economic aspects [57]. Ziyaee (2018) conducted a literature review on existing studies that provide characterisations of urban identity [58]. Among them, the study by Smith and Relph (1978) on the characteristics of place identity includes three components: physical features and appearances, activities, and meanings and symbols [45]. With an emphasis on the physical aspect of urban identity, Ziyaee (2018) suggests that urban identity can be realised from a combined understanding of different physical urban elements, including streets, squares, buildings, public spaces, urban furniture, and sculpture [58].

Researchers often provide urban-identity frameworks that include both physical and non-physical characteristics. Lynch, in his book, *Image of the City* (1960), argues for three aspects to analyse a city's image: identity, structure, and meaning. The three characteristics created are for what Lynch defines as 'manageability'. He identifies five elements that showcase the imageability of cities: paths, edges, districts, nodes, and landmarks. Although in Lynch's research five physical elements are determined as attributes of the imaginability of cities, he still emphasises meanings and emotions, which are often viewed as intangible. Ziyaee (2018) hybridises factors of place identity with the characteristic elements of the cultural landscape, presented as a matrix. With the new matrix, the study provides an analysis framework emphasising place identity from the cultural aspects of the urban settlement, derived from both physical and non-physical perspectives [58]. Punter (1991) and Montgomery (1998) also focus on attributes shaping the sense of place in urban public spaces [59,60]. Physical settings, activities, and meanings are listed by Punter (1991). Similar to Ziyaee's study (2018), Montgomery's study (1998) categorises elements determining a user's cognition of a place, including forms, activities, and images. Also, according to Carmona (2010), physical and non-physical aspects of urban identity are often interrelated [61].

Another aspect of urban identity is the soundscape, which stimulated numerous discussions during the pandemic. For urban areas at large, Lenzi et al. (2021) investigate the impact of reduced social and economic activity during the COVID-19 lockdown on the soundscape of an urban neighbourhood in the Basque Country. Perceptual analyses reveal changes in aspects such as acoustic richness, technological sounds, and sound related to indoor human activity and birdsong, emphasising the significance of the soundscape in urban design strategies. Such impact also occurs in the context of urban heritage. Spennemann and Parker (2020) address the challenge of preserving auditory heritage, including soundscapes that contribute to the cultural-heritage identity. It highlights the struggle to integrate auditory heritage into heritage legislation and management frameworks, addressing conceptual and managerial challenges. Additionally, their study discusses the impact of the pandemic on soundscapes in heritage, suggesting that the enforced silence during

lockdowns presents an opportunity to evaluate and recognise the potential heritage value of sounds that have been overlooked. Expanding into religious heritage, Spennemann (2022) furthers the discussion by highlighting the cultural significance of the church bell ringing, emphasising its role in creating a distinctive community soundscape with heritage values. The pandemic showcases the impact of individual preferences on soundscapes, underlining the need to formally acknowledge the heritage value of religious sounds within comprehensive heritage frameworks.

Other non-physical aspects of urban identity are also argued to be vital in providing a place an identity for urban heritage sites [58]. The Historic Urban Landscape approach views spatial organisation and connection as essential considerations for the intangible dimensions of urban heritage [62]. Valera (1998) claims that the social characteristics of a place take a special role in making a place a symbolic urban space. Different dimensions (e.g., traditional, temporal, behavioural, psychosocial, social, and ideological) of a built environment can influence the identity of the place [63]. Rapoport (1970) argues that people react to the environment based on their perception of the environment's meaning [64]. His approach to urban identity relies much on feelings and experiences caused by material objects for users of spaces.

Although spatial attributes are often rephrased and sorted into different themes (e.g., some components under the theme 'form' in Montgomery's framework and five elements of imageability in Lynch's framework), it is apparent that spatial attributes have an unneglectable impact on urban identity, from both tangible and intangible perspectives. In other words, urban identity comprises several aspects, including the spatial aspect. The impact could be made from tangible (e.g., spatial configuration) and intangible (e.g., spatial experience) changes. Formulating a typology of spatial attributes/characters (both tangible and intangible) of urban identity for urban heritage can add to the existing scope of the study, where spatial attributes are often mixed in the overall typology under different themes of factors. In existing studies, having the spatial attributes blended with other characteristics of urban identity limits the potential of creating a standardised and targeted conservation assessment, which can inform explicit solutions.

3. Materials and Methods

The literature review shows that current heritage-assessment frameworks, particularly those that consider the urban identity aspects of heritage sites, need more emphasis on spatial attributes. To best address the research aim, this study proposes to engage a case study with qualitative methods as the main research methodology. The methodology of this study is adopted and developed based on the suggested methods for collecting and assessing the evidence to demonstrate cultural significance in the 'Guidance on identifying place and object of state-level social value in Victoria' under Criterion G [65,66]. The Heritage Council Victoria (HCV) advises that for a place/object to be included in the Victoria Heritage Register, it must meet at least one of the following criteria (Table 1). The purpose of adopting such a suggested method by the heritage council is that the methodology framework has been practised in many local places to assess its social value, identity, and cultural-heritage significance and for possible inclusion in the Victorian Heritage Register under Criterion G. Also, when looking at Chinatown in the contemporary context, Criterion G is the most suitable for a precinct that is actively being adaptively reused with social values and cultural significance. When using the framework, the focus is to, firstly, describe the evidence that demonstrates the existence of a current community or cultural group(s), including describing the community's core/distinguish characteristics; secondly, present the evidence that demonstrates the social value of a place/object to the community/cultural group(s) through the facets of time depth, intensity of attachment/association, and the nature of the community, ensuring that the connection between the place/object and the social value is evident [65].

Table 1. Criteria for inclusion in the Victoria Heritage Register by HCV.

Criterion A	Importance to the course, or pattern, of Victoria's cultural history
Criterion B	Possession of uncommon, rare or endangered aspects of Victoria's cultural history
Criterion C	Potential to yield information that will contribute to an understanding of Victoria's cultural history
Criterion D	Importance in demonstrating the principal characteristics of a class of cultural places and objects
Criterion E	Importance in exhibiting particular aesthetic characteristics
Criterion F	Importance in demonstrating a high degree of creative or technical achievement at a particular period
Criterion G	Strong or special association with a particular present-day community or cultural group for social, cultural, or spiritual reasons
Criterion H	Special association with the life or works of a person, or group of persons, of importance in Victoria's history

As seen in Figure 1, the HCV recommends three possible approaches, including people within the communities, representatives of the communities, and observations of the communities. As this study has a spatial focus, representatives of the communities become the focal point with maps and use place as primary evidence. The study will engage the two-step approach between direct and observed engagement. First, community websites and publications (archival review) about the precinct are scanned through. Then, on-site observation is conducted to gather evidence on the use and mapping of the site. Archival review and field observation capture the shifts in the case study during the pandemic, particularly spatial changes.

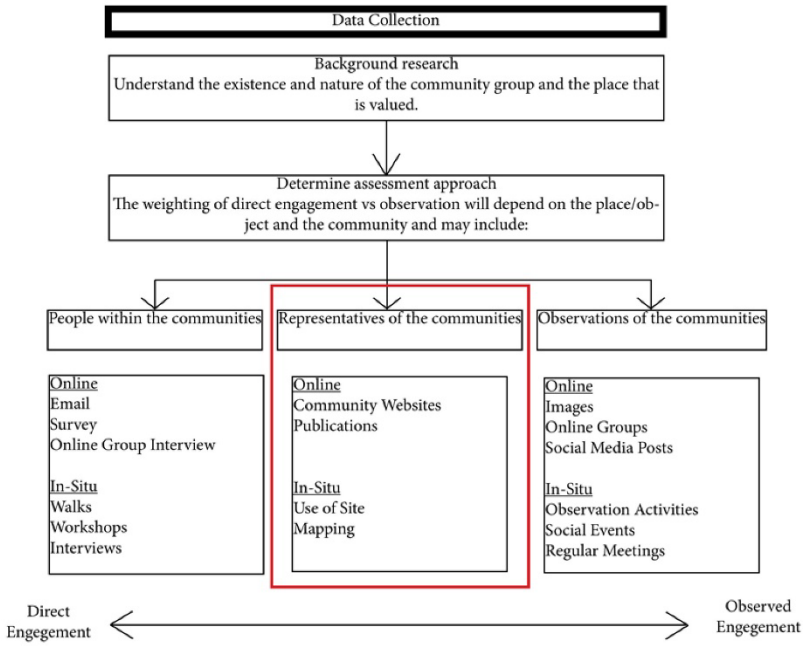

Figure 1. Suggested evidence-collection methodology framework by HCV.

In this study, Chinatown, Melbourne, is chosen as the case study due to its significant decline as an urban heritage precinct during the pandemic. Such a case study provides an opportunity to test the capability of the existing framework to capture changes, and the related adaptability of policies. The Victorian Heritage Register identifies three levels of protection from the state level (highest level of heritage significance) to the local level, namely the Victorian Heritage Register, Heritage Inventory, and Heritage Overlay [66].

With the entire precinct being recognised as having national value, most of Chinatown, Melbourne, recognised with heritage significance by Heritage Victoria, establishing the quarter as a key heritage site in Melbourne. As the precinct has been recognised with heritage significance at the national level since the 1980s, most recent heritage registrations within the precinct focus primarily on individual buildings with state-level significance [66]. Testing the precinct with Criterion G's framework in the modern context provides many new insights into how social value, cultural significance, and identity have shifted in the modern context, particularly in the era of post-pandemic revitalisation. Such an examination also provides researchers with a new layer of understanding of attachment type, intensity, and time-depth when facing adaptative reuse of the historical and commercial precinct.

Through such an examination, the study also aims to see if the current framework can capture the spatial features within the precinct and if there is a need to add such spatial measures in future frameworks. Using Chinatown, Melbourne, as a case study also provides high transferability of results, as there are many ethnic enclaves across the world possessing similarly high heritage significance, many of which underwent a decline phase due to the pandemic [67]. In terms of data collection, field observation is critical in this study, as spatial changes are hard to capture through textural evidence, such as data gathered through archival and literature review. Results of field observation are documented through field notes and photos. To provide further qualitative data, archival materials such as migration records, historical photos, maps, and the existing literature were obtained from the Victoria Heritage Register database, the Museum of Chinese Australian History, the National Library of Australia, the State Library Victoria, and the University of Melbourne.

Then, these results were analysed to scrutinise changes within the case study during COVID-19 and to observe whether the changes are effectively captured in existing frameworks, particularly from a spatial perspective. To execute the results, this study refers to the 'Guidance on identifying the place and object of state-level social value in Victoria' to support the explanation of the field observations [65]. To best interpret/determine the cultural significance of the place based on its social values, the guide recommends a three-layer approach, as presented in Figure 2, where the type of community, the intensity of attachment and the time depth are considered. The results will be presented following the three-layer approach. Archival review mostly answers the first question, while field observation and mapping studies address the second and third aspects.

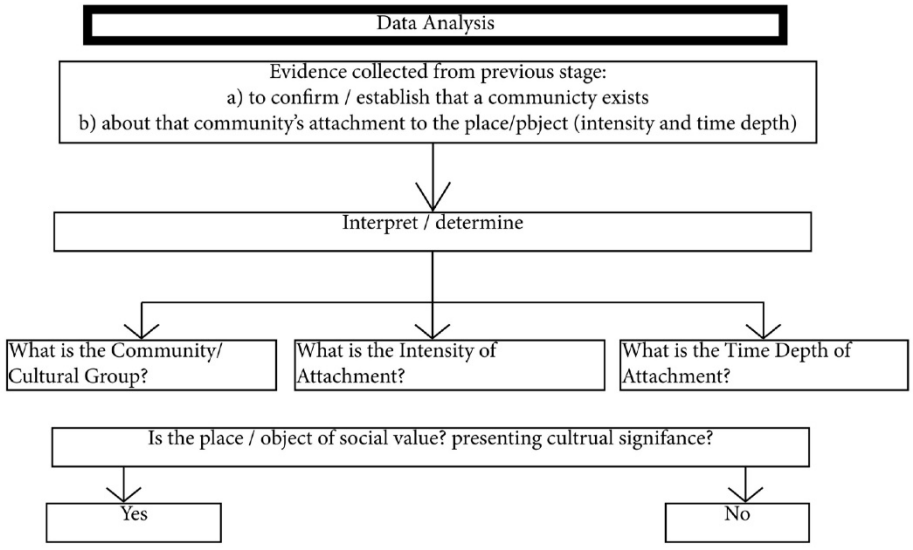

Figure 2. Suggested data analysis/interpretation framework by HCV.

Through critically analysing the results, the last step of this study is to address the research aim and to propose recommendations for future assessment frameworks on how to be more adaptable and sustainable and to better recognise the identity of urban heritage sites in complex and shifting situations concerning spatial aspects. The chosen methodology of this study from the HCV guide is labelled in red in Figure 1. One identified limitation of this study is the lack of direct engagement with the precinct users. Interviews and surveys can be engaged in future studies to collect more evidence based on direct engagement with the community in the precinct. Future research is recommended to test such a methodology framework on other heritage sites outside Victoria.

4. Case Study Results

Field observation, map analysis, and archival review methods were incorporated to comprehensively review the shifts in Chinatown, Melbourne, during the pandemic, including phenomena such as the declining of business, types of occupancy, and the spatial adaptability of the precinct. The results are also interpreted with the city council's rejuvenating strategies for the ethnic enclave. Upon looking closely at those shifts, this article addresses how existing heritage assessments are applied to the precinct and if they effectively capture those shifts during the pandemic to facilitate the building and rebuilding of the precinct's identity.

4.1. What Is the Community/Cultural Group in the Precinct?

Like many Chinatowns worldwide, Chinatown, Melbourne, was initially settled by migrants from China. However, with the urban sprawl, the number of migrants and the preference for suburban housing, more migrants prefer to live outside of Chinatown [68,69]. Cafes and specialty shops, with a clientele from diverse backgrounds, represent the most-recent post-war phase of the quarter [67,70]. Only one residential tower was observed in the precinct during the field observation. A study by Geng et al. (2023) suggests that such gentrification and change of occupancy type started in the 1940s when the precinct was claimed to be 'a place to dine for the westerns' by Chau et al. (2016) [67,71]. Then, with the removal of the White Australian Policy and the implementation of the Chinatown Historical Precinct Act and the Chinatown Action Plan, the government started to use Chinatown as an urban symbol to represent multiculturalism and tourism with a 'Chinese' character [72]. Some of the buildings in Chinatown incorporate Chinese decorative motifs, while most represent mainstream European architectural styles.

On top of financial reasons and pandemic-related policies, Geng et al. (2022) point out that the singularity of occupancy in the precinct also leads to the precinct's identity crisis. From the field observation and the map analysis, limited buildings in Chinatown, Melbourne, are associated with cultural usage. Most of the precinct is occupied by commercial activities, with restaurants as the dominant typology [67]. From the observation and archival review, this study argues that the Chinese community in Chinatown, Melbourne, no longer resides in the precinct. The Chinese community in Chinatown, Melbourne, are mostly business owners serving clients from diverse cultural backgrounds. This can be seen as one of the contributing factors to the identity crisis of Chinatown, Melbourne, where the original occupant typology shifted its role from residents to business owners, who only run Chinese-themed businesses in the precinct that aim to attract customers from all cultural backgrounds. Post pandemic, the identity crisis is primarily intertwined with the precinct's ability to attract business owners and customers.

4.2. What Is the Intensity of Attachment?

The intensity of the Chinese attachment remains high, as most businesses are owned and run by Chinese people. Apart from most of the restaurants and shops serving Chinese cuisine and selling Chinese goods, most of the cultural-related dwellings resemble a Chinese background, such as Chinese churches, museums, and regional associations in the precinct [67]. The field observation and archival review show these destinations are popular

among local Chinese people. It is interesting to see the different types and intensities of attachment co-existing in the precinct [73]. On one hand, non-cultural-related functions, such as restaurants, aim to attract customers from all backgrounds inclusively; on the other hand, cultural-related functions possess attachment with local Chinese people.

A different level of density is also evident during the map analysis (see Figure 3). As a heritage precinct, a need for more emphasis on cultural functions is identified during the field observation. The Victorian Heritage Register does not confine buildings to specific usage. As seen in the filed observation, only three (the Chinese Mission Church, Her Majesty's Theatre, and the Num Pon Soon Society) of the seven Victorian Heritage Register buildings within the enclave still possess cultural functions. Located at the end of the precinct, Her Majesty's Theatre does not necessarily reflect any Chinese-related cultural themes. The limited cultural usage of identified heritage buildings and the tourism focus of the precinct are causing unclear strategies targeting different types of attachment groups. This brings us back to the issue of an identity crisis. Particularly during the pandemic, when tourists were not visiting the precinct, and with limited residents the precinct has undergone a decline in commercial activity [67,74]. Despite the decline during the pandemic, the intensity of Chinese business owners remains the predominant type of attachment within the precinct.

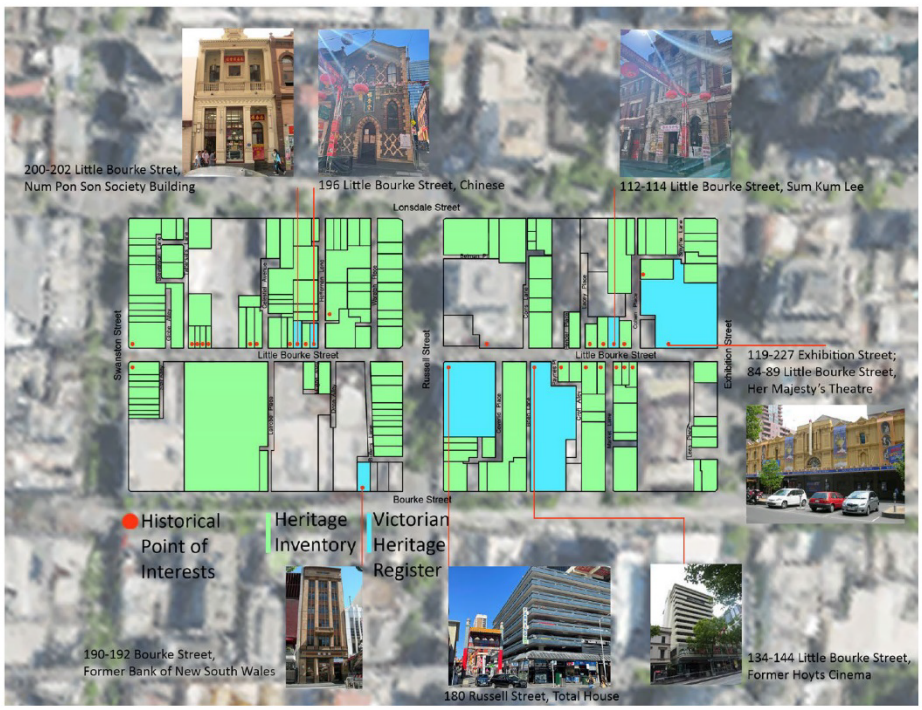

Figure 3. Map analysis with information on Heritage Inventory and Victorian Heritage Register (source: author SG).

4.3. What Is the Time Depth of Attachment?

The precinct has had a long history of occupation by Chinese migrants. Geng et al. (2023) elucidate that Chinatown, Melbourne's, urban identity has undergone radical changes due to non-organic cultural and identity shifts set by the authorities. Their study scrutinises the precinct's urban identity evolution through key phases, ranging from the 'slum' lounging house area and fruit wholesale market to the current heritage ethnic enclave. The current urban identity of the precinct is primarily built upon the pursuit of the original Chinatown Action Plan 1985 with some modifications, where the precinct is now a multicultural enclave with various functionalities, including entertainment, hospitality, and some cultural activities that suit visitors and locals. Throughout the history of Chinatown, Melbourne,

the attachment of Chinese residents has been relatively lower than before. However, the Chinese business owner's attachment to the precinct remains high [67,70].

Occasionally, the precinct is used as a gathering spot for Chinese festival events (Figure 4) [70]. Limited spaces within the precinct are occupied with cultural usage in the long term. Although the most-recent direction given by the government in the 1980s suggested Chinatown, Melbourne, should act as a multicultural tourism spot, the precinct nowadays is still mostly that it is 'a place to dine', which has faced a significant decline during the pandemic. However, when the precinct is used to celebrate Chinese festivals, the intensity of the attachment peaks, often causing traffic congestion. According to the official website of Chinatown, Melbourne, (run by the Chinatown Precinct Association), the Lunar New Year and Mid-Autumn festivals are the most celebrated festivals. The Melbourne Dai Loong Association performed dragon dances during those two festivals on Little Bourke Street [75].

Figure 4. Lunar New Year gathering in Chinatown, Melbourne, outside Cohen Place (source: author SG).

Overall, the precinct is well-known, with a prolonged history of having Chinese attachment. The challenge of revitalising the precinct is to maintain the Chinese attachment and culturally sustain such an attachment. Having such a long time depth of Chinese attachment can be a double-edged sword. The intensity and time depth can be used well to enhance tourist attraction. However, such prolonged history and cultural resonance can be constraining for business owners.

Undeniably, Chinese attachment has a great time-depth influence and attachment with the precinct. However, the type of attachment has indeed shifted throughout the year. Now, Chinese cultural events only happen occasionally every year [75]. With most of the precincts functioning as commercial precincts, the question now concerns less about the residents with Chinese backgrounds and business owners and more about clients from all cultural backgrounds. Further research can look into the precinct's client profile and attachment level.

5. Discussion

5.1. The Precinct's Value and Identity Based on the HCV Framework

Based on the three aspects above as part of HCV's framework for Creation G, it is undoubted that Chinese people are the predominant attached community to the precinct. However, this study finds that Chinatown, Melbourne's, attachment group, intensity, and time depth have changed dramatically throughout the precinct's history. Currently, the

precinct only acts as a cultural gathering spot during Chinese festivals. Limited dwellings resemble cultural functions. With the precinct having been acknowledged as a place with national-level heritage significance a long time ago, it is not facing the issue of not being recognised with heritage value and cultural significance. With the relative flexibility of adaptive reuse, the Chinese cultural background becomes a double-edged sword, causing blurring of recognition of its cultural significance. The precinct is celebrated with unique cultural significance and is constrained on some level. The identity crisis is significantly related to the current mixed type of attachment, where people with Chinese backgrounds are mainly business owners trying to attract visitors of all backgrounds. The precinct faces a severe identity crisis with limited residents and pandemic-related low visitor levels. A question that needs to be answered is whether when facing revitalisation during the pandemic, is the precinct opening to attached business owners with no Chinese background, or is it trying to maintain the current typology and attract more visitors?

This study also finds that the current framework needs to capture the spatial and architectural aspects of the precinct. The depth of the framework could be improved. Constraints and opportunities generated by the spatial setting of the precinct have yet to be identified using the framework provided, as it is mostly ignoring the architectural or built-environment features. The framework is also designed for places and objects, which is a deemed limitation. Referring to the literature review, as Spennemann (2023) elucidates in his definition of the historical conservation area, the spatial aspects of the precinct's identity also contribute significantly to the place's overall identity and heritage value [30]. Historical conservation areas' cultural significance and heritage values can stem from factors, including historical origins, subdivision patterns, building materials, styles, age, planting elements, and common uses, which are not identified in the existing framework tested in this study.

5.2. Aspects That the Current Framework Fails to Capture

Spatially, the adaptability of spaces in the precinct is low [73]. As observed in the maps, the precinct layout has mostly stayed the same due to the Hoddle Grid layout of Melbourne City. Throughout the years, small-scale layout renovations have been implemented in Chinatown, Melbourne, including widening pedestrian pathways and opening/closing laneways [73]. The original Chinatown Action Plan (1985) suggests that Chinatown, Melbourne, is set to be a valley-type precinct with low- to medium-rise buildings and narrow laneways on the side of the main street (Little Bourke Street). The grid layout restricts the flexibility of large-scale renovations in the precinct, such a plan set by the 1985 Action Plan remains unchanged [76]. With the restrictions of extensive spatial renovations in the precinct, the rejuvenation of the precinct largely relies on temporary installations and events under the top-down lead of the local government's initiatives.

A recent council media release in 2022 mentions that a night market is introduced in the precinct on Heffernan Lane, one of the only laneways that is open-ended and wide enough to accommodate the night market vendors/stools (Figure 5) [77]. Also, the outdated guidelines/identity strategies are contributing to the identity crisis of the precinct. Due to the rigidness of the grid layout, the local council has been actively implementing strategies to rejuvenate the area. However, there needs to be more emphasis on the identity development of the precinct. Most of the strategies are temporary and focus on the decorative features of the precinct (Figure 6). For instance, one recent implementation in 2023 was the streetlamp installation, which received 1.5 million in funding from the local government [75].

In 2021, Spennemann explored the nature and range of built-ups linked to the COVID-19 pandemic, including aspects of its containment and management. The study delves into both permanent and temporary structures developed as a result of the pandemic, including permanent structures and sites, temporary (ephemeral) emergency hospitals, facility extensions, testing facilities, border-control stations, morgues, and cremation grounds (Spennemann, 2021). The study argues that the ephemeral structures cannot be preserved

as heritage items and need to be documented while in operation to provide strategies only after the structures become obsolete. Limited spaces within the precinct were transformed into permanent or temporary sites for COVID-19-related functions. However, the discussion between permanent and temporary renovation applies to Chinatown, Melbourne. Many current implementations in the precinct may have an ephemeral nature due to their decorative and temporary nature.

Figure 5. Heffernan Lane night market (source: author SG).

Figure 6. Lunar New Year theme decoration on Tattersalls Lane (source: author SG).

From the field observation and archival review, spatial shifts in Chinatown, Melbourne, are usually the last to occur after business or occupancy changes decline, as spatial changes require layers of approval by the local authorities. With the existing Hoddle grid layout of the Melbourne City area, significant changes in spatial layout are often constrained [70,78,79]. The existing laneways are also viewed as hidden treasures, but spatially, it is difficult for shopfronts to attract new visitors. Secondly, organic change can occur, but most buildings are protected under Heritage Victoria with minimal modifications allowed. Under the heritage-protection restrictions, the heritage façades must usually be preserved with no changes allowed. This means the distance between the shopfronts and the main road can hardly be changed without changing the pedestrian pathways. This also relates to the case study results. Spatial constraints must be considered when establishing identity-development strategies for the precinct's revitalisation. However, the opportunities brought by the existing spatial layout can also add to the precinct's identity.

The current heritage guidelines mainly provide restrictions to maximise the preservation of the original precinct's external features on the main street. Limited studies look at the internal occupancy and layout of the side laneways, contributing to the precinct's overall identity building. Spatial changes and identity shifts in Chinatown are usually interrelated and cannot be viewed separately in this case study. Most studies address heritage-preservation policies and focus on individual buildings or facades. There is a lack of heritage guidelines and assessment frameworks that address the adaptive reuse of the area in dual consideration of the heritage image and spatiality of the precinct.

5.3. A Magnifying Factor of the Identity Crisis of Chinatown, Melbourne: COVID-19

In March 2020, as daily COVID-19 cases exceeded 200 in Australia, the national response was initiated, involving the implementation of social distancing and lockdown measures [72,80]. As cases rose, all states implemented partial lockdowns in their first-wave response. In most states, non-essential businesses closed, retail remained open, and cafes and restaurants operated through takeaway services [81]. Compared to other states, Victoria had the most stringent measures in response to the second wave of COVID-19, marked by school closures, business shutdowns, and travel restrictions, including a night-time curfew. Throughout this period, Melbourne became the most-locked-down city, significantly impacting the local hospitality industry [81,82]. The national border closure began in March 2020, with reopening starting in December 2020 and concluding only in March 2023, targeting travel to and from various regions worldwide at different stages. With border closures at both national and state levels and lockdown strategies in Melbourne, the impact on the hospitality industry has been amplified [80]. As Chinatown, Melbourne, relies primarily on the hospitality business, the impact of the pandemic on the precinct is magnified.

In particular, the food practices and habits of Australians have shifted greatly due to the pandemic [83]. Online meal ordering is gaining popularity and becoming a common practice in Australia [84]. Han and Liu-Lastres (2022) argue that it is critically important that restaurateurs understand predictors of consumers' dining behaviours to better foster strategies to recover their revenue [82]. The pandemic is, hence, a discriminating factor in the use and revitalisation of the urban heritage precinct that relies heavily on food services. As the restaurant is the predominant business type in Chinatown, Melbourne, declining businesses in the precinct are inevitable [72]. Moving away from COVID-19, business types in Chinatown can be diversified to help the precinct become more resilient and adaptable [2]. The common identity crisis for Chinatowns around the world existed long before COVID-19. Both the intensity and the time depth of the Chinese attachment have evolved. After the pandemic, many studies argue that such concerns in global Chinatowns are becoming more confronting. Evidence shows that such an identity crisis results from multifaceted factors. Geng et al. (2022) unveil that a decline in shopfront occupancy has occurred in Chinatown, Melbourne, during COVID-19 [70]. Combining the results presented in Section 4.1 with the fading of local residents, the precinct is primarily a commercial district that utilise

the Chinese background as a key business/tourism attraction. The types of communities attached to the precinct are blurred by the indistinguishable backgrounds of the visitors and singular cultural background of business owners. From the results, this study finds that the pandemic has amplified the identity crisis of Chinatown, Melbourne, which is interrelated with both the tangible and intangible values of the area.

5.4. Suggestions for Future Framework

With the current assessment framework focusing on individual buildings, capturing changes in the precinct is difficult. A recent study by Geng et al. (2023) suggests that Chinatown, Melbourne, has undergone radical spatial changes since the last official guideline, published in 1985 [67]. The protection of precincts should be emphasised in any existing policies or assessment frameworks. The city council does play a leading role in guiding the protection of the Chinatown heritage precinct. External experts are consulted occasionally during major heritage renovations. For instance, the gateway renovation was completed with the assistance of the University of Melbourne. Seemingly, no systematic guideline or assessment framework targets Chinatown, Melbourne. With its unique cultural background, applying a uniform framework to Chinatown, Melbourne, can result in more-apparent heritage-protection principles. Developing a separate set of heritage-protection guidelines for the precinct can also be challenging. As seen from the existing studies, a thematic approach can provide a feasible solution to such an issue, where key themes or features are extracted to form a guideline for heritage protection. With the lack of such direction/theme, the identity crisis of Chinatown, Melbourne, is leading the precinct to become a tourist district with no cultural emphasis. Occasionally, individual standalone buildings or precinct features are conserved or renovated. Spennemann (2023) also asserts that Victoria is the first state in Australia to enact heritage legislation, but the act pivots around stand-alone buildings (Historic Buildings Act of 1974) [39]. A clear guideline is needed to provide a thematic direction, which can negatively impact the precinct's overall identity building and ease the identity crisis amplified by the pandemic.

As seen from the case study, the current assessment framework does not sufficiently capture the changes and decline of the precinct, resulting in unclear directions for identity restoration and development in the precinct [2]. From the case study, major spatial changes have not occurred due to the pandemic. However, as Geng et al. (2022) discussed, spatial changes in the precinct happen as an accumulation of events/policies [73]. It is essential to capture the spatial changes on an urban level to better the heritage-protection process, including retaining and developing the precinct's identity. From the literature review and case study results, instead of categorising values as tangible/intangible, this study proposes to use a thematic approach and focus on the spatial attributes of urban identity on an urban heritage scale for urban heritage precincts like Chinatown, Melbourne. Unlike traditional heritage-assessment approaches, where attributes in the value typology must reach a certain length/complexity to capture all values, this study suggests urban heritage precincts should focus on a thematic perspective [85]. Different from looking at a standalone heritage building, urban heritage precincts can be more complex as both the urban factor and the heritage factor need to be thoroughly addressed [39]. It is often common to see urban heritage sites being heavily involved in adaptive reuses. Therefore, sustaining their identity is ever more critical to ensure the cultural sustainability of these urban heritage sites. Hence, to capture the overall urban spatial identity, the authors of this study recommend similar heritage sites to incorporate a thematic approach for heritage assessment where spatiality can be one of the themes [86]. To address the spatial theme attributes such as the spatial layout, street network, architectural typology, building characteristics, public spaces, urban policies, mobility, and citizens' perceptions can be examined [73]. However, the choice of attributes should be site-specific to ensure the openness and adaptability of the thematic approach assessment.

6. Conclusions

To conclude, this study first investigates current value-based heritage assessments, particularly those addressing urban heritage. Within the scope of heritage assessment for urban sites, spatial attributes impacting the site's urban identity have often been neglected. The literature review reveals that assessment frameworks attempting to capture all aspects of a heritage site often fail due to a lack of focus, thus advocating for a thematic approach when addressing identity issues. Examining the identity and value shifts of Chinatown, Melbourne, during the pandemic within the HCV framework, the study finds that the identity crisis is exacerbated by a blurred distinction among the communities associated with the precinct. This stems from the indistinguishable backgrounds of visitors and the singular cultural background of business owners. The intensity and time depth of their attachment have also evolved. The study argues that the COVID-19 pandemic has amplified this identity crisis, revealing its interconnectedness with both tangible and intangible values within the area, such as spatial constraints, architectural aspects, and the impact on the hospitality industry.

To address the research aim, this study concludes that investigating spatial characteristics and attached urban identity is vital for urban heritage sites, especially those adapted to modern functions in complex urban settings in the post-pandemic era. Although mapping and functionalities are involved in the methodology, the current HCV framework does not capture the spatial features of the case study well. A site-specific understanding of spatial characteristics and the embedded identity can facilitate policymakers in making better conservation and adaptation decisions. Hence, the study suggests that future heritage-assessment typologies incorporate spatial attributes with a thematic approach, which can adapt to different heritage sites considering their identity pursuits. The current assessment framework is criticised for not adequately capturing spatial and architectural elements, leading to suggestions for a thematic approach to heritage assessment that considers both tangible and intangible aspects, especially in the context of urban heritage precincts like Chinatown, Melbourne. Future studies are encouraged, to test the framework in case studies of different cultural-heritage backgrounds.

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Chapter 6 Smart Heritage and Urban Identity

6.1 Introduction

While the previous chapters focused on the case study and current heritage assessment frameworks, this chapter provides a broad overview of existing Smart Heritage frameworks, exploring their role in sustaining urban identity and examining the technologies employed in selected case studies. As a newly established field within the heritage discipline, Smart Heritage requires a deeper understanding before recommendations and strategies can be formulated for the case study. Therefore, this chapter offers an overview of current Smart Heritage frameworks and provides insights into the technologies used in three selected Smart Heritage case studies.

Smart Heritage is an emerging discourse that integrates smart technologies with heritage conservation, emphasising the central role of place identity within value-based frameworks for built heritage. However, its integration within Smart Heritage systems remains under-explored, which this chapter aims to address. The chapter addresses two key research aims:

1) To unveil the role of identity within existing Smart Heritage frameworks, addressing a current research gap in the field.
2) To extend the discussion on the technologies engaged in current Smart Heritage practices.

For the first research aim, which seeks to better understand place identity in the context of Smart Heritage and support the development of future frameworks, this chapter employs a cross-case analysis method to examine common trends in identity formation across seven exemplary case studies. Multiple case studies are utilised to reduce the risk of data bias and provide comprehensive insights into how urban identities are addressed within Smart Heritage. These case studies are selected from previous winners of the Compendium of European Capital

of Smart Tourism (ECST), as they align with the research's selection criteria, ensuring a robust and credible sampling process. Details on the data types and data collection process can be found in the full journal paper.

For the second research aim, a cross-case analysis methodology is employed to scrutinise, compare, and illuminate current practical implementations in the Smart Heritage context. The chapter reveals that while urban identity is typically addressed in existing projects and frameworks, it is predominantly considered at a local scale. The analysis of European best practices in Smart Heritage demonstrates the potential of smart technologies to rebuild or sustain the identities of heritage sites, particularly at the local level. However, the impact of city-wide or global-scale smart strategies on local heritage and broader user engagement in an autonomous manner remains underexplored.

Furthermore, existing Smart Heritage frameworks have yet to comprehensively integrate identity building, especially in terms of how large-scale implementations can influence local heritage. This gap could be addressed by drawing insights from existing value-based heritage frameworks. The chapter also finds that integrating IoT, AI, and big data analytics—particularly through sensor networks for environmental monitoring and AI-driven predictive maintenance—enhances preservation efforts and operational efficiency in Smart Heritage. However, a significant lack of stakeholder engagement reveals a need for more user-centric approaches.

In addressing the first research goal, this chapter advances the discourse on the connection between Smart Heritage, urban identity, and marketing strategies, thereby contributing to the fields of city branding and tourism management. Future research should broaden the selection of case studies beyond Europe to overcome the limitations of this study. In addressing the second research goal, the chapter contributes significantly to the existing

knowledge of Smart Heritage by identifying tangible examples of its practical realisations, which can assist relevant decision-makers and designers.

In terms of managerial implications, this study recommends that future policymakers, particularly within Europe, adopt Smart Heritage strategies to enhance city branding and strengthen place identity through ongoing dialogue with a broader group of stakeholders. As Europe is currently pioneering most of the Smart Heritage innovations, this study focuses on case studies in the region. Nevertheless, the findings provide transferable results for policymakers and researchers worldwide. To contextualise these insights within the Australian framework, the next chapter provides feasible recommendations on how the findings from this chapter can be applied to Chinatown Melbourne. Future research can further improve the transferability of this study's findings by investigating global precedents.

This chapter also establishes a foundational understanding of how Smart Heritage is constituted in practice, setting the stage for the next chapter to examine the potential enablers and challenges associated with its implementation in the context of Chinatown Melbourne. The following paper is included in the chapter;

1. Geng, S., Chau, H., Jamei, E., & Vrcelj, Z. (2023). Understanding place identity in urban scale Smart Heritage using a cross-case analysis method. *International Journal of Tourism Cities*, *9*(3), 729-750. https://doi.org/10.1108/IJTC-10-2022-0244
2. Geng, S., Chau, H. W., Jamei, E., & Vrcelj, Z. (2024). Deciphering Smart Heritage: current technologies and best practice strategies. *47th Australasian Universities Building Education Association Conference (AUBEA 2024)*.

6.2 Declaration

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DECLARATION OF CO-AUTHORSHIP AND CO-CONTRIBUTION: PAPERS INCORPORATED IN THESIS

This declaration is to be completed for each conjointly authored publication and placed at the beginning of the thesis chapter in which the publication appears.

1. PUBLICATION DETAILS (to be completed by the candidate)

Title of Paper/Journal/Book:	Understanding the Role of Place Identity in Urban-Scale Smart Heritage Using a Cross-Case Analysis Method

Surname: GENG First name: SHIRAN

Institute: Institute for Sustainable Industries and Liveabl Candidate's Contribution (%): 89

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2. CANDIDATE DECLARATION

I declare that the publication above meets the requirements to be included in the thesis as outlined in the HDR Policy and related Procedures – policy.vu.edu.au.

[redacted] 05 NOV 24

Signature **Date**

3. CO-AUTHOR(S) DECLARATION

In the case of the above publication, the following authors contributed to the work as follows:

The undersigned certify that:

1. They meet criteria for authorship in that they have participated in the conception, execution or interpretation of at least that part of the publication in their field of expertise;
2. They take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;

3. There are no other authors of the publication according to these criteria;
4. Potential conflicts of interest have been disclosed to a) granting bodies, b) the editor or publisher of journals or other publications, and c) the head of the responsible academic unit; and
5. The original data will be held for at least five years from the date indicated below and is stored at the following **location(s)**:

Victoria University, Footscray Park, Ballarat Road, Melbourne, VIC 3011, Australia

Name(s) of Co-Author(s)	Contribution (%)	Nature of Contribution	Signature	Date
Shiran Geng	89	Conceived concept. Literature review. Data collection and analysis. Writing Manuscript	[redacted]	5 NOV 24
Hing-Wah Chau	5	Critical review of manuscript. Feedback and discussion on research and writing.		4 Nov 24
Elmira Jamei	5	Critical review of manuscript. Feedback and discussion on research and writing.		4 Nov 24
Zora Vrcelj	1	Critical review of manuscript. Final approval of manuscript.		5 NOV 24

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6.3 Understanding Place Identity in Urban Scale Smart Heritage Using a Cross-Case Analysis Method

Understanding place identity in urban scale Smart Heritage using a cross-case analysis method

Shiran Geng, Hing-Wah Chau, Elmira Jamei and Zora Vrcelj

Abstract

Purpose – *Smart Heritage is a recently established discourse that entwines smartness and the heritage discipline. Studies have shown that place identity is at the core of value-based frameworks of built heritage. This study aims to unveil the role of identity in existing Smart Heritage frameworks, which is currently a gap in existing research.*

Design/methodology/approach – *To better understand place identity in the Smart Heritage context and facilitate future framework establishments, this study uses a cross-case analysis method to scrutinise common trends in the identity development of seven current best practices.*

Findings – *The results show that current best practices involve smart technologies in sustaining or rebuilding heritage identities, mostly mapped on the local scale. Catered solutions are essential in this context due to historic cities' variegated pursuits of identity. Most current Smart Heritage projects are at the transitioning stage from digital to smart, as the autonomous ability of smart innovations is yet to be fully realised on the city or the global scale. Researchers are encouraged to draw essence from existing heritage frameworks considering the built heritage's place identity, which is at the core of culturally sustainable Smart Heritage transitions.*

Originality/value – *This study concludes with five recommendations for addressing heritage identity in Smart Heritage frameworks, targeting future research avenues. Also, this study furthers the discussion on the linkage of Smart Heritage, place identity and marketing strategy, contributing to the city branding and tourism management field. Future research should extend the case-study selection beyond Europe, which is a recognised limitation of this study.*

Keywords *Place identity, Smart cities, Tourism cities, European cities, Smart Heritage*

Paper type *Research paper*

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1. Introduction

Smart Heritage is derived from the heated topic – Smart City. According to existing research, Smart Heritage can connect tangible and intangible heritage with its visitors, among both the real and virtual worlds (Lupo & Özdil, 2013; Vattano, 2014). In other words, Smart Heritage is about digitally connecting institutions, visitors and objects in dialogues at different built heritage sites, involving tangible and intangible cultural heritage. It seeks to adopt participatory and collaborative approaches, making cultural data more available to the public and consequently increasing opportunities for interpretation, digital curation and innovation. To define the discourse, Batchelor, Schnabel & Dudding (2021) indicate that Smart Heritage is the convergence between the Smart City and Heritage discipline, where autonomous and automatic capabilities, innovation of smart technologies and contextual and subjective interpretation of the past entwine. From such a viewpoint, the aspects of smartness and heritage are two entangled theoretical compositions of Smart Heritage. As the discourse was established recently, many projects with significant heritage components were previously proposed under the Smart City or Smart Tourism umbrella, often making

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them urban-scale projects, involving built heritage sites. Hence, in this study, the role of place identity in urban-scale Smart Heritage projects becomes the focal point. As the place identity of heritage has been widely acknowledged in existing heritage assessment frameworks, the authors of this paper intend to unveil the role of place identity in Smart Heritage deductively on an urban scale to help form holistic frameworks that draw essence from the heritage discipline.

In the heritage discipline, decision makers frequently propose conservation solutions based on the heritage sites' cultural significance, mostly through value-based frameworks (Reher, 2020). A value-based approach is mostly defined as seeking to recognise and enhance significance, which can be understood as heritage values (Fredheim & Khalaf, 2016; Mason, 2002). Cultural significance is a well-acknowledged concept in the Burra Charter, a "doctrinal treaty" designed initially to convey conservation solutions in Australia, which soon became influential worldwide (Australia ICOMOS, 1979; The Burra Charter, 1999). Accordingly, cultural significance was accepted as "embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects" (The Burra Charter, 2013). Having cultural values is usually referred to as the reason behind considering a heritage site significant (Bandarin & van Oers, 2012; Veldpaus, Pereira Roders, & Colenbrander, 2013). Official heritage conservation guidelines particularly acknowledge the concept of place identity and its underlying cultural significance, which is worth protecting. The Burra Charter, 2013, established by the ICOMOS, defines cultural significance as aesthetic, historic, scientific, social or spiritual value for past, present or future generations, which is embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects (The Burra Charter, 2013). Studies affirm that the "sense of place" is deeply embedded in the heritage assessment framework in heritage conservation guidelines (O'Connor, 2000). In the Burra Chater, the place is defined as "sites, area, land, landscape, building, group of buildings and may include components, contents, spaces and views". Among economic, environmental and social sustainability, the concept of cultural sustainability is regarded as the fourth pillar of sustainability (Birkeland & Birkeland, 2008; Soini & Birkeland, 2014). Aligning with the guidelines and principles of the United Nations Educational, Scientific and Cultural Organization (UNESCO), in the heritage discipline, achieving cultural sustainability often involves retaining and improving the place identity of heritage sites (UNESCO, 2019).

Derived from place identity, the term "urban identity" often refers to the place identity of an urban fabric (Gospodini, 2004; Salah Ouf, 2001; Ziyaee, 2018). Research on this topic can be traced back to the 1950s when modernist planning and architecture led cities to inherit similar and repetitive characteristics (Davison, 2013). The repetitiveness of these built environments was coupled with a sense of losing the place identity (Manahasa & Manahasa, 2020). Concepts that progressed as a reaction to this phenomenon of losing distinctive place peculiarities are regarded as the origin of urban identity. Many of these concepts are still used as alternative terms for place/urban identity today. As Cheshmehzangi (2020) summarises, terms of such connotation include "sense of place" or "image of the city" (Lynch, 1960), "placelessness" (Relph, 1976), "genius loci" (Norberg-Schulz, 1980), "townscape" (Cullen, 2012) and "place identity" (Canter, 1977; Hummon, 1986; Proshansky, Fabian, & Kaminoff, 1983; Relph, 1976). Since then, urban identity as a concept has been widely discussed in many disciplines, including urban planning, architecture, human geography and environmental psychology (Hauge, 2007). Concerning both the heritage discipline and the recently developed Smart Heritage discourse, this study aims to unfold how the urban identity, a key aspect in achieving cultural sustainability, has been mapped in current Smart Heritage projects to foster the development of future Smart Heritage frameworks and future policy-making.

2. Literature review

To best capture the study's scope, the literature review aims to capture current discussions on urban identity, Smart Heritage and how urban identity can be integrated in Smart Heritage frameworks to enhance cultural sustainability.

2.1 Urban identity: a miscellaneous concept

Researchers have provided different conceptual understandings of urban identity. Kaymaz (2013) contends that urban identity can be evaluated from the spatial, social, cultural and economic aspects. Ziyaee (2018) conducted a literature review on existing studies that provide characterisations of urban identity. Among, them, Relph (1976)'s study of the characteristics of place identity includes three components: physical features and appearances, activities, meanings and symbols. With an emphasis on the physical aspect of urban identity, Ziyaee (2018) suggests that urban identity can be realised from a combined understanding of different physical urban elements, including streets, squares, buildings, public spaces, urban furniture and sculpture. Also, studies often provide urban identity frameworks that include both physical and non-physical characteristics. Lynch, in his book, Image of the City (1960), argues for three aspects to analyse a city's image: identity, structure and meaning. The three characteristics created what Lynch defines "mageability". He identifies five elements that showcase imageability of cities: paths, edges, districts, nodes and landmarks. Although in Lynch's research, five physical elements are determined as attributes of the imaginability of cities, he still emphasises meanings and emotions, which are often viewed as intangible. Ziyaee (2018) hybridises factors of place identity with the characteristic elements of the cultural landscape, presented as a matrix. With the new matrix, the study provides an analysis framework emphasising place identity from the cultural aspects of the urban settlement, derived from both physical and non-physical perspectives. Punter (2007) and Montgomery (1998) also focus on attributes shaping the sense of place in urban public spaces, listing physical settings, activities and meanings. Similar to Ziyaee's study (2018), Montgomery's study (1998) categorises elements determining a user's cognition of a place, including forms, activities and images. Also, according to Carmona (2014), physical and non-physical aspects of urban identity are often interrelated. From existing literature, urban identity is often viewed as a multifaceted concept. Bringing all the essence of these previous studies, urban identity has to include all the distinctive elements of a city that make a certain urban environment recognizable from other ones (Negri & Lelli, 2022). Hence, this study looks at urban identity as a holistic concept, regarding both the form of the settlement and the different cultural backgrounds (tangible and intangible). Moreover, the dynamic nature of urban identity is recognised, as derived from the constant shifts of the hybrid relationships between physical and cultural components of any urban settlement. The term urban identity is hence even more relevant from a heritage study aspect, as heritage contributes to the urban identity through presenting a relationship between the community and the urban environment when buildings or other historical artifacts embody a collective connotation from historical, cultural and material aspects.

2.2 Smart Heritage research method

Although Smart Heritage is a recently developed field, it has been constantly addressed in the Smart City field (Batchelor et al., 2021). Due to the lack of a holistic theoretical foundation in this recently established discourse, existing studies frequently use case study approaches in Smart Heritage research. In Barcelona's Smart City initiative, culture and education are considered crucial integration fields. In the Amsterdam Smart City initiative, applications in the category' tourism/culture/sports/leisure' count for 26% of the overall Smart City services portfolio (Angelidou, Karachaliou, Angelidou, & Stylianidis, 2017). Smart museum and park arena are created in Genova (Italy) platform to advance its heritage

visiting experience and safety in urban spaces (Schaffers et al., 2011). Also, Gold Coast in Australia received an IBM Smarter Cities Challenge Grant, for which researchers propose that the preservation and promotion of cultural and natural amenities should be the priority of the Smart City strategy (Bajracharya, Cattell, & Khanjanasthiti, 2014). Vienna's Smart City initiative envisions those innovative applications to be developed across various fields, including culture and leisure. In Stockholm's Smart City plan, all urban assets, including heritage assets, are viewed as potentially beneficial to environmental and social sustainability (Angelidou & Mora, 2019). In Heraklion's Smart City agenda, various interactive applications were developed to enable physical and digital browsing across the city's heritage and other cultural assets. Similarly, the cities of Graz (Austria), Budapest (Hungary) and Tarragona (Spain) are also engaged in promoting the integration of Smart City initiatives and cultural heritage (Zubizarreta, Seravalli, & Arrizabalaga, 2015). Based on the European Capital of Smart Tourism (ECST), Adamış & Pınarbaşı (2022) chose Helsinki, Lyon and Gothenburg as case studies to analyse visual characteristics in social media communication of these smart tourism destinations. Sotiriadis (2022) outlines the best practices in the cultural heritage and creativity domain in the ECST. However, how identity has shifted in the Smart Heritage context is not addressed. These studies adhere to the potential involvement of case studies in Smart Heritage research, particularly in developing frameworks and proposing future policies.

2.3 Smart Heritage implementation

In terms of the potential positive effect of Smart Heritage implementations, many existing studies focus on assessing the possibility of adapting smart strategies to local needs and shifting developing tactics based on the city's assets and the urban identity (Angelidou, 2014; Angelidou et al., 2017; Kitchin, 2015; Paskaleva, Cooper, & Concilo, 2016). Lupo & Özdil (2013) theorise "smart heritage" as a concept that "can be intended as an intangible geography of cultural contents associated with tangible elements of a patrimony, that can be enabled, accessed, experienced, and shared by different technologies and communities of users in person or remotely". Vattano (2014) suggests that smart heritage can be conceived as "an identity element of a place, to share through the implementation of smart technologies, knowledge and social inclusions, for a total participation to the promotion of cultural heritage". From both researchers' view, Smart Heritage can be defined as a relation and connection heritage: among the users of a common digital platform, among the institutions and its visitors, among the objects and the visitors and among the real and virtual worlds, fulfilling the constant shifts of demands that are entwined with the place identity. One school of thought underlines that the development of smart heritage can offer unprecedented access to cultural artefacts and experiences across distances, in which cultural consumers are no longer passively receiving but actively engaging (Borda & Bowen, 2017). Griffinger *et al.* (2007) indicate that smart strategies could promote tangible and intangible cultural assets, facilitating cities to become more attractive to tourists and businesses. In this sense, Angelidou et al. (2017) claim that one-size-fits-all solutions should be prevented when contextualising smart cities. Instead, customised strategies should be adopted, tailored to the unique cultural assets and urban identities of the specific site. Additionally, Vattano (2014) emphasises that integrating heritage elements into modern reality is critical in advancing urban intelligence. He further contended that optimising the use of technology in heritage management can reduce the potential cost of maintenance. Belissent (2012) proposes that different ideas could inspire the vision of what kind of Smart City is desired: cities might want to become a business hub, a tourist and heritage destination, or a manufacturing centre. Some existing studies have also been focusing on proposing possible technological innovations for smart cultural heritage (Zhang, Liu, Kang & Al-Hussein, 2020). Big data management, augmented reality (AR) and virtual reality (VR) allow storing, administering and visualising a large amount of data that are beneficial for protecting cultural heritage and the sustainable development of its life cycle conservation.

These technology-focused articles in the Smart Heritage domain mainly present standalone Smart City applications that aim to better the conditions of the site, increase the attraction, preserve heritage goods and enhance the user experience of cultural heritage sites and creative attractions (Angelidou & Mora, 2019; Kolivand, El Rhalibi, Tajdini, Abdulazeez & Praiwattana, 1989; Olshannikova, Ometov, Koucheryavy & Olsson, 2015). However, drawing back to the argument made by Angelidou and Stylianidis in 2020 on the need for catering strategies for each heritage site, these articles on standalone applications seem isolated without looking into the surrounding environments and context, concerning the discussion of place identity.

2.4 Integration of urban identity in Smart Heritage and Smart City frameworks

To enhance the implementation of Smart Heritage strategies and technologies, many studies within the Smart Heritage discourse currently pinpoint on setting up frameworks. A literature review on the topic by Angelidou & Stylianidis (2020) concludes that the first set of academic publications that proposes a holistic framework of cultural heritage in a Smart City context appeared after 2018. For instance, Allam & Newman (2018) present the first integrated Smart City framework that includes culture as a key constituting factor. In 2019, Kourtit (2019) proclaims the necessity of developing an intelligent, data-driven cultural policy in Smart Cities. From a planning perspective, Papa, Gargiulo & Galderisi (2013) highlight the critical role that urban planning, based on a holistic tactic to cities' development, should play in harmonising and assimilating urban policies in creating a Smart City. However, limited studies have discussed how urban identity can be integrated into Smart Heritage frameworks to achieve cultural sustainability. Errichiello & Micera (2018) advise that limited research conceptualises the relationship between cultural sustainability and smart innovations; empirical studies are particularly scant. They develop a framework linking the strategic and practice levels in addressing cultural sustainability and conceptualising the role of collaborative structures in developing smart innovation. By testing the framework with the case of the MuseoTorino in Turin (Italy), they claim that the framework can identify the role of social structures in achieving cultural sustainability goals through Smart City strategies.

Due to the limited studies in this domain, the authors expand the literature search to the Smart City index and framework (benchmarks for the development of Smart City) for the literature review, where some address heritage as a component. Negri & Lelli (2022) also provide a study of the three main Smart City indexes, including the European Smart City Index (ESCI by Vienna University of Technology), CITYkeys Index (by VTT-Technical Research Centre of Finland) and Ernst & Young (EY) index (by Ernst & Young Italy) to study how urban identity is evaluated and regarded to retaining and improving place identity of heritage sites, to enhance cultural sustainability (Centre of Regional Science Vienna UT, 2007; Huovila et al., 2017; Ernst & Young, 2022). With an economic focus, the ESCI has a loose reference to urban identity, and it is limited to the impact of cultural heritage, mostly addressed as indicators relating to the "tourist" aspect. Indicators include the "importance as tourist location", and "overnights per year by resident". While the CITYkeys index reflects on several indicators related to urban identity, including, "diversity of housing", "preservation of cultural heritage", "attractiveness & competitiveness", "quality of housing and the built environment", "connection to existing cultural heritage", "increased access to urban public outdoor recreation space" and "design for a sense of place". Indicators within the index are also found to have direct reference to Jane Jacob's concept of urban vitality, such as the ground floor usage, public outdoor recreation space and green space (Jacob, 1961). In this index, indicators relate closely to the urban identity theme, particularly referencing the characteristics of the urban environment, the tourist attractiveness of cultural heritage and its ability to appeal to and host international visitors with strong reference in shaping the identity of a place. In the EY index, urban identity is replaced by

digital identity to capture the digital dimension and information and communications technologies. The only consideration of such an aspect is reflected in the "tourist apps", emphasising the digital apps in touristic services. The review of these existing Smart City indexes reveals a multiplicity of methods that can be complementary used to integrate urban identity issues in Smart City and Smart Heritage frameworks, combining the existing theoretical dimensions of urban identity, linked to place and heritage, with the digital one, linked to services and opportunities to best serve cultural sustainability (Negri & Lelli, 2022). From this aspect of the literature review, the authors of this article identify how urban identity is mapped in existing frameworks, through physical and non-physical indicators. However, with the limited studies currently available, this study aims to add to the existing knowledge of urban identity in the scope of Smart Heritage and the enhancement of cultural sustainability.

The current stage of art acknowledges the significance of integrating smart technologies with heritage sites. However, the place identity impacts of smart strategies in cultural heritage sites have yet to be scrutinised. Although technological advances have taken place in standalone applications to protect and enhance heritage sites, as seen in practice, Smart Heritage, with a holistic and multifaceted framework, is at a nascent stage. Hence, this study addresses proactive issues and provides scenarios for future studies in the Smart Heritage field by identifying common trends of how identity has been mapped in existing projects.

3. Materials and methods

Drawing from the theoretical framework elucidated from the literature review, the methodology of this study is based on the original case study research design set by Yin (2014) and adaptations. Furthering the guideline by Yin (2014) with a recent attempt by Halinen & Törnroos (2005), Piekkari, Plakoyiannaki & Welch (2010) summarise a seven-phase linear model, including relating theory to empirical data, choosing and justifying empirical cases, establishing case boundaries, selecting appropriate data sources, analysing findings and data reduction, ensuring the quality of data and writing up and presenting case data. This study inherits the essence from this linear model Piekkari et al. (2010) in structuring the foundation of its case study selection criteria, data collection and data analysis process. As the study aims to inform how urban identities are addressed in the context of Smart Heritage, multiple case studies can be used to minimise the potential of data singularity. Therefore, this study incorporates cross-case analysis, which is a research method within the umbrella of the case study. Using multiple case studies, cross-case analysis enables researchers to compare commonalities and differences in events, activities and processes (Yin, 2014).

Three notions of case study research have been induced from Piekkari et al. (2010)'s content analysis in the scholarly domain, including "common practice", "best practice" and "innovative practice". Echoing the research aim and the theoretical framework, the case study selection in this study is defined to represent the "best practice" in existing Smart Heritage cities and enable the comparison of how urban identity has been mapped out in them. The case sample method is adopted and revised from the methodology set by Angelidou & Stylianidis (2020) in a study on identifying adaptations in cultural heritage under the Smart City context, which asserts the appropriateness of cross-case analysis in Smart City related research fields. Other studies have also supported Angelidou & Stylianidis's (2020) study by arguing that the cross-case study method can facilitate the identification of commonalities and differences in Smart City cases, where schools of thought are yet to be organised in a comprehensive theoretical system (Batchelor & Schnabel, 2019; Miao & Phelps, 2019; Mora, Deakin, & Reid, 2019). Based on their study, the selection criteria of cases of this study, resembling "best practice", are scrutinised to include four factors, including heritage component within the case study; the urban scale;

published information; and international acknowledgement. In this study, due to the substantial heritage component, the case study selection recognises some Smart Tourism and Smart City projects as Smart Heritage projects.

To facilitate the sampling of case studies and ensure the integrity of the selection process, case studies are chosen from the previous winners of the Compendium of ECST, as the case studies presented in this competition match the selection criteria of this study. The European Commission organises the competition under the ECST initiative (European Commission, 2020, 2022). The 2021 ECST was postponed and later combined with the 2022 compendium. Established in 2019, the competition is renowned internationally for selecting best practices in Smart Tourism cities of Europe, which presents "cultural heritage and creativity" as a key category. In the contest, the effective program of activities and suitability as Smart Tourism Cities are also accessed by initiatives in another three categories, including "sustainability", "accessibility" and "digitalisation". The overall winners are determined based on the four categories mentioned above ("cultural heritage and creativity", "sustainability", "accessibility" and "digitalisation"), while each category has its individual winner. "Sustainability" and "accessibility" categories are used in the ECST, only if the project is not related to the cultural heritage domain. Therefore, the authors of this study select the case studies from the "cultural heritage and creativity" and the "digitalisation" domain, as these best practices echo the study's scope and selection criteria. Table 1 presents a summary of the best practices of the "cultural heritage and creativity" and "digitalisation" categories in the ECST. Cities nominated in the ECST in the above categories represent relevant and innovative contexts for the future adoption of Smart City initiatives (Pasquinelli & Trunfio, 2020). Although the competition guide suits the research aim and the theoretical framework, one limitation of the sampling process is identified. As the ECST sets its case boundary to European cities, future studies are encouraged to incorporate the methodology of this study in cities from outside Europe. As listed in Table 1, to best match the selection criteria and the study scope, overall winners and winners of cultural heritage related categories (Cultural Heritage and Creativity and Digitalisation) in the ECST are selected as samples for the cross-case analysis. Lyon and Helsinki were the winners based on all four categories in 2019; Malaga and Gothenburg won in 2020; Bordeaux and Valencia came first in 2022. Together seven cases in this study include Athens, Bordeaux, Copenhagen, Dubrovnik, Helsinki, Ljubljana, Lyon and Malaga, as they are regarded as best practices with most tributes under the "cultural heritage and creativity" and "digitalisation" categories.

To collect data for the seven cases selected, the authors of this study use documentation and archival information, including existing literature and reports. Obtaining evidence from the above sources helps provide specific, stable and non-obtrusive data that can be reviewed repeatedly. The authors identify only having two sources of evidence as a potential limitation of this study. Hence, future studies are encouraged to engage in field observation or interviews to enhance data triangulation (Yin, 2014; Welch, Piekkari, Plakoyiannaki, & Paavilainen-Mäntymäki, 2011). Regarding the data analysis, this study engages pattern matching as the primary analytic technique to answer the research questions. Authors first identify Smart Heritage projects within the best practice case studies and sort them according to subcategories with the support of the ECST guide. Then using information from existing literature and reports, authors seek to find patterns of how place identity has been mapped in these projects. Welch et al. (2011) contend that Yin's case study method is formed on the foundation of tackling the "how and why" question with an explanatory nature. Similarly, by comparing the data of the seven case studies, the authors of this study aim to elucidate trends on how current best practice urban-scale Smart Heritage cases are engaging and reflecting place identity. Then, based on the findings, the authors further the impact of this study by providing discussions on the linkage between marketing practices regarding Smart Heritage and place identity, as well as informing policy implications for Europe.

Table 1 Best practices in the ECST under the "cultural heritage and creativity" and "digitisation" categories

Best practice category in the ECST	*Cultural heritage and creativity*			*Digitalisation*		
Subcategory	*Reviving traditions and cultural heritage sustainably*	*Communal infrastructures*	*Usage of cultural heritage for new creativity*	*Facilitating information for specific target groups*	*Collecting information for smart management*	*Physical and psychological accessibility through innovation*
Athens		1. Experiencing Athens like a local		1. Expanding the visitors' market with the Toorbee app	1. Park smarter	1. Apps to experience history or sights
Bordeaux	1. City walks with a creative touch	1. A Wine tasting pass	1. Old becomes new 2. Les Bassins à Flot: the rise of a new tourist district			1. Apps to experience history or sights 2. Promoting local tourism
Copenhagen	1. A glimpse into a genius' mind 2. A cultural platform for all	1. Collaboration of local creative players	1. Generating values for tourists 2. A gourmet agenda for the region 3. A chatbot giving guided tours			1. Apps to experience history or sights 2. AR And VR experiences
Dubrovnik	1. Innovative and creative offer exploiting synergies 2. Lazareti – creative hub of Dubrovnik	1. Dubrovnik summer festival	1. The Old becomes new		1. Park smarter 2. Data collection and sharing for a better tourism experience	1. Attracting digital nomads
Helsinki	1. Reinventing sauna culture	1. Public library	1. Design officer/district/week 2. Open-air museum	1. WeChat mini program to attract Chinese tourists		1. Virtual reality programme 2. #Myhelsinki
Lyon	1. The "Bouchons Lyonnais" quality label 2. The triboulets agreement		1. The festival of lights			1. Understanding visitors via elaborate data
Malaga	1. Repositioning Málaga as the "City of Museums" 2. Smart tourist trails				2. Create your own digital travel itinerary	1. Understanding visitors via elaborate data 2. Smart traffic control for tourists and locals

Source: Created by authors

4. Results

4.1 Athens

In the ECST, Athens is featured as a best practice in communal infrastructures with its "Experiencing Athens Like a Local (EALL)" project. The city is also listed as best practice with other projects in the digitisation and accessibility categories. Through EALL, visitors can book thematic walks through an online platform guided by local volunteers. "Explore Athens Architecture with a Local" is a featured theme on the platform, where visitors can experience both monumental and modern architecture of Athens through a guided walking tour. Chlouveraki, Stefanis, Helvaci & Zervaki (2019) highlight the imbalance in conversation focus and resources used between monumental and non-monumental buildings in Greece, particularly in Athens, where many monuments present self-evident values. Evidence shows that monuments in Athens have been prioritised with smart technology implementations. Many studies have already begun to test the use of smart monitoring technologies and sensors to deliver real-time condition reports of archaeological monuments in Athens, such as the Acropolis (Georgopoulos, Kontogianni, Koutsaftis, & Skamantzari, 2017; Kapogianni, Psarropoulos, & Sakellariou, 2020). However, few projects involving smart sensor technologies focusing on non-monumental heritage have reached the implementation stage. In the EALL project, a digital online platform is created to promote both the monuments and modern architecture in Athens. It provides an opportunity for visitors to see more of the city's non-monumental architectural features, which is often a marginalised element of historical city's identity. In 2021, Andrioti *et al.* present an initiative where industrial buildings in the historical centre of Athens are managed with smart technologies and adapted for other uses such as theatre and cultural centres. Information about the building's location, history and adapted functionalities are continuously enriched and updated through a digital interactive map, accessible to smartphones. In their view, the conservation and engagement of modern industrial buildings has to be promoted which is an inseparable element of the city's architectural and urban history. They also argue that with the transformation of derelict spaces being reanimated into active spaces and the involvement of smart technologies industrial spaces can actively and continuously play a critical role in the city's storytelling (Andrioti, Kanetaki, Drinia, Kanetaki, & Stefanis, 2021). In the case of Athens, the preservation of non-monumental buildings and precincts of heritage significance is elevated with the engagement of smart technologies, which also aligns with the pursuits of the Burra Charter and UNESCO (Andrioti et al., 2021; Chlouveraki et al., 2019).

The involvement of Smart Heritage in Athens is also apparent in the "Accessible Citizens Engagement" project. On the city scale, Athens is a pilot city as an arena for a *locus* operando of a Living Lab, where "human behaviour changes through participatory service co-production processes" (Paskaleva, Copper, Linde, Peterson, & Gotz, 2015). Paskaleva et al. (2016) use smart technologies to engage variegated stakeholders in city-scale civic decision-making. Invoking a co-design process arose the stakeholders and was identified as an important principle in making Athens a sustainable and Smart City. On the heritage and cultural dimension, policy makers in Athens have also been applying smart technologies, such as the pioneer social innovation platform – "SynAthina" – to involve citizens in policymaking, service launching and urban designing. "Co-Athens", a recent initiative realised by this platform, created an opportunity for local authorities and the refugee community to co-design and implement small-scale urban interventions to create new identities for urban precincts.

4.2 Bordeaux

As the largest World Heritage urban area listed by UNESCO, Bordeaux has most of its city fabric protected by variegated conservation measures, covering both monuments, zones within a certain distance from monuments and non-monumental precincts. Different from

some cities where strengthening and building a heritage identity to boost the tourism industry is the sole goal in heritage conservation, increasing research identifies the potential of "museumification" of the City of Bordeaux and over tourism as adverse outcomes (Appendino, 2017; De Luca, Dastgerdi, Francini, & Liberatore, 2020). In the case of Bordeaux, the emphasis on heritage protection also lands on creating a liveable historic city, where the city can develop and sustainably adapt to residents' needs with dual consideration of the heritage characteristics (Appendino, 2017). For instance, through the advancement of transport networks (Metropolitan Challenges Project) and the building of pedestrian-friendly open spaces (Public Urbain), the historic city centre of Bordeaux is actively being adapted and revitalised to avoid compromising liveability in the historic centre.

Referring to the ECST, such pursuit is also inherited in projects around Smart Cities and Smart Heritage in Bordeaux. A "Webzine That Promotes Local Tourism (Un air de Bordeaux)" was started and distributed weekly by the local tourist office to support community-oriented tourism through sharing local attractions outside the known heritage regions with respect to its inhabitants. De Luca et al. (2020) also highlight that with the emphasis on local events and places, the Webzine promotes a strong sense of local identity, vicinity, authenticity and sharing. In the "Apps to Experience History or Sights", a treasure hunt trail took place over the Nouvelle-Aquitaine Region through a mobile app in 2018. The hunt is presented as an interactive map-based game in which users can physically discover heritage places of natural and cultural significance through hunting for digital treasures and awards. Despite the overwhelming demand, the local tourist office initially only created a trail outside Bordeaux city centre. With the success of the first app, two more walking trails were made in the treasure hunt gaming format in two other places with rich heritage: Lormont (added in 2018) and Gradignan (added in 2019), where are rarely visited compared to the UNESCO-listed Bordeaux historic city centre. Meanwhile, in the ECST, more passive and less autonomous approaches have been involved in the adaptive reuse of and the creation of new identities in heritage precincts listed as often non-monumental in the UNESCO. As a part of the "Old Becomes New, Bordeaux" project, the industrial Darwin Village was transformed into a cultural hub of green economy, involving co-working spaces and organic food markets. Another initiative within the project focus on transforming an industrial port into a residential hub and environmentally sustainable river tourism with electric-ready cruise ships and a waste collection system via barge.

In the case of Bourdeaux, it is summarised that projects in the ECST primarily focus on preventing over-tourism and "museumification" of the historic city centre. The emphasis of the city's conservation regime seems to be to create new identities in non-monumental urban areas, addressing the existing heritage and the frontiers of environmental, social and economic concerns with the assistance of smart technologies.

4.3 Copenhagen

Copenhagen has been recognised as a best practice in numerous indexes and publications for its eco-friendliness, sustainability and smartness (Bjørner, 2021; Gehl, 2013). Such recognition resulted in the term – "copenhagenise", which means to use Copenhagen' s urban model as an example to modify other cities. Such a precedential approach is coined with a focus on creating a sustainable urban environment like Copenhagen, promoting pedestrian and cycling-friendly transportation systems (Colville-Anderson, 2018). Today, the city' s dedication to creating green, sustainable and smart urban environments is at the centre of its identity (Bjørner, 2021). Cristea, Alexandru, Suleski and Birsan (2015) argue that the core of such place identity with international recognition is the participation of the residents. The expansion of Smart City projects in Copenhagen is also at an advanced stage, enabling research to draw on real-life examples implemented in the city. This pioneer city presents an opportunity for researchers to detect problems of

such initiatives in a practical context. For instance, the "Street Lab" project offers a testing area in Copenhagen for Smart City innovations in a real urban environment and showcases new technologies in Smart City and IoT (Bjørner, 2021). Critically analysing existing smart projects in Copenhagen, researchers have highlighted issues only visible after the implementation stage, such as the disadvantage of one-size-fit strategies, the potential electronic wastes in sensor implementations and the emergent need to involve public participation and dialogue-oriented Smart City solutions (Angelidou, 2014; Bjørner, 2021; Ipsen, Zimmermann, Nielsen, & Birkved, 2019).

According to the ECST, Copenhagen has already largely invested in the field of smart cultural heritage. Its advocacy for digitalisation of heritage data, heritage preservation and enhancement of cultural identity is the core of "Generating Values for Tourists" and "Cultural Platform for All". Copenhagen also set examples in a wide range of smart innovations involving the use of artificial intelligence and virtual reality. The "Collaboration of Creative Players" and the "Tour Museum with Chatbot Guide" showcase the utilisation of online chatbots to digitally engage visitors with a more open and spontaneous communication during museum tours. The visitors of the National Museum can not only have chatbot-guided tours but also simultaneously provide feedback on the experience.

Copenhagen is also listed as the best practice for its use of data sources and AI to create innovative digital solutions, in which artificial intelligence was involved to auto-generate relevant and customised push messages to users to improve their experience and safety in the city. The use of virtual reality is apparent in "Local Guide to Copenhagen" and "Glimpse into the Genius Mind". The former immerses the virtual experience of the city with safe biking to show visitors how to navigate through the city; the latter project documents the architectural and construction evolvement of a museum with heritage value. In Copenhagen, smart technology has already been integrated into existing projects to preserve heritage identity on both building and urban scale. Studies can benefit from examining the outcome of these projects in Copenhagen in practice, as Smart Heritage remains relatively unacquainted in practice among other smart sectors.

4.4 Dubrovnik

Many existing studies view Dubrovnik as a city facing the threat of potential over-tourism (Panayiotopoulos & Pisano, 2019). The overarching focus of implementing smart technology in the city is to reduce the adverse effects of such a phenomenon (Pasquinelli & Trunfio, 2020). Namely, the smart parking system has been widely endorsed in Dubrovnik to facilitate visitors and residents to reduce overcrowding and enhance transport efficiency, where spontaneous parking information can be accessed through mobile apps (Griffinger *et al.*, 2007; Ninčević Pašalić, Ćukušić, & Jadrić, 2021; Saric, Mihaljevic, & Marasovic, 2017). In the ECST, despite "Park Smarter" (listed in the ECST), another best practice with a similar aim is executed to create environmentally sustainable marine transportation around the city's historic urban centre. In the cultural heritage sections of ECST, projects in Dubrovnik pinpoint on tangible and intangible heritage, such as celebrating cultural festivals and creating creative hubs in existing museums with heritage values. Other initiatives in the ECST, such as the data collection platform created by the Dubrovnik Visitor Centre, enable the city authorities to monitor the visitors in the Old Town (historic centre). Based on the data on visitor access, authorities can make more informed and smarter decisions, addressing pedestrian movement and preventing potential overflows in the centralised historic centre.

Social media platforms and other digital cultural promotions channel a significant flow of tourists to Dubrovnik, the filming location of Game of Thrones (Peeters et al., 2018). Under the inevitable influence of international stakeholders, often outside the local policy makers' control, Pasquinelli & Trunfio (2020) address the need to recognise passive and active stakeholders in handling over-tourism with smart strategies (Peeters et al., 2018). Their

study highlights the modality of international stakeholders in destination development and management should also be under scrutiny in future Smart City frameworks. As seen in the ECSCT, not only Dubrovnik but most of the best practices still use a top-down approach in favour of the authority's management without much engagement of international stakeholders.

4.5 Helsinki

Helsinki is dedicated to building a Smart City that enhances environmental and economic sustainability and accentuates the use of open data and participation of its inhabitants and users (Miao & Phelps, 2019). Miao & Phelps (2019) advise that due to the Helsinki's unique culture in having pragmatism policies, the Smart City is mostly developed to achieve an "efficient city". Hence, they intended Smart Cities to understand the cultural and socio-economic conditions before planning for smartness. Best to be reflected through the lens of local citizens, the heritage and culture of cities are critical in developing future Smart Cities, as a Smart City is not a one size fits all solution. According to Mora *et al.*'s research (2019), out of the 34 identified Smart City activities in Helsinki, 58.5% have citizen involvement, the highest participation rate among all the best practices (Barcelona, Amsterdam and Vienna). Overall activities of 8.7% target the cultural heritage domain, also the highest in the four case studies.

In the ECST, Helsinki's best practices are recognised in all three cultural heritage and creativity sub-categories, all including spatial and non-spatial innovations. For instance, "#Myhelsinki" provides a diversified range of online tools to gain insights into the inhabitants' and visitors' experiences and feedback on living and travelling in the city. "Public Library" project seeks to increase the safety, inclusiveness and accessibility of the Oodi Library public by equipping the space with digital technologies and flexible spaces and books. Ultimately, the library is renovated through spatial and service adaptation to enhance the building and the city's urban diversity. "Reinventing Sauna Culture in the City" modifies existing saunas by introducing solar and wind power to hearing, serving organic produce within the restaurants and constructing responsibly managed forests (certified by the local Forest Stewardship Council). These projects set an example for engaging economic, social and environmental resolutions to establish and strengthen place identity and cultural sustainability. Studies imply that integrating urban and architectural interventions can effectively modulate built fabric and its emergent qualities to unlock cultural energy and build culturally diverse, resilient and sustainable cities, which is fundamental for the next step – developing Smart Cities (Clarke, Kuipers, & Roos, 2020). Although autonomous technologies are not yet practised in this project, it showcases how a foundation for the Smart City respecting the culture and identity root can be invigorated.

4.6 Lyon

Although some smart technologies have already been implemented in heritage precincts of Lyon, many projects are still considered heritage with digital innovations due to the lack of autonomous technologies. As the city's innovative territorial marketing program, "ONLYLYON" establishes a city-scale customer relationship management (CRM) tool, acknowledged in the ECST. The CRM tool aims to gain an understanding of visitors and improve travelling guidance by creating a database of customer-related information (up to two million contacts by 2021). Through the information, the system can formulate highly relevant touring information and catered travelling itinerary suggestions, assisting visitors improve the travelling experience and potentially reduce traffic in peak hours. Another example is the use of temporary and mobile sensors to measure urban heat island effects in city's historic centre (Robert et al., 2017).

Through investigating the visual characteristics of social medial content from both management organisations and visitors, Adamış & Pınarbaşı (2022) find that Lyon's official social media accounts often highlight the "art" theme of the city in promotion images, while Helsinki and Gothenburg revolve around cultural-specific facilities. The study also affirms that buildings, monuments and artistic objects reflect the city's cultural and historical characteristics, on digital social platforms. The analysis also identifies that Lyon's official accounts use highly self-similar photos in social media posts, meaning their visual communication aesthetic and identity is homogeneous. It is observed that Lyon's official social media accounts are consistently and cohesively trying to convey the city's overall artistic identity through online visual contents. It is also worth noting that the ECST recognised event, the Festival of Lights, takes place during variegated festivals at sites scattered across the city of Lyon. The study above also shows that the festival is frequently portrayed with the crowd gathering in different urban environments with lighting artworks on digital social platforms.

In the case of Lyon, smart technologies have been implemented with initiatives in environmental and social domains for tourism and the overall growth of a Smart City. It is apparent that city officials actively attempt to preserve and promote the city's identity through digital platforms. The interaction between digital technologies and urban environments in the Festival of Lights is particularly engaging. As seen in Lyon, without the autonomous interaction between users and heritage, many projects are still considered heritage with digital engagement, not Smart Heritage. The line between the two is still blurry in many best practices.

4.7 Malaga

From 2009 to 2013, a smart grid control system was developed to facilitate the implementation of a range of Smart City initiatives in Malaga, including real-time (remote control, tele-protection, distributed-energy resource control and management of prices in real-time) and non-real-time services (report equipment management, reading smart metres and electric-vehicle charging systems). The smart grid system not only helps integrate advanced Smart City applications in the physical environment but also sets a successful pilot example for others attempting to adopt the Smart City system (González-Reverté, 2019; Ruiz-Romero, Colmenar-Santos, Mur-Pérez, & López-Rey, 2014). In terms of cultural heritage, in 2016, Femenia-Serra and Perea-Medina conclude Malaga as a consolidated position with innovation and creative potential; it presents better conditions to become a Smart Tourism destination than other cities in the cross-case analysis (Femenia-Serra & Perea-Medina, 2016). In the 2019 and 2020 ECST, Malaga is recognised as one of the winners with many best practice projects, included in the cultural and heritage and creativity category. Numerous city-wide sustainability action plans continue to be executed, such as the 2020–2025 integrated sustainability strategy, involving more LED public lighting, smart watering systems, air quality smart metres and advanced energy management systems.

One key aspect reflected in the best practice projects in Malaga is the pursuit of building the city's new identity by the local government. For instance, the "Repositioning Malaga as The City of Museums" initiative aims to create the city's new image as a city 'where art lives by diverging the tourists from traditional beach scenery to museums and art galleries. The city invests heavily in creating new exhibition spaces using strategies such as adaptive reuse of heritage dwellings. By 2019, the position of Malaga's identity has been accepted as a successful and best practice in the ECST; visiting museums has become one of the main activities for visitors travelling to the city. Other projects within the best practices also contribute to the overall identity repositioning, including the project "Smarter Information for Tourists", where museums and other tourist information centres offer apps with audio guides, QR codes for information and online support guides. Through engaging 1,230

residents with questionnaires, Ruiz, de la Cruz & Vázquez (2019) showcase that Malaga's city identity and branding are currently built under the concept of culture and art, which encourages economic growth and employment from the resident's perspective. When asked to give only three responses that represent the identity and brand of Malaga, most of the responses refer to buildings or precincts with heritage significance and cultural usage, including museums and theatres. Although the rebranding of Malaga concentrations mostly on boosting its tourism industry, it is still apparent that the branding and identity building through accentuating and strengthening the city's smart use of heritage and cultural built environment has enabled the repositioning of the city from a seasonal tourist destination to a town of art. Future studies are encouraged to engage users and residents' perceptions, which seem lacking in existing research on the city's identity reform when establishing smart historical centres (Snis, Olsson, & Bernhard, 2021).

Best practices in Malaga pivot around building and sustaining identities by emphasising the cultural and heritage values, using both spatial and non-spatial measures. The establishment of heritage and cultural identity is already immersed in the city's successful Smart City network. Further development in connecting the museums and cultural sights through systems involving autonomous user engagement can be the next step (Ruiz et al., 2019).

5. Discussion

Cities have variegated pursuits when creating Smart Heritage initiatives. For instance, some of the case studies provided in this study intend to diverge visitors away from the historic city centre and create liveable and sustainable systems, while others aim to attract visitors to the city through the repositioning of urban identity. Existing studies have elucidated that the realisation of Smart Heritage is not a one-size-fits-all transition (Miao & Phelps, 2019; Paskaleva et al., 2016). The authors of this study further argue that Smart Heritage transitions require holistic frameworks to consider the different pursuits of cities' identities to propose catered strategies, which is currently lacking. This study finds that measurements in existing heritage conservation value-based assessments can stipulate a valuable background for Smart Heritage frameworks with attention to the place and identity pursuits of variegated heritage, according to the type of heritage (tangible, intangible or both) and the scale (building, precinct or urban system; The Burra Charter, 2013). From the cross-case analysis, current best practices in the field of Smart Heritage are paying attention to the identity-building of heritage sites through implementing smart technologies. These case studies have shown that the transition from heritage to Smart Heritage is often entwined with the potential of identity repositioning. This study finds that Smart Heritage innovations are observed to be influential in building and sustaining the identity of cities, particularly when the urban fabric is rich in history with high tourism flow and heritage values.

As discussed in the methodology section, "sustainability" and "accessibility" are addressed as separate categories in the ECST, where cultural heritage is not touched on. In other words, even if a heritage project incorporates strategies to enhance its cultural sustainability or environmental sustainability, it is listed under the cultural heritage category. From looking at the case studies, findings suggest that the boundaries between the four categories are often blurry. Two points are identified by having the categories in this manner. First, cultural heritage is indeed viewed as a critical aspect in the framework, where the comprehensiveness of such projects is reflected as a category in itself. Second, by having the framework this way, the ECST is suggesting that cultural heritage projects can be evaluated as a completely standalone element in the larger urban fabric. The contradicting argument presented here is that the effect of cultural heritage in shaping the urban identity is greatly emphasised by gathering projects specifically targeting cultural heritage with Smart Heritage initiatives. However, the impact of the entire urban fabric on cultural heritage sites is overlooked and limited to a local scale, to look at the impact of urban and city scale

implementation of smart strategies to local heritage should be the ultimate goal of having Smart Heritage strategies, to connect a larger scale of audience and urban fabric.

Drawing back to the aim of this study, from the case studies, urban identity is indeed mapped in the existing Smart Heritage projects through variegated aspects which help to rebuild, retain or improve such identity, including mostly the consideration of digitisation and the use of technologies in existing cultural heritage projects to better showcase and reach a larger audience; monitor and data collection in cultural heritage sites to enhance visitor experiences. With much of the current urban identity discussion focusing on the tourism aspect, this study finds that current case studies mostly touch on individual sites and how urban identity can be impacted by engaging smart technologies in individual sites on a local scale. The reverse of such an effect is not addressed. The characteristics of the existing infrastructural network and the qualities of the local urban heritage have been integrated into heritage sites as part of enhancing the urban identity (Negri & Lelli, 2022). Also, the issue of how an urban-scale Smart Heritage project can impact the cities and different cultural heritage sites' identities is not yet discussed in existing frameworks, as many projects are yet to reach that scale. The current urban identity concern is Smart Heritage project is mostly reflected from site to city on a local scale; much discussion is needed from city-to-site or global-to-city and site perspectives. To active implementations from such perspectives, another key aspect that needs to be encompassed is the end-user's perspective. Existing projects focus on collecting data from end users and returning catered solutions to users (Ruiz et al., 2019; Snis et al., 2021). Although best practices seek to engage visitors and residents and foster the participatory nature of Smart Heritage, autonomous technologies are yet to be fully used to build Smart Heritage sites, connecting users on an urban scale. As Smart Heritage is perceived as the next step in heritage studies, its impact on identity from city to site and from global to city and site should be prioritised. Hence, when building Smart Heritage frameworks, elements from existing value-based heritage assessment frameworks help create and sustain urban identity with respect to its original identity. Existing Smart Heritage projects are often beyond the building scale; instead, they tend to be urban-scale projects. However, some Smart Heritage projects still target individual heritage buildings (Garzia, 2022). Future studies are recommended to look closely at the effect of smart innovations on place identities with heritage sites beyond Europe as case studies.

5.1 Marketing practices, Smart Heritage and place identity

As managerial implications, this study is relevant for policymakers that wish to incorporate Smart Heritage strategies to improve city branding and its embedded place identity. As a concept often included in the theory of place marketing, city branding is grounded on the theoretical basis of destination marketing and the sense of place (Campelo, Aitken, Thyne, & Gnoth, 2014). Due to its consistency and continuity, city brand identity is a central concept of city brand management (Casais & Poço, 2021; Mueller & Schade, 2012; Riza, Doratli, & Fasli, 2012; Kavaratzis & Hatch, 2013). Casais & Poço (2021) argue that creating a place brand often entails and manifests identity and image and is connected with the city's cultural context (Pedeliento & Kavaratzis, 2019). Studies also argue that city brand identity, as a central concept of city brand management, should go beyond a logo and represent a whole culture and personality perceived through different experiences, both physical and emotional (Mueller & Schade, 2012; Riza *et al.*, 2012; Kavaratzis & Hatch, 2013; Sadeque, Roy, Swapan, Chen, & Ashikuzzaman, 2020; Botschen, Promberger, & Bernhart,2017; Kim & Lee, 2015; Hudson, Cárdenas, Meng, & Thal, 2017; Ritchie & Hudson, 2009).

As seen in the case studies, Smart Heritage strategies can be used to capture and improve such experiences in both physical and emotional dimensions. For instance, best practices are using smart metres to retrieve immediate data and measurements to improve value

propositions that the heritage site and city offer through infrastructure, transport and sustainability. Regarding the emotional aspect, the stakeholder experiences can be assessed through digital surveys while they engage in innovative tours and trails guided by smart technologies. It is evident that smart technologies can be used to enhance variegated experiences that are vital for identity development and foster the ultimate city brand. Studies have also delved into the relationship between place marketing strategy and place attachment, which includes place identity as an essential factor, highlighting the social aspect (Casais & Poço, 2021). Using a survey technique to measure emotional city brand and place attachment, Casais & Poço (2021) suggest future studies to quantify the impact of brand management on place attachment involving visitors and locals. Greater and continuous communications towards visitors and locals can be beneficial to provide spontaneous adaptations in city identity building. The case studies showcase that smart technologies can facilitate heritage sites and cities to reach a large group of audience and provide spontaneous feedback. Such ability can foster continuous communications between different destinations and various stakeholders.

Many existing successful brand-driven city development showcase that place attachment and the creation of city brands are often entwined, involving place identity as a key aspect. In other words, in the theories of place branding and the tourism marketing field, place identity is important for enhancing place attachment and developing strong city branding, while the two are often interlinked. Regarding the marketing practice, smart strategies can facilitate the enhancement of stakeholder experience and the engagement of continuous and broad communication, which are essential to place identity and the city's brand development. While being applicable to heritage sites across the globe, such enhancement is particularly valuable to European tourism cities, where heritage and its identity are central concerns. As seen in best practices, such a positive connection between Smart Heritage sites and place branding can be better manifested with a higher level of maturity of autonomous technologies and implementation scale.

6. Conclusion

Using a cross-case analysis method with seven best practices, this study exhibits insight into the current state of place identity in Smart Heritage projects. The urban identity is mapped in current projects and frameworks restrained to a local scale. The impact of how the city and global scale implementations of smart strategies can impact local heritage and a broad end-user engagement in an autonomous manner is currently lacking. As Smart Heritage is a recently established discipline entwining research on smartness and the heritage discipline, this study finds that the existing heritage assessment framework's emphasis on the place identity can be extracted to smooth Smart Heritage transitions. Due to the lack of holistic frameworks in Smart Heritage that look into the identity of built heritage, future studies are encouraged to:

- centre on the early engagement of end-users in the decision-making phase before project execution;
- cater for frameworks with an emphasis on building or repositioning identities of heritage sites;
- draw essence from existing heritage assessment frameworks that address place identity;
- better define the scale of identity (building, precinct or urban system); and
- explore the new territory of virtual/physical identity development of heritage.

This study finds that the discussion of identity is at the core of Smart Heritage transitions. Therefore, to enhance cultural sustainability, the identity of heritage sites should be

elucidated and respected before transitioning to Smart Heritage sites. To conclude, this study identifies that current European best practices in Smart Heritage show the possibility of rebuilding or sustaining the identities of heritage sites through smart technologies, especially on a local scale. However, Smart Heritage frameworks are yet to fully incorporate the aspect of identity building holistically and thoroughly, addressing how broad-scale implementation can act on local heritage, which can be borrowed from existing value-based heritage frameworks. Regarding the managerial implications, this study suggests future policymakers, particularly in the European region, to engage Smart Heritage strategies to spontaneously improve city branding and its embedded place identity, through continuously communicating with a larger and wider group of stakeholders. Future studies can enhance the transferability of the study's results by examining global precedents.

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Deciphering Smart Heritage: Current Technologies and Best Practice Strategies

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Chapter 7 Smart Heritage Transition in Chinatown Melbourne

7.1 Introduction

Building on insights from Chapter 6, this chapter explores the practicalities of implementing Smart Heritage in Chinatown Melbourne, focusing on identifying enablers and challenges. It also provides an overview of Smart Heritage by exploring practical solutions and real-world applicability in Chinatown Melbourne. While local-scale Smart Heritage projects have successfully fostered a sense of heritage identity, scaling these efforts to the precinct level presents new challenges, particularly in enhancing the urban identity of Chinatown Melbourne. Overall, two research objectives and associated publications are derived from this chapter.

The previous chapter concluded that Smart Heritage has been engaged in some heritage projects on small scale to foster heritage identity, visitor experience, and cultural sustainability. However, there is a lack of holistic studies on how Smart Heritage can be implemented in real-life case studies, particularly in large-scale heritage precincts. Therefore, two research objectives are established:

1) To engage the case study and explore how Smart Heritage can influence an urban heritage precinct's identity and identify the enablers and challenges of such implementation.
2) To examine the currently available open-access data for an urban heritage precinct in Australia (Chinatown Melbourne) and explore how these datasets can be employed within the Smart Heritage context.

For the first research objective, this chapter involves interviews with eight professionals in community development, practitioners in the built-environment discipline, and experts in heritage conservation in Chinatown Melbourne. An inductive thematic approach is then employed to analyse the collected data. To fulfil the second research objective, this chapter

uses Chinatown Melbourne as a key case study. Data are collected from archival maps, open-access databases, and 3D models of the case study at various points in time, provided by the local city council.

Findings from to the first research objective offer practical insights for facilitating the development of Chinatown Melbourne as an urban heritage site and provide recommendations for other heritage precincts considering the adoption of Smart Heritage as part of their conservation strategy. Findings for the second research objective provide an overview of available data resources, including on-street parking, pedestrian counting, microclimate data, dwelling functionalities, and 3D models, and link them with frontier applications within the Smart Heritage field, illustrating how these resources can benefit the precinct as an urban heritage site.

Overall, the findings from this chapter contribute essential insights to the broader discourse on Smart Heritage. The outcomes can help researchers and policymakers demystify this newly established field by linking the use of data with practical applications and demonstrating how the adoption of Smart Heritage can enhance heritage identity while addressing potential challenges. As a concluding chapter, this section ties the practicality of Smart Heritage implementations with the case study, drawing on an in-depth understanding of the precinct and providing a foundation for future recommendations. The following paper is included in the chapter;

1. Geng, S., Chau, H., Jamei, E., & Vrcelj, Z. (2024). Enablers and challenges of Smart Heritage implementation – the case of Chinatown Melbourne. *Smart and Sustainable Built Environment.* Under Review.
2. Geng, S., Chau, H., Jamei, E., & Vrcelj, Z. (2024). Demystifying the Use of Open-Access Data in Smart Heritage Implementations. *Tourism and Hospitality.* Under Review.
3. Geng, S., Chau, H. W., Jamei, E., & Vrcelj, Z. (2024). Exploring the Use of Open Access Data in Smart Heritage – Using Chinatown Melbourne as a Case Study. *International Conference of Smart and Sustainable Built Environment (SASBE 2024)*.

7.2 Declaration

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Title of Paper/Journal/Book:	Enablers and Challenges of Smart Heritage Implementation – the Case of Melbourne Chinatown
Surname:	GENG
First name:	SHIRAN
Institute:	Institute for Sustainable Industries and Liveab
Candidate's Contribution (%):	89

Status:

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Name(s) of Co-Author(s)	Contribution (%)	Nature of Contribution	Signature	Date
Shiran Geng	89	Conceived concept. Literature review. Data collection and analysis. Writing Manuscript	[redacted]	5 NOV 24
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Zora Vrcelj	1	Critical review of manuscript. Final approval of manuscript.		5 NOV 24

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Title of Paper/Journal/Book:	Demystifying the Use of Open-Access Data in Smart Heritage Implementations

Surname: GENG First name: SHIRAN

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Shiran Geng	89	Conceived concept. Literature review. Data collection and analysis. Writing Manuscript	[redacted]	5 NOV 24
Hing-Wah Chau	5	Critical review of manuscript. Feedback and discussion on research and writing.		4 Nov 24
Elmira Jamei	5	Critical review of manuscript. Feedback and discussion on research and writing.		4 Nov 24
Zora Vrcelj	1	Critical review of manuscript. Final approval of manuscript.		5 NOV 24

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1. They meet criteria for authorship in that they have participated in the conception, execution or interpretation of at least that part of the publication in their field of expertise;
2. They take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;

3. There are no other authors of the publication according to these criteria;
4. Potential conflicts of interest have been disclosed to a) granting bodies, b) the editor or publisher of journals or other publications, and c) the head of the responsible academic unit; and
5. The original data will be held for at least five years from the date indicated below and is stored at the following **location**(**s**):

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Elmira Jamei	5	Critical review of manuscript. Feedback and discussion on research and writing.		4 Nov 24
Zora Vrcelj	1	Critical review of manuscript. Final approval of manuscript.		5 NOV 24

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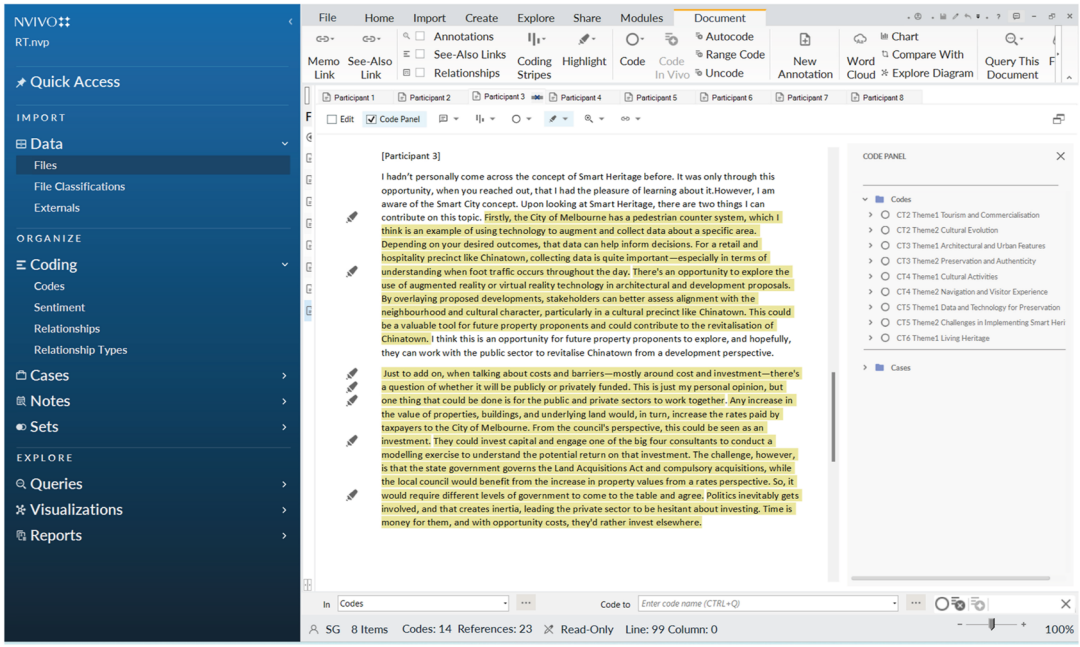
Appendix 2
Sample transcribed interview coding with NVivo



Source(s): Authors' own work

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tourism and hospitality

MDPI

Article

Demystifying the Use of Open-Access Data in Smart Heritage Implementations

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Abstract: Smart Heritage, a concept closely linked to Smart Cities and Smart Tourism, is an emerging field focused on enhancing heritage identity, visitor experience, and cultural sustainability. While initial frameworks have been developed, there is a gap in applying Smart Heritage at the precinct level, especially in large-scale heritage sites. This study addresses this gap by examining how open-access data can be utilised in a real-world case study of Chinatown Melbourne, a key urban heritage precinct. Data sources include archival maps, open-access databases, and 3D models provided by the local city council, covering resources such as on-street parking, pedestrian activity, microclimate, and dwelling functionalities. This study employed a structured methodology that transitions from global best practices to local applications, linking these data resources to Smart Heritage applications and identifying opportunities for improving urban management, heritage curation, and the tourism experience within the case study precinct. The findings offer practical insights for researchers and policymakers, demonstrating how data can support the development of culturally sustainable and technologically integrated heritage precincts. Future research should explore additional data types and case studies to further advance the field of Smart Heritage.

Keywords: Smart Tourism; Smart Heritage; urban heritage; open-access data; cultural sustainability; Chinatown Melbourne

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1. Introduction

As a recently established field, Smart Heritage has become a heated topic derived from the Smart City concept, often intertwined with Smart Tourism. Most of the current research in the field has a theoretical focus and framework establishment. Batchelor et al. (2021) define the discourse as a convergence between the Smart City and Heritage disciplines, where autonomous and automatic capabilities, innovation of smart technologies, and contextual and subjective interpretation of the past intertwine [1]. Smart Heritage seeks to adopt participatory and collaborative approaches, making cultural data more available to the public and consequently increasing opportunities for interpretation, digital curation, and innovation. It can connect tangible and intangible heritage with its visitors in both the real and virtual worlds [2]. Recent studies in the field argue that many of the current Smart Heritage implementations are still at the digitisation stage. Geng et al. (2023a) argue that Smart Heritage differs from digital heritage by emphasising autonomous capabilities. However, it is undeniable that both digital and Smart Heritage require the inputs and outputs of data, making open-access data essential for both transformations [3]. The current transition phase for many heritage sites from being digital to being smart remains mysterious for many policy and decision-makers in terms of the practical output of Smart Heritage implementations. Existing literature in Smart Heritage primarily pivot around theoretical frameworks and standalone digital heritage applications, with a significant gap in practical implementations using real-world data. Hence, this study addressed this gap by analysing the role of open-access data in transformation of heritage precincts to Smart Heritage.

As an iconic heritage precinct in the heart of Melbourne, Chinatown Melbourne is one of the oldest ethnic enclaves in Australia. Established during the gold rush in the 1850s, it has transformed from a stigmatised ghetto to a vibrant tourist destination, reflecting the broader multicultural narrative of Australia [4,5]. The precinct's architectural styles and demography have been well-documented, yet its spatial characteristics, such as the street network within the urban grid, visibility relationships, and the interaction between buildings and streets, remain underexplored [6]. Existing studies have also offered insights into the heritage conservation aspects of the precinct, aiming to unpack shifts of urban identity assessments in heritage frameworks under the impact of COVID-19 [7]. As an urban heritage precinct situated in the city centre, different categories of open-access data of the precinct have been made available by the local city council (the City of Melbourne). The City of Melbourne also has a strong emphasis on the goal of creating a Smart City on their strategic agenda, including a range of innovative initiatives and pilot projects aimed at enhancing urban sustainability, digital transformation, and community wellbeing. Key initiatives include the Melbourne Renewable Energy Project to support 100% renewable energy, Power Melbourne to develop neighbourhood-scale batteries, and the Emerging Technology Testbed for piloting smart solutions. Pilot projects such as the Digital Wayfinding Project test new technologies for improving city services and enhancing urban liveability [8]. However, limited projects have been conducted in the scope of Chinatown Melbourne itself or with a focus on heritage. The precinct's unique spatial configuration and historical depth, as well as the availability of detailed open-access datasets, make it an ideal case study choice for testing Smart Heritage strategies. These factors, coupled with its central location in Melbourne and the uniqueness in the tourism market, present a rare opportunity to explore data-driven Smart Heritage within a complex urban context. The precinct is yet to fully utilise these resources with the potential implementation of Smart Heritage strategies. A significant gap in existing research is the lack of emphasis on how to implement such strategies practically. To demystify this tactic, this study used current best practices relevant to Smart Heritage implementations to advise potential Smart Heritage strategies with the assistance of currently available open-access data. Based on a problem-based foundation, this study uses Chinatown Melbourne as the case study to best define the study scope and provide practical recommendations for the selected case study, transferable to heritage sites with similar open-access data resources. By applying the analysis to Chinatown Melbourne, the research demonstrates the practical applicability of Smart Heritage strategies, thereby bridging the gap between theoretical frameworks and real-world applications with feasible data. The primary aim of this study is to examine the currently available open-access data for Chinatown Melbourne and how these datasets can be employed for its potential Smart Heritage transformation. Future studies are recommended to test the methodology framework with other heritage sites.

2. Literature Review

2.1. Heritage Tourism in the New Era

With the use of technological innovations, heritage tourism has revolutionised how cultural heritage sites are conserved, managed, and experienced in the new era. With tools such as augmented reality (AR), virtual reality (VR), and digital platforms, heritage sites can now offer interactive and immersive experiences. As demonstrated by Chen et al. (2024), AR applications can overlay historical information onto physical landscapes, enabling tourists to visualise heritage sites in their original form, thus enhancing the depth of their experience [9]. Similarly, Jia et al. (2023) emphasised the importance of AR in recreating intangible heritage elements, such as vanished buildings, for educational purposes [10]. Virtual museums and online platforms, accelerated by the pandemic, have become key tools for maintaining engagement with heritage sites globally. Suanpang and Pothipassa (2024) explore how the integration of artificial intelligence (AI) and the Internet of Things (IoT) facilitates real-time, remote heritage engagement, which opens up cultural experiences to a broader audience [11]. Similarly, Perfetto (2018) discussed how digital platforms allow for

a more inclusive access to heritage sites, catering to those who cannot physically visit these locations [12].

The balance between technological innovation and cultural authenticity is a common concern. Chapagain (2017) suggests that while digital tools can enhance the visitor experience, they may risk commodifying heritage sites, thus diminishing their historical and cultural value [13]. This sentiment is echoed by Bastidas-Manzano et al. (2020), who assert that careful management is required to ensure that digitalisation supports rather than undermines the authenticity of cultural sites [14]. At the same time, digital tools offer substantial benefits for sustainable heritage management. For instance, Song et al. (2023) and Maulina et al. (2023) explore how IoT-enabled monitoring systems can collect real-time data on environmental conditions and visitor flow, which assists in minimising the physical impact on sensitive heritage sites. Giuffrida et al. (2021) further explored how digital tools such as Geographic Information Systems (GIS) and Building Information Modelling (BIM) are increasingly being used to monitor and manage heritage conservation [15].

In urban contexts, particularly precincts like Chinatown Melbourne, such technologies can ensure that heritage conservation efforts align with broader urban planning and sustainability goals [16,17]. Nevertheless, Kalia et al. (2022) and Jeong and Shin (2019) point out the challenges related to access and infrastructure [18,19]. They observe that heritage managers and visitors may not always have access to the necessary digital infrastructure, creating a digital divide that must be addressed to ensure that these technologies can be fully utilised. Moreover, Valentini et al. (2018) point out that heritage sites in less economically developed regions often face difficulties in acquiring and maintaining such advanced technological systems [20]. Thus, the new era offers unprecedented opportunities for heritage conservation and engagement, yet it also introduces challenges regarding authenticity, accessibility, and sustainability. For urban heritage precincts like Chinatown Melbourne, the key to success lies in adopting these technologies thoughtfully, ensuring that they enhance both cultural preservation and visitor engagement.

2.2. Smart Tourism in the Heritage Context

This section of the literature review will focus on Smart Tourism in the heritage context, which aims to focus on the autonomous ability of these innovative technologies in the new era. Smart Tourism has become integral to managing heritage sites more effectively while enriching the visitor experience. In the context of heritage, Smart Tourism technologies are increasingly being applied to create more personalised, sustainable, and engaging experiences for visitors. Tsang and Au (2023) explore how the implementation of Smart Tourism systems, including mobile apps and AR experiences, significantly enhance visitor engagement at heritage sites by providing tailored, real-time information [21]. Calle-Lamelas et al. (2024) expands on this by discussing how smart destination models have been successfully implemented in Spanish World Heritage Cities, improving both the management of tourist flows and the sustainability of these sites [22]. The data-driven insights generated by these systems allow heritage managers to monitor visitor preferences, manage crowds, and improve site conservation efforts. This is especially relevant for densely populated heritage precincts such as Chinatown Melbourne, where the influx of visitors can threaten the site's long-term sustainability. Further, smart technologies support operational sustainability at heritage sites. Jeong and Shin (2019) and Maulina et al. (2023) highlight the use of real-time analytics to monitor visitor behaviours, enabling managers to predict peak times and adjust site operations accordingly [19]. Salvia et al. (2016) also highlight the importance of integrating Smart City infrastructures into heritage precincts to enhance resource efficiency, especially in areas like energy and water usage [23]. Similarly, Mitro et al. (2022) find that IoT sensors can be employed to monitor microclimate conditions, preserving both the natural and built environment of heritage sites [24].

However, Kalia et al. (2022) points out that the cost of implementing Smart Tourism technologies and the complexity of these systems can be prohibitive for some heritage sites, particularly in less developed regions [18]. They also point out that not all heritage

sites have the infrastructural capacity to support such technologies, which is a challenge that policymakers must address. Moreover, there are concerns that an over-reliance on technology could overwhelm visitors or detract from the authenticity of the heritage experience. Salvia et al. (2016) also stresses the need for collaborative governance structures to ensure smart technologies are implemented in ways that benefit both tourists and heritage sites [23]. Jeong et al. (2022) emphasise that while personalisation is valuable, smart technologies should not overshadow the cultural and historical significance of the site [19]. Despite these challenges, the potential of Smart Tourism to enhance heritage site management and visitor engagement is immense. Pinke-Sziva (2024) shows that data analytics could help heritage managers better understand visitor preferences, allowing for more targeted marketing and improved visitor experiences [25]. Zubiaga et al. (2019) also emphasise the importance of using smart technologies to manage overtourism in historic centres, which can cause significant damage to cultural sites [26]. Integrating smart technologies into urban heritage precincts, such as Chinatown Melbourne, could transform the precinct into a leading example of how technology and culture can coexist harmoniously, supporting both heritage conservation and contemporary urban development.

2.3. Smart Heritage and Practical Implementations

Limited studies have been undertaken to address the practicality of Smart Heritage implementations, which is a concept derived from Smart City and Smart Tourism [27]. Some studies have pointed out that Smart Heritage utilises tools such as Geographic Information Systems (GIS), BIM, and the Internet of Things (IoT) to create intelligent support mechanisms for sustainable tourism and heritage conservation [26,28]. For instance, the Smart Heritage City (SHCITY) project utilises IoT and big data to monitor tourist flows, helping manage visitor impact on historic centres and prevent overtourism [26]. Portable sensor technologies, such as non-invasive contact sensors, further support the analysis of cultural heritage and control damage to artifacts [20,29]. Adaptive reuse projects, such as those in Siracusa, Italy, highlight the importance of evaluating the impacts of heritage conservation on urban development, using indicators that assess physical, cultural, social, environmental, and economic systems [29]. Despite progress, many Smart Heritage projects still focus predominantly on environmental sustainability, often neglecting advanced technological criteria and social sustainability issues [30]. Using the European Capital of Smart Tourism (ECST) competition best practices of 2020–2022, Geng et al. (2023) argue that attributes like accessibility, informativeness, interactivity, and personalisation are essential for creating positive Smart Tourism experiences, influencing tourists' engagement and satisfaction [3]. It is important to differentiate between being digital and being smart, where the autonomous ability helps to define the two. Their study also asserts that many existing projects are digital heritage without the autonomous ability embedded, making them not fully Smart Heritage. Overall, the literature review concludes that open-access data have been utilised widely in heritage sites, particularly urban heritage. However, there is a lack of research on how Smart Heritage can be best intertwined with open-access data and achieve the autonomous aspects with directions in practical applications. Hence, this study aims to fulfil this research gap with Chinatown Melbourne as an urban heritage example, aided by best practice examples from (ECST) 2020 to 2024.

2.4. Open-Access Data and Heritage Management

Open-access data play a pivotal role in preserving and managing heritage by providing accessible information that can support diverse conservation efforts. For heritage in the urban context (urban heritage), such a role is even more critical, as the surrounding contexts of urban heritage sites can be complex. The integration of digital analytical tools and 3D modelling/documentation, such as Building Information Modelling (BIM), has significantly enhanced heritage analysis, leading to improved quality and cost reduction in conserving heritage, particularly in an urban setting [15,31]. Researchers have also pointed out that open-access data not only enhance the reconstruction of historical and

social memories but also transform the role of historians and the narrative of historical events. Social media and open data sources have been widely engaged in to promote heritage sites and receive feedback from visitors, aiding the revitalisation of many heritage sites worldwide [32]. Similarly, spatially enabled web applications with open-access data demonstrate the potential of integrating multiple data sources for efficient urban heritage monitoring, management, and reporting [33]. Remote sensing and open-source tools, such as Sentinel-2 data and microclimate datasets, have proven beneficial in archaeological investigations and monitoring urban sprawl around cultural heritage sites in the urban region [24,34]. Based on a participatory approach, Shehata (2022) asserts that engaging residents and adopting innovative solutions in urban heritage conservation can improve the vitality and sustainability of historic urban centres, as evidenced by studies in Jeddah and Amman [35]. Various cultural heritage institutions are facilitating open dataset development and improving data quality, such as linked open data (LOD), essential for AI-based heritage assessments [36]. Overall, existing research suggests that open-access data are integral to the effective conservation and management of urban heritage, fostering informed decision making and sustainable urban development.

3. Materials and Methods

To fulfil the primary research aim, this paper addresses three key research questions:

1. How are key best practices in the field utilising Smart Heritage strategies?
2. What types of open-access data are available for Smart Heritage implementations in Chinatown Melbourne?
3. What strategies from best practices can be adapted to the precinct with the aid of available open-access data?

Table 1 illustrates the methodology framework adopted for this study. To answer the first research question, Stage 1 of the study reviews data from the European Capital of Smart Tourism (ECST) competition. Established in 2019, the ECST is internationally recognised for showcasing best practices in Smart Tourism cities across Europe, particularly in the 'cultural heritage and creativity' category. The competition evaluates initiatives based on effective activity programs and suitability as Smart Tourism Cities, alongside three other categories: 'sustainability', 'accessibility', and 'digitalisation'. The study by Geng et al. (2023b) analyses leading examples of Smart Tourism practices from 2020 to 2022, offering a methodological foundation for this research by highlighting how place identity is represented in urban-scale Smart Heritage projects [3]. Extending this foundation, this study reviews the best practices from the 2023 and 2024 ECST competitions with content analysis [37]. The approach is used to categorise best practices based on their objectives and implementation strategies [38,39]. Differences and shifts in focus within the 2023 and 2024 best practices, compared to previous years, are addressed in the discussion section. The findings are combined and compared with the earlier study's categories of best practices and presented in the results section. The 'sustainability' and 'accessibility' categories are considered only if a project is related to cultural heritage, thereby narrowing the focus to the 'cultural heritage and creativity' and 'digitalisation' categories, which align with the study's scope and selection criteria. The results from this stage will be explored in the results section, where the categorised best practices from the ECST competition will be analysed to determine their relevance to Smart Heritage strategies in Chinatown Melbourne, focusing on how key patterns and trends can inform local applications. To address the second research question in Stage 2, a case study method is employed, with Chinatown Melbourne serving as the primary case. The study first explores existing open-access data and 3D models provided by the local city council, selecting the most suitable datasets that can facilitate Smart Heritage transformation. Melbourne's open-access data platform encompasses seven categories with 235 datasets: transportation, sensors, business, environment, people, property, and city council [8]. Relevant real-time datasets, such as pedestrian counting and on-street parking from the sensors category, are selected for their potential to inform dynamic heritage management. Additionally, non-real-time data, such as the 3D historic models from the

property category, are incorporated due to their relevance to the heritage context. The selection of these datasets is guided by their ability to address key challenges in heritage management, such as monitoring visitor impact and public space utilisation. Data quality, completeness, and accuracy are verified through cross-referencing with historical data and city council reports to ensure robustness. The case study approach is effective for emerging research areas where frameworks and theories are still being established [40]. This approach provides in-depth insights into complex, context-dependent phenomena such as Smart Heritage implementations [41,42]. Due to its capacity to link theoretical concerns with existing heritage sites, the case study method is well-suited to this research [16,43,44]. However, this approach may limit the generalisability of findings across different contexts. Future research should incorporate comparative case studies across multiple heritage sites to validate the findings [42]. Data analysis in this stage involves evaluating the potential uses and limitations of the available datasets concerning the precinct's heritage management, while contextualising it with the case study. Each dataset is examined for its relevance, potential applications, and ability to address specific challenges within Chinatown Melbourne. This analysis is primarily qualitative, discussing the strengths and gaps in the data and exploring how future implementations could be enhanced by integrating new data sources or sensors for more effective heritage management. The results section presents insights from this stage, focusing on the specific applications of the selected datasets, while addressing challenges related to visitor management, space utilisation, and the integration of technology in heritage conservation. For the third research question, Stage 3 of the study consolidates findings from the previous stages by aligning the available open-access data from the City of Melbourne with five relevant best practice projects. A comparative case study approach is used to analyse these projects based on their objectives and strategies, considering the suitability of the datasets for the local precinct [45]. One current Smart City project piloted in Chinatown Melbourne was selected for comparison, as it is the only initiative located within the precinct according to the City of Melbourne. This comparative analysis identifies key strategies that align with Chinatown Melbourne's unique cultural and urban context, evaluating their transferability to local conditions. By linking global best practices with the available datasets, this study provides guidance for policymakers and decision-makers on how data can be effectively used in Smart Heritage transformations. Although the reliance on European best practices presents a limitation, the study acknowledges their value as initial benchmarks in the absence of widely implemented Smart Heritage projects outside of Europe. Future research should explore case studies from other regions to create a more comprehensive understanding of global Smart Heritage applications. The results section addresses the findings from this stage, evaluating the effectiveness and transferability of the identified best practices to assess their suitability for Chinatown Melbourne's Smart Heritage transformation.

This study follows a structured approach, ensuring a clear relationship between the stages of the research and the research questions. Stage 1 addresses the first research question by reviewing best practices from the European Capital of Smart Tourism (ECST) competition, identifying key Smart Heritage strategies relevant to cultural heritage and digitalisation. In Stage 2, these best practices are matched to the local context of Chinatown Melbourne by analysing specific open-access datasets, such as pedestrian counting and on-street parking, to assess their suitability for heritage management. The findings from Stage 1 and Stage 2 are combined to inform Stage 3, which responds to the third research question by determining how best strategies from other cities can be adapted to Chinatown Melbourne using the available data. By integrating the insights from global best practices (Stage 1) with the practical applications of local datasets (Stage 2), Stage 3 also evaluates the transferability and effectiveness of these strategies in the precinct. This progression from global insights to local implementation ensures that each stage builds on the previous one, deepening the logical relationship between the methodology, results, and discussion sections. Previous studies have employed a similar approach, demonstrating

the value of linking global strategies with local contexts to enhance the applicability of smart solutions [46–48].

Table 1. Stages of the study and research questions.

Focus	Global Best Practices and Strategies	Local Datasets	Local Strategies and Implementations
Stage	Stage 1	Stage 2	Stage 3
Scope	Review of relevant ECST best practices from 2019 to 2024	Scrutinise available open-access data within the case study (Chinatown Melbourne)	Identify how Chinatown Melbourne can best utilise available resources for Smart Heritage implementations
Research question	How are key best practices in the field utilising Smart Heritage strategies?	What types of open-access data are available for Smart Heritage implementations in Chinatown Melbourne?	What strategies from best practices can be adapted to the precinct with the aid of available open-access data?
Key method	Content analysis	Case study	Comparative case study
Data collection	Best practices from the European Capital of Smart Tourism (ECST)	Datasets from the City of Melbourne data platform	Consolidation of findings from Stages 1 and 2
Data analysis	Content analysis	Contextual analysis	Comparative analysis

4. Results

The results are structured to reflect the progressive stages of the study, starting with global Smart Heritage best practices, followed by the analysis of local datasets for Chinatown Melbourne, and concluding with the application of these insights to inform practical strategies for the precinct.

4.1. 2023 and 2024 Best Practices from the ECST

Stage 1 highlights key best practices and strategies from the ECST competition, specifically focusing on initiatives that effectively integrate cultural heritage. These practices serve as a foundation for identifying approaches that can be adapted to enhance Smart Heritage in Chinatown Melbourne. As Smart Heritage is derived from the Smart City concept and most current innovations in the field are covered and addressed as Smart City projects, this study extracted the two most relevant major categories in the ECST compendium to study key strategies that current Smart Heritage projects use, including cultural heritage and creativity, as well as digitalisation. This methodology was tested in the study by Geng et al. (2023a) to elucidate how urban identity is mapped in current Smart Heritage projects [3]. This study adopts such a methodology but aims to study how data and practical implementations are projected in the current best practices of Smart Heritage. Each major category includes one to five subcategories with several projects included. Table 2 showcases all the subcategories within the best practice list of ECST. Projects prior to 2023 do not have specific years in the table due to the competition arrangements.

Table A1 in Appendix A shows the projects that are relevant to Smart Heritage or have been applied in a heritage context. Upon retrieving best practices from the 2023 and 2024 ECST compendium, the next step of the study is to consolidate and combine the findings of the previous best practices within the ECST compendium and the 2023 and 2024 ones, integrating both sets of data. As the results from Geng et al. (2023a) concern previous ECST best practices before 2023 within the Smart Heritage context, this study reframes their findings to best combine the tables from both studies [3]. This step is essential for the case study comparative case study identification.

Table 2. Full list of themes and subcategories of ECST under 'cultural heritage and creativity' and 'digitalisation' in 2023 and 2024 ECST.

Best Practice Category in the ECST 2024	Subcategory	Project Themes
Cultural Heritage and Creativity	Revival of Cultural Heritage	(2024) Experiential Tourism Projects; Cultural Events and Festivities; Preservation of Cultural Heritage; Establishing Nation Institution; Preserving the Traditional Spirit (2023) Sustainable Cultural Gastronomy, Transformative Cultural Events, International Cultural Partnerships, Experiential Tourism Projects, Capitalising on Cultural Spirit
	Creating Communal Infrastructure	(2024) Creating a Cultural Company (2023) Creating Communal Infrastructures: Smart Public Buildings, Creating New Public Space
	Cultural Heritage Usage for New Creativity	(2024) Promotion of Creative Industries; Use of New Technologies; Creating New Cultural Spaces (2023) Public Street Art, Providing Easy Access to Cultural Activities, Creative Perspectives on Discovering Cities, Creating New Cultural Heritage, Creating New Cultural Industries
	Maintaining Cultural Heritage	(2024) Community Engagement; Cultural Heritage and Creativity Strategies (2023) Maintaining Cultural Heritage: Cultural Heritage and Creativity Strategies, Community Engagement, Integrating All into Cultural Heritage
Digitalisation	Facilitating Information for Specific Groups	(2024) Digital Innovation in City Guides; Digital Tours and City Exploration (2023) Digital Tours and City Exploration, Augmented Reality in Tourism, Digital Innovation in City Guides
	Collecting Information for Smart Management	Open Data for Improving Tourism; Smart Urban Management; Digital Municipal Solutions; Digital Solutions in Business
	Transformation into Digital Knowledge Sharing	Digital Access to Information; Promotion of Digital Innovations; Digtalisation in Cultural Spaces; Digital Culture and History Experience
	Innovative Mobility through Digitalisation	Smart Benches; Local Community Engagement; Knowledge and Technological Capabilities

4.2. Types of Open-Access Data of the Case Study Area Provided and Best Matched Case Studies

Building on the global insights from Stage 1, Stage 2 focuses on analysing local open-access datasets, matching these datasets with relevant best practices to inform how they can be effectively applied in the Chinatown Melbourne case study. To highlight key case studies from the ECST, the study presents five initiatives as examples of best practices, aligned with five key open datasets provided by the City of Melbourne: open-street parking, pedestrian counting, microclimate, dwelling functionality, and the Historic 3D model. Additionally, the study identifies one current pilot initiative in Melbourne's Chinatown. Although this pilot initiative does not have a specific tourism or heritage focus, presenting it as a case study allows for comparison with other examples, helping to elucidate potential smart strategies and relevant data types. The results are presented in Table 3 below, which are further discussed and analysed in the following sub-sections according to each data category.

Table 3. Key sample case studies selected from the ECST and Chinatown Melbourne.

Category of Information	Smart Parking System (Pafos)	Discovery Trails City	Smart Kalea Platform San Sebastian	Zagreb Smart City Hub	3D Reconstruction of Alcazar of Seville	Laneway Waste Management Pilot
Location	Pafos, Cyprus	Dublin, Ireland	San Sebastian, Spain	Zagreb, Croatia	Seville, Spain	Melbourne, Australia
Implementation Goal	Optimises parking management using real-time sensor data to enhance parking efficiency and reduce congestion across over 3000 parking spaces.	Interactive platform offering AR-enhanced historical and cultural trails for visitors to explore Dublin's heritage through immersive digital storytelling.	Improves energy efficiency in commercial and residential areas using smart meters, monitoring systems, and renewable energy solutions.	Integrates advanced digital infrastructure (e.g., high-speed broadband, smart sensors) to support sustainable urban development and smart applications.	Virtually recreates Seville's historic Almohad Mosque, allowing immersive exploration of its architectural features and historical significance.	Uses IoT devices and CCTV analytics to optimise waste management and improve laneway cleanliness.
Statue of the Project	In-use	In-use	In-use	In-use	In-use	Completed, now expending to other laneways
Main Source	https://smartparkingsystems.com/en/smart-parking-systems-in-pafos-cyprus/ (20 August 2024)	https://dublindiscoverytrails.ie/ (20 August 2024)	https://www.smartkalea.eus/en/smartkalea/energy-efficiency (20 August 2024)	https://english-smart-city-zagreb.hub.arcgis.com/pages/strategic-area-digital-infrastructure (20 August 2024)	https://voyagerseville.com/en/3d-reconstruction-of-the-mosque-of-seville/ (20 August 2024)	https://participate.melbourne.vic.gov.au/emerging-tech-testbed/bullens-lane (20 August 2024)
Full Datasets	1. Parking occupancy data from in-ground sensors (LoRaWAN® and BLE technology). 2. Real-time availability of parking bays. 3. Payment and usage data from the Pafos Smart Parking mobile app. 4. Geographic location and type of parking spaces (e.g., disability, short-term).	1. Digital content data (AR experiences, historical narratives). 2. Visitor interaction and engagement data from the app. 3. Geospatial data for themed trail routes (e.g., Docklands, Castleknock). 4. Pedestrian flow.	1. Energy consumption data from smart meters in residential and commercial properties. 2. Water usage and cost-saving analysis. Aggregated data on energy efficiency improvements. 3. Data on renewable energy adoption and purchasing patterns. 4. Microclimate.	1. Broadband coverage and usage data. 2. Sensor data for urban services and environmental monitoring. 3. Integrated data from smart applications (e.g., public services, mobility). 4. Spatial and dwelling analytical data.	1. Architectural and historical data of the mosque. 2. 3D spatial data for virtual modelling. 3. Digital imagery and photogrammetry data for detailed reconstructions.	1. CCTV footage and analytics data for waste disposal patterns. 2. IoT device data on bin usage and compactor operation. 3. Sensor data on blockages, waste levels, and system downtime.
Matching Data Type with the City of Melbourne	On-street parking (real-time)	Pedestrian (real-time)	Microclimate (real-time)	Dwelling functionality	3D modelling	Sensor installed in bins (real-time)

4.2.1. On-Street Parking Data

As part of its commitment to enhancing transparency and public services, the City of Melbourne has made on-street parking data openly accessible, facilitated by 6000 in-ground sensors installed throughout the city. These sensors detect vehicle movements through individual parking bays, providing information on bay availability, parking limits, and disability parking restrictions (Figure 1). The City of Melbourne also provides recommendations for developers, entrepreneurs, and the public who wish to use the open-access dataset, including improving parking efficiency, reducing time spent searching for parking, enhancing traffic flow, and lowering emissions.

From the 2023 and 2024 ECST best practices, an increasing number of projects focus on evolving traffic and parking with smart solutions. This study identifies that open-street parking data can enhance initiatives like Park Smarter (Athens and Dubrovnik), Smart Parking System (Pafos), Smart Traffic Control for Tourists and Locals (Malaga), and the First Autonomous Bus in Denmark (Aalborg). These projects involve parking and traffic

control systems where access to on-street parking data would directly enhance functionality and user experience [49]. Existing research suggests that Chinatown Melbourne's spatial layout consists of narrow main streets and open and closed laneways. Aligning with the Chinatown Action Plan 1985, the main street accommodates both pedestrians and vehicles to maintain a bustling streetscape that reflects Chinese characteristics, a concept proposed by Geng et al. (2023) as 'Chinatown characteristics'. Due to its mixed-use nature and central location, traffic and parking have been long-term issues in the area. This conflict between the original urban identity and functionality, as experienced in Chinatown Melbourne, can be effectively addressed with smart solutions through automated data collection on traffic and parking [50]. Like the best practices identified, smart parking and traffic control systems can help the precinct better manage vehicle influx, ensuring efficient traffic and parking control decisions are implemented.

Figure 1. On-street parking sensor locations at and around Chinatown Melbourne (source: Open-access data platform by the City of Melbourne).

Integrating open-access on-street parking data has the potential to greatly enhance traffic and parking management in Chinatown Melbourne. Given the precinct's narrow streets and mixed pedestrian and vehicular spaces, smart parking solutions are essential to maintaining its vibrancy and accessibility. Drawing on ECST best practices, such as the Smart Parking System in Pafos (Table 3), which uses real-time data from in-ground sensors (LoRaWAN® and BLE technology) to manage over 3000 parking spaces, Chinatown Melbourne could adopt a similar system. It provides real-time availability of parking bays, payment, and usage data via the Pafos Smart Parking mobile app and maps the geographic location and type of parking spaces, serving as an ideal model for Chinatown Melbourne to enhance its parking management.

Implementing these systems could also resolve long-standing challenges noted in the Chinatown Action Plan (1985), which stressed the importance of balancing pedestrian accessibility with vehicular movement to preserve the precinct's streetscape and cultural identity. A smart traffic management system, similar to the Park Smarter initiatives in Athens and Dubrovnik, would allow the City of Melbourne to make data-driven decisions on parking availability, pricing, and traffic routing. This could reduce congestion, particularly during peak times, by directing drivers to available parking spaces or alternative locations, ultimately reducing illegal parking and enhancing pedestrian safety. Furthermore, integrating parking data with other datasets, such as pedestrian and microclimate

data, would facilitate a more holistic approach to precinct planning, ensuring that infrastructure developments meet both vehicular and pedestrian needs. Aligning these smart solutions with the precinct's 'Chinatown characteristics' would foster a balance between heritage values and modern urban functionality, positioning Chinatown Melbourne as a model for integrating Smart Heritage practices in mixed-use urban environments.

4.2.2. Pedestrian Counting Data

Melbourne City's automated sensor network provides real-time information on pedestrian activity, which is crucial for maintaining city vibrancy and vitality [51,52]. There is a proven link between a city's economic health and safety and the convenience of pedestrian experiences [53]. The City of Melbourne uses these data to understand how people move through different areas at various times, aiding decision making and future city planning [54]. Chinatown Melbourne, centrally located within the Hoddle Grid, benefits from this data collection, with Figure 2 below showing the current locations of pedestrian counting sensors in the precinct.

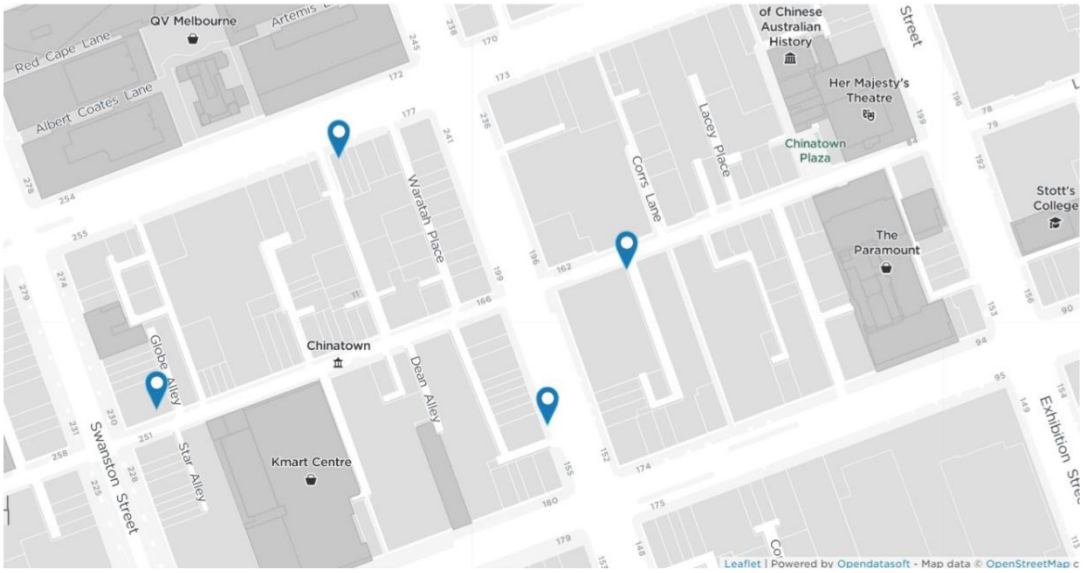

Figure 2. Pedestrian counting sensor locations at and around Chinatown Melbourne (source: open-access data platform by the City of Melbourne).

Incorporating pedestrian counting data has been a key feature of many ECST best practices relevant to Smart Heritage. One notable application is its integration with mapping and trail apps, such as A Walkable City (Barcelos), Smart Tourist Trails (Malaga), and the Discovery Trails City App (Dublin). These applications use pedestrian flow data to recommend optimal tourist routes, enhancing the visitor experience through digital visualisations and AR features [55–57]. However, for Chinatown Melbourne, where pedestrians may pass through the precinct unintentionally, categorising visitors captured by the sensor or placing sensors outside cultural centres like the Museum of Chinese Australian History to collect heritage/tourist visiting data is essential [58]. Some of the aforementioned best practices combine sensor data with visitor feedback. Similarly, for Chinatown Melbourne, pedestrian counting data should be interpreted alongside visitor feedback to enhance the visitor experience. Several ECST best practices involve urban planning, tourism, pedestrian experiences, and mobility, where pedestrian counting data offer insights towards achieving Smart Heritage goals. These projects include Repositioning Málaga as the 'City of Museums' (Malaga), Old Becomes New (Bordeaux), Generating Values for Tourists (Copenhagen), The Festival of Lights (Lyon), Understanding Local Sentiment Toward Tourism (Dublin), Data Collection and Sharing for a Better Tourism Experience (Dubrovnik), and Innovation in Mobility (San Sebastián).

Pedestrian counting data have also been a critical tool for urban planning, tourism, and mobility in various ECST projects, providing insights into achieving Smart Heritage goals. For example, initiatives such as Repositioning Málaga as the 'City of Museums', Old Becomes New (Bordeaux), and Data Collection for a Better Tourism Experience (Dubrovnik) demonstrate how pedestrian data can inform decisions on infrastructure improvements, visitor flow, and tourism strategies. In the Discovery Trails City project (Dublin), an interactive platform uses AR and historical narratives to engage visitors with Dublin's heritage, supported by pedestrian data, geospatial mapping, and visitor engagement metrics (Table 3). A similar approach could significantly enhance Chinatown Melbourne's cultural appeal by curating mobile experiences that map historical routes, highlight landmarks, and guide visitors to hidden gems within the precinct.

Given Chinatown's central location within the Hoddle Grid, pedestrian data could also inform infrastructure upgrades, such as installing wayfinding signage or expanding pedestrian pathways. However, a current limitation is the general nature of foot traffic data, which may not capture heritage-specific visitors. Addressing this by placing sensors near entry points and cultural sites would enable more targeted data collection. Additionally, combining these quantitative data with qualitative visitor feedback, as done in the Bordeaux and Dubrovnik projects, would provide a more comprehensive view of visitor experiences and preferences. By integrating these insights, Chinatown Melbourne can create a vibrant and culturally significant precinct that responds to both heritage preservation and contemporary urban needs.

4.2.3. Microclimate Data

Melbourne City currently employs a network of sensors to collect microclimate data, updated every fifteen minutes. These sensors monitor ambient air temperature, relative humidity, atmospheric pressure, wind speed and direction, gust wind speed, particulate matter 2.5 and 10, and noise levels. However, a key limitation for Chinatown Melbourne is that the nearest sensor is two blocks away and does not accurately reflect the microclimate of the enclave (Figure 3).

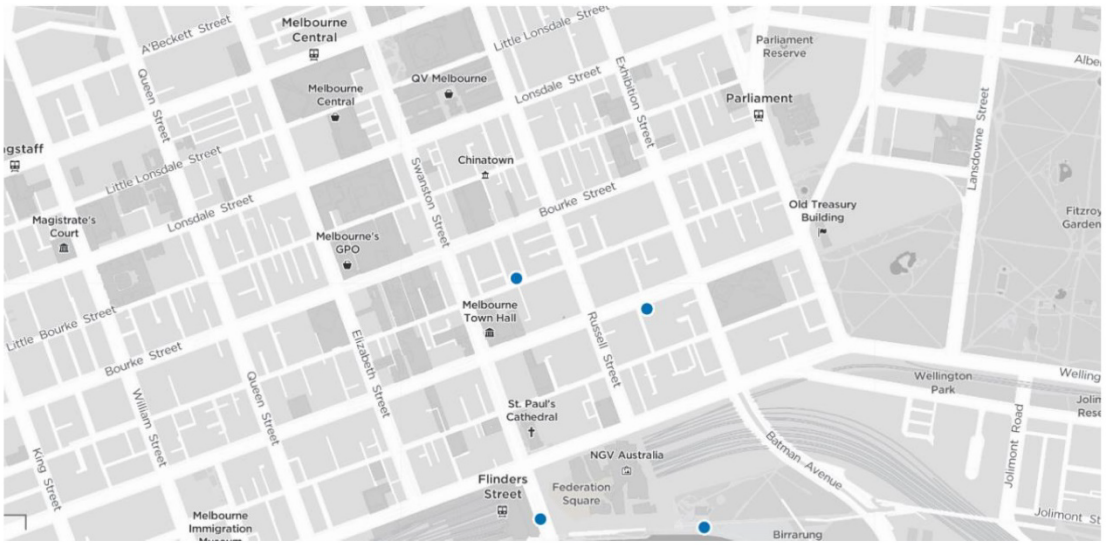

Figure 3. Microclimate sensor locations near Chinatown Melbourne (source: open-access data platform by the City of Melbourne).

The following ECST best practices demonstrate advanced strategies in Smart Heritage leveraging microclimate data, including City Management and Organisation (Padua), Smart Port for Integrated Urban Management (Aalborg), Smart Gateway for Smart Solutions and Solving Challenges (Cork), The Integrated Connectivity System (Palermo), Smart Kalea Platform, Data for City Management (San Sebastián), Smart Stations Project (Antalya), and Innovation in Mobility (San Sebastián). These projects focus on urban planning, city management, and outdoor events, and they use microclimate insights to enhance activity planning, infrastructure, and service implementation. While current studies predominantly focus on urban management phases involving data collection and processing, recommendations include implementing microclimate sensors within the precinct to gather data for future sustainable urban heritage planning. A fully integrated Smart Heritage precinct should gather and process data and then respond with informed decision making, making microclimate data pivotal for the precinct's environmental sustainability. Beyond ECST, existing studies explore smart heating, cooling, shading, and acoustic devices, offering future avenues for Smart Heritage research and application.

The best practices selected from other cities can be adapted to address challenges in Chinatown Melbourne, such as data-driven urban management, pedestrian safety, and environmental monitoring. For instance, the Smart Kalea Platform in San Sebastián is a smart urban project that enhances energy efficiency in commercial and residential areas using smart meters, renewable energy solutions, and monitoring systems. While originally developed in a different urban context, this project's strategies, such as energy consumption data, water usage analysis, and renewable energy adoption, can be adapted to improve resource efficiency in Chinatown Melbourne. Additionally, San Sebastián's integration of microclimate data to monitor pedestrian and vehicle flows is particularly relevant to Chinatown's need for better management of pedestrian density and parking congestion.

The relevance of these best practices lies in their adaptability to Chinatown's compact urban form, high visitor turnover, and unique cultural landscape. Incorporating San Sebastián's Smart Kalea Platform approach could help Chinatown implement smart energy management and microclimate monitoring systems, supporting sustainability and operational efficiency. Adopting these advanced strategies would not only enhance the precinct's resilience but also position it as a forward-thinking heritage site that integrates global Smart Heritage practices in a local context. This would ensure Chinatown's continued growth as a vibrant, culturally significant destination while benefiting from sustainable, data-driven urban management.

4.2.4. Dwelling Functionalities Data and Building Information Data

Currently, the City of Melbourne provides data on residential dwellings updated annually, based on the from the City of Melbourne's property rates database. This dataset categorises residential apartments, houses/townhouses, and student accommodations using a simplified classification schema. However, it does not extend to other functionalities. Figure 4 below records residential dwelling data, consistent with a previous study by Geng et al. (2022) using field observations [3]. Similarly, building information is available through the Census of Land Use and Employment (CLUE) dataset, covering the years 2002 to 2022, though updates for 2023 and 2024 are not yet included. This dataset includes building attributes such as location, construction year, refurbishment year, number of above-ground floors, predominant space use, bicycle/shower facilities, and accessibility features, although though accessibility data are primarily for internal City of Melbourne use. Few ECST projects directly address dwelling functionalities in their outlines, as the focus is primarily on heritage and cultural usage with tourism as a backdrop. However, some ECST best projects integrate urban and municipal services, particularly in tourism cities. Geng et al. (2023) notes that prior to 2023, most ECST projects were at a heritage site scale rather than city-wide implementations [3]. A shift towards city-wide implementation is evident in the 2023 and 2024 ECST best practices. This study suggests that dwelling functionality data could be effectively utilised in city-scale heritage projects or urban heritage precincts where

the distinction between heritage sites and urban settings is blurred. Sample best practices such as the Integrated Connectivity System (Palermo), Safety Circle Project (Antalya), Innovative Digital Municipal Solutions (Tetovo), Zagreb Smart City Hub (Zagreb), A Smart City Vocation (Palermo), Lviv IT Cluster (Lviv), and Smart Stations Project (Antalya) involve aspects of urban planning, Smart City initiatives, city management, and innovation in municipal services. Dwelling functionality data can provide insights into housing conditions, occupancy rates, and residential needs, contributing to more effective planning and resource allocation. Although current best practices do not fully utilise this potential, field observations indicate that Chinatown Melbourne predominantly consists of dwellings used for restaurants or retail, potentially leading to an identity crisis as an urban heritage precinct [4,5,59–61]. Open-access dwelling functionality data could accurately record dwelling functionalities to assist in re-vitalising the precinct's identity.

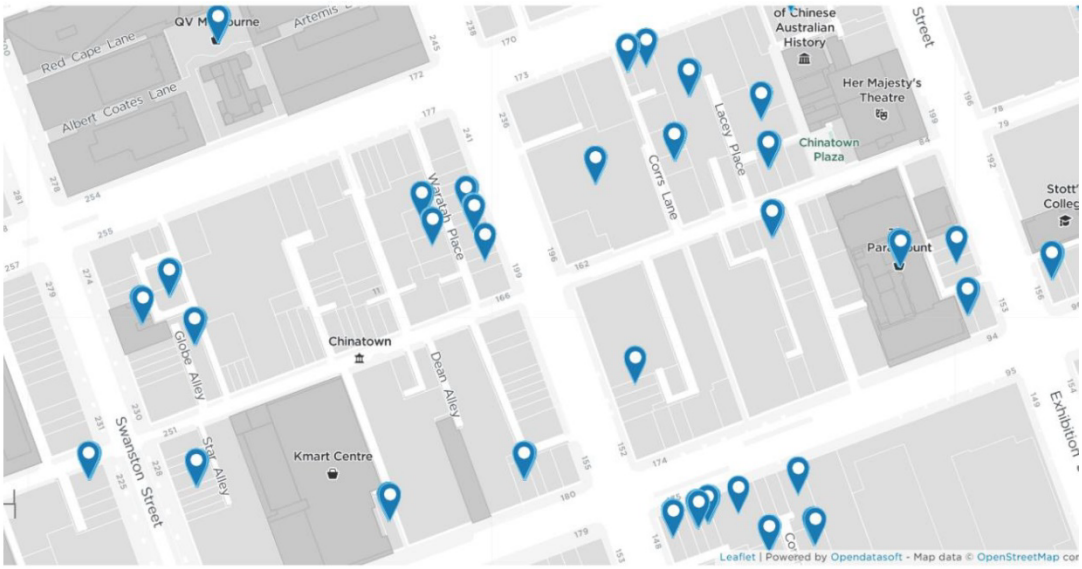

Figure 4. Residential dwelling locations in Chinatown Melbourne (source: open-access data platform by the City of Melbourne).

Using residential dwelling data presents an opportunity to enhance the urban heritage management of Chinatown Melbourne by providing insights into housing conditions, occupancy rates, and functional use patterns. Currently, the data collected by the City of Melbourne focus primarily on categorising residential types, without accounting for mixed-use developments or changes in property usage over time. Drawing on ECST best practices, such as the Integrated Connectivity System in Palermo and the Zagreb Smart City Hub in Croatia, a more comprehensive approach to data collection could better support urban planning strategies that balance residential needs with heritage preservation. The Zagreb Smart City Hub, for example, integrates digital infrastructure, including high-speed broadband and smart sensors, to gather spatial and dwelling data, monitor urban services, and support environmental management. Adapting this model in Chinatown Melbourne would enable more precise tracking of property use changes, particularly in residential spaces repurposed for commercial activity, providing a clearer understanding of how these shifts impact the precinct's heritage value.

Integrating dwelling functionality data into broader Smart City initiatives could also improve resource allocation and infrastructure planning in Chinatown Melbourne. Projects like the Safety Circle Project (Antalya) and Innovative Digital Municipal Solutions (Tetovo) show the potential for combining residential data with urban datasets to address safety, accessibility, and community wellbeing. Similarly, for Chinatown Melbourne, a more detailed understanding of residential dynamics could guide policies aimed at revitalising the precinct's heritage identity, ensuring that shifts in dwelling use do not detract from its

cultural significance. By capturing a more nuanced picture of property use and residential patterns, the City of Melbourne can make urban planning decisions that align with both the preservation of Chinatown's heritage and the needs of its residents. This would create a sustainable model for managing heritage precincts, bridging the gap between historical conservation and modern urban development.

4.2.5. Historic 3D Model of the Precinct Data

Based on Mahlstedt's 1895 image, a member of the City Council initiates a workflow to generate historic 3D models of Melbourne using an FME workbench to create 3D tiles comprising surface; Mahlstedt image; and extruded historic building footprints, including Chinatown Melbourne. Currently, these datasets and models are not publicly accessible, remaining in the documentation and digitisation stages (Figure 5). From the ECST, best practices engage in 3D modelling with AR and VR experiences, such as AR, VR, and 3D Reconstruction of the Alcazar of Seville (Seville) and AR and VR Experiences (Copenhagen). There is a noticeable shift in focus from best practices prior to 2023 to those in 2023 and 2024, where heritage projects move beyond digitisation to emphasise AR and VR experiences.

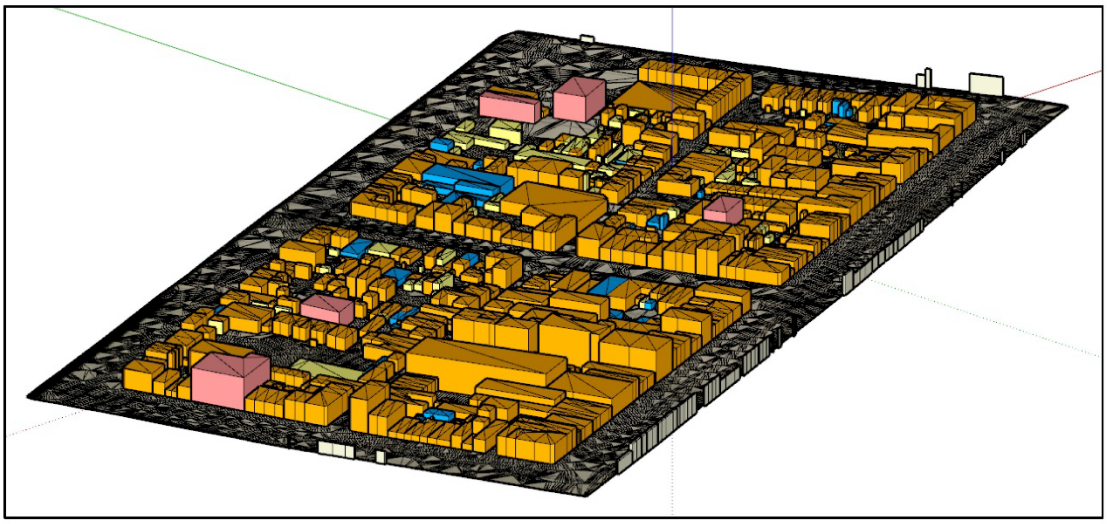

Figure 5. The 3D model data of Chinatown Melbourne based on Mahlsted's historical 1895 map (source: city data, the City of Melbourne).

Some best practices indirectly involve 3D modelling, integrating concepts with 3D models, such as A Walkable City (Barcelos), Smart Tourist Trails (Malaga), Old Becomes New (Bordeaux), Rollindagando—Cultural Mapping of The Old Town (Genoa), Repositioning Málaga as the 'City of Museums' (Malaga), Generating Values for Tourists (Copenhagen), Metrominuto Tour and Maps (Genoa), and Smart App for Infos to The Historical UNESCO Park (Pafos). These projects span urban planning, tourism, cultural heritage, Smart City initiatives, and digital innovations where a 3D model of the precinct offers valuable spatial context and visualisation for planning, management, and enhanced visitor experiences [62]. This study notes that the current use of 3D modelling for exhibition and documentation purposes focuses on heritage digitisation, lacking autonomous applications. However, recent ECST best practices increasingly use 3D modelling with autonomous output capabilities focusing on historic data and current spatial massing and modelling. Beyond heritage documentation, 3D modelling data can be applied to ventilation and shading testing as well as integrated with other open-access datasets such as microclimate data. Future studies are encouraged to explore these applications further to enhance Smart Heritage transformations in Chinatown Melbourne and other urban heritage precincts.

The ongoing digitisation of Melbourne's historic 3D models, using the Mahlstedt 1895 image and FME workbench, marks an important step in digitally preserving the city's heritage. By generating 3D tiles that include surface data, historical imagery, and

extruded building footprints, the project offers a valuable spatial reference for the historical context of Chinatown. However, the current focus on documentation limits its potential, as these models are not yet accessible to the public and remain underutilised for broader heritage applications. Drawing from ECST best practices, such as the 3D Reconstruction of the Alcazar of Seville, which uses architectural and historical data to create immersive experiences, Chinatown's 3D modelling initiative could greatly benefit from expanding its scope.

Incorporating AR and VR technologies into Chinatown Melbourne's 3D modelling project would transform it from static documentation into an interactive experience. Visitors could virtually explore historic streetscapes and buildings, enhancing their connection to the precinct's heritage. Additionally, combining 3D models with other datasets, like microclimate data, could support innovative applications such as environmental simulations for shading and ventilation. By aligning with global best practices, Chinatown's heritage management could shift from a passive archival role to an active contributor to urban planning and public engagement. Moving beyond documentation to interactive and functional outputs would help Chinatown Melbourne leverage its historical assets to create a forward-thinking Smart Heritage precinct, balancing preservation with future development.

4.3. Data-Driven Approaches for Smart Heritage Implementation in Chinatown Melbourne

Building on insights from global best practices and local data analysis, Stage 3 synthesises these findings to develop data-driven strategies for Chinatown Melbourne's Smart Heritage initiatives, ensuring a tailored approach that addresses both cultural preservation and practical urban needs. To address the third research question, the study consolidates findings from previous stages by aligning available open-access data with relevant strategies for the City of Melbourne to support Smart Heritage implementations (Table 4). These findings are derived from case studies and the literature, as discussed in Section 4.2, where the matched case studies are detailed. In Chinatown Melbourne, on-street parking data enable real-time monitoring, facilitating traffic management systems that reduce congestion and improve accessibility, particularly during peak tourist periods. Efficient parking management will minimise disruptions to pedestrian areas, making the precinct more welcoming to visitors. Pedestrian counting data provide valuable insights into visitor movement patterns. These data can guide the development of infrastructure like walkways and signage, improving foot traffic flow while ensuring key cultural sites remain accessible without overcrowding. Managing visitor movement effectively enhances the overall visitor experience. Microclimate data help maintain a comfortable environment by monitoring temperature, humidity, and air quality. This information can inform urban planning decisions, such as where to place shading or seating, ensuring the precinct remains comfortable for visitors throughout the year. The 3D historical models offer opportunities to create immersive educational experiences. These models can be used in AR/VR applications, allowing visitors to explore Chinatown's architectural history interactively and enhancing the precinct's educational and cultural offerings. Dwelling functionality data identify underutilised spaces that can be repurposed for cultural activities like exhibitions or community hubs. This revitalisation fosters greater cultural engagement and strengthens Chinatown's identity as a dynamic cultural and Smart Heritage destination. The strategic use of these datasets will optimise visitor access, improve sustainability, enhance cultural engagement, and revitalise underused spaces, all contributing to Chinatown Melbourne's role as a vibrant cultural and Smart Heritage precinct.

Table 4. Summary of Smart Heritage strategies and expected outcomes using open-access data in Chinatown Melbourne.

Available Open-Access Data Type	Strategy for Chinatown Melbourne as a Smart Heritage Precinct	Potential Outcomes
On-Street Parking Data	Implement real-time parking availability and traffic control systems using smart sensors	Reduced congestion, improved visitor access, enhanced traffic efficiency
Pedestrian Counting Data	Improve foot traffic management and develop infrastructure (e.g., walkways, signage) based on crowd flow data	Improved visitor experience, smoother movement within the precinct, targeted infrastructure development
Microclimate Data	Use environmental monitoring (e.g., temperature, humidity) to inform sustainable urban planning and comfort measures	Enhanced sustainability, better visitor comfort, climate-adaptive infrastructure
Dwelling Functionality Data	Repurpose underutilised spaces for cultural and community activities based on occupancy and usage data	Revitalised precinct identity, increased cultural engagement, flexible space use for events and exhibitions
3D Historical Models	Create AR/VR experiences showcasing Chinatown's historical architecture for educational and tourism purposes	Interactive visitor experiences, strengthened heritage education, immersive heritage interpretation

5. Discussion

This discussion examines how the findings from the results integrate ECST Smart Heritage best practices with local data insights to inform effective strategies for Chinatown Melbourne and their further implications. It highlights the challenges and opportunities for enhancing cultural engagement and sustainability while proposing actionable approaches to revitalise the precinct's identity and address key challenges.

5.1. ECST Best Practices—Current Trends

A prominent trend in recent ECST best practices, as concluded from this study and Geng et al. (2023) on previous best practices, is the integration of smart technologies. Recent ECST best practices emphasise moving beyond mere digitisation to incorporate advanced technologies such as AI, IoT, and big data. These technologies enable autonomous capabilities that enhance the management and conservation of cultural heritage sites. Current frontier research explores how AI can enhance the overall experience and management of heritage sites. From an urban heritage perspective, IoT and AI can effectively link heritage sites with the surrounding city context. Another notable shift is the emphasis on enhancing visitor experience and engagement through Smart Heritage interventions. ECST best practices increasingly focus on creating interactive and personalised experiences for visitors, leveraging AR, VR, and smart tourist trails to provide immersive heritage experiences.

Environmental sustainability remains critical in Smart Heritage best practices. Projects often integrate smart solutions for monitoring and managing environmental impacts, including smart traffic control systems, microclimate analysis, and energy-efficient technologies, utilising relevant open-access data. Aligned with findings from Geng et al. (2023), there is a clear trend towards integrating Smart Heritage solutions at the city scale, moving beyond individual heritage sites or stand-alone applications. Many projects inherit Smart City initiatives, integrating heritage projects with the surrounding city's needs and environment, encompassing urban planning, mobility, and city management systems.

While European case studies like the 3D Reconstruction of the Alcazar of Seville and AR and VR Experiences in Copenhagen highlight large-scale smart heritage and tourism projects, Chinatown Melbourne's pilot project is a more localised effort with a different focus. The European projects pivot around advanced technologies and integrated datasets to provide immersive experiences aimed at attracting international tourists and promoting cultural tourism. In contrast, the Chinatown project focuses on resolving the precinct's identity crisis through digital curation and community-oriented heritage management

rather than tourism. This difference in scope underscores a gap in Chinatown's current heritage strategy—there is significant potential to expand the use of smart technologies beyond local interpretation to include elements of smart tourism.

Expanding the Chinatown Melbourne project to incorporate components of successful European models could greatly enhance the precinct's appeal. By integrating 3D visualisations with AR-based historical narratives, the project could offer more immersive and educational experiences for visitors [63,64]. This would not only attract a broader audience but also align Chinatown with global best practices in smart heritage and tourism. Additionally, leveraging smart technologies for personalised visitor experiences and combining them with data-driven environmental sustainability measures could transform Chinatown into a model for integrating local heritage with cutting-edge smart city solutions. This expansion would bridge the current gap between community-oriented heritage management and the broader potential for smart tourism, positioning Chinatown as both a local cultural hub and a forward-thinking smart heritage precinct.

5.2. Possible Smart Heritage Solutions for Chinatown Melbourne

Chinatown Melbourne, one of Australia's oldest ethnic enclaves, offers a unique opportunity to showcase its rich history and cultural significance through advanced digital and smart technologies. The application of data-driven Smart Heritage strategies not only addresses logistical issues such as traffic management but also provides a pathway for revitalising Chinatown's cultural identity. By repurposing underutilised spaces for community activities, as highlighted in Section 4.3, the precinct can strengthen its position as a cultural hub, fostering deeper engagement with both locals and visitors. As highlighted in the results, the precinct's identity crisis, driven by a shift away from its residential and community roots towards a more commercial focus, presents both challenges and opportunities. To address this, use of smart technologies and digital platforms could play a critical role in recontextualising the precinct's cultural significance [65]. Utilising 3D modelling to enhance digital curation and interpretation could effectively attract more visitors and educate the public about its heritage significance. However, this is linked to the precinct's identity issue, where culturally used dwellings are limited. Currently, the precinct has only one museum, with most visitors attracted to the dining scene. Implementing interactive heritage trails and AR-based historical narratives offers not only an opportunity to educate visitors but also to transform Chinatown into a living museum [66]. By integrating open-access data with urban planning strategies, Chinatown Melbourne can achieve a dual objective of rejuvenating the precinct while preserving its cultural heritage. The alignment of real-time data with urban sustainability efforts, as explored in Section 4.3, demonstrates how smart technologies can support both immediate operational improvements and long-term cultural preservation. By creating experiences that emphasise both the tangible and intangible heritage, such as the lived experiences of early Chinese migrants, Chinatown could address the identity crisis by reconnecting with its cultural roots. Moreover, integrating these digital tools with existing cultural events like the Moon Lantern Festival could foster a deeper connection between the community and its history, expanding the precinct's appeal beyond dining to a broader cultural experience [5].

As noted in the results by Geng et al. (2023), the Chinese community no longer resides in the precinct, primarily comprising business owners serving diverse cultural backgrounds, contributing to the precinct's identity crisis. Increasing cultural attractions could enhance the precinct's tourist appeal, while open-access data on dwelling functionalities could facilitate decision-making processes. While the results identified the potential of using this data to develop new cultural attractions, the discussion must consider how these initiatives can be tied to broader urban planning and cultural preservation goals. For instance, transforming underutilised commercial spaces into pop-up museums, community centres, or cultural galleries would not only revitalise the area but also create spaces for storytelling and cultural exchange [67,68]. These projects, integrated with smart technologies like AI-

guided tours or interactive displays, could become anchors for re-establishing Chinatown as a place of cultural significance rather than purely a commercial zone [69].

Another area for improvement through open-access data and Smart interventions is the precinct's traffic. Given its unique spatial layout with narrow streets and laneways within the cityscape, Chinatown Melbourne could significantly benefit from smart parking and traffic control systems. Beyond alleviating congestion, smart traffic solutions could help preserve the precinct's vibrant atmosphere by making it more accessible and safer for pedestrians. Drawing on global best practices, such as those seen in Málaga and Athens, implementing IoT sensors and real-time traffic management could also support Chinatown's heritage goals by guiding visitors through key historical landmarks and less congested pathways, ensuring that visitors engage with the precinct's cultural heritage as part of their overall experience [35]. These systems could alleviate long-standing traffic and parking issues while preserving the precinct's vibrant atmosphere, as outlined in the Chinatown Action Plan 1985, effectively dispersing foot traffic and highlighting lesser-known cultural landmarks.

5.3. Further Implications

The successful implementation of digital and smart heritage solutions in Chinatown Melbourne hinges on sensitivity to the precinct's unique socio-cultural dynamics and ensuring broader community concerns regarding heritage authenticity are addressed [70,71]. These technologies, such as 3D modelling, AR, VR, AI, and autonomous data analytics, must be deployed in a participatory framework that prioritises the agency of the local community [72,73]. Without this involvement, there is a risk of commodifying or oversimplifying the precinct's cultural identity. Collaborating with local stakeholders, business owners, cultural organisations, and the wider Chinese Australian community is crucial to ensure that these digital projects resonate authentically and contribute to a deeper understanding of the precinct's heritage [5].

A Community Heritage Advisory Group could serve as a structured mechanism for incorporating diverse community perspectives into the design and execution of digital heritage projects. This group would play a critical role in curating content, advising on interpretation strategies, and ensuring alignment between new technologies and existing cultural narratives [74]. Through co-design workshops and focus groups, community members could contribute oral histories, personal narratives, and artefacts for inclusion in 3D reconstructions or AR heritage trails, reframing the precinct's identity to reflect the lived experiences of Chinese Australians across generations [74,75]. Partnerships with educational institutions and cultural organisations could amplify the impact of these digital heritage initiatives. Educational programs using digital tools like VR and 3D modelling could engage students and visitors alike with Chinatown's complex history, offering interactive learning experiences [60]. For example, students could digitally reconstruct historic buildings, learning both architectural techniques and the socio-cultural dynamics that shaped the precinct. A Living Heritage Archive could further support this by collecting and digitising community-contributed materials with GIS, creating an evolving resource that reflects Chinatown's diverse narratives [76,77]. This archive could be an asset for future research, heritage programming, and policy development.

In addition to these educational strategies, public engagement could be enhanced through interactive digital kiosks installed throughout the precinct. These kiosks could disseminate historical information while allowing visitors to leave reflections and engage dynamically with the content [78]. Real-time feedback systems would offer valuable insights into visitor interests, helping to shape future heritage programming and bridging the gap between static heritage presentations and community-driven narratives [79]. Data-driven urban planning is also essential for balancing heritage conservation with commercial and infrastructural needs. Open-access data could inform adaptive reuse strategies for underutilised spaces, revitalising the precinct with new cultural centres, creative hubs, or community spaces that reflect Chinatown's evolving identity. Additionally, pedestrian

flow and mobility data could improve walkability and accessibility, ensuring the precinct remains inclusive and safe for all visitors [80]. These data-driven interventions would not only address functional challenges but also enhance Chinatown's social and cultural vitality, reinforcing its role as a living, dynamic heritage precinct. Ultimately, these strategies, grounded in community engagement, inclusive representation, and data-driven urban planning, would position Chinatown Melbourne as a leading example of smart heritage interventions that go beyond preservation. By transforming the precinct into an interactive, community-driven space, these initiatives would ensure that heritage is actively experienced, interpreted, and reshaped for future generations. This integrated approach would foster cultural resilience, promote social cohesion, and align Chinatown Melbourne with broader trends in sustainable urban development.

6. Conclusions

This study examines the available data for Chinatown Melbourne, largely open-access, and explores its application within the Smart Heritage context. By using Chinatown Melbourne as a case study, the findings provide an overview of key data resources, on-street parking, pedestrian counting, microclimate, dwelling functionalities, and 3D models, and they connect them with relevant ECST best practices. This study identified several key strategies to transition Chinatown to a Smart Heritage precinct and improve visitor engagement, such as smart traffic control systems, AR/VR integration for heritage curation and education, and data-driven urban management. Notably, trends in recent ECST projects highlight a shift from digital to autonomous technologies and from small-scale to city-wide implementations. By aligning these Smart Heritage best practices with Chinatown Melbourne's unique data and urban characteristics, the highlighted data-driven strategies, such as real-time parking monitoring and pedestrian flow management, are crucial for revitalising the precinct and enhancing the visitor experience.

Furthermore, the findings directly address the research questions by demonstrating how open-access data can be leveraged to implement Smart Heritage strategies, promote the revitalisation of underutilised spaces, and enhance cultural engagement in Chinatown Melbourne. Engaging local stakeholders and the Chinese Australian community is vital for maintaining the precinct's cultural integrity and ensuring that digital heritage solutions reflect authentic cultural narratives.

While this study provides valuable insights, certain limitations should be acknowledged. The reliance on open-access datasets meant that some aspects of heritage management, particularly those requiring more granular spatial data, could not be fully explored. Additionally, as the study focused primarily on Chinatown Melbourne, generalising these findings to other heritage sites will require further comparative research. Addressing these limitations in future studies through expanded datasets, additional global case studies, and increased institutional collaboration could significantly enhance the scope and applicability of smart heritage strategies. Future research could focus on integrating autonomous technologies and expanding data-driven strategies to other urban heritage precincts, as well as understanding the role of stakeholders and investigating funding.

This study identified several current constraints for the precinct's use of open-access data, including the lack of localised microclimate sensors and the need for better categorisation of pedestrian data. A collaborative approach will be essential for addressing these challenges. Based on this study's findings that demystify Smart Heritage through practical applications and the use of open-access data, key recommendations for future research include:

- Comparing Smart Heritage projects from the ECST with other global initiatives.
- Elucidating potential Smart Heritage applications for other urban heritage precincts using the transferable methodology from this study.
- Discussing the roles of stakeholders in Smart Heritage applications.
- Analysing funding mechanisms for Smart Heritage transformations.

Overall, this study offers valuable insights for researchers and policymakers, providing a framework for linking open-access data with practical Smart Heritage applications. The strategies highlighted in the results, derived from the integration of specific datasets, present actionable solutions that can support sustainable, community-driven heritage management in Chinatown Melbourne and serve as a model for other urban precincts. By connecting the findings across its progressive stages, this study demonstrates how global best practices inform local data strategies and ultimately shape actionable strategies for Chinatown Melbourne, reinforcing the logical progression from theory to practice in Smart Heritage implementation.

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Appendix A

Table A1. Best practices in the 2023 and 2024 ECST under the categories of 'cultural heritage and creativity' and 'digitalisation' relevant to Smart Heritage.

Best Practice Category in the ECST 2024	Subcategory	Project
Cultural Heritage and Creativity		
Cultural Heritage Usage for New Creativity	Promotion Of Creative Industries Use Of New Technologies	Chroma Light Show, Amiens The 'Lighting for Genoa' Project, Genoa
	Creating New Cultural Spaces	A Walkable City, Barcelos
	Non-Specified Subcategory Prior 2023	A Glimpse into A Genius' Mind, Copenhagen A Cultural Platform for All, Copenhagen Reinventing Sauna Culture, Helsinki Repositioning Málaga as the 'City of Museums', Malaga Smart Tourist Trails, Malaga
Creating Communal Infrastructures (2023 specific)	Non-Specified Subcategory Prior 2023	Experiencing Athens like a Local, Athens Public Library, Helsinki
Cultural Heritage Usage for New Creativity (2023 specific)	Non-Specified Subcategory Prior 2023	Old Becomes New, Bordeaux Generating Values for Tourists, Copenhagen A Chatbot Giving Guided Tours, Copenhagen The Festival of Lights, Lyon

Table A1. *Cont.*

Best Practice Category in the ECST 2024	Subcategory	Project
Digitalisation		
Facilitating Information for Specific Groups	Digital Innovation in City Guides	Technology-Enabled Tourist Information, Cork The Bremerhaven guide App, Bremerhaven The Visitgenoa App, Genoa 'Gdynia City Guide' Website and App as a Comprehensive Guide, Gdynia 'Tomis' Tablets as An Information Panel for Public Use, Matosinhos Making Suggestions to Visitors Via 'Tpnp Tomi Go Matosinhos' App, Matosinhos
	Digital Tours and City Exploration	Digital Innovation for an Enhanced Tourism Experience, Odense Digital Applications, Parma Our Destination Online, Helsingborg Detect Aarhus App, Aarhus Metrominuto Tour and Maps, Genoa Rollindagando (Cultural Mapping of The Old Town), Genoa Smart App for Infos to The Historical Unesco Park, Pafos World Heritage App and Portal, Seville
	Augmented Reality in Tourism	Augmented Reality of Zeugma Ancient City, Gaziantep Augmented Reality Routes, Gijón 'Tourist Lublin' App and AR, Lublin Myth Of Aphrodite App and AR Experience, Pafos AR, VR, and 3D Reconstruction of the Alcazar of Seville, Seville
Collecting Information for Smart Management	Open Data for Improving Tourism	Gijón Open Portal, Gijón Understanding Local Sentiment Toward Tourism, Dublin 'Istanbul Is Yours' App, Istanbul
	Smart Urban Management	Digital Strategy 2017–2030, Thessaloniki City Management and Organisation, Padua Smart Port for Integrated Urban Management, Aalborg Smart Gateway for Smart Solutions and Solving Challenges, Cork The Integrated Connectivity System, Palermo Smart Kalea Platform, Data for City Management, San Sebastián
	Public Safety Through Digital Solutions	Safety Circle Project, Antalya
	Digital Municipal Solutions	Innovative Digital Municipal Solutions, Tetovo
	Open Data for Improving Tourism	Destination Hub. Ruhr, Essen Fiware, Seville The Realisation of the Taranto Ecosystem Platform, Taranto Zagreb Smart City Hub, Zagreb
	AI In Smart Tourism	'Virtual Clerk' as an Artificial Intelligence Tool, Gdynia
	Digital Solutions in Business	Digital Training for Private Businesses, San Sebastián:
	Non-Specified Subcategory Prior 2023	Park Smarter, Athens Park Smarter, Dubrovnik Data Collection and Sharing for A Better Tourism Experience, Dubrovnik

Table A1. *Cont.*

Best Practice Category in the ECST 2024	Subcategory	Project
Transformation into Digital Knowledge Sharing	Digital Access to Information	'Trafiku Urban' Mobile App, Prishtina Promotion of Digital Applications, Gaziantep Culture in One Click, Saint-Denis A Smart City Vocation, Palermo
	Promotion Of Digital Innovations	Lviv It Cluster, Lviv Klaipeda University, Klaipeda
	Digitalisation In Cultural Spaces	'City Memory Museum', Eskisehir
	Digital Culture and History Experience	Discovery Trails City App, Dublin Essen 1887, Essen Technology Developments, Helsingborg
Innovative Mobility through Digitalisation	Smart Benches	City-wide Free Wifi, Iasi
	Local Community Engagement	'Engage Skopje' Platform, Skopje
	Knowledge And Technological Capabilities	Innovation In Mobility, San Sebastián
	Autonomous Driving Public Transport	First Autonomous Bus in Denmark, Aalborg
	Smart Bus Stops	Smart Stations Project, Antalya
	Smart Parking	Smart Parking System, Pafos
Physical and Psychological Accessibility Through Innovation	Non-Specified Subcategory Prior 2023	Apps to Experience History or Sights, Athens, Bordeaux, Copenhagen AR and VR Experiences, Copenhagen Virtual Reality Programme, Helsinki # Myhelsinki, Helsinki Understanding Visitors via Elaborate Data, Lyon, Malaga Smart Traffic Control for Tourists and Locals, Malaga

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7.5 Exploring the Use of Open Access Data in Smart Heritage – Using Chinatown Melbourne as a Case Study

Exploring the Use of Open Access Data in Smart Heritage – Using Chinatown Melbourne as a Case Study

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Chapter 8 Conclusion

8.1 Research Progress and Addressing the Aim

The chapters of this thesis build upon one another to form a comprehensive exploration of Chinatown Melbourne's urban identity and the potential for implementing Smart Heritage to enhance cultural sustainability. Following the introduction to key concepts and literature in Chapter 1, Chapter 2 reviews existing frameworks, revealing gaps in how urban identity and spatial attributes are currently assessed. This sets the background for the case study in Chapter 3, which examines Chinatown Melbourne's urban history, while Chapter 4 further investigates its spatial characteristics, presenting an in-depth spatial analysis of the precinct. Building on this understanding, Chapter 5 critiques heritage assessment frameworks, identifying the need for adaptations to better reflect the identity of post-pandemic urban heritage sites. Chapter 6 explores Smart Heritage frameworks, showcasing case studies that integrate technology with heritage conservation. Finally, Chapter 7 synthesises and applies these insights to Chinatown Melbourne, assessing the feasibility of Smart Heritage implementation through stakeholder engagement and analysis of open-access data. This logical progression of chapters ensures a coherent investigation into how the preservation and enhancement of urban identity can be achieved through both heritage frameworks and potential smart innovations.

This thesis set out to explore how urban identity is mapped within heritage precincts and how Smart Heritage strategies can enhance cultural sustainability, using Chinatown Melbourne as a case study. This research integrates spatial analysis, heritage frameworks, and Smart Heritage technologies to provide a comprehensive understanding of their interactive roles in preserving and enhancing urban precincts' cultural identities.

The first research aim is to provide an overview of Chinatown Melbourne from an urban heritage perspective, which was addressed in Chapter 3. This chapter analysed the precinct's historical development and urban characteristics, revealing how both top-down interventions by the City Council and bottom-up community-driven initiatives have shaped Chinatown's identity. It highlighted the tensions between imposed identity shifts and the cultural pursuits of the local community, which have affected the preservation and transformation of the precinct's heritage identity.

The second aim was fulfilled in Chapter 4, which investigated the spatial qualities of Chinatown Melbourne. Chapter 4 examined key spatial features such as the street network, visibility relationships, and laneway system. The chapter also demonstrated how these spatial characteristics contribute to Chinatown's unique urban identity. Despite challenges like low spatial intelligibility, the research revealed that these spatial features enhance the precinct's distinct sense of place, enriching the visitor experience.

The third aim, to explore how heritage assessment frameworks can be adapted in the post-pandemic context, was addressed in Chapter 5. This chapter critiqued existing frameworks for their neglect of spatial elements and intangible cultural values. It proposed a thematic approach that integrates both tangible and intangible aspects, offering a more comprehensive framework for heritage conservation, particularly in response to the challenges posed by the COVID-19 pandemic. This adaptation ensures that heritage frameworks remain relevant in reflecting the evolving identity of urban precincts like Chinatown Melbourne.

The fourth research aim was explored in Chapter 6, which scrutinised the role of identity within current Smart Heritage frameworks. Chapter 6 investigated best practices in Smart Heritage and demonstrated how digital technologies—such as IoT, AI, and big data—can be leveraged to support cultural sustainability. However, it also highlighted gaps in current

frameworks, particularly in how they fail to fully incorporate local identity-building. The findings called for more identity-centred Smart Heritage strategies that actively engage local communities and stakeholders.

Chapters 6 and 7 address the fifth research aim, assessing available open-access data and strategies relevant to the case study. Together the two chapters explored how open-access datasets, such as pedestrian traffic and environmental monitoring, can be used to inform Smart Heritage strategies. The research showed that such data is critical for enabling adaptive and responsive heritage management, helping align local strategies with global best practices for urban heritage conservation.

The final aim is to evaluate how Smart Heritage can influence an urban heritage precinct's identity and scrutinise the enablers and challenges of such implementation. This was synthesised in Chapter 7, which engaged key stakeholders, including representatives from the City Council of Melbourne and the Chinatown community, to assess the feasibility of implementing Smart Heritage strategies in the precinct. The findings highlighted the importance of stakeholder engagement in ensuring that technological solutions are aligned with the cultural values and needs of the community. Challenges such as securing sustainable funding, technical expertise, and balancing innovation with preservation were identified as key factors in determining the success of Smart Heritage implementations.

Overall, this thesis addressed its research aims by demonstrating how urban identity can be preserved and enhanced through the integration of spatial analysis, heritage assessment frameworks, and Smart Heritage technologies. The research provides valuable insights into how cultural sustainability can be achieved in urban heritage precincts, offering a scalable and adaptable model for implementing Smart Heritage strategies in similar contexts worldwide.

8.2 Research Findings

This thesis explores the complex relationship between urban identity and Smart Heritage within the context of Chinatown Melbourne. The study has offered a comprehensive view of how heritage precincts can evolve while maintaining their urban identity. The transformation of Chinatown Melbourne has been shaped by both external forces, such as municipal planning decisions, and the cultural needs of the local community. This dynamic has revealed a critical tension: while top-down interventions have facilitated key changes to the precinct, these changes have often overlooked the community's deeper cultural values. The historical analysis reveals that Chinatown's identity is shaped both by these interventions and by community-driven activities and living heritage that sustain its unique character. The research thus highlights the importance of a balanced approach to heritage conservation, one that integrates both imposed and organic elements to preserve the precinct's authenticity while allowing for future growth.

The spatial analysis provides critical insights into the role of Chinatown's laneways in shaping its distinct urban identity. Despite the perceived complexity of its laneway system within Melbourne's broader Hoddle Grid, the precinct offers a navigational experience that is both distinctive and enriching. The laneways, although spatially isolated from the main street, contribute to Chinatown's sense of place and its cultural vibrancy. This analysis highlighted those spatial characteristics, often seen as secondary to heritage assessments, play a pivotal role in shaping the visitor experience and urban identity. Balancing the main street's commercial activity with the quieter laneways is essential to preserving Chinatown's role as an active urban and cultural precinct.

The pandemic's impact on Chinatown exposed weaknesses in existing heritage assessment frameworks, which often fail to account for both the spatial and intangible elements

that define a precinct's identity. The thesis argued for a more inclusive and adaptive framework that reflects the realities of post-pandemic urban life. This approach would not only capture the physical attributes of heritage precincts but also the social, cultural, and spatial dynamics that contribute to their identity. Such a framework is vital for ensuring that heritage precincts like Chinatown can evolve in ways that respect both their historical significance and contemporary needs.

The introduction of Smart Heritage strategies offered a forward-looking perspective on how technology can be used to enhance the preservation and engagement of heritage sites. The research demonstrated that digital tools, such as IoT, AI, and big data, have the potential to transform heritage management, offering new ways to monitor and conserve urban spaces while enhancing public interaction with these sites. However, the study also cautioned that these technologies must be carefully implemented, with a strong focus on community involvement. Technological solutions should support, not replace, the cultural and social fabric of heritage precincts. By integrating local identity-building into Smart Heritage frameworks, a more sustainable and inclusive approach can be achieved.

Finally, the engagement with stakeholders revealed both the opportunities and challenges of bringing Smart Heritage to life in Chinatown Melbourne. On one hand, the use of open-access data and digital tools can significantly improve urban management and visitor engagement, aligning local efforts with global best practices. On the other hand, challenges such as securing sustainable funding and ensuring that technology does not overshadow the precinct's cultural identity must be addressed. The success of Smart Heritage implementations depends on the careful balance between innovation and preservation, as well as the active involvement of the community in shaping the future of their heritage.

In conclusion, this thesis provides insights into preserving and enhancing urban identity by integrating traditional heritage frameworks with possible smart technological innovations. Chinatown Melbourne serves as a case study that illustrates the complexities of heritage conservation in a modern urban context, offering insights that are not only applicable to similar precincts worldwide but also serve as a foundation for future Smart Heritage initiatives.

8.3 Reflecting on the Research Process

The methodology framework for this thesis followed a staged and combined approach to explore urban identity, heritage assessment, and Smart Heritage implementation in Chinatown Melbourne. Each methodological stage contributed to the overall study while also revealing challenges and limitations. The first stage relied on qualitative methods, including archival research, literature review and field observation, to build an understanding of Chinatown Melbourne's urban history and identity. However, this phase encountered challenges with the subjectivity of historical sources and fragmented data, requiring a balance between documented history and interpretive analysis. The second stage introduced quantitative spatial analysis using space syntax to examine connectivity, visibility, and spatial intelligibility. While this approach provided valuable insights into Chinatown's laneways as spatial outliers, it struggled to capture the intangible cultural dynamics of the precinct. Field observations were used to mitigate this limitation, although they provided only a snapshot view of spatial usage. In the third stage, the research analysed heritage assessment frameworks using a thematic approach, combining spatial and cultural dimensions. This stage highlighted the tension between established frameworks, which focus on tangible elements, and the need to account for intangible values like community identity and spatial experience. The fourth stage explored Smart Heritage technologies and datasets. This phase posed methodological challenges due to the blend of heritage studies and digital technology, as well as limitations in

accessing detailed comparative case studies and the underdeveloped nature of Smart Heritage frameworks. Transferring insights from European case studies to Melbourne's unique context required careful consideration. The final stage involved semi-structured interviews with local government, heritage experts, and community members to understand the challenges and opportunities of implementing Smart Heritage in Chinatown Melbourne. However, the small sample size limited the diversity of perspectives, and practical challenges like funding and how to balance innovation with cultural preservation remained unresolved.

Overall, the mixed-methods approach enabled a comprehensive investigation of the research questions but introduced challenges in data integration, methodological coherence, and balancing qualitative and quantitative insights. Despite these limitations and challenges, the research process adapted to evolving theoretical landscapes and practical limitations, offering meaningful contributions to the fields of urban identity, heritage conservation and Smart Heritage. Future research can build on this foundation by further refining methods to bridge the quantitative-qualitative divide, which remains a significant opportunity within Smart Heritage studies.

8.4 Novel Contributions

This thesis has made significant contributions to the field of Smart Heritage, urban identity, and the preservation of heritage precincts, specifically in the case of Chinatown Melbourne. Key research outcomes are stated as follows:

- The transformation of Chinatown Melbourne's urban identity, from a neglected slum to a vibrant multicultural enclave, has mostly been shaped by top-down council decisions. However, some interventions have overlooked the cultural nuances and needs of the

local community, leading to misalignments between imposed identity shifts and the precinct's heritage. (Chapter 3)

- A sustainable future for the precinct requires an adaptive development framework that considers its historical and cultural significance while incorporating community-driven, bottom-up approaches to balance stakeholder interests with authentic identity preservation. (Chapter 3)
- While Chinatown Melbourne has low spatial intelligibility due to its laneways acting as spatial outliers in the Hoddle Grid system, wayfinding is not significantly hindered. These laneways reflect Melbourne's unique laneway culture, offering a distinct and enjoyable navigational experience for visitors, presenting a spatially unique Chinatown. (Chapter 4)
- Despite the precinct's commercial vibrancy on the main street, cultural activities in dwellings are lacking. A strategic approach is necessary to balance its commercial vitality with cultural sustainability and enhance its identity as an urban heritage attraction. (Chapter 4)
- This thesis critiques current heritage assessment frameworks for neglecting spatial attributes that impact urban identity, particularly in complex urban settings like Chinatown Melbourne. It argues that the pandemic has amplified the identity crisis within the precinct, highlighting the need to incorporate both tangible and intangible values, such as spatial constraints and community dynamics. (Chapter 5)
- A thematic approach is advocated for heritage assessment frameworks that better integrate spatial characteristics with urban identity. This approach can lead to more effective conservation and adaptation strategies, particularly in post-pandemic urban contexts. (Chapter 5)

- The thesis reveals the centrality of place identity in Smart Heritage transitions, particularly at a local scale. While European best practices demonstrate the potential for preserving or rebuilding heritage identities through smart technologies, current frameworks do not fully incorporate identity-building, especially in terms of how large-scale implementations can influence local heritage. (Chapter 6)
- Findings suggest that Smart Heritage strategies should focus on enhancing place identity and cultural sustainability by actively engaging a broad range of stakeholders, thereby improving city branding and reinforcing the embedded identity of heritage sites. (Chapter 6)
- This thesis delves into how advanced technologies—IoT for environmental monitoring, AI for predictive maintenance, and big data analytics—can transform heritage management. It highlights the role of 3D visualisation and digital twins in enhancing real-time monitoring and public engagement. The study also underscores the importance of multi-level management systems that integrate stakeholder input, enabling dynamic, context-specific Smart Heritage solutions that respond to conservation needs and visitor interactions. (Chapter 6b)
- Chinatown Melbourne's identity is shaped by its living heritage, distinctive spatial features like narrow laneways and heritage facades, and community-led management practices. As a vibrant multicultural hub, the precinct's cultural and spatial characteristics provide a strong foundation for Smart Heritage initiatives, which can incorporate these elements to further enhance its urban identity. (Chapter 7)
- The integration of Smart Heritage strategies, such as digital technologies for cultural storytelling and spatial data analytics for urban planning, can enrich the precinct's cultural sustainability. However, challenges such as securing sustainable funding and

maintaining a balance between technological innovation and cultural preservation must be addressed to ensure inclusive outcomes. (Chapter 7)

- This research explores how open-access data can transform urban heritage precincts into Smart Heritage sites, using Chinatown Melbourne as a case study. By integrating data like pedestrian counting, on-street parking, and microclimate, the project aligns local strategies with global best practices to enhance visitor engagement, urban management, and cultural sustainability. The study highlights the critical role of open-access data in enabling autonomous Smart Heritage, offering scalable, data-driven solutions for heritage sites worldwide. (Chapter 7b)

Overall, the findings highlight the essential role of stakeholder collaboration in feasible and culturally aligned Smart Heritage initiatives. For local government agencies, the research underscores the importance of prioritising community identity within heritage frameworks. Specifically, local governments might consider adopting policies that support continuous community engagement through public consultations and workshops, ensuring that Smart Heritage strategies align with community values and identity. Heritage organisations could apply these findings by integrating digital and smart tools, to enrich conservation efforts and visitor experiences. This approach enables heritage organisations to move beyond traditional methods, providing dynamic, real-time insights into heritage management that respond to evolving environmental and social needs. Incorporating local narratives and stories into digital heritage experiences also supports community identity-building, fostering a deeper connection between heritage sites and the public. Community groups are encouraged to actively participate in Smart Heritage projects, as their input is essential in shaping heritage frameworks that authentically reflect local culture and identity. The research suggests that community-led initiatives, such as storytelling projects or heritage walks, could offer an adaptive approach to heritage conservation, supporting a more inclusive model of cultural preservation. These

groups might also partner with local authorities and heritage organisations to advocate for Smart Heritage practices that are both culturally sensitive and technologically advanced. These recommendations aim to enhance collaboration and align the goals of Smart Heritage with the needs of diverse stakeholder groups, ensuring that technological innovations in heritage conservation also contribute to cultural sustainability.

8.5 Further Research

In Chapter 2, gaps were identified in the areas of Smart Heritage, Chinatown Melbourne's urban identity, and cultural sustainability, forming the basis for the research objectives of this thesis. While this thesis addresses several of these gaps, such as Chinatown Melbourne's identity crisis and the integration of Smart Heritage in urban heritage settings, further research is needed to evaluate cultural preservation, visitor engagement, and community benefits. Unanswered questions include assessing Smart Heritage outcomes such as visitor engagement, community benefits, and the use of technologies like AR, VR, IoT, and interoperable systems for heritage sites. Additionally, practical strategies for enhancing community participation, such as surveys and outreach to a wider audience, require further exploration. The remaining knowledge gaps may serve as future research directions, with the following suggestions to extend the research outlined in this thesis:

- Future research can incorporate quantitative methods to compare findings with this thesis, enabling a deeper understanding of Chinatown Melbourne's transformation, the effects of top-down interventions on identity shifts, and the integration of community-driven strategies. (Chapter 3)
- Further studies should examine the correlation between entrance density, street width, functional adaptability, and intervisibility using diverse global case studies. Testing the proposed methodology framework in other urban heritage precincts will validate its applicability, particularly in exploring laneways as spatial outliers that influence urban

identity. Addressing the limitations of micro-scale analysis and incorporating human-scale analysis, such as field observations, can reconcile inconsistencies between space syntax results and real-world spatial experiences. (Chapter 4)

- A broader range of precinct visitors should be engaged in future research through surveys to deepen understanding of community attachment. Testing the site-specific methodology framework in other heritage sites with distinct identities will help tailor assessments. There is also a need to adapt thematic approaches in heritage assessments to better capture urban and heritage elements, especially in post-pandemic urban heritage contexts like Chinatown Melbourne. (Chapter 5)
- To enhance the implementation of Smart Heritage, future research should focus on the early engagement of end-users to ensure projects reflect community needs and preserve cultural essence. Developing frameworks that rebuild or reposition heritage identities is also crucial, with a focus on defining the scale of identity (building, precinct, or urban system) and exploring the potential for virtual identity development. (Chapter 6)
- A larger number of participants can be involved to apply the methodology framework across global case studies, providing more generalisable conclusions about the impact of Smart Heritage. Surveys can be employed to gather data from a broader range of stakeholders, including residents, tourists, and professionals, to enable a more holistic understanding of how Smart Heritage can be effectively implemented. Expanding the sample size and involving IT professionals will also offer valuable insights into the technical aspects of Smart Heritage deployment. (Chapter 7)

This thesis offers a unique lens through which to view Smart Heritage as a critical bridge between technological innovation and the preservation of urban identity, with broader implications that resonate across fields of heritage, urban studies, and sustainability. By focusing on Chinatown Melbourne, the research challenges existing frameworks that often

generalise technological applications without adapting to the nuanced cultural identities within heritage precincts. The findings highlight that sustainable Smart Heritage initiatives must be underpinned by an understanding of local identity, community values, and spatial characteristics, elements which, if overlooked, may reduce heritage to mere data points, disconnecting it from its cultural roots. The thesis advocates for a more nuanced, adaptive approach that embraces both tangible and intangible aspects of heritage, proposing that urban sustainability efforts in heritage precincts must extend beyond physical conservation to include dynamic cultural narratives and community engagement. In this way, the research aligns with but also pushes forward global discussions on sustainable heritage management, suggesting that true resilience in heritage conservation lies in the co-creation of solutions with local communities. The case study findings provide a model for integrating smart strategies into urban heritage precincts in ways that respect and reflect specific cultural landscapes, illustrating how technology can enrich, rather than overshadow, urban and cultural identities. Community-led initiatives, such as storytelling projects or heritage walks, could provide an adaptive approach to heritage conservation, promoting a more inclusive model of cultural preservation.

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