

# Are people ready for a Digital CBD?

## The new infrastructure demands



RMIT Blockchain Innovation Hub

RMIT Centre for Cyber Security Research & Innovation

RMIT Digital Ethnography Research Centre





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# Table of Contents

<b>Foreword</b>	<b>4</b>	<b>Case study II: Digital infrastructures connect and coordinate entrepreneurial ecosystems</b>	<b>37</b>
<b>Executive Summary</b>	<b>6</b>	We must build more effective digital infrastructures	40
<b>Twin Shocks create new demands of digital infrastructures</b>	<b>8</b>	Victoria's startups need ecosystem frameworks	44
<b>Cities need to meet stakeholder needs</b>	<b>11</b>	<b>Case study III: Digital infrastructures are a way of being for engagement with the city</b>	<b>49</b>
Digital inclusion is vital for access and engagement	12	Culture and sociality are important in the city	50
Social factors impact digital inclusion	13	Engagement with the city is changing	51
Secure and resilient infrastructure supports growth and access	14	Digital infrastructures are a way of being	52
<b>Digital infrastructures require a conceptual toolkit</b>	<b>16</b>	Digital infrastructures are immersive and playful	54
Digital infrastructures coordinate networked technologies	18	An augmented city is gamified	55
Digital infrastructures are complex	20	The metaverse is one potential of an augmented city	56
Digital twins coordinate physical and digital relationships	23	<b>Are people ready for a Digital CBD?</b>	<b>58</b>
Digital infrastructures are a tool, place and way of being	26	Physical and digital immersion is supported by digital infrastructures	59
<b>Case study I: Digital infrastructures extend the 'place' of work</b>	<b>27</b>	People have high skills to work through and in digital infrastructures	60
The twin shocks disrupt work environments	28	Digital infrastructures support the future-orientation of the city	61
Digital infrastructures are a 'place' of work	30	<b>We must build future orientated digital infrastructures</b>	<b>63</b>
Access to digital infrastructure interfaces from the home is variable	32	Policy Recommendations	65
Digital infrastructures extend to living infrastructures	34	Digital CBD Index Recommendation	67
The purpose of the city must evolve	35		





# Foreword

from Directors Tania Lewis and Annette Markham



Professor Tania Lewis



Professor Annette Markham

**As Co-Directors of the Digital Ethnography Research Centre, we are delighted to introduce this landmark report, the final in a series of five major interventions into what we have been collectively terming the Digital CBD.**

It's a privilege to work alongside some of the brightest and best thinkers and researchers in our sister centres at RMIT, the Blockchain Innovation Hub and the Centre for Cyber Security Research and Innovation, to push the limits of imagining and shaping Melbourne as a digital polis within the context of the Anthropocene.

The Digital Ethnography Research Centre (DERC) provides rich and granular understandings of digital transformations in social contexts.

This approach is quite distinctive, yet highly complementary, to the (digital) economic expertise of the Blockchain Hub and the information systems, engineering and computer science-led concerns of the Cybersecurity Centre. DERC researchers offer crucial insights into digital as they study the complexity

of the connections between digital transformations and human experience.

This report focuses on infrastructures, the often hidden but fundamentally powerful scaffolds that support and influence our everyday economic, work, social, care, learning and creative ecosystems.

Recent crises, including devastating bushfires, floods and of course the COVID-19 pandemic, have made each and every Australian aware of the importance – and fragility – of infrastructures.

Peeling back the layers of what makes a community, city or nation work smoothly reveals details of how these infrastructural systems are operating in the present, as well as showing us trends over time.

Infrastructures are conventionally seen in narrow terms. The word can conjure up images of neutral or physical supporting mechanisms, such as roadways and rail tracks for the efficient flow of people and vehicles through cities, interconnecting networks of pipes and cables that supply water, electricity or the internet, and the national and/or international chains of connection that ensure the steady supply of raw materials, food and products.

But this report expands this understanding, emphasising that the infrastructures essential to building a resilient, inclusive, sustainable and innovative future Melbourne are not only physical, digital and economic, but also everyday, social and political.

Once we add these layers of what we can term as 'living infrastructures', we build a richer picture of Melbourne, an essential step toward addressing complex questions about supporting, equitable possibilities and what globalisation theorist and anthropologist Arjun Appadurai calls the 'capacity to aspire' for the extraordinary diversity of its residents.

The analysis underpinning this report involved an array of social, science and humanities researchers using rich, culture-oriented methods to capture the complexity and richness of these layers of infrastructures.

The cases presented here, about Melbourne as a digital city, illustrate how digital mechanisms and capacities can be conceptualised and used as tools, but when we shift the lens, digital transformations also influence how people experience a sense of presence and place.

Shifting the lens again, we can recognise that digitalisation has become a way of being, melting into the background of the everyday pulse of a city. These lenses highlight different aspects of how infrastructures underpin how we live, learn, consume, socialise and work.

# Foreword

from Directors Tania Lewis and Annette Markham

**The recent crisis has made visible many previously unnoticed infrastructures, digital and physical alike.**

These historic moments give us the opportunity to stress the importance of making collective, democratically informed decisions about Melbourne's future, as we imagine how we might live and thrive in times to come.

Just as our city boasts extraordinary diversity, it is also home to multiple experiences and access to infrastructures. Put differently, for those lucky residents with unfettered access to data and high-speed connections to the internet, the infrastructural 'scape' may look very different from those who do not.

In the Digital CBD project, we have been mapping the city with diverse and enabling visions. In addition to the typical economic indicators such as GDP, we add quality of experiences, vibrancy, and wellbeing, which invokes infrastructures associated with households, events, social

organisations, human networks of friends, students, families and co-workers, as well as the systems of non-human entities that influence and support the city (like trees, parks, living green buildings, urban sensors and AI).

While we might not immediately think of digital infrastructures when thinking of the future of the city, this report emphasises that our futures are hybrid, meaning digital capacities are embedded and embodied to the point whereby physical and digital aspects of everyday life fully overlap.

This, along with the growing integration of automated data analytics in decision making, urges us to openly debate and discuss which infrastructures should be prioritised and how we ensure access, inclusion and sustainability through these infrastructures. These decisions have huge implications for the kinds of lives we want to live.

This report opens up conversations about the value of reconceptualising what counts as infrastructure and offers us a chance to see the infrastructural fabric of our cities as something that should be imagined and shaped collaboratively.

One of the three case studies discussed in this report focuses on households as key infrastructural hubs of the city. Made visible during COVID-related lockdowns, the home became a site of organisational work, schooling, health care, the in/outsourcing of food provisioning for example.

As households became more conscious of the infrastructures involved, as well as their own role in and engagement with providing infrastructural support in everyday life, we saw a growing awareness of the urgent need to replace fossil-fuelled infrastructures with low carbon infrastructures, reflected in a boom in solar and home battery sales and huge demand for electric vehicles. This and other examples illustrate the value of expanding our understanding of infrastructures.

Here, what is crucial about the contribution of the rich socio-cultural insights that DERC brings is its unique focus on understanding infrastructure not as a 'what', but as a 'how'. By focusing on the processes of infrastructuring, we can look at where infrastructures come from,

how they are shaping and enabling the daily ebbs and flows of the city and how they are also outcomes of the everyday practices of organisations and citizens themselves.

This is how we might, to paraphrase a statement made by RMIT Deputy Vice Chancellor Julie Coglin from our first Digital CBD report, reinvent the city itself as a living, evolving human-centred technology infrastructure. This fifth report in the Digital CBD series thus shifts our conceptions of infrastructure, providing additional layers, scapes and dimensions through which we can focus energy to create better, more ethically informed and climate-conscious digital futures.



**Professor Tania Lewis**

Co-Director DERC



**Professor Annette Markham**

Co-Director DERC

# Executive Summary



Melbourne has experienced ‘twin shocks’ in the form of the COVID-19 pandemic and the supercluster of existing and emerging technologies. They have accelerated Industry 4.0 and the digital transformation of the city.

The new infrastructure demands of the digital CBD are linked to these shocks. In this report, we profile the existing and emerging technologies at the core of digital transformations in industry, the economy, and social and cultural life.

This report starts with the position that any city, Melbourne included, must meet the needs of various stakeholders, and so too must digital infrastructures. It highlights how digital inclusion is vital for equitable access to digital infrastructures and vibrant engagement with a digital CBD.

It also identifies how secure and resilient infrastructures support economic growth and ensure access to essential services for residents across the regions to the CBD. Our key point is that digital infrastructures must be secure and inclusive, and that people must have the digital capabilities to use them.

Next, we provide a conceptual toolkit that offers three ways to see the scale, complexity and scope of digital infrastructures and we showcase three real-world case studies that make digital infrastructures visible and tangible. Across the cases, the report provides original evidence from the Digital CBD survey conducted in April 2022.

The survey presents a living baseline of residents of Melbourne’s metro, urban and regional centres as we re-emerge and re-open. The survey captures their engagement with the city and their everyday practices for work, learning and thriving, alongside their digital abilities.

The first case study presents digital infrastructures as a **place** of work that extends Melbourne’s workplaces into the home and outlying areas of the Victorian regions. The twin shocks radically disrupted work and workplaces, and forced people into technologically mediated ways of working. Drawing on empirical research, we discuss how access to digital infrastructures from the home vary by location.





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**We also observe how digital infrastructures now extend through our living infrastructures and highlight how technological innovation is responding to these changes.**

This discussion emphasises that digital infrastructures extend decentralised work environments into the home and must be accessible, usable and mobile.

The second case study presents digital infrastructures as **tools** in the larger entrepreneurial ecosystem that connect and coordinate for entrepreneurial benefit. The past two years of twin shocks exacerbated ongoing problems in the entrepreneurial ecosystem.

The challenge for Melbourne's entrepreneurial ecosystem concerns startups moving through the lifecycle of commercialisation.

If we look at entrepreneurial ecosystems as complex adaptive systems, we can build more effective digital infrastructures to support this lifecycle. Drawing on industry engagement and relevant research, we explore how the use of a digital twin can anticipate investment in the ecosystem.

This discussion highlights that a City Digital Twin can be used to coordinate and connect relationships in the entrepreneurial ecosystem.

The third case study presents digital infrastructures as a **way of being** for immersive and playful engagement with the city. The shock of the pandemic emphasised the importance of entertainment, sociality, arts and culture, and play and pleasure in the city.

This case study draws on the Digital CBD survey findings to observe how engagement with the city is changing.

We speculate how digital infrastructures can become a way of being in, with, and around a city that is immersive and playful.

A vibrant city is an augmented city and the creative industries lead the way on how immersive engagement and playful technologies can enhance the experience of the city.

We also explore how the metaverse presents the potential for us to imagine an augmented city of the future.

But, are people ready? A vibrant city emerges as Melbourne more fully interweaves the digital and physical infrastructures, focusing on people as well as other entities.

Returning to the challenges Melbourne faces amidst the pandemic, we discuss how digital infrastructures support both digital immersion and physical immersion in the city and the digital skills Melbourne residents need.

We observe that the increasing variety of digital infrastructures and the resulting data produced by the people and the city engaging with them, need collective governance and raise questions of consent, privacy and data ownership.



This report then provides the following policy recommendations:

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**Recommendation 1:**

Provide all Victorians with affordable and reliable access to digital infrastructure.

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**Recommendation 2:**

Enhance the readiness of Victorians to engage with a digital CBD through awareness raising and digital skill building, particularly for marginalised groups.

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**Recommendation 3:**

Ensure a secure and resilient cyber environment that aligns public and private interests.

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**Recommendation 4:**

Embed digital infrastructure across the regions, into homes and public transport to support a decentralised workforce.

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**Recommendation 5:**

Utilise a City Digital Twin model to enhance opportunities for entrepreneurs through building connections and coordination across the entrepreneurial ecosystem.

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**Recommendation 6:**

Create a data governance framework that promotes inclusivity within the city and allows stakeholders to access, use, own and apply city-data.



**Twin Shocks create  
new demands of  
digital infrastructures**





# Twin Shocks create new demands of digital infrastructures

## **The digital infrastructures report responds to the twin shocks of the pandemic and accelerated digital adoption to ask what a city of the future requires of digital infrastructures.**

We have been accelerated into a digital environment powered by combinations of artificial intelligence (AI), machine learning, Internet of Things (IoT) networked devices, advances in cloud storage, and computing and Web3 technologies. Alongside these technological advances, augmented reality has facilitated immersive experiences and data overlays on the physical environment. Through this supercluster of technologies, digital infrastructures of the future will be more fully integrated into our everyday lives and both shape and respond to the ways that people engage with the city.

Our reliance on digital infrastructures has grown exponentially and will continue to do so. The past 30 years of digital innovations have transformed societies everywhere, but these transformations may have been experienced more directly during 2020 and 2021, when the pandemic forced people to remain physically distant, which prompted a global turn toward the internet for work, learning, and socialising. Digital infrastructures were made more visible as scaffolds for economic enterprises, political processes, and health and wellbeing.

Whether or not Melbourne residents were ready to transform into a full-blown digital city, they did. In the wake of these past two years, as cities everywhere begin to revive and recover, our Digital CBD research team conducted a benchmarking survey among Melbourne residents to learn more about their basic digital access, skills and practices, and to understand broadly how they are engaging with the central business district at this moment, as a digital and physical city.

As the city emerges from the pandemic, the attributes of the CBD that made it 'central' to Melbourne are still there: the cultural institutions and theatres, nearby sports venues, the seat of government, the hub of the public transport system and many of the shops, lanes, cafes and restaurants.

So too are the offices and buildings, representing significant investments in the city. These places and functions were valued before the pandemic as the CBD was as much the social centre as the business centre.

The research team, led by RMIT Digital Ethnography Research Centre (DERC) researcher Professor Annette Markham, conducted a large-scale survey in April 2022, canvassing a representative sample of more than 2,000 Melbourne residents from metropolitan, urban and regional centres.

The Digital CBD survey collected data about engagement with the city as well as current attitudes and perceptions of Melbourne residents as they shifted out of two years of lockdowns into their 'new normal' economic, cultural, work and learning environments.

**This report documents how Melburnian's social and workplace interactions will be augmented by the digital transitions rather than replaced by them.**



Among the wide range of topics addressed, the survey assessed digital abilities, accessibility and typical digital media usage, online engagement with commerce and cultural features of the city and future imaginaries of the city.

The findings from this survey inform key discussions in this report.

Melburnians faced in shifting to working from home during lengthy lockdowns. It draws on original research to illustrate what changes to workforce distribution and working practices occurred, and what the implications of a decentralised workforce are for digital infrastructures of the future.

In this case, digital infrastructures become a 'place' where people work, and the home environment becomes a part of the living infrastructure of a city, through which digital infrastructures must extend.

'Small businesses suffered and the entrepreneurship lifecycle was severely disrupted'

The report will present a discussion of Melbourne's entrepreneurial ecosystem, with a focus on tech start-ups. Drawing on consultation with industry stakeholders and Web3 start-ups, the report highlights the challenges and opportunities faced by founders when everything went digital. It then explores how digital infrastructures can create enabling conditions for three related forces

that influence entrepreneurial ecosystem emergence: intentionality of entrepreneurs, coherence of entrepreneurial activities, and injections of resources.

'The vibrancy of the city suffered as engagement in arts, culture, play and pleasure was cut off'.

This report focuses on the vibrancy of social life in the city. It explores how our social lives are, and can continue to be, augmented through digital experiences that are intimate, embodied, pleasurable and playful. We lift off through augmented reality and mixed-reality environments into a playful city and consider the ramifications of the metaverse for this.

This report does not sketch a utopian city of flying cars and the Jetsons, but rather, presents a pragmatic, realistic and visionary engagement with the real-world challenges and opportunities the city faces.





**Cities need to meet stakeholder needs**





# Digital inclusion is vital for access and engagement

The benefits of any digital economy cannot be shared when some members of the community face real barriers to online participation.<sup>1</sup> When focusing on emerging digital infrastructures for the city, it is an important reminder that even the basic infrastructures that these emergent technologies require are not experienced evenly by all.

Digital inclusion describes universal access to the technologies necessary to participate in social and civic life.<sup>2</sup> Digital inclusion requires more than simply access to technologies; people also need the skills and knowledge to use the internet and digital technologies effectively.

In addition, the costs associated with being online – for internet connections, sufficient data and data storage access, and for necessary devices—require negotiating.

Victoria scores relatively high on the Australian Digital Inclusion Index (ADII) compared to the rest of Australia. In 2021, Victoria registered an Index score of 72.0, 0.9 points higher than the national average, and 6 points higher than Tasmania, the lowest-scoring state in Australia in that year. Metropolitan Melbourne is amongst the most digitally included regions of Victoria.

Of the 31 local government areas that make up this region, 26 received 2021 Index scores that were above the national average. The City of Melbourne received a 2021 Index score of 77.0—5.9 points higher than the national average.

Not unexpectedly, there is a significant digital inclusion divide between metropolitan and regional or remote areas across Australia. Greater Sydney and Melbourne areas provide more information and communications infrastructure and affordability.

In 2021, Metropolitan Australia scored 72.9, 1.8 points higher than the national average, and 5.5 points higher than the regional Australian score of 67.4.



Researchers such as Ali, Alam<sup>3</sup> emphasise that such stark divides contribute to the persistent underdevelopment and disadvantage of regional Australia.

Digital inclusion is influenced by income levels. Those earning more than AU\$156,000 per annum experience the highest levels of digital inclusion—recording a 2021 Index score of 82.3, more than 11 points higher than the national average of 71.1 points. This strongly contrasts with the Index score 55.8 for those earning less than \$33,800.

The Australian Digital Inclusion Index (ADII) measures digital inclusion across dimensions of access, ability, and affordability. The Index draws on Australian Internet Usage Survey data from approximately 2,000 Australians to identify the demographic and geographic contours of digital inclusion over time. ADII scores range from 0 to 100, with a score of 100 indicating a 'perfectly' included individual.

<sup>1</sup> Thomas J, Barraket J, Wilson C, Rennie E, Ewing S, MacDonald T. Measuring Australia's Digital Divide: The Australian Digital Inclusion Index 2019. Melbourne: RMIT University and Swinburne University of Technology, Melbourne, for Telstra.; 2019

<sup>2</sup> Helsper E. Digital inclusion: an analysis of social disadvantage and the Information Society. London, United Kingdom: Department for Communities and Local Government; 2008. Report No.: 1409806146.

<sup>3</sup> Ali MA, Alam K, Taylor B. Measuring the concentration of information and communication technology infrastructure in Australia: Do affordability and remoteness matter? Socio-Economic Planning Sciences. 2020;70:100737.

In their survey of recently arrived culturally and linguistically diverse (CALD) migrants in the Shepparton region, Thomas, Barraket<sup>4</sup> found this cohort to have an ADII score of 61.2, 0.7 points below the national average (61.9) and 2.8 points lower than that reported by the broader culturally and linguistically diverse migrant population of Australia (64.7).

Through this population, they found that affordability and literacy are key obstacles to enhancing digital inclusion for recently arrived CALD migrants.

We know from the 2016 Census that, for the Victorian population, just under a third are born overseas (28.4%) and just over a quarter (26%) spoke a language other than English at home.<sup>5</sup>

This suggests that considerations of literacy and affordability are likely to shape the digital participation of culturally and linguistically diverse Victorians.



<sup>4</sup> Thomas (n 1)

<sup>5</sup> DPC. Victoria's diverse population: 2016 Census. Victoria: Department of Premier and Cabinet, Cabinet DoPa; 2017.

Digital infrastructures that support the essential services of everyday life are considered 'critical infrastructures.' Each day, Victorians rely on the services provided by critical infrastructure owners and operators: water and sewage, food, transport, health services, energy for homes and industry, access to banking, finance, supply chains and government services, and global communications networks.<sup>6</sup>

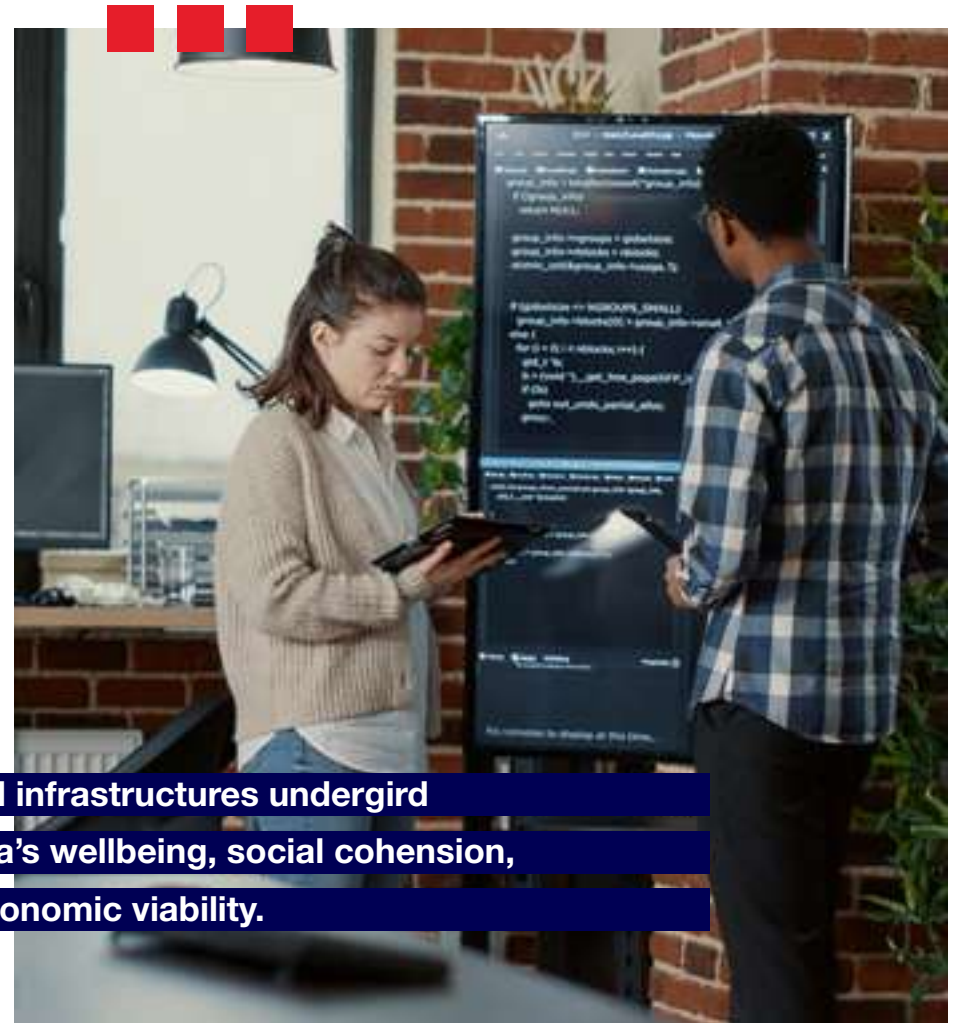
Critical infrastructures, therefore, undergird Victoria's wellbeing, social cohesion, and economic viability.

Victorian critical infrastructures of the future encompass the technologies and digital infrastructures associated with what we might call Industry 4.0 or Smart Cities. There are a range of current and emerging technologies that will be a part of this future, including machine learning and protective cybersecurity technologies that fall into the category of artificial intelligence, computing and communications.

While some emerging technologies might focus on public safety, such as drones and sensors, others might focus on enhanced mobility through autonomous transportation systems, which involve machine learning, autonomous systems operation technology or even swarming and collaborative robots.

Digital infrastructures that are secure and resilient are more likely to provide robust support for critical infrastructures. The increased dependence on the internet triggered by the pandemic created an increased attack surface, generating more opportunities for malicious cyber actors to exploit vulnerable targets in Australia.

Cybercrime occurs mainly through fraud, shopping, and online banking. Self-reported financial losses due to cybercrime in Australia have totalled more than AU\$33 billion, according to recent reports.<sup>7</sup>



**Critical infrastructures undergird  
Victoria's wellbeing, social cohesion,  
and economic viability.**

<sup>6</sup> ACSC. ACSC Annual Cyber Threat Report: 1 July 2020 to 30 June 2021. Australian Cyber Security Centre; 2021.

<sup>7</sup> CTPCO. Blueprint for Critical Technologies: The Australian Government's framework for capitalising on critical technologies to drive a technologically-advanced, future-ready nation. 2021.



### Cybersecurity threats and trends for the city include:

- Malware and ransomware, which is the most destructive and commonly used tool comprising of almost 49% of incidents.
- Sustained disruption, exfiltration, deletion, damage of key sensitive data or intellectual property is the most severe, although a less regular threat.
- Business email compromises, which constitute a major threat to Australian businesses and government enterprises.
- Malicious actors targeting supply chains, particularly software and services, to gain access to a vendor's customers.
- The capture and misuse of sensitive personal data through the exploitation of our desire for digitally accessible information or services.

These threats can be countered through innovative digital infrastructures. For example, blockchain-based supply chain processes can enhance cybersecurity by facilitating instant tracking and preserving privacy through private chains with preauthorisation. This type of Web3 infrastructure can reduce costs related to updating information, enabling automatic payments and, in general, improving automation.<sup>8</sup>

Mitigating risks also involves building stronger awareness around cybersecurity. Awareness, along with a willingness and readiness to adopt and adapt hygienic and healthy cyber habits, generates a social layer of digital infrastructures alongside the critical layers of digital infrastructure, both facilitating a secure cyber environment and aligning public and private interests.



### The report provides evidence and presents the need for updated digital skills in Melbourne

The fourth Digital CBD report on digital skills 'Digital skills and cybersecurity. How do we secure our future?'<sup>9</sup> provides insight into the current digital skills of Information and Communication Technology (ICT) and cybersecurity professionals and provides a framework on digital skills gaps and shortages both nationally and internationally.

These skills must meet our current needs and help us continue to adapt as technology, applications and data produced through the technology supercluster continues to iterate.

The report argues that doing so will make Melbourne one of the most digitally connected and secure cities in the world.

The report closes with specific recommendations to bring us towards the goal of high levels of digital skills for a digital CBD. It also identifies what we need to secure digital transformation in public and private sectors in Melbourne and beyond.

<sup>8</sup> Chang SE, Chen Y-C, Lu M-F. Supply chain re-engineering using blockchain technology: A case of smart contract based tracking process. Technological Forecasting and Social Change. 2019;144:1-11.

<sup>9</sup> Digital CBD Project Report 4 Digital Skills and Cybersecurity - Digital skills and cybersecurity. How do we secure our future?



**Digital infrastructures  
require a  
conceptual toolkit**



Given the acceleration of digital adoption in personal life and work, it is no longer 'enough' to view digital infrastructures as merely a question of grids and hardware, it has become interwoven in people's lives, especially given the ubiquity of smart devices that connect us, not least smartphones.

Markham and Tiidenberg<sup>10</sup> remind us that our basic toolkit for understanding what a digital infrastructure is, as well as how it operates, is determined by what metaphors we are using. From 'the internet as an information superhighway', an early 1990s metaphor, to descriptors such as 'cloud', 'ecosystems', 'smart', 'digital twin', or 'metaverse', each phrase highlights particular aspects of physical and digital infrastructures, which can be a useful tool for cities, citizens, and researchers alike.

Thus, a concept like 'infrastructure' includes people, information, data, objects, and place. Below, we unpack some of what this complex concept implies or includes for discussions and analysis of Melbourne's future digital infrastructures.

**It is no longer 'enough' to view  
digital infrastructures as merely  
a question of grids and hardware.**



<sup>10</sup> Markham AN, Tiidenberg K, editors. Metaphors of internet : ways of being in the age of ubiquity: Peter Lang Publishing; 2020.



The backbone of a digital society is hyperconnectivity,<sup>11</sup> which refers to the interconnectedness of people, institutions and machines gained from the internet, mobile technology such as laptops and smartphones, and the Internet of Things (IoT).<sup>12</sup> Through digital and physical infrastructures, people can access digital services such as banking and healthcare, and they can also engage in entrepreneurial, entertainment, social and cultural experiences.

From a user perspective, primarily in western contexts, our experience of the internet is largely shaped by Web 1.0 and 2.0 technologies including websites, search engines and social media.

They also include enterprise software likely encountered in the workplace such as content management and learning management systems; the precursors of which were intranets and enterprise software linked to the internet such as Adobe or Microsoft Office.

In the early 2000s, Web 2.0 signalled the growth of bi-directional communication, greater diversity in content types, and easy-to-use software that enabled general users to produce as well as consume content.<sup>13</sup> This merging of the role of producer and consumer, labelled 'produsage',<sup>14</sup> coincided with a rapid convergence of mediums for communication and interaction that were once distinct and separate.

For the general user, this can include television converging with Youtube, newspapers converging with social media newsfeeds, and conversations typically relegated to the editorial columns of newspapers or coffee shops occurring in comment sections of news websites, and later Twitter.

For digital technology developers, economists, and network culture scholars, this convergence was additionally recognised as massive shifts in how information flowed across and within sectors and special interest groups.



This meant that as formal and informal networks of relations overlapped, stakeholder groups became more difficult to define, and social media was splintering audiences even as the platforms were consolidating the places for interactions among and across diverse communities.

These convergences paved the way for social media to not only thrive but also solidify as global sites – what is now called 'platforms' – for social interaction and information sharing.

While the first decade of the 21st century created decentralisation through technological capabilities, the consolidation of these capabilities in large corporate-owned platforms led ironically to more centralised business models.

Web3 has introduced the potential for bringing back the decentralised features of digitalisation.

Defined by 'blockchain', Web3<sup>15</sup> represents the next iteration of the internet. The core operational principles of blockchain focus on decentralisation, transparency and accountability.

<sup>11</sup> Fredette J, Marom R, Steiner K, Witters L. The promise and peril of hyperconnectivity for organizations and societies. The global information technology report. 2012:113-9.

<sup>12</sup> Bukht R, Heeks R. Defining, conceptualising and measuring the digital economy. Development Informatics working paper. 2017(68).

<sup>13</sup> Cormode G, Krishnamurthy B. Key differences between Web 1.0 and Web 2.0. First Monday. 2008.

<sup>14</sup> Bruns A. Blogs, Wikipedia, Second Life, and beyond: From production to produsage: Peter Lang; 2008.

<sup>15</sup> The use of Web3 terminology instead of Web 3.0, signals the focus upon the crypto/economy aspects rather than on the semantic web.

**In their discussion of the potential application of blockchain technology to challenges that arose during the onset of the COVID-19 pandemic, Khurshid<sup>16</sup> suggests that public blockchain networks:**

- Allow individuals to share their information in complete privacy while maintaining full control of that information;
- Can maintain an audit record of each transaction, making it readily available when needed;
- Can validate information sources to avoid misinformation;
- Allow tracking of assets as part of the architecture of the network; and
- Provide global connectedness and minimise barriers of information flow.



These features of blockchain technologies hold potential for application in areas that build social impact, can foster social good, and build trust and integrity in information and data systems.

This is because blockchain is based on tracked, audited, and publicly communicated information.

Web3 technologies move from the transmission and recognition characteristics of digital networked technologies to distributed action through smart contracts.

Thus sensing, awareness, responsiveness and action potential is available within our digital infrastructure, giving it a liveliness that connects people, information/data, objects, and place.

The internet has changed significantly from Web 1.0 to Web3. Strong values and aspirations underpin the most recent transformations: equitable access, fair and transparent automation technologies, sufficient telecommunications infrastructure and a digitally capable population.

These resources and skills vary dramatically between and within countries in the developed and developing world.<sup>17 18</sup>

<sup>16</sup> Khurshid A. Applying Blockchain Technology to Address the Crisis of Trust During the COVID-19 Pandemic. *JMIR Med Inform.* 2020;8(9):e20477.

<sup>17</sup> Al-Saqaf W, Seidler N. Blockchain technology for social impact: opportunities and challenges ahead. *Journal of Cyber Policy.* 2017;2(3):338-54.

<sup>18</sup> Riddlesden D, Singleton AD. Broadband speed equity: A new digital divide? *Applied Geography.* 2014;52:25-33.

## Digital infrastructures are complex

A 'digital infrastructure' can be thought of as a complex ecosystem consisting of multiple interconnected and interdependent infrastructures operating within, under or on top of existing physical structures. Like social or economic infrastructures, digital infrastructures shape how people, information and objects interact and behave.

To see the relationship between physical and digital infrastructure in action, we can turn to the trains of our public transport.

Trains need tracks to run on, a complex signalling and tracking system to coordinate their movement, stations for commuters to get on and off, while commuters need publicly accessible apps to plan their journeys.

Location-based technologies, such as GPS (Global Positioning System), further enhances the physical and digital infrastructure at the heart of public transport. GPS allows us to track the movement of objects, such as when a train will arrive at a station, or to locate ourselves within or navigate the city using app-based maps.

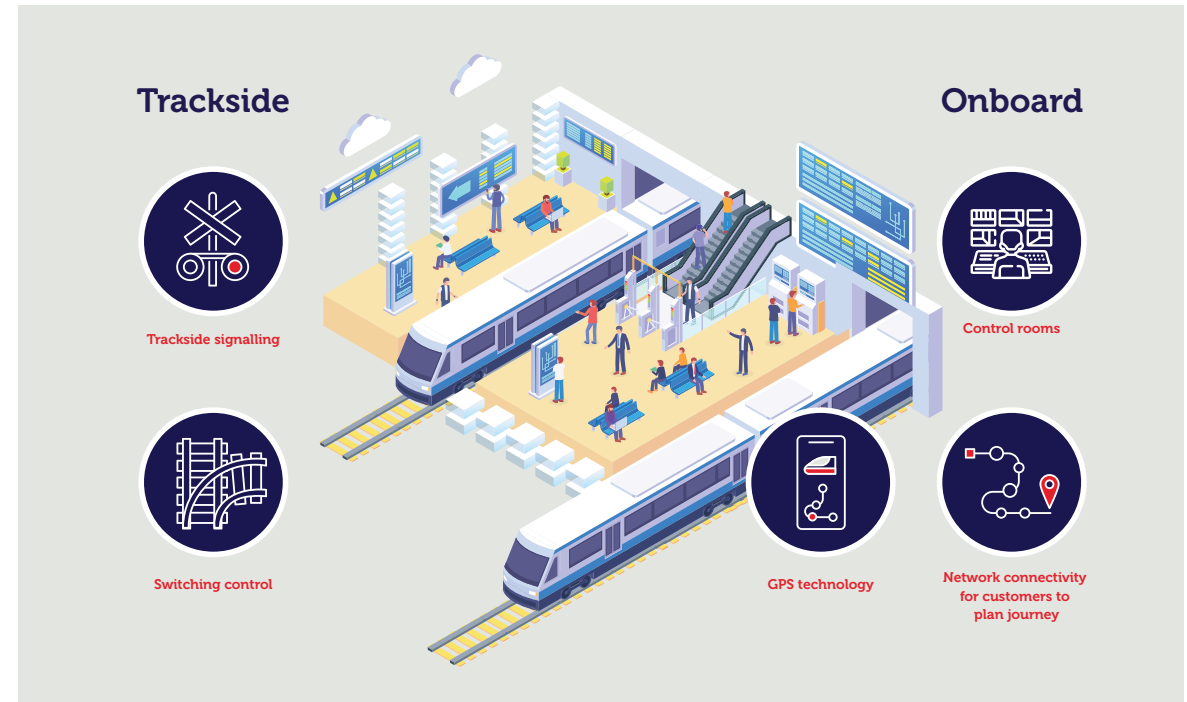
The 'reach' and strength of network connectivity, such as 4G, 5G, and 6G, add another infrastructure to this picture. Currently, 4G and 5G coverage provide the bandwidth and signal strength to power the public transport system. Under development is 6G, which is expected to be the key driving force for information interaction and social life after 2030.<sup>19</sup>

This simplified illustration demonstrates how our public transportation system is a combination of connected physical and digital infrastructure that harness computational power to interpret real time data flows and automate decision-making.

Digital infrastructures are increasingly complex. Not only are they connected to physical infrastructures, but they also imbricate multiple technologies that need to work together.

To return to our example, in order to support the efficiency of autonomous or driverless vehicles, 6G, AI, and physical tracks/roadways, along with traditional traffic management systems like traffic lights, coordinated walk signals, and traffic cameras, must operate seamlessly to enable the rapid analysis of multiple data sources and automated decision-making that ideally results in reduced traffic congestion.

This means working with massive volumes of varied data in 'real time' which requires computing power, data storage, and strong analytical approaches, as well as sensible and ethical data ownership solutions.



<sup>19</sup> Guo H, Zhou X, Liu J, Zhang Y. Vehicular intelligence in 6G: Networking, communications, and computing. Veh Commun. 2022;33(C):19.



**A quick example illustrates the scale of data in question:**

Many Melbourne residents spent much of 2020 at home. For that year, the Melbourne suburb Williams Landing claimed the title of 'Download Capital of Australia' with residents downloading an average of 567.70GB per home over the course of 2020.<sup>20</sup>

Scaling this high intensity use up to over 2.5 million dwellings with internet access in Victoria,<sup>21</sup> we would witness more than 1.4 billion GB of data transfers for domestic dwellings alone.

Over the last ten years, data centres and cloud growth in Australia has accelerated significantly with Amazon Web Services, Microsoft Azure and Google Cloud locally hosted in Australia.<sup>22</sup>

While 'the cloud' can be thought of as an invisible infrastructure, data is stored physically in servers. There are 279 Australian data centres; most of these facilities are located along the eastern coast in Brisbane, Sydney and Melbourne. These provide some choice for Australians and Victorians to select a particular data centre to store their data.

However, as Velkova<sup>23</sup> notes, the lifespan of data centres is intimately tied to the lifespan of the server racks inside them, which the hardware industries invested in producing 'artificial obsolescence' have set to be between three and five years. This demonstrates the need to plan for and respond to changes in digital infrastructures. Another challenge, aside from data security, is data ownership and jurisdiction. The ease and speed at which data travels across borders and the physical disconnect between where data is stored and where it is accessed, critically tests jurisdictional purview over data.<sup>24</sup>

Within these masses of data exchange and demands on digital infrastructures, data storage is a significant issue. The infrastructural elements of data storage comprise a blend of local and international, or cloud-based, entities. Cloud computing refers to the delivery of computing services – including servers, storage, databases, networking, software, analytics and intelligence – over the internet.

Having access to secure cloud services is crucial, particularly for companies or institutions with a geographically distributed workforce.



<sup>20</sup> Kelly Z. NBN in 2020: Telstra reveals Australia's most data-hungry suburbs: Canstar; 2021

<sup>21</sup> .id. Australia community profile: Victoria population and dwellings: Informed decisions; 2021

<sup>22</sup> Cloudscene. Australia: Cloudscene; 2022

<sup>23</sup> Velkova J. Data centres as impermanent infrastructures. Culture machine. 2019.

<sup>24</sup> Daskal J. The un-territoriality of data. Yale Law Journal. 2015 2015/11//:326+.

Data is an increasingly important economic resource for production and innovation in a digital economy. As such, there is significant benefit to data being controlled, if not owned, by users and consumers (rather than platforms) to ensure efficient trade-offs with privacy and maximise the social value of collected data.<sup>25</sup>

In an example of an alternative formulation of data ownership, the founder of the web, Tim Berners Lee, champions 'data sovereignty' – which means giving users power over their data.

Following on from this discussion of infrastructure relationships in the city, the technology trend considered important for the future of the Melbourne Digital CBD by the largest percentage of Melbourne residents (40.3%) in the Digital CBD survey, was accessible city data.

This referred to data made available in forms that are readable and usable by the general citizen. Accessible city data also requires a collective governance mechanism.



### **The second report in this series – The Docklands**

**DAO:** Reimagining precincts in a Digital CBD<sup>26</sup> – draws on the innovative Web3 technology of Decentralised Autonomous Organisations (DAOs), to propose a collective data governance solution for city data. The report charted out a staged regenerative strategy targeting specific regions and precincts, such as the Docklands, aimed at helping the businesses that need data to survive and thrive.

The report proposed a pilot for CBD26 people flow and other data collections to be utilised and managed through a Docklands DAO. Retail/residential/commercial tenants could then take responsibility for their local environment by creating a pilot Docklands Management Commons DAO ('Docklands DAO'), utilising crucial pooled data to optimise resource allocation, increase efficiency, and create opportunities for strategic placemaking.

<sup>25</sup> Potts J. A proposal for a new type of intellectual property: Time-locked data vaults. Amsterdam Law and Technology forum: Amsterdam Law & Technology Institute; 2022.

<sup>26</sup> Digital CBD Project Report 2 The Docklands DAO: Reimagining precincts in a Digital CBD



## Digital twins coordinate physical

## and digital relationships

The connection between digital infrastructures and the material environment of the city is achieved through a composite of technologies, including Internet of Things technologies.<sup>27</sup> The Internet of Things (IoT) refers to a world of products that are connected to a network, such as the internet, a company intranet or a network using industrial communication protocols.

The rapid development of these information technologies within industry has enabled the creation of a new manufacturing paradigm in which every machine is interconnected to each other: the Industry 4.0 and Cloud Manufacturing.<sup>28</sup> This interconnectivity and real time communication between products in a network produces information flows and actions that can be controlled and modelled.<sup>29</sup> Because of this, IoT technologies facilitate the development of digital twins. The digital twin concept refers to developing a mirrored digital counterpart to a physical system.<sup>30</sup>

Their defining characteristic is the provision of mutual interaction between the two counterparts in real-time. For instance, using sensors and IoT, technologies can provide the transfer of information, which updates the virtual model according to the physical counterpart's live updates.<sup>31</sup>

Specific examples of digital twin use include their integration into smart factories/productions for product design, model engineering and the agricultural supply chain.<sup>32</sup>

The 'avatar' of a physical entity can be used for different purposes, for example to speed prototyping, testing, or validating specific processes, predicting problems, and optimising solutions.<sup>33</sup>

**Digital twin systems are argued to transform business by accelerating holistic understanding, optimal decision-making and effective action.**

<sup>27</sup> Rozario C. The PropTech Guide to IoT: Metrikus; 2020

<sup>28</sup> Vespoli S, Grassi A, Guizzi G, Santillo LC. Evaluating the advantages of a novel decentralised scheduling approach in the Industry 4.0 and Cloud Manufacturing era. IFAC-PapersOnLine. 2019;52(13):2170-6.

<sup>29</sup> Chen F, Deng P, Wan J, Zhang D, Vasilakos AV, Rong X. Data mining for the internet of things: literature review and challenges. International Journal of Distributed Sensor Networks. 2015;11(8):431047.

<sup>30</sup> Grieves M, Vickers J. Digital twin: Mitigating unpredictable, undesirable emergent behavior in complex systems. Transdisciplinary perspectives on complex systems: Springer; 2017. p. 85-113.

<sup>31</sup> Shahat E, Hyun CT, Yeom C. City Digital Twin Potentials: A Review and Research Agenda. SUSTAINABILITY. 2021;13(6).



### Key

- Alamein, Belgrave, Glen Waverley and Lilydale
- Cragieburn, Sunbury and Upfield
- Cranbourne and Pakenham
- Frankston, Stony Point, Werribee and Williamstown
- Hurstbridge and Mernda
- Sandringham

We have encountered the utility of the digital twin in our third report – 'Towards just and resilient supply chains for the Digital CBD'<sup>34</sup>. This report presented the evidence on how real-time data coordination through dynamic simulation and analytical optimisation can ensure the resilience and stability of supply chains. It recommended that a supply chain digital twin is one way to achieve this level of data coordination and improve information symmetry to all entities in the network.

Through optimising and simulating the supply chains, companies can generate new information about the impact of failure and influence the supply chain and its performance by looking at various scenarios that simulate the locations of failures, the duration and recovery policies.<sup>35</sup>

The digital twin achieves deep synchronisation and dynamic interaction between the physical and virtual worlds.<sup>36</sup>

It can also act as a comprehensive simulation model of a real supply chain which uses real-time data to see information from the past, optimises the present and forecasts supply chain behaviours. The report also provided future trends in supply chains, drawing an example from the Web3 space where businesses are now able to explore more secure data infrastructures for supply chains by embedding NFTs within supply chain digital twins.

<sup>32</sup> Barykin SY, Bochkarev AA, Dobronravina E, Sergeev SM. The place and role of digital twin in supply chain management. Academy of strategic management journal. 2021;20:1-19.

<sup>33</sup> Gaggioli A. Digital Twins: An Emerging Paradigm in Cyberpsychology Research? Cyberpsychology, Behavior, and Social Networking. 2018;21(7):468-9.

<sup>34</sup> Digital CBD Project Report 3 Towards just and resilient supply chains for the Digital CBD

<sup>35</sup> Barykin SY, Bochkarev AA, Kalinina OV, Yadykin VK. Concept for a Supply Chain Digital Twin. International Journal of Mathematical, Engineering and Management Sciences. 2020;5(6):1498-515.

<sup>36</sup> Wang Y, Wang X, Liu A, editors. Digital Twin-driven Supply Chain Planning 2020 2020: Elsevier B.V.





**Digital twins can also be used at scales beyond industrial contexts, for example to model a city.**

City-scale Digital Twins (CDTs) are anticipated to accurately reflect and affect the city's functions and processes to enhance its planning, visibility, realisation, operability, management and development.<sup>37</sup>

City-scale Digital Twins are digital representations or 'virtual replicas', of cities and are currently linked to the next generation of urban models that draw on real-time sensory data (IOT), big data analytics, 3D visualisation and automation.

A city's products, processes and services obtain a digital shadow. Through this digital shadow they become intelligent, autonomous, interconnected and integrated, the effect of which can facilitate ecological and social improvements.<sup>38</sup>

<sup>37</sup> Shahat (n 31)

<sup>38</sup> Gassmann O, Böhm J, Palmié M. Smart cities: introducing digital innovation to cities: Emerald Group Publishing; 2019.

<sup>39</sup> Nochta T, Wan L, Schooling JM, Parlikad AK. A Socio-Technical Perspective on Urban Analytics: The Case of City- Scale Digital Twins. Journal of Urban Technology. 2021;28(1/2):263-87.

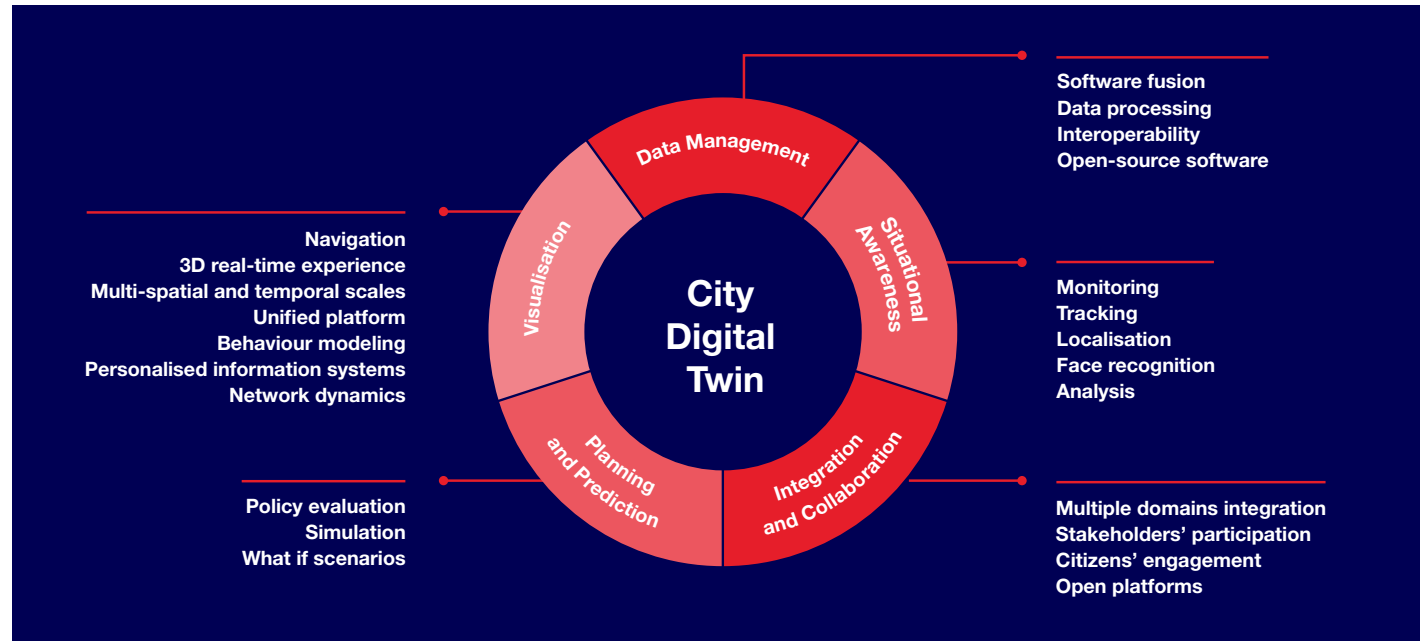


Figure 1 - City Digital Twin potentials<sup>42</sup>

City-scale Digital Twins certainly offer many benefits—for example, in terms of speed of identifying issues, automated data systems can highlight certain crises on the ground in real time.

For long term resilience of a system, data modelling from a city's digital twin can simulate and test scenarios, providing suggestions for tweaking systems in the present to maximise the potential for optimal outcomes in the future.

They can also be used as simulation and management environments to develop scenarios in response to policy problems.<sup>39</sup>

The ability to integrate several data models across time and space and present the information on a single 3D model enriches the exploration, understanding, and foreseeing of current and future trends of the city's operations.<sup>40</sup>

Some of these and other potentials are laid out by Shahat et al<sup>41</sup> in Figure 1 above.

<sup>40</sup> Shahat (n 31)

<sup>41</sup> CDSILA. CDSILA Digital Twin: Centre for spatial Data Infrastructures and Land Administration, University of Melbourne; 2020

<sup>42</sup> LandVic. Digital Twin Victoria: Victoria State Government, Environment, Land, Water and Planning; 2022

More specific to the Victorian context, a digital twin platform was developed by academics at the University of Melbourne in response to requirements for finding, accessing, aggregating, and visualising different datasets maintained and hosted in disparate databases across state and local governments and other data custodians.<sup>43</sup>

Taking this city modelling a step further, Digital Twin Victoria (led by Land Use Victoria) seeks to recreate Victoria online so that government, industry and the community can collaborate through shared open data, technology and algorithms, to enhance ‘real world outcomes’.<sup>44</sup>

The Digital Twin Victoria program aims to bring together rich 3D and 4D spatial data, as well as AI and sensor data from across the State to visualise and model places virtually.

This initiative is purported to enable intelligent planning and development solutions, unlock greater savings and efficiencies across entire asset life cycles, provide advanced algorithms and artificial intelligence that support faster, more robust regulatory assessments and compliance monitoring, like the eComply project,<sup>45</sup> and fuel the State’s startup ecosystem to create more skills and attract investment, a point we take up later in this report when discussing entrepreneurial infrastructures.

What appears to be missing in the city’s narrativisation of the digital twin is a sense that the city is a living system stratified by many forms of social inequality, limited avenues for meaningful involvement of citizens in technological decision-making, and consumptive practices that take away from its sustainability and ability to regenerate.

Shahat et al<sup>46</sup> highlight that the city is not an automated system that can be easily understood and predicted, but rather a living system that evolves every day through variations and developments of its physical constructs, economic and political activities, social and cultural settings and ecological systems.

**This latter point raises an important consideration that no matter how effectively a digital twin might mirror certain material aspects of the city, there are multiple social and living infrastructures that cannot be identified as a part of this twinning endeavour.**




<sup>43</sup> CDSILA. CDSILA Digital Twin: Centre for spatial Data Infrastructures and Land Administration, University of Melbourne; 2020

<sup>44</sup> LandVic. Digital Twin Victoria: Victoria State Government, Environment, Land, Water and Planning; 2022

<sup>45</sup> LandVic. eComply: Victorian State Government, Environment, Land, Water and Planning; 2022

<sup>46</sup> Shahat (n 31)



How we see digital infrastructures change according to what we are looking at.

Different aspects of digital infrastructures will become salient depending on how we are looking at them.<sup>47</sup> If we consider digital infrastructures as tools, we may begin to focus on physical qualities or how the tool works to augment human abilities. As a tool for connecting people, the internet reaches across the globe. As a tool for transmitting data, the speed of the pipelines or conduits for information become relevant. As a tool that replaces human cognitive capacities to analyse massive datasets, a salient consideration might be the precision of these calculations, or a concern for the lack of transparency in how the tool works.

If we see digital infrastructures as places, we might focus on their spatial dimensions, shapes or boundaries, which enable certain movements or actions while limiting others. Focusing on the platforms that supports interactions between people may highlight how these digital spaces compare to face-to-face forms of engagement or facilitate a sense of presence.

Focusing on digital infrastructures as ecosystems draws attention to how information or energy flows through these spaces, or how people enter and exit, or how these places evolve.

When digital infrastructures are so common and interwoven into everyday life – from individual behaviours to city functions, they become less visible as tools and are simply a way of being. When focusing on the vibrancy or life of the city, for example, we may not recognise or focus on the densely overlapping digital infrastructures that support this vibrancy. Instead, we just live in the connected environment. If we think of it as a way of being, we might focus on how its even basic aspects of everyday life depend on these digital infrastructures.

Building robust and resilient digital infrastructures may require us to pay attention to all three concepts at different times – as tools, places, or ways of being – to zoom in on particular aspects of what they are doing, or how well they are doing it.

We illustrate digital infrastructures as a tool, place, and way of being through case studies on work, entrepreneurship, and engagement with the city.





Case study I:

# Digital infrastructures extend the 'place' of work



# The twin shocks disrupt working environments

**The shift to WFH has been fuelled by technology advances and lifestyle preferences, among other factors.**

During the extended lockdowns, our work environment changed dramatically,<sup>48</sup> making working from home one of the defining trends of the pandemic.<sup>49</sup> As lockdowns were enforced, those who could work from home did... and felt more productive but gained weight(!).<sup>50</sup> Estimates indicate approximately 40% of workers are in occupations suited to home working, both internationally and in Australia.<sup>51-52</sup>

While increased work from home practices were expected under these conditions, they can be situated in a longer and global trend. For example, Doling and Arundel<sup>53</sup> found that by 2015, about one in six European Union workers were working at home. Similar research suggests that home-based work – also known as work from home (WFH) – is an increasingly popular form of work in cities.

This shift has been fuelled by technology advances and lifestyle preferences, among other factors.<sup>54</sup> It is expected that the forced experiment in working from home during the pandemic will result in an ongoing shift to working from home for part of working weeks.<sup>55</sup> Early findings from the 2022 Digital CBD survey provides insights about Melbourne-specific trends for post-pandemic work.

These insights include how much residents work from the office (WFO) versus work remotely (WFH/WFA), how they felt about their work time and locations recently, and how they would like to balance home and office-based work in the future.

**78.7%**

Melbourne residents reported being in the workforce. Of these...

**46.5%**

reported working full-time

**26.6%**

reported working part-time or casually.

In the past three months, Melbourne residents who worked, reported typically spending on average of just over three days a week in their primary workplace.

**45.9%**

respondents' primary workplace was the CBD

**12.5%**

were full-time working in the CBD on a typical week.

<sup>48</sup> Umishio W, Kagi N, Asaoka R, Hayashi M, Sawachi T, Ueno T. Work productivity in the office and at home during the COVID-19 pandemic: A cross-sectional analysis of office workers in Japan. *Indoor Air*. 2022;32(1).

<sup>49</sup> Patanjali S, Bhatta NMK. Work from Home During the Pandemic: The Impact of Organizational Factors on the Productivity of Employees in the IT Industry. *Vision*.0(0):09722629221074137.

<sup>50</sup> Guler MA, Guler K, Gulec MG, Ozdoglar E. Working from home during a pandemic: investigation of the impact of COVID-19 on employee health and productivity. *Journal of Occupational and Environmental Medicine*. 2021;63(9):731-41.

<sup>51</sup> Dingel JI, Neiman B. How many jobs can be done at home? *Journal of Public Economics*. 2020;189:104235.

<sup>52</sup> Ulubasoglu M, Onder Y. Teleworkability in Australia Melbourne: The Conversation; 2020

<sup>53</sup> Doling J, Arundel R. The Home as Workplace: A Challenge for Housing Research. *Housing, Theory and Society*. 2022;39(1):1-20.

<sup>54</sup> Zenkteler M, Darchen S, Mateo-Babiano I, Baffour B. Home-based work in cities: In search of an appropriate urban planning response. *Futures*. 2022;135:102494.

<sup>55</sup> Barrero JM, Bloom N, Davis SJ. Why working from home will stick. *National Bureau of Economic Research*; 2021.

The primary benefits associated with the workplace from the survey respondents were physical comfort (ergonomics, facilities), psychological comfort (wellbeing and belonging), having a boundary between work and home and contact with colleagues.

Contact with colleagues is also seen as a primary motivation for employers encouraging workers back into the office, even if not for the entire working week,<sup>56</sup> with one employer indicating that work location should respond to the requirements of the tasks to be undertaken.<sup>57</sup>

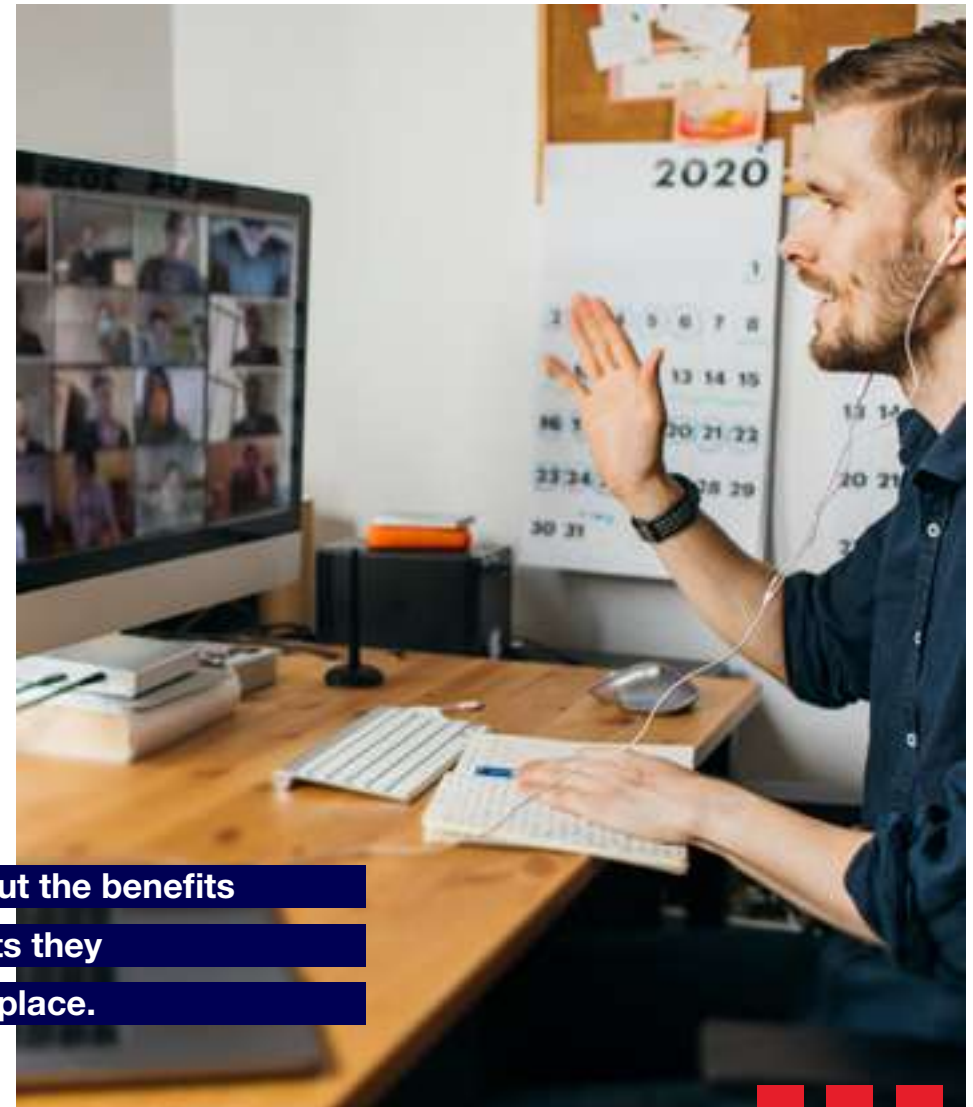
On average, Melbourne residents spent 1.8 days a week working from home. The benefits they found most important on average when working from home were a comfortable environment to work from, no commute time, flexibility and time with family.

A majority of the sample (91.3%) indicated that increased productivity was (moderately, very or extremely) important when working from home. This benefit is significant as it is a prominent factor in businesses' consideration of home working.<sup>58</sup>

In general, people felt more strongly about the benefits of working from home than those benefits they identified as being important in the workplace.

So, it is no surprise that when asked how important it was to have the choice of whether to work from home or the office in their current or future potential job, over three quarters (78.2%) thought it was (moderately, very or extremely) important.

**In general, people felt more strongly about the benefits of working from home than those benefits they identified as being important in the workplace.**



<sup>56</sup> Productivity Commission. Working From Home: Research Paper. Canberra: Australian Government; 2021.

<sup>57</sup> Wood M. NAB to embrace hybrid working permanently with new Sydney and Melbourne offices: Australian Broker; 2021

<sup>58</sup> Productivity Commission (n 55)





To unpack the notion of digital infrastructures as a place of work, we look at the visible manifestation of digital infrastructure interfaces in the home-based work environment.

These interfaces can extend the office-based workplace into the home environment and complicate the 'where' of where we work. This was especially evident at the beginning of the pandemic in early 2020 where the personal, intimate space of the home collided with the professional public space of work.

The following evidence discussed draws on original research by DERC researchers on two different but related projects about remote work and working from home:

- 1. The 2020-2022 'eChange' project** focused on remote workers who relocated rurally while keeping their city jobs. This project was conducted by Andrew Glover, Tania Lewis and Julian Waters-Lynch and funded by the Australian Communications Consumer Action Network (ACCAN) – the Australian body representing consumer concerns in the telecommunications realm. The project included 21 households in New South Wales and Victoria and remote workers in Queensland. The investigators also conducted interviews with stakeholders who were broadly involved in or affected by the e-change movement, including local government and planning personnel, small businesses and proprietors of regionally based co-working spaces.
- 2. The 'Shut-In Worker' project** focused on working from home and digitally enabled labour practices during COVID-19. Conducted by Tania Lewis, Indigo Holcombe-James and Andrew Glover in 2020, this study included 12 households in New South Wales and Victoria over several months during the most intense moments of the pandemic lockdown period.

Both projects used online ethnographic methods to capture the experiences of employees working from home through two online interviews held several months apart, household walk throughs via video conferencing software and collecting diaries and pictures from householders.

In these studies participants found themselves engaging in an unexpectedly diverse array of skills and practices to organise and self-manage including IT management, the coordination and set up of workspaces such as dealing with ergonomic issues, provisioning of food and other goods and services and handling utilities and energy use.

To illustrate the challenges and considerations of extending decentralised and digital working practices into the home environment, the following discussion presents participants' experiences.

These discussions are underscored by the intimate negotiations that occur between family members when video meetings become prominent and mindsets adjust to undertake paid work from the home as well as the increased costs that working from home incurs in terms of internet and electricity consumption.

'Because I'm on videos all day, the desk setup meant that my camera was facing the opposite way. So right now you're looking out into my balcony. But before I was like looking back into the room, which created, like this really strange environment for my partner because they had to be cautious walking around the house.'

And that went on for about a month before we eventually swapped how the table was set up, so that I could move my workstation looking out here, so that they could walk around the house without kind of having to tiptoe to make sure that I'm not on meetings and make sure that they're not on camera.'

**Rohan, Shut-In-Worker study**

Rohan, a participant in the Shut-in-Worker study articulates the struggle many of us faced when conducting video meetings with our colleagues while family members also occupied the home.

From Rohan's experience we can see that when digital infrastructures for remote work become a surveillant eye into our home spaces, this reshapes how people use their homes to avoid intrusion into their personal lives.



### **Digital infrastructures must adapt to commuting corridors**

In the eChange study participants discussed the challenges of working on the commute to and from regional areas by train, and the need for digital infrastructures to be more effectively entwined in public transport.

'The train is dreadful compared to Europe. We really need to do something about improving high speed rail infrastructure if we're going to grow regional areas. Ten and a bit hours, no Wi Fi in the train – using digital hotspot dropping in and out, but I could still work down and back by being on the train and not having to drive.' (Leah, eChange)

The eChange study prompts thinking about the growing number of ostensibly city workers who are dispersed remotely and how the digital CBD might accommodate them literally and figuratively into the future as mobility and work become increasingly entwined.

Digital nomads and e-changers still have strong ties to cities and see themselves in many ways as living across urban-rural spaces. How might digital infrastructure deal with/support this new reality?

Access to work environments through the interfaces of digital infrastructures in our homes is not equally experienced by all. In both the e-change and Shut-in Worker studies, participants faced practical considerations for working from home in terms of increased costs, setting up the internet in regional locations and supporting co-workers to come up to speed on using the technology.



**Kelly, a participant in the Shut-In Worker study, discusses the increased costs of getting an internet connection that made it viable for her to work from home during the lockdowns.**

'I had to buy a new package. So, I was on like a \$49 plan, which was absolutely adequate for all of my streaming needs and everything. We have by no means skimped, but as soon as we went online, it was clear that that was not going to be good enough. We've got NBN but even with NBN it wasn't, I had to go up to like \$100 extra fast blah-di-blah plan. So double, Yeah, double the cost of my Internet.'

**Kelly, Shut-In-Worker**

**For those working remotely from regional areas, reliability as well as cost of the internet became a consideration.**

**Angela, a participant in the eChange study who had moved to a rural area, talked about the impact of unreliable internet on her productivity.**

'I was remembering that three-week period where I was having that terrible internet. I guess it depends on your perspective of what productivity is... so the employer is still receiving what they need to receive, except for perhaps a couple of [video based] face to face meetings. But for me, I had a longer day, because things were a bit slower.'

**Angela, eChange**



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**In regional areas, mobile phone coverage is also variable, depending on the provider. This coverage variability has implications for using a work assigned mobile phone for regional workers, as Katie, a participant in the eChange study, mentioned.**

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'Now my work phone is with Optus and my private phone is Telstra and Telstra would give me more reliable service. We've always had that perception in our house anyway, I don't know why. But I would find that sometimes I couldn't use my work phone effectively, I would have to use my personal phone, which isn't a problem, but just different providers, which I find quite interesting... So I definitely find that Optus out in the rural locations is worse than Telstra.'

**Katie, eChange**

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**Finally, in the Shut-In Worker study, Jess highlighted how co-workers assisted older colleagues to learn how to use the remote work technologies as they transitioned to working from home.**

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'But I know a lot of my other friends who work for kind of older lawyers, now that they don't really know what to do with the technology, they're appreciating their assistance more. Yeah, most people are kind of, like, especially the older lawyers, really, really grateful for us, because we're like, 'Okay, this is how you do it. This is how you take the call.'

**Jess, Shut-In Worker**



Doling and Arundel<sup>59</sup> argue that using the home as a workplace introduces a third element of housing as capital good. Thus, housing holds the same characteristics as other 'capital goods' such as offices, factories, and machines, in that it contributes to producing goods and services.

This means that housing may have a value, in addition to the consumption of a flow of services and its investment potential, by virtue of its use as an input to production; with the physical structure of the house providing not only somewhere to live but also somewhere to work to obtain an income.<sup>60</sup>

The focus of these two studies was on how people managed working from home via digital technology, with this focus evolving to look at the reconfigured role of home life more broadly. What the working from home experiences gathered in these studies point to is a reconfiguration of domestic space through shifts in practices in and around the management of 'living infrastructures' and 'everyday economies'.<sup>61</sup>

These living infrastructures are now an extension of our work environments and a location of both knowledge and value production for the city.

The critical conclusion for this report is that digital infrastructures undergirding our work environments must now be understood to extend into living infrastructures – our homes.

**The home is now both a site of consumption**

**and leisure as well as a site of value**

**production for the economy.**



### **Technological innovation is responding to these changes**

It is noteworthy that during the pandemic there was an increase in patent applications related to home working.<sup>62</sup>

In line with the documented increase in innovation to support working from home, the Productivity Commission<sup>63</sup> refers to a second wave of home-working experimentation post-pandemic, as the costs and benefits for both workers and employers of flexible and hybrid arrangements are assessed.

<sup>59</sup> Doling (n 51)

<sup>60</sup> Ibid

<sup>61</sup> Lewis T, Holcombe-James I, Glover A. More than just 'working from home': domestic space, economies and living infrastructures during and beyond pandemic times. Cultural Studies. Forthcoming.

<sup>62</sup> Bloom N, Davis SJ, Zhestkova Y, editors. Covid-19 shifted patent applications toward technologies that support working from home. AEA Papers and Proceedings; 2021.

<sup>63</sup> Productivity Commission (n 55)

## The purpose of the city must evolve



The Digital CBD survey suggests that Melbourne is similar to other cities globally, shifting toward ‘new normal’ scenarios whereby work includes a greater mix of remote-from-home than prior to the forced experiment.<sup>64-65</sup>

This is an important consideration for the city, as it indicates a changing relationship of metro, urban and regional residents with the CBD. Melbourne residents indicated that work was still the most prominent driver for engagement with the city, with an average of 9.8 hours being spent in the CBD working on a typical week for the employed people in the survey sample – this increases to 16.8 hours for the 45.9% of workers who indicated that the CBD is their primary workplace.

The Digital CBD survey findings suggest that Melbourne residents have a preference towards being able to choose in the future whether to work from home or the office.

What the impacts of the continuation of decentralised workplaces are for the Melbourne CBD, and whether residents will continue in this way, are still to be understood.



However, as the prevailing opinion is that hybrid working modes will become the norm post-pandemic,<sup>66-67</sup> the implication is that the workplace function of the CBD will be diminished. This is borne out in the survey results: 60% agreed that their own suburb is the CBD of most of their everyday life and just under half thought the city was less important than before the pandemic.

This suggests a shift of not just workplaces out of the city, but also the service, retail and hospitality industries that supported CBD workers to fulfill their day-to-day needs.

It may also indicate a shift to co-working hubs across Melbourne’s suburbs as an intermediate option between home and office.

This shift may also influence residential choices as the commuting burden diminishes with home working.<sup>68</sup>

As the ongoing experiments with working from home take hold, the changing residential and employment geographies of the city and surrounding regions will become more apparent.

Considering the work from home trends and experiences discussed above, digital infrastructures of a city must support the economic productivity of a city through their interwovenness with living infrastructures that house a decentralised workforce.

<sup>64</sup> Florida R, Rodríguez-Pose A, Storper M. Cities in a post-COVID world. *Urban Studies*. 2021;0(0):1-23.

<sup>65</sup> Denham T. The limits of telecommuting: Policy challenges of counterurbanisation as a pandemic response. *Geographical research*. 2021;59(4):514-21.

<sup>66</sup> Barrero (n 53)

<sup>67</sup> Productivity Commission (n 55)

<sup>68</sup> Denham (n 64)





The replacement of commuting with videoconferencing and robust platforms for interacting and file sharing implies a changing relationship between work and residential locations, recalling the earlier reshaping of cities with improvements in transport and telecommunications.<sup>69-70</sup>

Attending closely to where existing digital infrastructures are strong and weak can help the city evolve alongside these emerging ecologies. The plight of the CBD is also of concern as the reduction in office working time, along with the reduction in international students who resided in the CBD and added vitality to it,<sup>71</sup> impacted the viability of retail, service, hospitality and cultural sectors.

<sup>69</sup> Walker RA. A theory of suburbanization: capitalism and the construction of urban space in the United States: Routledge; 1981.

<sup>70</sup> Jackson KT. Crabgrass frontier: The suburbanization of the United States. Oxford: Oxford University Press; 1985.

<sup>71</sup> Hurley P. Coronavirus and international students. 2020.



Case study II:

**Digital infrastructures  
connect and coordinate  
entrepreneurial ecosystems**



The past two years of twin shocks caused by the collision of COVID-19 and accelerated technology adoption has been tough on small businesses, startups, creative workers and the entrepreneurial ecosystem overall.

In consultation with local tech startups and stakeholders in Melbourne in early 2022, it became clear that founders were seriously impacted by the long lockdowns. For example, the lack of access to co-working spaces and in-person networking events during city-wide lockdowns reduced network building and limited access to necessary talent/employees. On the positive side, shifting online and adopting digital tools increased online collaborations that further strengthened local-global opportunities.

Entrepreneurs in tech startups reported challenges in being able to test their products with consumers and generate case examples of real-world application of their products. They also felt the daunting challenges of being unable to effectively build or sustain connection and collaboration with corporate partners and venture capital firms.

These challenges should not be dismissed as only a result of Melbourne being in lockdown.

Our research highlights that many of the challenges felt by these sectors are not new, but ongoing issues, characteristic of many global cities, Melbourne included. In this case study, we address this topic of the critical importance of digital infrastructures for early-stage technology startups and clarify how digital infrastructures are essential tools for providing interconnectivity and coordination between various layers and elements of the entrepreneurial ecosystem to support a stronger commercialisation lifecycle.

There is high value in the more informal capabilities brought by relationships and partnerships. Beyond money, a venture capital system will bring an already thriving network of investment, talent access, networks and corporate partners. Moreover, larger venture capital firms will have access to affordable services that support the development of a viable business model, marketing strategies, meeting accounting needs and ensuring legal coverage of contracts and terms of service. This is only one example of an infrastructure within the larger entrepreneurial ecosystem that requires nurturing by cities. **Digital infrastructures are tools of connection and coordination.**

A thriving entrepreneurial ecosystem incorporates conditions and practices that create a fertile environment for entrepreneurial activity, a key element of innovation, within a city.

**A key challenge for Melbourne's entrepreneurial ecosystem is enabling startups to move effectively through the full lifecycle of commercialisation.**







The insights presented in this section draw initially from consultation with founders of early-stage technology startups, industry stakeholders in the Melbourne startup scene and leading academics in the field during early 2022.

Focusing on startups is not meant to disregard more traditional entrepreneurial activities or social and creative entrepreneurs, but to draw attention to key challenges in the highest growth sectors.



### **The role of social and creative entrepreneurship**

The type of entrepreneurship generally considered to best serve a city is 'productive' or 'high-growth' entrepreneurship. This type of entrepreneurship contributes either directly or indirectly to the net output of the economy or the city's capacity to produce additional output and includes most startups.

In addition an important type of entrepreneurship that serves a city is social or creative entrepreneurship, in which entrepreneurs generate both economic and social value. This goes beyond entrepreneurship-driven economic development (measured through GDP and productivity growth or higher employment rates for example) to also include how entrepreneurial activity can impact the social and institutional fabric of a city in the dimensions of well-being and addressing social inequality.

A Melbourne based example of this type of social or creative entrepreneurship is Kinfolk Cafe (which unfortunately closed during the pandemic).<sup>72</sup> While neither 'high growth' nor startup, it supported and built the cultural and social fabric of the city. Kinfolk was also a hub for many entrepreneurs.

Examples of social entrepreneurship focused on solving social issues in ways beneficial to the city can be drawn from other contexts, such as the Bangladeshi startup, Women in Digital, whose focus is on bringing more women into the digital economy and addressing the gender divide within the IT sector.<sup>73</sup>

Similarly, startups can be incentivised to build business solutions and services for the needs of the city, for example an industry stakeholder pointed to the opportunity for startups to provide waste solutions for Melbourne.

<sup>72</sup> La Ruffa N. Cheery Social-Enterprise Cafe Kinfolk Is Closing This Month, After More Than a Decade: Broadsheet; 2021

<sup>73</sup> WID. Women in Digital: Women In Digital: 2022



## We must build more effective digital infrastructures

**These dynamic systems of interconnected infrastructures have been shown to undergrid high-growth entrepreneurship.**

The entrepreneurial 'ecosystem' metaphor has grown in popularity<sup>74</sup> to highlight the complex and dynamic relations between the sets of actors, institutions, social networks and cultural values that produce and sustain entrepreneurial activity.<sup>75</sup>

In Silicon Valley, Bahrami and Evans<sup>76</sup> found not only deep reservoirs of venture capital, which is one part of the system, but also connected systems of knowledgeable talent and labour, research institutions, professional services and informal networks of innovation leaders.<sup>77</sup>

These and other advances in systems thinking shift analysis and planning from a focus on individual entrepreneurs and ventures to a focus on entrepreneurial ecosystems.<sup>78</sup>

This broader community perspective towards entrepreneurship incorporates the role of social, cultural and economic forces alongside infrastructure and institutions in the entrepreneurship process.

An ecosystem approach emphasises the importance of underlying infrastructures. To this end, French et al<sup>79</sup> suggest that rather than waiting for ideas and innovations to be 'discovered' by suitably motivated social entrepreneurs, founders and convenors of social innovation ecosystems should invest in the supporting ecosystem elements.

In this way, multiple infrastructures – networks, flexible funding, relevant training, access to knowledge bases and development opportunities – are better coordinated. This direction is also useful when thinking about what role digital infrastructures of a city can take to support innovation in the Melbourne entrepreneurial ecosystem.

<sup>74</sup> Stam E, van de Ven A. Entrepreneurial ecosystem elements. *Small business economics*. 2021;56(2):809-32

<sup>75</sup> Roundy PT, Bradshaw M, Brockman BK. The emergence of entrepreneurial ecosystems: A complex adaptive systems approach. *Journal of Business Research*. 2018;86:1-10.

<sup>76</sup> Bahrami H, Evans S. Flexible Re-Cycling and High-Technology Entrepreneurship. *California Management Review*. 1995;37(3):62-89.

<sup>77</sup> Kenney M, von Burg U. Technology, entrepreneurship and path dependence: industrial clustering in Silicon Valley and Route 128. *Industrial & Corporate Change*. 1999;8(1):67

<sup>78</sup> Roundy (n 74)

<sup>79</sup> French M, McGowan K, Rhodes ML, Zivkovic S. Guest editorial: Complexity as a model for social innovation and social entrepreneurship: is there order in the chaos? *Social Enterprise Journal*. 2022;18(2):237-51.

The term ecosystem implies significant complexity. When used to describe ecological, biological or social systems, the concept emphasises how the entities and subsystems within an ecosystem are numerous, dynamic and have complex interdependencies.<sup>80</sup> Roundy et al<sup>81</sup> demonstrate that entrepreneurial ecosystems are complex adaptive systems because they possess the properties of self-organisation, open-but-distinct boundaries, complex components, nonlinearity, adaptability and sensitivity to external or internal conditions that will disrupt or alter the system overall. From this position, entrepreneurial success relies on more than the intentions or drive of entrepreneurs.

Success relies on the ability of the infrastructures in the ecosystem to support the growth and evolution of entrepreneurial entities. The point of this report is to clarify the increasingly vital role of digital infrastructures as support within the overall Melbourne entrepreneurial ecosystem.



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### **Digital twins to anticipate investment in the ecosystem and improve coordination of the ecosystem.**

Productive and high growth entrepreneurship, most often associated with a startup, is considered central to thriving city economies.

A key challenge for successful startups is that they move rapidly in and through larger ecosystems that may not yet be transformed enough to accommodate their particular infrastructural support needs.

For example, an entrepreneurial ecosystem for high-growth startups must support the entry of new ventures as well as the exit of successful firms out of it. This lifecycle occurs through supporting relationship building between investors and founders, as well as ensuring market-fit that sees innovative products and services move from early prototypes to serving local, national, and global markets.

**Startup lifecycles can be improved by building and monitoring interdependent infrastructures.**

<sup>80</sup> Cavallo A, Ghezzi A, Balocco R. Entrepreneurial ecosystem research: present debates and future directions. *International Entrepreneurship and Management Journal*. 2019;15(4):1291-321.

<sup>81</sup> Roundy (n 74)



This process is a critical part of what enables the 'recycling' of wealth, contacts, and knowledge from successful entrepreneurs, who then become investors and mentors of the next generation.

**This process of wealth recycling is a prime example of how cycles of interdependencies in ecosystems operate as connected and collaborating subsystems.**

All systems rely on all other systems. This wealth and reinvestment life cycle likewise cannot function properly if not supported by other social infrastructures such as networks, or knowledge infrastructures such as how to find flexible funding, connect with and access talent, expedite certain bureaucratic tangles, or stay ahead of the technology curve with constant skilling-up.

Startups require funding across the startup financing cycle, with angel investors being funding sources at the early stage while typically venture capital enters in at the commercialisation stages once startups have viable and tested products or services.

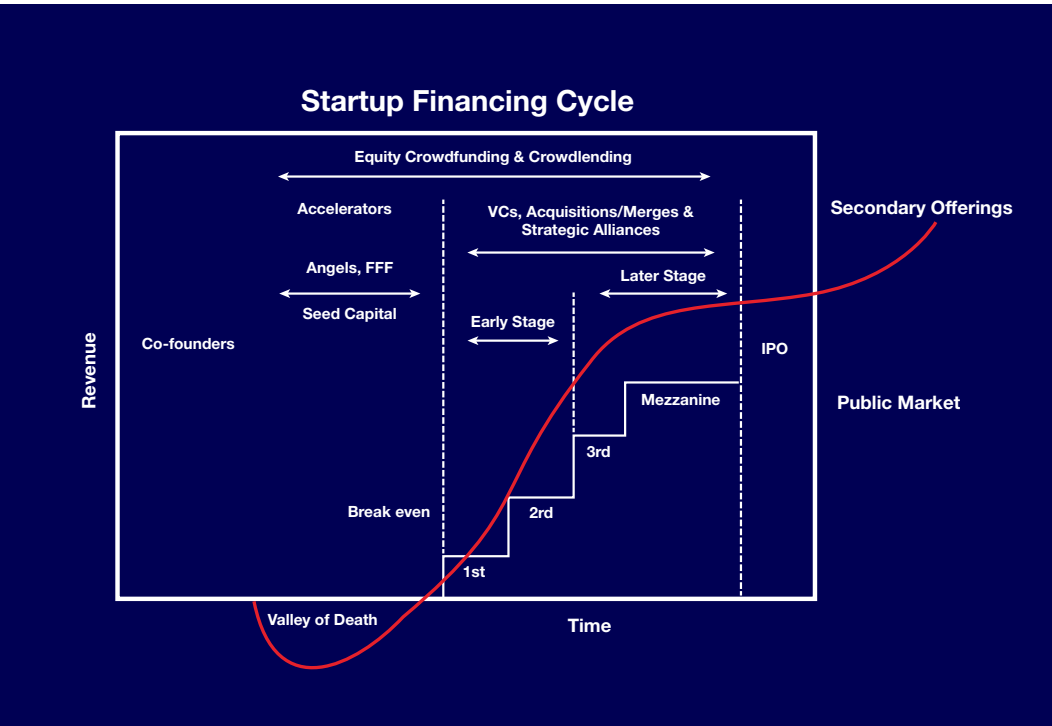


Figure 2: The start up financing cycle and the Valley of Death<sup>83</sup>

Narratives such as 'bootstrapping' and 'side hustle' proliferate for early-stage founders, who may face the Valley of Death as they transition from public sector to private sector funding<sup>80</sup> see Figure 2.

Having a healthy ecosystem that supports wealth recycling through the exit of successful firms, who then become investors and mentors, will reduce this risk.

Some cities have dealt with the rapidly shifting challenges of supporting startups by creating digital twins of their city, a process of identifying layers of digital connections and data analytic capabilities across the city, which in a way makes more visible essential flows of data and networks of information that can be tracked, monitored and drawn upon when needed.

<sup>82</sup> Kam-fai MT. 15 - Commercialization of rehabilitation robotics in Hong Kong. In: Hu X, editor. Intelligent Biomechatronics in Neurorehabilitation: Academic Press; 2020. p. 241-58.

<sup>83</sup> Ibid



**Digital twins can capitalise  
on the computational power of  
automated decision-making systems.**

This effort to identify these often-obscured infrastructures of the entrepreneurial ecosystem can reveal blockage points, key gaps, as well as areas of strong flows and connections that might be models for other less productive elements of the ecosystem.

These systems use predictive analytic real time data flows to anticipate change and identify glitches before they happen or opportunities before they disappear. Digital twins can also model relationships between entities in the system, not only in a current snapshot, but over time.

This becomes a useful way to connect critical elements across subsystems in the overall ecosystem, such as physical structures, owners and founders and networks of potential and actual funders.

It is also a fruitful tool for amplifying action within certain areas, building better possibilities for self-organisation and building in mechanisms that automatically observe and monitor various system functions and processes.

This feedback signals to the city as well as other stakeholders in these entrepreneurial ecosystems when things are working seamlessly as well as when they are not.

The ability for a digital twin to capture the growth of startups and track their transition towards commercialisation through to an Initial Public Offering (IPO), would then support anticipating this wealth recycling process and signal the potential growth in funding (Angel Investment Network and the emergence of venture capital) that could enter the ecosystem.



Victoria has a diverse startup ecosystem and is home to more than 2,600 startups that are rapidly driving a digital economy.<sup>84</sup> Melbourne is renowned for its innovative ideas, given that it is a university town, but still faces the challenge to improve its commercialisation of these ideas. In an early report comparing the Australian start up scene to other countries, fewer than 5% of Australian startups were scaling into sustainable, global businesses.<sup>85</sup> While this challenge may not be historically Melbourne-specific, it remains relevant for the Melbourne entrepreneurial ecosystem.



Melbourne is a thriving hub for startups across an array of sub-sectors including Life Sciences, SaaS, AI, blockchain, Advanced Manufacturing, IoT, big data and fintech. Victoria is also the home to some of Australia's most successful startups including REA Group, CarSales, MECCA, Mr Yum, SEEK, Lord of the Fries, Judo Bank, VinoMofo, Kester Black and Red Bubble among many others.

A recent report led by LaunchVic and Dealroom<sup>86</sup> suggests that the Victorian startup sector is the State's new jobs' growth engine. However, an earlier ecosystem mapping exercise by Launch Vic (2018) found that startup and scaleup density is lower in Melbourne compared to other cities.

In terms of investment and funding opportunities, Victoria has over 50 accelerators and nearly 500 VC investors.<sup>87</sup> The 2018 Victorian Startup Ecosystem Mapping Report<sup>88</sup> found that while a strong supply of venture capital is fuelling scaleups, the investor landscape for startups needed to be grown to secure commensurate growth. Victoria's government startup agency LaunchVic, received funding of \$110.5 million in the government's 2020-2021 budget. Of this, \$60.5 million was allocated to the Victorian Startup Capital Fund – a Fund of Funds<sup>89</sup> designed to catalyse investment in early-stage startups and \$10 million was earmarked for the Women's Angel Sidecar Fund to support female founders.

<sup>84</sup> Genome S. Melbourne, Australia: Startup Genome; 2022

<sup>85</sup> Morie P, Kitschke Z, Jones A, Tanchel J. Silicon Beach, Building momentum: A study of the Australian Startup Ecosystem. 2012.

<sup>86</sup> LaunchVic, Dealroom. Startup employment in Victoria, Australia. 2021 July.

<sup>87</sup> WadeInstitute. An introduction to Melbourne's startup scene: Wade Institute; 2020

<sup>88</sup> Victorian Startup Ecosystem Mapping Report 2018

<sup>89</sup> Victorian Startup Capital Fund – a Fund of Funds





Other local factors such as the impacts regulatory frameworks have upon the entrepreneurial ecosystem, are particularly relevant for technology startups pursuing Web3 products and services. The challenge for the regulatory environment is to 'keep up' or anticipate as new technologies emerge. While entrepreneurs in this space can take advantage of being a first mover, they face the challenges of operating in a regulatory grey zone.

Regulatory sandboxes for technology-oriented startups extend how entrepreneurs engage with digital infrastructures to generate a competitive advantage. They do this by creating fixed-duration, permissive environments for experimentation and product development to create new forms of value.

Australia was one of the early adopters of the regulatory sandbox concept: for example, the first fintech sandbox was launched here at the end of 2016, following the establishment of sandboxes in major financial centres like the United Kingdom (by the Financial Conduct Authority), Singapore (by the Monetary Authority of Singapore (MAS)) and Hong Kong (by the Hong Kong Monetary Authority).<sup>90</sup>

<sup>90</sup> Genome S. Melbourne, Australia: Startup Genome; 2022

<sup>91</sup> MAS. Overview of Regulatory Sandbox: Monetary Authority of Singapore; 2022

<sup>92</sup> Laurent B, Doganova L, Gasull C, Muniesa F. The Test Bed Island: Tech Business Experimentalism and Exception in Singapore. *Science as Culture*. 2021;30(3):367-90.

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**The MAS provides an example of how the permissive environment of their fintech sandbox is contained through the implementation of appropriate safeguards that contain the consequences of failure and maintain the overall safety and soundness of the financial system.<sup>91</sup>**

In discussing Singapore's Smart Nation program and deployment of regulatory sandboxes for tech business experimentalism, Laurent et al<sup>92</sup> observed that regulatory sandboxes are expected to attract local and international experimenters and perform demonstrations addressed to diverse audiences, made of local regulators and global investors.

**An example they provide outlines the possible advantage these permissive environments create to attract funding for startups.**



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'For instance, an entrepreneur who was in the sandbox when we interviewed her, explained to us that the fintech regulatory sandbox allowed her to put technology into the market in conditions that would have been considered 'illegal' otherwise (a license is mandatory to be able to operate in financial markets) and obtain results that could 'convince venture capitalists' who would not have been convinced otherwise (eg by a laboratory test, without people actually using the product).'



When regulatory sandboxes are accompanied by coordinated access to corporate partners and technology testbeds, as is the case in the San Francisco entrepreneurial ecosystem mentioned earlier, startups can utilise this opportunity to innovate and develop a minimum viable product with demonstrated use case scenarios.

This both gives them a development advantage and a stronger case for venture capital investment. In discussing Singapore's testing ground for microgrid technologies, Laurent et al<sup>93</sup> highlights how such facilities act to involve private companies and government partnerships in technology development which they argued had the capacity to increase Singapore's global leadership position in this market and to benefit private companies involved in the testing environment.





**The City of Melbourne has launched an emerging technology testbed initiative, which forms a part of their ‘Economy of the Future’ strategic objective (aligning with the 2021-2025 Council Plan).<sup>94</sup>**

Like the agendas put forward by Singapore’s MAS, these testbeds are anticipated to support the development of globally competitive ecosystems through international engagement, emerging technology trials and digital infrastructure delivery; as well as positioning Melbourne as an accessible and attractive environment for domestic and international startups and technology companies.

They are linking this to specific precincts within Melbourne and its surrounds, such as the proposed Cremorne Digital Hub.<sup>95</sup> Such entrepreneurialism seeks to weave the technology testbed approach into the selling and branding of the city.

Given the agenda established to drive this approach for Melbourne, it is worth understanding what the benefits and challenges are. A Swedish study evaluating 38 digital health testbed organisations provides a series of learnings and insights that identify both the benefits and challenges of testbeds to support entrepreneurial innovation.<sup>96</sup>

Within testbed collaborations, they identified the challenges of and then principles for engaging and further improving collaborations alongside the essential principle of testbed governance and management.

They introduce the concept of value co-creation in which the needs of the users and owners and matching organisational requirements with entrepreneurial ideas, strengthened product development, innovation and service and project partnership.

Jabin et al<sup>97</sup> observe that empowering and enhancing collaboration among the various stakeholders was one of the main benefits of the testbed projects.

<sup>94</sup> CoM. Emerging Technology Testbed: City of Melbourne; 2022

<sup>95</sup> DJPR. Cremorne Digital Hub: Department of Jobs, Precincts and Regions, Victorian State Government; 2021

<sup>96</sup> Jabin MSR, Nilsson E, Nilsson A-L, Bergman P, Jokela P. Digital Health Testbeds in Sweden: An exploratory study. Digital Health. 2022;8:205520762211075194.

<sup>97</sup> Ibid





We note that the many infrastructures mentioned above require clarity not just in policies and guidelines, but also in how they are made visible and mapped as part of the overall entrepreneurial ecosystem. This visibility helps build transparency and fosters commitment and trust across many stakeholder groups, their organisations, and their top management. It also supports coherence and coordination across the ecosystem that will align engagement incentives for talent, investment, professional services and corporate partnerships.

**These infrastructures can be made visible and agential by building a digital twin that both models how various elements intersect and incorporates automated decision making into feedback loops to cultivate strong ecological conditions.**



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**Effective digital infrastructures are those that are made more visible or usable for entrepreneurs.**

Having access to and awareness of these infrastructures is essential for entrepreneurs to engage early, access prior knowledge, network successfully and find suitable partners. To make sure people have equitable access to these necessary resources for the startup journey, the infrastructures must be visible and easy to navigate. This raises the significant issue of digital inclusion.

As one founder we consulted highlighted in early 2022, we still have a long way to go to achieve this with many of our indigenous population and CALD communities, 'Digitisation is in its infancy in the Aboriginal community anyway. We don't get access to what the future looks like or what the potential is' (Founder 4).

This founder pointed to the value of a concierge style service to match indigenous led startups with funding opportunities and access to expert knowledge and technologies.



Case study III:

**Digital infrastructures  
are a way of being for  
engagement with the city**



# Culture and sociality are important in the city

The pandemic resulted in the closure of theatres, studios, galleries, entertainment precincts and limited 'take away' services offered by cafés and restaurants. The shock of the pandemic has highlighted the importance of entertainment, sociality, engagement with arts and culture and informal play and pleasure in the city, by emphasising their very absence.

From the quasi-desertion of the city during periods of pandemic lockdowns to now frequent encouragements and incentives by government and business owners to return to the CBD, the city is clearly not only a centre for economic action. The city is also a social, cultural, consumptive and experiential location where people learn, play, stroll and express themselves through forms of collective action and identity building.

**The city is clearly not only a centre for economic action. The city is also a social, cultural, consumptive and experiential location.**





**As noted in previous pages, the pandemic and the augmentation of technologies in our lives, has dramatically altered how we work and live. Likewise, how we engage with the city has changed.**

So, what do people *do* in the city? We can begin this conversation by drawing on our survey of Melbourne residents and looking into what they prioritise experientially and how they imagine the city's future. Melbourne residents engage with Melbourne CBD at least weekly, on average.

They spend the most amount of time in the city working, followed by socialising with family and friends and shopping.

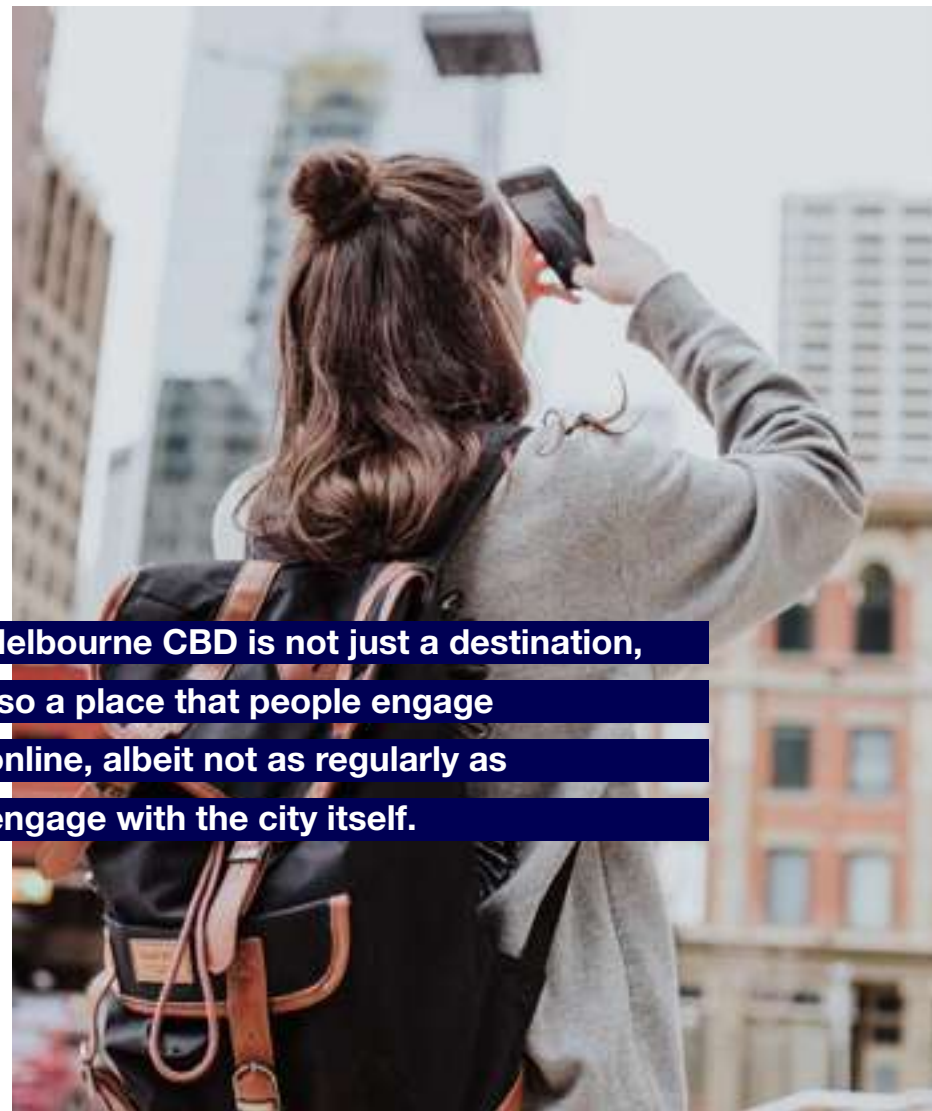
Within the CBD, Melbourne residents rated hospitality as most important followed by essential services then cultural and sporting activities. The role of digital infrastructures in evoking experience through play is important and can be most tangibly observed in the performative, immersive and engaging nature of the creative arts, cultural and sporting sectors – areas that contribute significantly to generating economic wealth in the city.

The Melbourne CBD is not just a destination, but also a place that people engage with online, albeit not as regularly as they engage with the city itself. They most regularly engaged with business or organisations in the CBD online (by apps, website or through social media) for leisure and shopping.

However, they engaged online with businesses or organisations in the CBD for these purposes on average only at least once in the last three months.

In terms of engaging with the city as a place to learn, 29.2% of Melbourne residents were students and of these, around two-thirds studied in Melbourne (60.3%). On average, they used an even mix of in person and online learning environments, with less than a fifth (17.6%) studying in person only.

For the broader population, the city represented a learning space that was very important for providing opportunities for personal growth and development and events that facilitated learning, formally or informally. They also felt that it was a very important space for children and adults to learn about art and culture.



**The Melbourne CBD is not just a destination,  
but also a place that people engage  
with online, albeit not as regularly as  
they engage with the city itself.**

### Digital transformations have become interwoven into almost every aspect of how residents live, learn, socialise and work.

This shift is recognised broadly as the 'digital age', whereby people do not just use digital media, smart devices or platforms as tools to enhance various parts of their lives, but also absorb these technological capabilities, as a 'way of being'.<sup>98</sup> Examining the infrastructural or supporting components of this way of being often requires focusing on the mundane and everyday aspects of city life.

In instances too varied and numerous to recount in full, the digital and human interact. These are often moments that would be described as ephemeral, intimate, visceral and embodied. Yet, they are moments that also invoke and access many types of digital infrastructures.

The city is characterised by its vibrancy and social effervescence – the bubbling up of a spontaneous, temporary and self-generating social energy or joining of feelings and ideas that it is communal and collective.<sup>99</sup>



Social effervescence often bubbles up during gatherings in public spaces, such as during commemoration events, sport and entertainment and protests, and is characterised by intimacy, intensity and immediacy that involves intention and symbolic focus.

This vibrancy also manifests in more localised ways when people engage in the city through public space and connective, playful and pleasurable infrastructures that speak, play and resonate with residents in an experiential way.

You might know it as a buzz of social excitement or the 'vibe' around a place or your encounters with a scene in the city, such as the music scene or movements around street art in laneways. The encounter of cultural, creative and social expression that creates this social frisson is a core attractant of a city. While such emergent events are often experienced in a moment, the impression lasts and pulls people to return and reconnect.

<sup>98</sup> Markham AN, editor *Metaphors Reflecting and Shaping the Reality of the Internet: Tool, Place, Way of Being*. Presented at the 4th annual conference of the International Association of Internet Researchers (AoIR); 2003 October; Toronto, Canada.

<sup>99</sup> Olaveson T. Collective effervescence and communitas: Processual models of ritual and society in Emile Durkheim and Victor Turner. *Dialectical anthropology*. 2001;26(2):89-124.



Importantly, the collective expression of social effervescence can be linked to the interconnections of material, social and living infrastructures. These infrastructures support the quality of life and wellbeing of our communities, directly impacting Melbourne's economy, liveability and sustainability.<sup>100</sup>

We could extend the list of infrastructures to include welfare services (social policy), grounded services (housing, utilities, health, education and care), mobility networks (transport systems), social spaces (libraries, community centres) and green infrastructure (parks, outdoor opportunities and nature-based solutions).<sup>101</sup>

How then, can digital infrastructures of a digital CBD intersect with such social moments of experience and connection?

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**As a way of being in the city, digital infrastructures stimulate playfulness and the liveliness of experience. Following these lines, for Melbourne residents in our Digital CBD survey, around a third (31.3%) thought mobile apps that can be used to enhance city-specific play, shared celebration or collective responses to crisis were important.**

In terms of designing these environments to be inclusive, 42.2% did not currently feel more included in the CBD than other areas of the city. However, technology that prioritises inclusion for greater accessibility and equity was an important trend for the future of Melbourne CBD (28.2%).



**For example, RMIT researchers sought to tackle this real-world issue of designing inclusive cities through articulating sensorial moments in the city scape for the 2019 Design Challenge.**

The project, Haptic Pathways, reimagined the suburban street creating diverse sensory experiences that include urban residents or visitors of all mobilities and neurodiversities.<sup>102</sup>

The project sought to create everyday incidental urban pathways that focus on the under-emphasised and under-explored facets of sensory connection, such as touch and smell.

These immersive nature experiences included such design elements and interventions as block plantings of native species; accessible sensory spaces; and braille graffiti walls.

<sup>100</sup> Australia I. Social Infrastructure: Australian Infrastructure Audit. 2019 October.

<sup>101</sup> Barbera F. Inequalities and Local Infrastructure: The Challenges of Post-Covid Recovery Investments: The International Spectator; 2022.

<sup>102</sup> Thomas F, Garrard G, Bekessy S, Myers Z. Haptic Pathways: Co-Designing Inclusive, Civic and Sensorial Moments in the City: DCP Design Challenge; 2019



## Digital infrastructures are immersive and playful

Digital infrastructures powered by popular technologies such as augmented reality (AR) and virtual reality (VR) can activate the potential of playfulness for the city and can produce immersive and vibrant environments for Melburnians.

Digital infrastructures can be playful and social – it is through their connectivity, sensing capacities and interactivity that a sense of collective spirit can arise.

AR can be understood as an immersive experience in mixed-reality environments. One of the most well-known manifestations of AR in everyday life is the QR (Quick Response) Code.

The application of QR code technology extends the role of the camera in the smartphone to enable it to 'read' objects.

Invented in 1994, the past two years have been marked by the pandemic practice of using one's smartphone to read the QR code and 'check in' to indicate one's 'presence' in a venue and facilitate retrospective contact tracing.<sup>103</sup>

QR codes are used in many other ways: to support value exchange through payments, which has been particularly relevant for the tourism industry<sup>104</sup> and as one of the technologies that supports contactless payment.<sup>105</sup>

The smartphone/QR code has been explored to support navigation in cities where people can read the city through their phones,<sup>106</sup> for example finding maps of a building or learning about its history in the form of interactive tourist guides.<sup>107</sup>



QR codes have also been proposed for providing information about spaces in spoken format as an aid for visually impaired people.<sup>108</sup> From these examples, we can start to understand how being in the city can be augmented by providing more layers of experience for the body in physical space, particularly as we navigate, interact with and experience material environments.

Taking a step further into a more immersive experience, VR comprises technologies that build 3D environments that can be experienced by users through sensory perception, physical movement and text or speech communication.<sup>109</sup>

These environments are a continuum from immersive virtual reality, such as headsets like Oculus Quest that act as a viewing window into a complete 360 visual environment, to mixed reality and augmented reality technologies that incorporate some qualities of immersive elements of an artificial world into the real world to add information.<sup>110</sup>

<sup>103</sup> Lucivero F, Hallowell N, Johnson S, Prainsack B, Samuel G, Sharon T. COVID-19 and Contact Tracing Apps: Ethical Challenges for a Social Experiment on a Global Scale. *Journal of bioethical inquiry*. 2020;17(4):835-9.

<sup>104</sup> McKenna B, Cai W, Tuunanen T. Technology Enabled Information Services Use in Tourism: An Ethnographic Study of Chinese Backpackers. *Pacific Asia journal of the Association for Information Systems*. 2018;10(4):37-64.

<sup>105</sup> Chang V, Chen W, Xu QA, Xiong C. Towards the Customers' Intention to Use QR Codes in Mobile Payments. *Journal of Global Information Management (JGIM)*. 2021;29(6):1-21.

<sup>106</sup> Basiri A, Amirian P, Winstanley A. The Use of Quick Response (QR) Codes in Landmark-Based Pedestrian Navigation. *International journal of navigation and observation*. 2014;2014:1-7.

<sup>107</sup> Fino ER, Martín-Gutiérrez J, Fernández MDM, Davara EA. Interactive Tourist Guide: Connecting Web 2.0, Augmented Reality and QR Codes. *Procedia computer science*. 2013;25:338-44.

<sup>108</sup> Elgendy M, Sik-Lanyi C, Kelemen A. Making Shopping Easy for People with Visual Impairment Using Mobile Assistive Technologies. *Applied sciences*. 2019;9(6):1061.

<sup>109</sup> Burdea G, Coiffet P. *Virtual reality technology*. 2nd ed. ed. Hoboken, NJ: John Wiley; 2003.

<sup>110</sup> Milgram P, Takemura H, Utsumi A, Kishino F, editors. *Augmented reality: A class of displays on the reality-virtuality continuum*. *Telemanipulator and telepresence technologies*; 1995: International Society for Optics and Photonics.

At the convergence of VR and AR is gamification, as the technologies are increasingly incorporated into gameful experiences. Gamification refers to the application of game design features, such as point-based systems, in non-game contexts.<sup>111</sup>

In marketing for example, Liu and Tanaka<sup>112</sup> have sought to integrate gamification, social interaction and a point-system based on AR to create engagement incentivisation strategies for a loyalty program.

Their elements of AR game design and the multi-user environment that drew together social cues (competitive and non-competitive interactions) and social networks, sought to establish a memorable and emotional connection between users, the system and the brand/merchant.

This however, potentially misses the notion of (digital) play, the movement from scrolling to 'strolling' and leisure in the city. The relationship between playful phenomena and gamification is important<sup>113</sup> as it can encourage more creative, individual and collective experiences of an augmented city.

Our Digital CBD survey asked people whether they engaged with leisure activities online (78.5%), used entertainment services such as streaming video or music (63.7%), attended a music arts or cultural event such as a virtual exhibition or live streamed performance (20.7%) or played games on their phones, tablets or through a gaming console (45.3%).

So, there is a strong level of existing practices amongst our population that could translate these skills into immersive and gamified environments. Almost half of the population is familiar with gaming features and gamification as a broader concept. However, over half of the population is not engaging with gamification.

### Online leisure activities and gamification

### are increasingly popular ways

### to engage with the city.



<sup>111</sup> Deterding S, Dixon D, Khaled R, Nacke L, editors. From game design elements to gamefulness: defining 'gamification'. Proceedings of the 15th International Academic MindTrek Conference: Envisioning

<sup>112</sup> Liu B, Tanaka J. Integrating Gamification and Social Interaction into an AR-Based Gamified Point System. Multimodal technologies and interaction. 2020;4(3):51.

<sup>113</sup> Deterding (n 110)



At the vanguard of digital innovation is the metaverse, which describes the aesthetic infrastructure of the digital CBD. The metaverse presents a potential for us to imagine an augmented city of the future.

Nabben<sup>116</sup> argues that the metaverse is the outcome of linking digital and physical spaces to such degrees that they are fully integrated, creating hybridised experiences. It is not a singular place, but any virtual reality (digital space) or augmented reality (physical space enhanced by a digital overlay) that is built and accessed through computer interfaces. It is constructed through the movement from a set of independent virtual worlds to an integrated network of 3D virtual worlds.<sup>117</sup>

Physical devices provide the gateway interfaces to the metaverse, including AR devices such as Ray Ban Stories smart glasses, VR goggles such as Oculus, mobile phone applications and computers. The experience of the metaverse is then facilitated by enabling technologies such as Extended Reality, AI and blockchain.<sup>118</sup>

Virtual spaces such as the metaverse can potentially transform cities, extending their spatial reach and facilitating their integration in everyday life. They may also introduce a new era in technology entrepreneurship and digital innovations, generating new business models, modes of work and leisure and cultural experience and expression.<sup>119</sup>

Santa Monica, for example, offers users who download a social gaming application the ability to collect tokens as they move through and a mixed-reality version of the city's retail district,<sup>120</sup> while the Seoul Metropolitan Government announced in 2021 its intention to invest \$4.3 million to become the first city to immerse itself in the metaverse, including to host cultural events to attract global tourism, a virtual city hall for citizens to interact with public officials and access services and community recreation spaces.<sup>121</sup>

<sup>114</sup> Joshua J. Information Bodies: Computational Anxiety in Neal Stephenson's *Snow Crash*. *Interdisciplinary literary studies*. 2017;19(1):17-47.

<sup>115</sup> Lee L-H, Braud T, Zhou P, Wang L, Xu D, Lin Z, et al. All One Needs to Know about Metaverse: A Complete Survey on Technological Singularity, Virtual Ecosystem, and Research Agenda. 2021.

<sup>116</sup> Nabben K. Building the Metaverse: 'crypto states' and corporates compete, down to the hardware. Available at SSRN. 2021.

<sup>117</sup> Dionisio JDN, Burns III WG, Gilbert R. 3D Virtual worlds and the metaverse: Current status and future possibilities. *ACM Comput Surv*. 2013;45(3):Article 34.

<sup>118</sup> Lee (n 114)

<sup>119</sup> Momtaz PP. Some Very Simple Economics of Web3 and the Metaverse. Available at SSRN. 2022.

<sup>120</sup> NLC. The Future of Cities. *Cities and the Metaverse 2022*

<sup>121</sup> Government SM. Seoul Digital Foundation launched Metaverse Office: Seoul Metropolitan Government; 2021



**The next steps in this process include identifying what infrastructural components are required to enable the metaverse.**



Given the commercial interests that undergird the metaverse, a pressing concern is whether the metaverse will be privatised and monopolised or be publicly owned, developed, and operated.

Despite the commercial potentials of the metaverse,<sup>122-123</sup> alternative visions are being developed in decentralised technology communities of multiple implementations, openness, cryptography, interoperability and user-driven curation of experiences.<sup>124-125</sup>

These visions seek to achieve an agenda closer to that of the interests of an augmented city of a diverse business ecosystem with multiple entities and the possibility of its application for the social good. In addition, although it is an iterative process, efforts are being made to improve and promote diversity and inclusion in the metaverse.

One example is a recent call for startups to donate virtual space for cultural ‘embassies’ for under-represented groups.<sup>126</sup>

Interacting with the potentials of the metaverse requires considerable investments. The next steps in this process include identifying what infrastructural components are required to enable the metaverse, what new products and services are made possible in the metaverse, what business models are viable and inclusive and how digital overlays and embodied physical-digital experiences can enhance people’s cultural engagement with the city, and of course, what entities will provision these.



<sup>122</sup> Goldberg M, Kugler P, Schär F. The Economics of Blockchain-Based Virtual Worlds: A Hedonic Regression Model for Virtual Land. Available at SSRN 3932189. 2021.

<sup>123</sup> Knight R. Metaverse Economy Could Value up to \$30 Trillion Within Next Decade: Be in Crypto; 2021

<sup>124</sup> Nabben (n 115)

<sup>125</sup> Messari. Crypto Theses for 2022: Key trends, people, companies, and projects to watch across the crypto landscape, with predictions for 2022. Messari; 2022.

<sup>126</sup> Barba B, Lee-Ah Mat V, Gomez A, Pirovich J. Discussion Paper: First Nations’ Culture in the Metaverse. SSRN. 2022.



# Are people ready for a Digital CBD?

Returning to the challenges

Melbourne faces in a post pandemic...



## Physical and digital immersion is supported by digital infrastructures

The physical CBD includes commercial, political, cultural and educational institutions and acts as a hub of the transport networks (where people meet under the Flinders St clocks). All of that is still there and so are the values of in-person social connections that some would argue are why we have cities in the first place.

Participation in social activities is an area where we would expect to see some interesting patterns in the Digital CBD survey data given that, after several lockdowns, most Melbourne residents (78%) now feel free to move around the city.

Most Melbourne residents indicated that they kept up to date with the latest 'COVID safe' recommendations provided by the government before moving about the city (72.5%), and over two thirds (65.3%) found it reassuring when busy city venues actively checked vaccination certificates. While these measures appear to have built confidence in socialising and engagement in the city for Melbourne residents, this was not the case for everyone.

The caveat here is that while 'most' people are now free to move around the city, it is not all the population. For those who regarded engagement in the city as risky, just under half of Melbourne residents felt vulnerable to exposure risks if and when they were in the city (48.6%) and a similar proportion (41.2%) avoided the city because of COVID-19 related risks from other people's behaviour.

These sentiments parallel substantial public discussion about people feeling left behind or abandoned as restrictions ease. Perhaps because of specific health issues or life circumstances (eg elderly parents), they cannot see people or move around as others can.

In our survey, around a fifth of Melbourne residents (26.4%) indicated that they had a disability, health condition or injury that has lasted, or is likely to last, six months or more which restricts their daily activities. This is an important part of our population who needs more accessible experiences to ensure that our digital CBD is inclusive and that they can achieve the types of vibrant social lives they desire.

While we were physically distanced, the digital environment provided a means through which we could stay socially connected. The shift of social and entertainment activities online during the lockdowns opened these experiences to people who may not usually have been able to or desired to engage with these aspects of the city in person. On the flipside however, this opportunity may have been more available to those who had the skills and capacity to use digital means to connect with others.







**In this section, we report on findings related to internet access, use of digital technologies and digital abilities, especially as these factors relate to engagement with the CBD.**

### **Internet access, at home and elsewhere**

According to the survey results, 98.5% of residents have internet connections at home. While only 40% of residents report this access as 'fast,' a majority of them describe their access as 'reliable' (55%). In addition to accessing the internet at home, more than two-thirds of respondents used the internet supplied by others, either at a place of work or education (36%) or houses of friends and family (35.4%).

### **Device use: Digital media**

The most common device used by respondents is the smart phone (89.2%), followed by laptops or notebook computers (56.5%), desktop computers (41.1%) and tablets (41.1%). While we most commonly think of digital infrastructures as large in scale, especially in the context of a city, most people experience these infrastructures through their pocket-sized smartphones. These personal devices are the window into how Melbourne residents' access digital infrastructures and are a core part of them.

### **Digital skills**

Melbourne residents reported generally high proficiency in everyday digital skills. In Table 2 we can see that they reported that it was 'very true' that they could perform everyday functions such as downloading and opening files, using keyboard shortcuts to copy and paste, connecting to a Wi-Fi network and opening a tab on a browser.

They also reported high proficiency in engaging with platforms through their skills at finding and installing apps, as well as setting and managing passwords.

Proficiency in these and other surveyed activities suggest that Melbourne residents are comfortable with accomplishing the word processing needed to complete online forms, as well as perform various copy-paste techniques, common in utilising services and finding information via search engines and Web 2.0 platforms.

These findings also suggest that they can set up unique accounts within the platform economy and access and experience the high levels of personalisation and curation these environments afford.

## Digital infrastructures support the future-orientation of the city



Residents expressed only slightly less confidence in more specialised digital skills, with 64.7 % reporting that it was 'mostly true' that they could save and reopen files in the cloud.

A similar percentage of respondents indicated it was 'mostly true' they could customise their experiences through their ability to change the look or sound of a device, by managing online risks or by enacting privacy/security measures such as adjusting privacy settings or identifying which apps/software are safe to download.

These skill sets will only become more important and relevant as the world continues to shift to digital infrastructures for basic as well as advanced services one typically finds in the CBD.

**Melbourne residents will require a high level of ability to navigate our digital streets, particularly as we experiment and engage with emerging technologies.**



### Device use: Smart devices

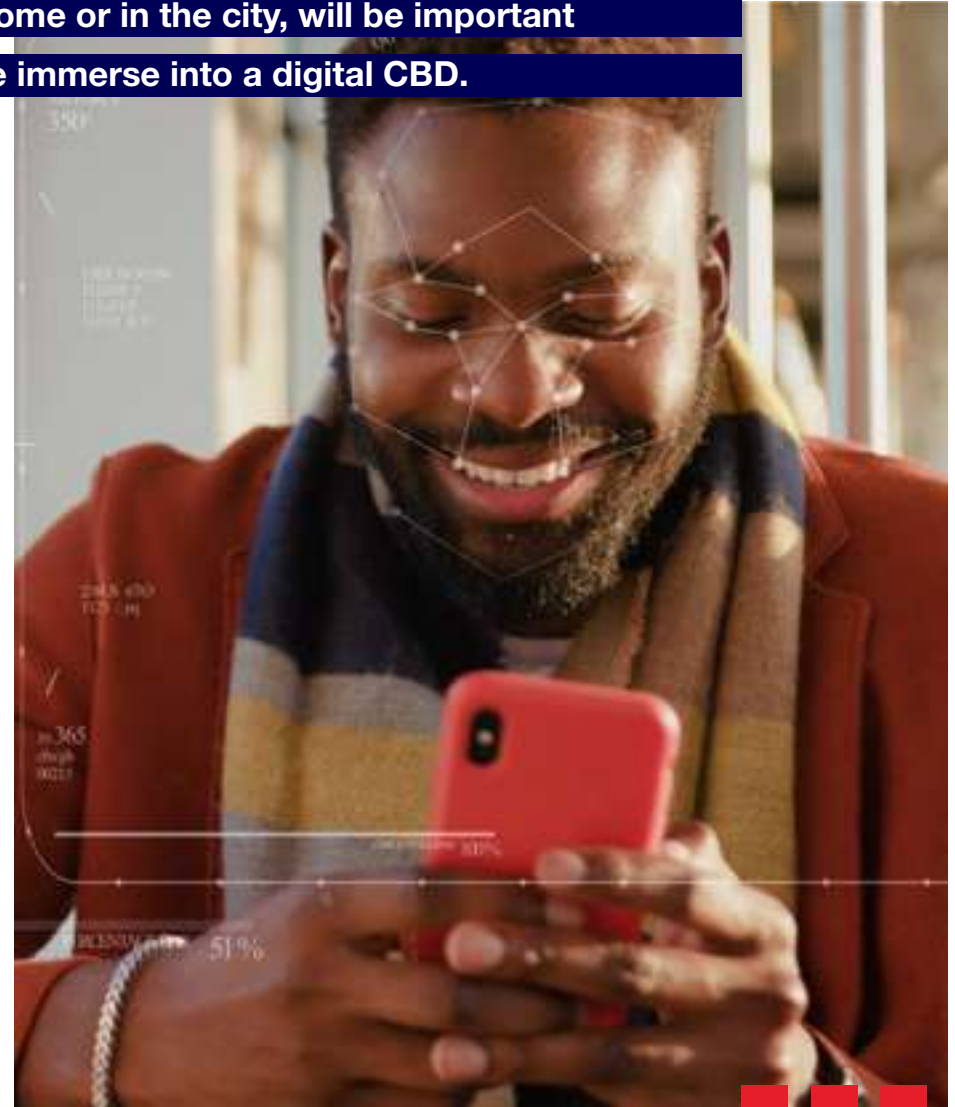
Beyond smartphones, how much do Melbourne residents use smart devices? We found that although just over half (51.2%) used a smart TV, far fewer used other smart devices in the home. Only a small cohort (14%) used smart speakers like Amazon Echo or Google Home and even fewer reported using smart appliances or devices such as lights, security system and sprinklers (8%).

In terms of digital skills relating to the use of smart devices, on average respondents felt that it was very true that they could connect to the internet. However operating smart devices using apps, adjusting privacy settings and customising the look or sound of a smart device was mostly true on average. These findings suggest that while there are fewer smart devices in homes, the skills to use these devices are still prevalent to some extent across the population.

Empirical research with low-income households in the Shepparton region of Victoria by RMIT researchers Kennedy and Holcombe-James<sup>127</sup> demonstrate that while it is likely that many low-income households will have fewer smart devices and especially fewer devices than households in higher income brackets, it should not be presumed that this is the case for all low-income households. They argue that smart home and automated technologies are no longer found solely within the homes of digitally included people.

They observe that it is increasingly difficult to buy a 'dumb' television, noting that unless households are wary of their settings, the introduction of such technologies can result in dramatically increased data consumption with potentially dire affordability consequences, especially for those households on pre-paid or limited data plans.

**The ability of Melbourne residents to understand and navigate smart environments, whether in the home or in the city, will be important as we immerse into a digital CBD.**



<sup>127</sup> Kennedy J, Holcombe-James I. 'It's almost impossible to buy a dumb TV' Experiences of automated decision-making and smart technologies in low-income homes. *Telematics and Informatics*. 2022;68:101767.





**We must build  
future orientated  
digital infrastructures**



## The Digital CBD is already here.

As digital technologies grow more embedded and ubiquitous, they become less visible and more infrastructural. Their transformative power impacts every aspect of the city, in ways both mundane and profound. We rely on digital infrastructures so deeply that they are to us like water is to fish.



Invisible, yet essential. In this way, the infrastructures of the Digital CBD is not something residents or planners or business owners or policymakers focus on directly, but it is rather, as Markham<sup>128</sup> notes, ‘something we all see through, live through. Whatever else these experiences are, they are tacit enactments of the internet in a time when it has become a taken for granted as a global way of being.’

What does the future hold for the Melbourne CBD? A better question might be, what future do we want to create? And how can we take proactive steps now to work toward better ethical futures? While resilience and sustainability have been the catch phrases of the past five years, now we also need to bring a sense of play and pleasure back to the city, especially after two long years of anxiety and isolation.

The Digital CBD can be augmenting and regenerative, complementing the city’s business, cultural and social life.

A key part of planning and building digital infrastructures for best effect, as we have emphasised in this report, is to build infrastructure in ways that make them more flexibly adaptive and resilient.

Another key is to recognise that digital infrastructures are not just ecosystems in themselves, but also, they are part of larger ecologies comprising political, social, and physical infrastructures. These larger ecologies all operate together to influence what the city is and what it will become.

Digital technologies are simultaneously tools, places and ways of being. As we shape and develop these technologies, they extend our possibilities and these possibilities are not only matters of efficiency, commerce and economic wellbeing in a city. They are important matters of the heart and we need the foresight to use these infrastructures to nurture and sustain the vibrant heart and soul of the city.

In this way, digital infrastructures can enact liveliness and become a voice that murmurs in the city ... ‘come play with me’. They can weave together home places and workplaces. They can augment our ability to anticipate and respond well to crisis. They can contribute to what we will become as communities of people coming together to thrive in troubled global times.

<sup>128</sup> Markham (n 10)



### Inclusion

#### **Recommendation 1: Provide all Victorians with affordable and reliable access to digital infrastructure.**

In this report we have discussed Victoria's current levels of digital inclusion and the high level of digital skills Victorians already bring to engaging with a digital CBD. As we progress into the next digital era, ensuring that all of Victoria can access, engage and benefit from the new infrastructure is increasingly important. As a result, creating affordable and reliable access to digital infrastructure is required, especially for those in the regions and from lower socio-economic backgrounds.

### Education

#### **Recommendation 2: Enhance the readiness of Victorians to engage with a digital CBD through awareness raising and digital skill building, particularly for marginalised groups.**

To prepare Victorians for the transition into a digital CBD, raising awareness of technology trends and digital skill building is essential. It is recommended that the Victorian government fund digital capability development to create a smooth transition for all, especially Aboriginal and Torres Strait Islander Australians and CALD communities. Exploring the application of gamification could bolster digital skill development and prove beneficial.

### Cyber

#### **Recommendation 3: Ensure a secure and resilient cyber environment that aligns public and private interests.**

Our discussion of cybersecurity considerations highlighted the known vulnerabilities of digital infrastructures and the emerging risks. In improving our cyber resilience, a city can maintain a state of readiness for swiftly dealing with rising crises (through preparedness and mitigating risk) and take advantage of opportunities.

### Liveability

#### **Recommendation 4: Embed digital infrastructure across the regions, into homes and public transport to support a decentralised workforce.**

As our relationship with the city changes, we begin to rely more on the home as a site for productivity. A decentralised and mobile workforce also highlights the need for digital infrastructures to be accessible, useable and mobile, particularly in ways that strengthen regional interconnectivity and commuting corridors.





**Ensuring the framework promotes ease of interpretation and useability for data will ensure accessibility for all stakeholders.**

### **Entrepreneurialism**

**Recommendation 5: Utilise a City Digital Twin model to enhance opportunities for entrepreneurs through building connection and coordination across the entrepreneurial ecosystem.**

Being able to visualise the entrepreneurial ecosystem through a digital twin will aid us to anticipate wealth recycling and increase both the responsiveness of the ecosystem and coordination of awareness across it. Doing so will foster commitment and trust amongst actors alongside supporting coherence and coordination across the ecosystem to align engagement incentives for talent, investment, professional services and corporate partnerships.

### **Data governance**

**Recommendation 6: Create a data governance framework that promotes inclusivity within the city and allows stakeholders to access, use, own and apply city data.**

Data needs to be accessed by multiple city stakeholders including people, businesses, researchers, local government and policy makers. In addition, engagement with the interfaces of digital infrastructures by flows of people, technology, information and objects produces immense amounts of data. Therefore, creating a framework that establishes collective ownership and clear governance rights is required to facilitate the use of data within the city. Ensuring that the framework promotes ease of interpretation and useability for data will ensure accessibility for all stakeholders.

The report has presented digital infrastructures through conceptual lenses that can be used to inform a framework for measuring the dynamics underpinning the evolution of a digital city. At the center is the representation of digital infrastructures as an ecosystem enabling interactions at complex scale and scope.

The enormous scale of the overall digital infrastructure in a city is due in part to the way the ecosystem contains multiple interfaces, each facilitating particular types of physical and digital interactions. The Digital CBD index will draw on a taxonomy of interfaces that will allow for the mapping and capture of the diversity of these interfaces in the hybrid city. It will also be developed with the potential for connection into a city scale digital twin as a means to provide a benchmark from real time city data.

The purpose of the digital city index project is to conceptualise the digital city as a creator of a collection of interfaces enabling complex and diverse interactions between different entities, from human to digital artifacts. The index will seek to formalise and measure the evolutionary dynamics of a digital city. Analyses of these dynamics can then be used to inform policy making processes and create a benchmark of a city.

**The Digital CBD index will develop an interface taxonomy that will allow for the mapping and capture of the diversity of physical and digital interfaces in the hybrid city.**

