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Innovation Districts:

a rapid systematic review and synthesis of innovation district studies

Dylan Kneale, Carol Vigurs, Jie Xu, Katherine Marshall Kissoon, Rosa Mendizabal-Espinosa, Mukdarut Bangpan

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Dylan Kneale, Carol Vigurs, Jie Xu, Katherine Marshall Kissoon
Rosa Mendizabal-Espinosa, Mukdarut Bangpan

Evidence for Policy & Practice Information Centre (EPPI Centre)
Social Research Institute, University College London

Author affiliations

The following are all affiliated with the EPPI Centre, UCL Social Research Institute:

Dylan Kneale, Carol Vigurs, Jie Xu, Katherine Marshall Kissoon,
Rosa Mendizabal-Espinosa and Mukdarut Bangpan.

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Executive Summary

Introduction

Innovation Districts are urban interventions designed to cluster key actors and resources within specific geographical areas to spur technological, creative, and scientific advancements. These districts are increasingly regarded by policymakers and urban planners as strategic tools for promoting sustainable economic growth and social integration. The theoretical benefits of Innovation Districts suggest a potential to drive equitable growth and reduce spatial inequalities, although empirical evidence supporting these claims is uncertain.

Aims and Approach

We undertook a rapid systematic review of the evidence. We aimed to map the empirical literature on Innovation Districts and then synthesise the evidence on the economic and social impacts of Innovation Districts. We used mapping approaches, narrative synthesis and quantitative and qualitative synthesis approaches to combine the evidence.

Results

We first mapped the characteristics of 66 studies with empirical results and synthesised a smaller pool of 55 studies that contributed to our synthesis. It is important to note that most of the synthesised results are based on evidence from outside the UK, particularly from the US as well as to a lesser extent Australia, and thus do not directly reflect Innovation District activity in the UK.

Short-term Economic Effects: Innovation Districts are hubs for the creation of highly skilled jobs related to Research and Development. A meta-analysis of US data the proportion of roles within an innovation district that are directly linked to innovation stands at 34%;95% CI: 29-40%. These proportions are higher in Districts led by Strategic Government Initiatives than Local Government Initiatives. Studies emphasise that the diversity of businesses and organisations, and not just the absolute numbers, may be more important as indicator of the success of an Innovation District. On average, US data reveals that companies within an Innovation District employ 23.4 staff, corresponding with a 'small' sized enterprise.

Despite agglomeration of innovation expertise and experience being a core underlying mechanism, co-location alone is not sufficient to trigger collaboration between companies. The physical design of an Innovation District, the balance of companies (a mixture of sizes), and the coordination of formal networking events helps to foster collaboration.

Longer-term Economic Effects: Most of the evidence did not include a longitudinal component, making it difficult to unpick the 'impact' of Innovation Districts. Some studies present compelling descriptive data demonstrating that the creation of Innovation Districts is associated with a sizable number of new jobs over time within the district itself. Among 50 Innovation Districts in the US, the unemployment rate stood at 5% (95% CI: 4-7%), although there was substantial variation and evidence suggested that some Innovation Districts had little impact om unemployment rates. Secondary Analysis of data for 50 Innovation Districts in the US indicates that sizable numbers of additional support jobs can be created in the broader economy beyond the immediate confines of the Innovation District. However, other evidence

also suggested that some roles created within an Innovation District may be inaccessible to local residents.

Innovation Districts may undertake a range of education and capacity building activities in terms of making links with children, young people and schools, as well as undertaking broader lifelong learning capacity building among community members. However, the success of these activities is unclear. Overall, evidence indicated that Innovation Districts could exacerbate levels of local income inequality as perceived by residents, although one study provided some evidence that Innovation Districts provided more equitable employment opportunities than other types of areas of planned employment (e.g. industrial zones).

Social and System-wide Effects: Where Innovation Districts can develop community or civic amenities, or develop links with existing amenities, this may lead to economic benefits. Conversely the absence of community and civic amenities is perceived by developers to be economically detrimental. Several Innovation Districts struggle to form 24-hour communities (i.e. areas where people work and live).

Long-term residents of Innovation Districts and the areas immediately bordering Innovation Districts are likely to be socially distanced from new residents and employees. In some Innovation Districts engagement with residents can appear tokenistic, with potential mismatch between the resources that developers of Innovation Districts hold to engage with communities, and the resources that communities must enter into discussions. Strategies have been recommended and/or deployed to enhance the embeddedness of Innovation Districts within local areas. These appear to have mixed success although have not been fully evaluated.

The literature suggests that some Innovation Districts have tended to exacerbate housing pressures particularly around affordability. 'Value capture' policies, where funds are secured through increased taxes and fees and then reinvested to offer subsidised housing and/or tax relief to lower income residents could help address housing pressures. The success of such measures is unclear and such measures have not been fully evaluated.

Several successful Innovation Districts may, in fact, share characteristics with other areas of innovation. Examples of those that resemble Innovation Clusters, Hybrid Science Parks as well as those the resemble a 'classic' model were identified as successful.

Conclusions and implications

The evidence suggests that Innovation Districts are effective in generating short-term economic outcomes such as the creation of highly skilled jobs in innovation, and longer-term outcomes including jobs within the broader economy. However, the mechanisms through which new jobs and broader economic opportunities permeate to the wider community are not well defined in the literature. Innovation Districts in some settings may function under the assumption that mere co-location of businesses will foster significant collaborative and community integration, and that economic gains are consequently felt across local communities. However, there is little direct evidence suggesting these assumptions are upheld in the literature.

Developing meaningful community engagement strategies, inclusive housing policies, and taking steps to ensuring that economic gains are accessible to all residents, not just those within the innovation sectors, are essential from the outset to ensure that future Innovation Districts do not exacerbate social and economic inequalities.

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1. Introduction

1.1 What are Innovation Districts?

Innovation Districts are a form of place-based intervention that involve the physical clustering of actors and stakeholders necessary to develop innovative practice and products in new technologies, science or creative sectors (1, 2). Innovation Districts, also known variously as, innovation precincts, knowledge districts, or innovation zones (among other terms), are viewed as a tool by policy-makers and urban planners as a tool for economic development and social development (1-3). In particular, economic activity and development stimulated by Innovation Districts is intended to be both sustainable and inclusive, although the extent to which Innovation Districts do stimulate equitable growth and reduce spatial inequalities is largely unknown and claims around their potential are often derived from theory rather than empirical observation (4).

Some of the first Innovation Districts include those developed in Barcelona (22@ Barcelona), that started as an urban regeneration scheme in 2000, and in Boston (Waterfront innovation district, focussed on creative industries). Today, the Global Institute of Innovation Districts estimates that there are more than 100 Innovation Districts (5). In the UK, the UK Innovation Districts Group includes twelve members[1] in its peer network of Innovation Districts and Knowledge Quarters across England, Scotland and Northern Ireland (6); no member in Wales was included at the time of writing.

1.2 How are Innovation Districts thought to 'work'?

An underlying mechanism through which Innovation Districts are thought to stimulate equitable growth is through the clustering or agglomeration of different stakeholders (4). This feature tends to preclude the zoning of an innovation district in more rural or geographically disparate areas. Innovation Districts are described as occupying parts of cities (7) as geographically compact, physically and technologically accessible, and represent mixed use developments combining housing, office and retail properties (4, 8). Moreover, developing successful Innovation Districts may rely on developing social networks that promote idea sharing and support interactions between different stakeholders than having the right physical infrastructure (7). Successful Innovation Districts therefore may rely as much on fostering a sense of place as much as the physical and economic infrastructure of the space (7).

In practice, these characteristics are fuzzy in nature and lead to differences in the conceptualisation of what are (and are not) Innovation Districts. For example, Silicon Valley in the USA is viewed as an example of a high-technology intensive innovation district by some (for example (2)), although not by others (for example (4, 8)) as it lacks the connectivity and the mixed use development expected of an Innovation District. Indeed, Katz and Wagner (8) and Kayanan (4) suggest that Innovation Districts are a response to the failings of settings like Silicon Valley, described by Katz and Wagner (8) as '*suburban corridors of spatially isolated corporate campuses, accessible only by car, with little emphasis on the quality of life or on integrating work, housing, and recreation*' (p1).

[1] As of January 2024.

In their review of Innovation Districts, Yigitcanlar and colleagues (2) identify that Innovation Districts differ across three main domains including:

Function and the extent to which the innovation district is focussed on high-technology-intensive section, or creativity-intensive sectors, or a blend of these; and the extent to which the sector is also supported by knowledge-intensive service activities.

Features including the composition of stakeholders, spatial features and connectivity, and social features of the innovation district.

Space use including the design, use of open/closed innovation systems, size and scale, and governance.

Meanwhile the Global Institute of Innovation Districts (5) suggests that common aims of Innovation Districts are an ambition to:

1. **Facilitate convergence** through blending of different sectors to drive new innovative growth
2. **Strengthen R&D specialisations** that exceed regional, if not national, strengths
3. **Create quality, connected places** that draw firms and talent and strengthen connections
4. **Create buzzing, connected communities** and a set of shared systems

Underpinning these are values that include a need to:

1. **Advance sustainability** and promote climate resilience
2. **Advance equity and inclusion** to support broader citywide and regional growth
3. **Build critical mass** (as a mechanism to ensure the success of Innovation Districts)

1.3 How can we measure the success of Innovation Districts?

Innovation Districts are immutably tied with policies that seek to promote economic development and urban renewal.

Short-term economic outcomes reflect the extent to which efforts to create a hub of creative, knowledge or technology-based innovation actors are successful. These could include changes in the amount that companies spend on R&D, the number of R&D jobs, the number of PhD students supported, the number of academic publications, and the number of actors/stakeholders that set-up within an innovation district (1). Given the relational nature of Innovation Districts and the importance of developing networks, measures of the extent and density of stakeholder networks may also be an important process-based measure.

Longer-term economic outcomes include those measures that are a consequence of formation or a hub of creative, knowledge or technology-based innovations. These could potentially include measures of economic development, levels of job creation and consequent decreases in unemployment, and measures that reflect reductions in place-based spatial inequalities. However, more commonly, outcome-focussed measures used within the literature are more proximal or short-term outcomes that reflect, for example, patents issued and receipt of business awards and further funding (1).

Other indicators of success could include broader systemic change. In the literature, these have reflected measures of 'place quality' (1); however, broader measures, for example reduction in regional inequalities, improvements in climate sustainability, and measures that reflect equalising educational opportunities could all represent outcomes triggered by the creation of successful Innovation Districts.

2. Aim and Research Questions

Aim: To understand the variation in type of innovation district and to examine the features of innovations districts that are aligned with 'successful' Innovation Districts

Research Questions:

1. What form and function do Innovation Districts take?
2. What evidence is there that Innovation Districts are effective ways of stimulating economic output/growth?
3. What evidence is there that Innovation Districts are effective ways of reducing spatial inequalities?
4. What are the implications of Innovation Districts (positive and negative) for broader systemic change (e.g. climate change, gentrification)?
5. What are the essential ingredients of successful Innovation Districts and how should places prioritise these different factors?

3. Methods

The methods for this review were described in a pre-prepared protocol published on the Open Science Foundation website (9). A more detailed account of our methods is included in Appendix 1.

3.1 Overall Approach

Stage 1: Mapping of existing and new literature

An existing systematic review undertaken by Yigitcanlar, Adu-McVie and Erol (2), with searches conducted up to 2019, identified 58 studies on Innovation Districts. We expected that this pool of studies would have expanded since this time. However, we imposed additional criteria for inclusion, and in particular a requirement for studies to represent empirical investigations of Innovation Districts. This map was intended to be used to identify typologies of Innovation Districts, research and publication practices with regards to work examining Innovation Districts, and to identify areas for further synthesis.

Stage 2: In-depth review of subset of innovation district literature

Using the results from stage 1, we then honed-in on a subset of the Innovation Districts literature that provides empirical results that measure the influence of Innovation Districts. Included studies were those that draw on a recognised evaluation methodology and that present results that support addressing questions 2-5.

Study Eligibility in terms of Innovation Districts

Eligible studies were those that exclusively focussed on Innovation Districts and did not have a broader focus including on allied forms of development (e.g. science parks) were excluded. This decision was partly a reflection of the research questions (see section 2) and partly a reflection of literature in this area, which emphasises the distinct characteristics of Innovation Districts (see Table 1 below). Although we included empirical-based studies that employed established and named research methods to understand and evaluate **self-described** or **researcher-identified** Innovation Districts, we drew on the work of Sanz, Klofsten (10) to understand an Innovation District as '*a designated existing urban area that has a strong mix of knowledge institutions, companies and startups that are focussed on innovation, but often without a very specific sectoral focus*' (p19). Implicit therefore in the definition of an Innovation District is that they are 'designated', and are therefore planned, designed, and governed as Innovation Districts. They differ in location, scale, and composition from other areas of innovative practice in that they are (i) urban; (ii) geographically contained (i.e. cover part of an urban area but would not constitute a complete or whole town or city); and (iii) are characterised by a mixture of functions that can include educational, commercial, industrial, creative and residential and community functions. However, a limitation of our approach is that not all researcher identified or self-described Innovation Districts may share these characteristics.

In addition, we drew heavily on data from the Atlas of Innovation Districts (see (11, 12)), a US resource of statistical data. We utilised both the published data from the reports and the online database and performed supplementary analysis where necessary to further explore the characteristics of Innovation Districts. The atlas is accessible online (though the data is not downloadable; see https://www.aretian.com/atlas) and through a published compendium of 25 of the 50 Innovation Districts. For our analysis, we used OCR technology to extract data from the online atlas and processed the data using Excel and STATA (13). Any errors in data extraction (through OCR) or analysis are the responsibility of the authors.

Table 1: Descriptions and definitions of areas of innovation and their alignment with the aims of the review

Concept	Description	Reason for inclusion/ exclusion in the review
Science and technology parks	Synonymous with 'technology part', 'technopole', 'research park' and 'science park'. Originally involved collaborations between firms, technology centres and universities; no emphasis on the mixed use as is the case with Innovation Districts (14).	**Excluded:** STPs tend to be located on the outskirts or outside of urban areas (10) and lack the distinctiveness of Innovation Districts as being (exclusively) a form of urban renewal (14).
Innovation clusters	Viewed as a form of innovation district by some (2), although descriptions and definitions of innovation clusters focus exclusively on solely on economic rather than also social rationality (15). Definitions emphasise the geographic concentration of interrelated businesses (but not on the mixed use and function of cluster areas).	**Excluded:** Innovation clusters do not necessarily incorporate the same mixture of functions within an area (e.g. a mixture of educational, commercial, industrial, creative and residential and community functions). For the purposes of this rapid review, we acknowledge that the terms overlap; although, we exclude innovation clusters as the mixed functions does not appear to be a core ingredient of an innovation district.
Knowledge quarters	A form of innovation district with a university/universities as a central hub aiming to create sustainable growth through innovation and collaboration (16).	**Included:** Knowledge Quarter is not a widely used term, although appears to be used more frequently in the British context to describe areas with overlapping characteristics to those of Innovation Districts in being designated mixed use urban areas designed to foster innovation.
Innovation precincts	A space for fostering interactions between research and commerce to stimulate the production of innovative goods and services (17).	**Included**: Innovation Districts and innovation precincts appear synonymous with one another. Both seem to (exclusively) focus on urban renewal involving the interaction between stakeholders to create areas with mixed functions.
Living Lab	User-centred open innovation ecosystems that are intended to foster co-creation. Often focussed on specific problems and were viewed as a real-world testing ground for new ideas and technologies, although their focus may be broadening (10, 18).	**Excluded:** LLs lack the distinctiveness of Innovation Districts as being (exclusively) a form of urban renewal (10)

4. Results

4.1 Descriptive Results – Mapping out what we know about Innovation Districts

After screening 1,201 results from bibliographic databases and manual searches, 66 studies met the inclusion criteria and were included within the map (Appendix 2). We describe their characteristics here, and these characteristics can be explored further by following the link. From the map, we identified 55 studies for inclusion within the synthesis of economic or social impacts (see Table of characteristics in Appendix 3). The publication ranged from 2008 to 2024, showing increasing interest in Innovation Districts over time (see Figure 1).

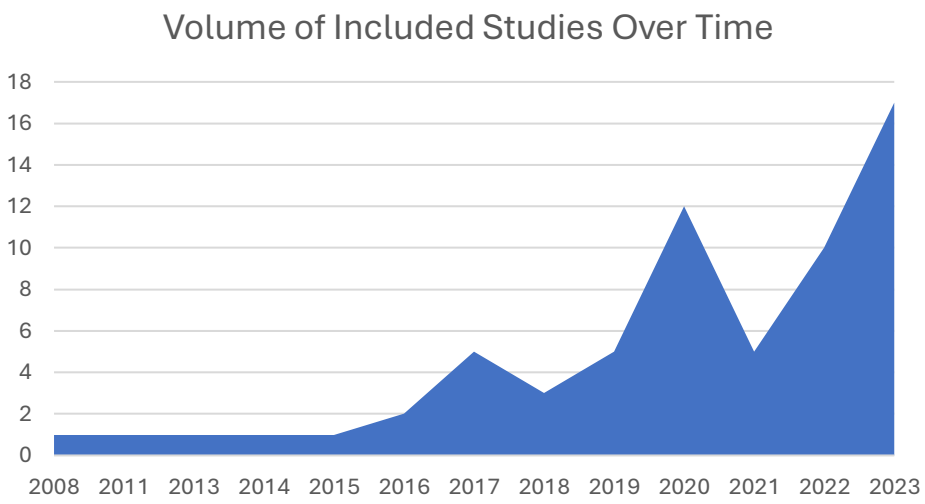

Figure 1 Year of publication of included studies

Countries featured in studies

Clusters of studies were identified in the USA (28) in 51 different cities, Australia (15) in six cities, Spain (11) which were all set in Barcelona, and seven studies set in China in three cities (see Figure 2). Given that one in every six studies featured @22 Barcelona, our understanding of how Innovation Districts function is derived from a limited range of settings. In other parts of the Americas, there were a small number of studies in Canada (4), Colombia (5), Brazil (3), and Mexico (2). Beyond studies examining @22 Barcelona, there was a smaller pool of studies of Innovation Districts in the rest of Europe, including Ireland (4), UK (2), Poland (2), the Netherlands (2) Russia (1) and Finland (1). In Asia, we identified 7 studies featuring Innovation Districts in China, Thailand (3), Singapore (2), South Korea (2), and one study set in Japan.

We did not find any studies of Innovation Districts that met our criteria in Africa, India or the Middle East apart from one for a planned innovation district in Israel. This absence could be a function of the inclusion criteria that necessarily took an inclusive but focused definition of Innovation Districts, given that there exists a wide range of terms that are used to describe similar functions. However, we did not find any discernible pattern to the excluded studies to explain this concentration.

We rescanned the studies that were found by our original search on innovation district keywords but were later excluded and found that the excluded studies were from the same geographical areas as the included studies.

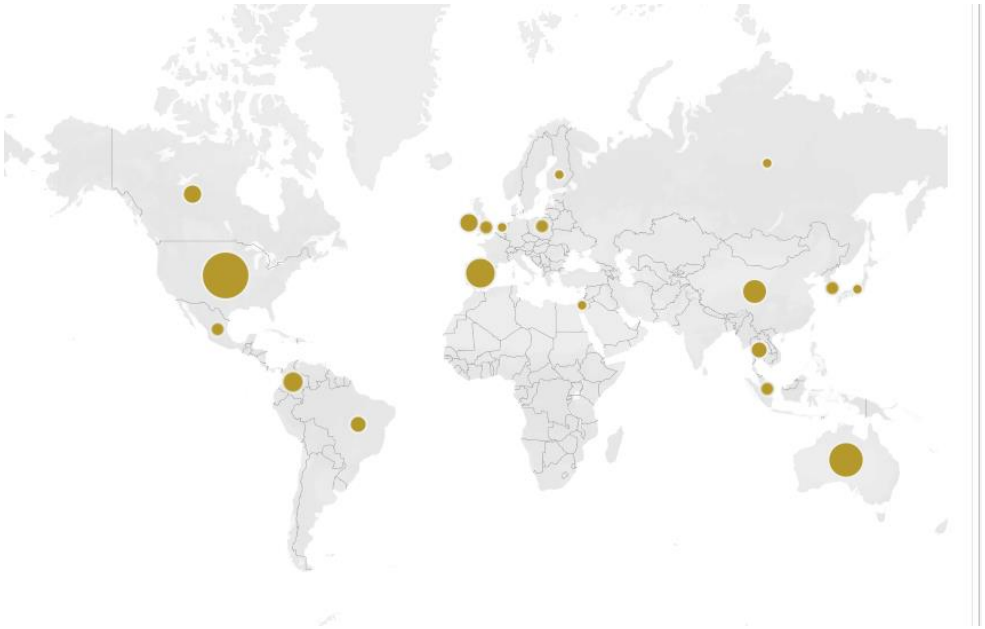

Figure 2 Geographic region of publication of included studies

Cities featured in studies

Most studies often researched the Innovation Districts from the same city (and often the same Innovation District). Studies conducted in the USA featured 51 different cities, but Boston, Massachusetts and St Louis, Missouri were featured 15 and 11 times respectively with the rest of the cities featuring between six times and once. This pattern of research interest concentrating on only a few areas could also be seen in the European studies, with 15 different cities featured but Barcelona appearing 11 times in the included research. Studies in Australia had a concentration of focus on three major cities, as they were usually featured together in the same research.

Study designs

Most of the included studies were mixed methods, in-depth case studies of single Innovation Districts (n=41). These case studies used interviews (n=22), documentary analysis (n=18), secondary analysis (usually of administrative data; n=11), Surveys (n=4), Ethnography (n=8) and Geospatial analysis (n=3).

The next most common study design was standalone secondary analysis of existing datasets (15). There were a few studies that looked at multiple Innovation Districts, notably the Atlas of Innovation Districts that examined the 50 Innovation Districts in the USA (11, 12). Two linked studies also based their study on the same dataset (19, 20).

We found no studies of experimental design such as randomised controlled trials or quasi-experimental with a comparison group, or before-and-after design for detecting an impact or effect. Studies were observational by design and described Innovation Districts or demonstrated relationships, patterns or associations.

Quality of studies

Focussing on those studies included in the synthesis (see Appendix 3 for list), we observed variable patterns in terms of study quality. Of the 55 studies included, we were unable to assess the quality of 20 of these (36%). This was due to incompatibility between the Mixed Methods Assessment Tool (MMAT) and the study designs in some cases, although commonly studies were not assessed as they did not present sufficient data to allow us to assess whether 'the collected data allow for addressing the research questions' (21), a core screening criteria. Among those that were assessed using the qualitative portion of the tool (n=32), only half (n=16) were assessed as having no or minimal quality concerns. Similarly, half of the small number of quantitative studies (3/7) were identified as having no or minimal quality concerns. As a body of evidence, the evidence on Innovation Districts appears to have several limitations in terms of quality of methods.

Summary

An evidence and gap map (shown here) summarises these patterns by displaying the high concentration of studies comprising case studies of Innovation Districts from the US that were established predominantly 2001-2020, and a visible cluster of case studies conducted in Spain (@22 Barcelona), an showing infrequent exploration in other settings and using other methods.

4.2 Forms and typologies of Innovation Districts

4.2.1 Evidence from existing systematic reviews

We identified five systematic reviews of Innovation Districts; four of the five reviews were conceptual in focus reviewing studies of Innovation Districts to synthesise their characteristics into models or frameworks. There is considerable overlap in the primary studies included across the reviews. All used narrative or qualitative methods of synthesis. There were no reviews that included a meta-analysis or provided a narrative overview of impact or effectiveness of Innovation Districts, reflecting the type of primary research studies conducted.

The earliest review aimed to describe Innovation Districts by function, feature and by use of the space (2). It drew on 58 studies of Innovation Districts but found no established or widely accepted typology or framework for Innovation Districts in the included literature. The authors developed a new framework of identifying the properties of Innovation Districts through exploring various domains, for example function (defined as High-technology-intensive activities, creativity-intensive activities, and Knowledge-intensive service activity (KISA)). Identification of Innovation Districts' key features also included examining economic, physical, operational and social characteristics. The review also indicated that Innovation Districts can be distinguished by their use of space, including spatial design and configuration, natural environment and surroundings. The review identified that the most popular governance model used in establishing Innovation Districts is the triple helix model – academic-industry-government partnership (2). While providing a useful framework for understanding the

components of an Innovation District, which we draw upon in our approach to data extraction, this review did not identify distinct 'typologies' of Innovation District per se.

Another review (22) included 190 qualitative studies to develop a framework of different approaches to establishing Innovation Districts, such as the anchor approach, hub approach, community approach and the standalone approach and evaluated their suitability for various levels of developed economies (22). This review suggested that as the foundation of a robust knowledge economy is less developed in low- and middle-income settings "*the implementation of an innovation district under anchor approach for these regions according to this model will be more feasible".* A linked review explored university anchor institutes model further and theorised the key features necessary for successful implementation of an anchor model (23). One review focused on the policy implications of a shift in working patterns and the movement towards remote working for Innovation Districts in the future (23).

While not strictly a systematic review, a critical review drawing on 99 publications attempted to integrate the literature on Innovation Districts with Mission-Oriented Innovation to understand 'Mission-Oriented Innovation Districts', which are characterised as challenge-led and place-based urban innovations (1). This provided a useful distinction between Innovation Districts being primarily led by social concerns (mission-oriented) and those that may be driven more strongly by economic concerns.

4.2.2 Evidence from primary studies

While not covered explicitly within the systematic reviews above, another distinction we note in the primary literature is between Naturally Occurring Innovation Districts (NOIDs) and Organised Innovation Districts (24, 25). We use the label Organised Innovation Districts to distinguish between these and Planned Innovation Districts; the latter may be those at the planning stage, or that are early on in implementation (e.g.(26, 27)). This distinction in terms of NOIDs is an important one. Several studies (for example (11, 12, 19, 20, 24, 25, 28-30)) define Innovation Districts through their characteristics (i.e. high concentrations of organisations working on innovation) and not as planned Innovation Districts. While NOIDs may also, in part, be the product of strategies to address spatial inequalities and encourage agglomeration and specialisation of industry (31), the extent to which they are driven by the same goals, or if they are driven by a defined strategy overseen by a governance structure, is unknown.

Many of the included studies tended to explore single case studies and often did not identify the Innovation District under study as belonging to a particular distinct type. However, some of the studies did make a distinction in terms of those with a main anchor institution that attracts and promotes change, and those that are more organic in nature involving the 're-imagination' of an existing urban area through physical and economic transformation intended to promote innovation-based economic growth (31).

4.3 Examining the economic performance of Innovation Districts – short-term outcomes

In this section, we explore the evidence around the performance of Innovation Districts in terms of short-term outcomes. Although many of these indicators are drawn from an existing framework for understanding Innovation Districts, the distinction between short-term and long-term measures of economic performance is our own. We view these short-term metrics as being those that could represent indicators of a thriving Innovation District (for example, a high number of organisations attracted to an Innovation District), but may not represent the ultimate economic motivations for establishing an Innovation District which may be longer-term economic changes (for example in Local GDP; see Section 4.4) or broader system-level impacts (for example, reduction in poverty and spatial inequalities; see Section 4.6). We may consider these short-term outcomes to be those that are largely dependent on the direct actions of stakeholders involved in the establishment of an Innovation District; longer-term outcomes may be more dependent on external factors and/or the decisions made by organisations that are established within an Innovation District.

4.3.1 Research and Development Jobs

Two studies provide indicative evidence on the **impact** generated by Innovation Districts with respect to job creation in highly skilled research and development (R&D) posts, with evidence presented in a study by Kayanan, Drucker and Renski (32), which focussed on Boston, suggesting that approximately 4,000 jobs in the 'tech economy' had been created within three years early on in the establishment of the district (equating to approximately 1,333 per annum); evidence in Morisson and Bevilacqua (33) suggests that 4,216 jobs had been created since the inception of an Innovation District in Medellin (Colombia) (equating to approximately 843 per year) although these are not specified as R&D jobs per se[2]. This distinction between 'innovative employment' and 'total employment' is one that is central to understanding the success of Innovation Districts and one that is explored as a key performance metric to understand the success of Innovation Districts (11, 12, 20). Burke, Gras Alomà and Yu (11) define 'Innovation Intensity' as the proportion of employees within businesses located within an Innovation District working on knowledge intensive activities including research, advanced production, and technology transfer.

The Atlas of Innovation Districts (12) represents a database of 50 of the 'most well-known' Innovation Districts[3] in the United States (11, p195) and presents data on the innovation intensity[4] of these areas. We meta-analysed the proportion of roles working in innovative employment (i.e. Innovation Intensity) from these areas; in addition we also incorporated data

[2] Based on the period 2012 to 2017.

[3] Note – not all the Innovation Districts included in the Atlas may be (i) planned or (ii) self-defined Innovation Districts.

[4] Innovation Intensity represents the proportion of jobs within an Innovation District that are working in innovative employment. Innovative employment includes workers belonging to one of three innovation categories (research, technology transfer, and advanced production) (see 11. Burke J, Gras Alomà R, Yu F. Multiplying Effects of Urban Innovation Districts. Geospatial Analysis Framework for Evaluating Innovation Performance Within Urban Environments. In: Piselli C, Altan H, Balaban O, Kremer P, editors. Innovating Strategies and Solutions for Urban Performance and Regeneration. Cham, Switzerland: Springer; 2022. p. 191-207.)

from a study presenting compatible data from Innovation Districts in Melbourne (28)[5]. The results of a random effects meta-analysis (figure 3) show that the overall the pooled proportion stands at 34% of employees within an Innovation District working in innovation-related employment (95% CI: 29-40%; the results without the addition of Melbourne stand at 35%;95% CI: 29-40%). The majority of employees in most Innovation Districts are therefore not directly working within innovation-related roles. To the extent that Innovation Intensity can be taken as a metric of the success of Innovation Districts, the results indicate a wide variation in the success ranging from an Innovation Intensity of 4% through to 96%.

[5] Innovation Districts is a term which appears to be used synonymously with National Employment and Innovation Clusters (NEICs) in this study, although we acknowledge there may be some differences in how the terms are used.

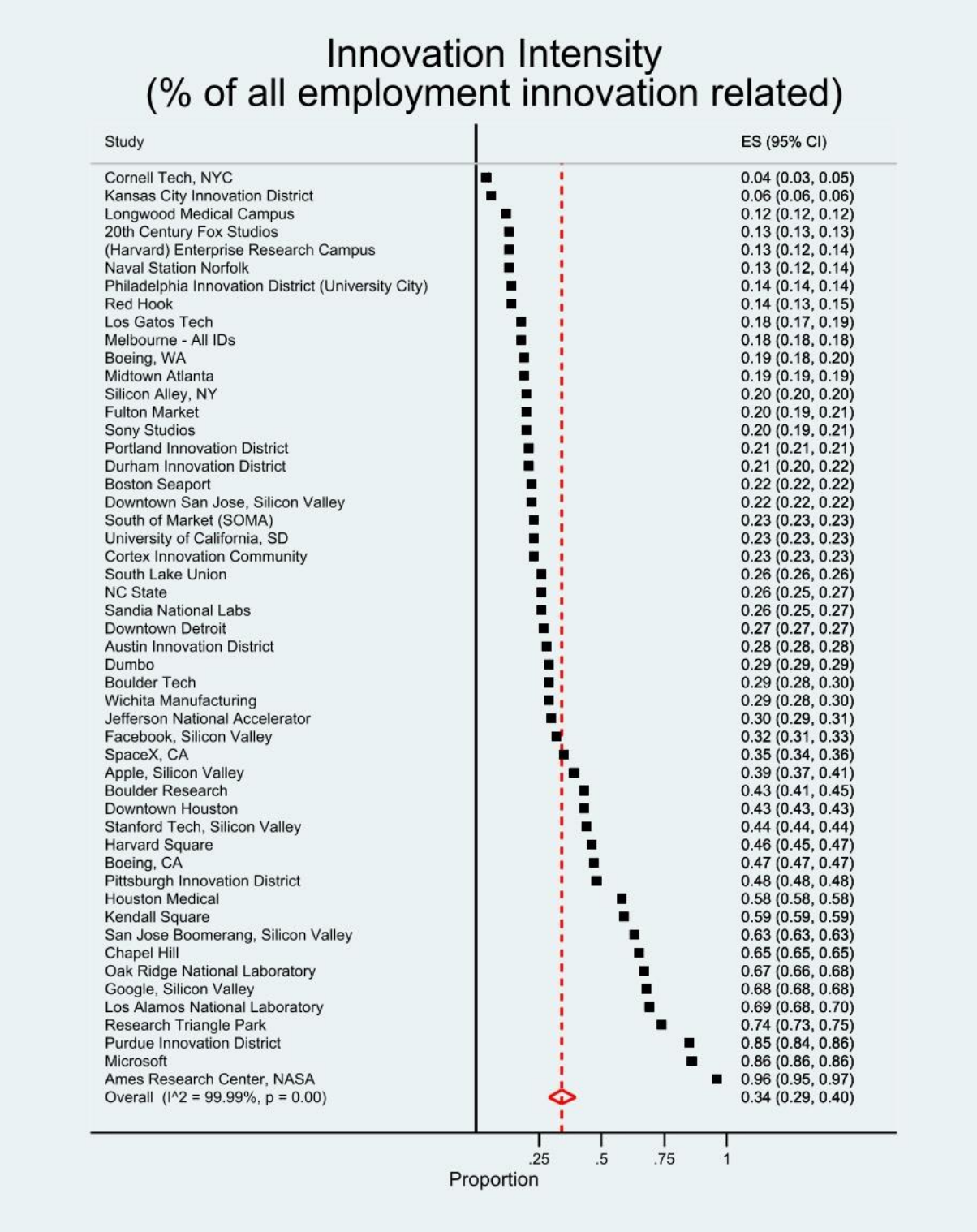

Figure 3: Innovation Intensity (the proportion of jobs within an innovation district that are classed as being involved in innovation roles) – data for all studies except Melbourne from (12); data for Melbourne from (28)

In appendix 4, further random effects meta-analysis of Innovation Intensity (drawing solely on US data from the Atlas of Innovation Districts (12)), grouped by type of innovation district, shows that variation in the level of Innovation Intensity is widespread across different types of innovation district. A pattern of variation persists regardless of whether the district is developed through Local Government initiatives or Strategic Government investments, whether it develops

through Research and Academic Activities, whether it grows around large industrial corporations, or whether it develops organically through interactions between entrepreneurs and start-ups (12). However, the meta-analysis also shows a tendency for Innovation Districts formed around Local Government initiatives to have a lower level of Innovation Intensity (24%; 95% CI:22-27%); this is significantly lower than those that develop around high-performing Strategic Government Agencies ((51%; 95% CI:30-72%) examples of the latter include NASA's Ames Research Centre). As has been speculated elsewhere, any differences in the performance of Innovation Districts driven by Local Government initiatives, with respect to Innovation Intensity and other key performance metrics, may reflect their differing goals which may be more encompassing around social as well as economic development (12, 20).

Finally, the Atlas of Innovation Districts also allows for exploration of how innovation metrics correlate (or not) with an "index of meritocracy" (12). This indicator is a measure of the ratio of income earned to net worth of individuals (12); we interpret that a higher value is indicative of income being generated through active participation in the economy and that these opportunities are accessible. Although this may be a narrow conceptualisation of meritocracy, it may nevertheless provide some indication, albeit imperfect, of the extent to which Innovation Districts facilitate opportunities for social mobility. The authors describe that the index will help to distinguish instances where 'inherited wealth is less of a determinant of higher income' (12, p15), although the extent to which such an index also conflates meritocracy with financial precariousness among lower income households is unclear. Rudimentary secondary analysis of data from the atlas showed a weak correlation between Innovation Intensity and the indicator of Meritocracy (r=0.102). Further tabulation of the data, examining the relative rank of Innovation Intensity and the indicator of Meritocracy is presented below; those districts in the top right quadrant are those that are highly ranked in terms of innovation intensity and the indicator of Meritocracy. These include the NASA Ames Research Centre and Purdue Innovation Districts as having distinctly high rankings in terms of Innovation Intensity and Meritocracy.

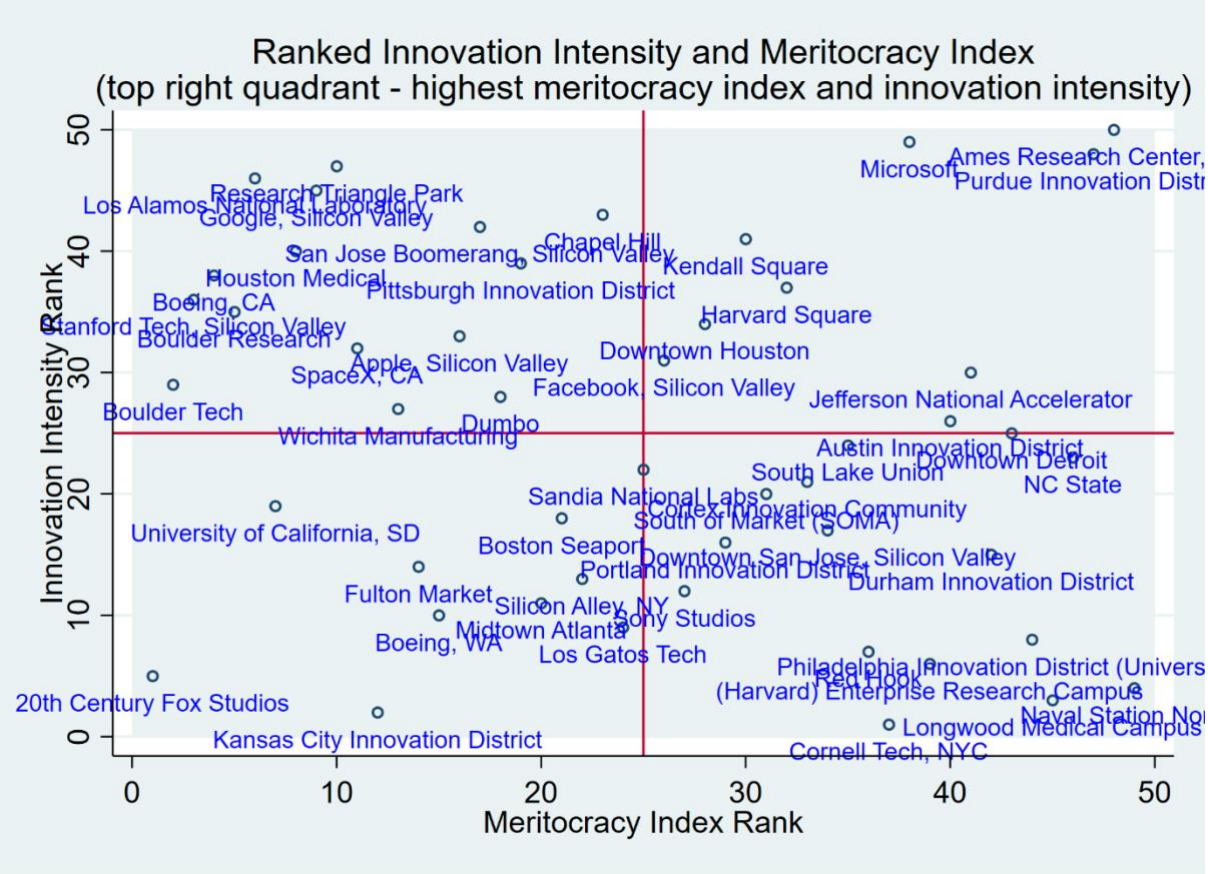

Figure 4: Ranked Innovation Intensity and Ranked Meritocracy – data from (12)[6]

While studies considered the level/number of R&D posts there was generally less consideration on the quality of these posts. One study, that considered issues in the expansion of @22 Barcelona, identified that a low number of international firms limited R&D career opportunities and also offered lower pay compared to international standards (34). Broader questions also exist, however, about the impacts and success of job creation efforts within Innovation Districts. These include the extent to which these roles are taken up by those in the areas immediately surrounding the innovation district (for example 35), as well as the capacity of residents in the immediate vicinity of areas that are the target of urban renewal projects to engage in employment without more system-wide structural reforms (36).

4.3.2 Number of organisations

Several studies provide impressive numbers to suggest that Innovation Districts attract large numbers of companies (11, 12, 20, 31, 37-42), and can do so within a short duration after establishment. For example, 143 technology firms had been established over a period of five years in Medellin (41), and that the number of international companies participating in 'landing programmes' (a form of induction to connect companies to the broader innovation ecosystem) increased from seven to over 90 over a similar period (33). As is the case for the evidence for Medellin, studies tend to report descriptive data that reflects early successes of the Innovation District in attracting companies. Data from two studies on the more established @22 Barcelona indicate that Innovation Districts may be most successful in attracting businesses early on in

[6] The index of meritocracy is a measure of the ratio of income earned to net worth of individuals.

their establishment (31, 40), although @22 Barcelona continued to be successful in attracting companies, even during the Global Recession of 2008/9 (31), and in its first approximately decade attracted '*an average of 545 [companies] per year and 1.2 per day*' (40, p1).

While the number of companies located within a district is an important indicator of the success of an innovation district (11, 12, 20), studies also emphasise that the diversity of businesses and organisations, and not just the absolute numbers, may be more important as indicator of the success of an Innovation District (4, 39, 40, 42-45) and/or its capacity to fulfil social justice objectives (45). In the case of the Cortex Innovation District in St Louis, for example, a deliberate strategy was put in place to attract a mixture of first in terms of size and tenure in an effort to foster a potent 'entrepreneurial ecosystem' (43); such a strategy may have evolved over time with an initial push on attracting larger corporations switching later to attracting 'nimbler, more flexible firms and entrepreneurs' in later years (4).

Data from the Atlas of Innovation (11, 12) allow for further exploration of the number of organisations and their size to examine the strength of entrepreneurial ecosystems within a subset of 25 'prominent' Innovation Districts in the United States (12, p44). Secondary data analyses of these data show wide variation in the number of companies per square mile, a measure of the success of Innovation Districts in creating an agglomeration of knowledge and innovation, ranging from 2.34 companies in Oak Ridge (Tennessee) to 23,334 in Silicon Alley (New York) (table 2, below). Both examples clearly show the diversity in areas considered to be Innovation Districts; while Oak Ridge is formed around a Strategic Governmental resource (a national laboratories focussed primarily on energy), Silicon Alley is an entrepreneurial Innovation District specialising in high tech innovation that includes companies including Google as well as start-ups funded through venture capital investment (12). The median number of companies per square mile among these prominent US Innovation Districts stands at 405. The data also show that Innovation Districts driven by Local Government initiatives had the highest number of companies per square mile, perhaps reflective of the site of these Innovation Districts within smaller urban areas and reflective of the ambition of these types of Innovation Districts being tied more closely to urban renewal.

The data also allow for the exploration of the average number of employees among organisations, to better understand the extent to which Innovation Districts are acting as entrepreneurial ecosystems that attract larger multinationals as well as smaller start-up organisations, with the average number of employees standing at 23.4. The Innovation District with the largest number of employees per company was Oak Ridge (described above); Harvard Square, which is anchored onto Harvard University and with a total area of less than half a square mile (0.42m^2), had the smallest ratio of employees per company at 14.9. Despite Harvard Square being an Innovation District formed around a university and having the smallest number of employees per company, the data show that overall companies within Innovation Districts formed around Research and Academia tend to be larger in terms of number of employees, and those formed around Entrepreneurial activities tend to be smaller (table 2).

Table 2: Density of companies and size of companies within Innovation District Areas – Analysis of Data from the Atlas of Innovation based on 25 prominent US Innovation Districts

Number of companies per square mile		**Average number of employees per company**	
Mean	309.4	Mean	23.4
Highest	23,343.4 (Oak Ridge)	Highest	129.8 (Oak Ridge)
Lowest	2.3 (Silicon Alley)	Lowest	14.9 (Harvard Square)
Type		**Type**	
Entrepreneurial	872.9	Entrepreneurial	18.4
Industry cluster	303.7	Industry cluster	25.2
Local Government	1191.0	Local Government	23.8
Research & Academia	282.0	Research & Academia	54.2
Strategic Governmental	16.0	Strategic Governmental	32.9

4.3.3 Size and density of social and innovation networks and collaborations

Clustering and agglomeration of innovative organisations is a key mechanism through which Innovation Districts are thought to 'work'; this agglomeration is expected to enable individuals and organisations develop collaborative networks that underpin the development of innovative practices and products. Some Innovation Districts contain co-working spaces intended to foster collaborations (33, 39); for example within Boston's Seaport Innovation District, approximately 40% of firms were estimated to share workspaces (co-location) (39).

One theme that emerged in a small number of studies was that **co-location of organisations alone was not sufficient to trigger collaboration** (29, 34, 35, 38, 39, 43, 46-48). Instead, collaboration can be supported through the **design features** of the Innovation District, and the extent to which spaces in the public realm are incorporated to support informal and formal interactions that could be developed further into collaborative networks (46-48). Where opportunities exist for informal interactions within the public realm, these are highly valued by workers within Innovation Districts (46). Public realm spaces are also important venues for more **formal or organised networking events** (38, 47, 49), although these need coordination between a number of social or grass roots organisations concerned with innovation (and not a single organisation) in order to be most effective (38). Such spaces and events are also important in fostering a sense of community within an Innovation District as part of placemaking (see later section 4.5). A few studies also emphasised the importance of achieving a balance of companies at different life cycle stages – from multinational to start-ups – to help foster productive innovation networks, as well as organisations across different sectors (34, 43, 47, 48). As one participant in a study by Pancholi and colleagues (48) expressed, *"there's plenty of knowledge in these companies but that's all about private enterprises. So you really need that air to collaborate"* (p18), emphasising the importance of both having access to public realm and achieving a balance of companies with respect to sector and life cycle within an Innovation District.

One study explored the clustering of arts and creative industries within areas designated as Innovation Districts, as well as across other areas within the US (35). The results suggested that

Innovation Districts, and their composite make-up of knowledge-based industries and amenities, were a strong predictor of the formation of arts clusters. This study provides some evidence that, with regards to clustering of creative industries, that Innovation Districts can be successful in fostering collaborations across different industries (e.g. creative and knowledge-based). However, other studies were more ambivalent about the success of Innovation Districts in fostering cross-sectoral collaborative networks. A small number of studies reported that anticipated collaborations – particularly cross-sectoral collaborations – had failed to materialise (35, 38). In Shenzhen, this was attributed to the gulf in cultures between universities and industry, and the absence of third sector/non-profit organisations that could help to foster collaborative relationships (38); in Oklahoma City, cross-sectoral partnerships were described as ad hoc and were fostered at an individual rather than team, departmental, or organisation level (35). In their exploration of four US-based Innovation Districts (Boston Seaport, Detroit, Cortex (St Louis), and IDEA (San Diego)), Drucker and colleagues (43) describe Innovation District as a long-term strategy in political terms, although highlight the contradiction that "*at least within the spatial confines of the innovation district, however, there is not an impetus for achieving the balance of firm types that is inherent in the strategy*" (p813).

Therefore, despite agglomeration – and the expectant collaborative networking that follows – being a core mechanism thought to underpin the success of Innovation Districts, the evidence suggests that (i) a number of Innovation Districts may experience lower than anticipated levels of collaboration; (ii) collaborations need to be supported as part of broader placemaking efforts; but that (iii) cross-sectoral collaborations and collaborations between companies at different life cycle points are not prioritised as a strategic goal. Furthermore, despite collaboration being a core mechanism, we identified few empirical evaluations of the success of Innovation Districts in fostering collaborative networks, and instead studies more commonly provided a description of the networks that Innovation Districts engaged with (for example (37)).

4.3.4 Research and Development Capital Investment

We explored the extent to which studies reported levels and changes in research and development (R&D) capital investment, as this is theorised to be a key distinguishing feature of Innovation Districts (2). In practice, this was a challenging indicator to evidence and synthesise across the studies. Some studies provided descriptive evidence on the amount invested by different organisations in an Innovation District (4, 42, 50), with some studies indicating higher levels of government funding ((38, 44); both studies examining Innovation Districts in China), and others indicating a greater mix of private and/or philanthropic funding (42, 50). However, distinguishing between government, philanthropic, third sector, or private funding is challenging. Innovation Districts involve a complex array of stakeholders and investors who jointly invest, often through public-private partnerships (for example, 42), and stakeholders may occasionally assume differing roles – for example Local Government may invest in or establish third sector organisations (36).

The decision of a company to establish their presence in an Innovation District can also be taken to signal a form of investment, which may be subsidised by other actors (for example, the local government). Studies generally did not provide evidence on company-level investments. Where available, overall or central investment was reported in different forms including through tax credits (50), conditional subsidies (38), as well as in direct capital investment in Innovation

Infrastructure (4, 38, 44). The success of these investments was rarely evaluated, although one study provided indicative correlational evidence that higher levels of funding within European Innovation Districts corresponded to higher levels of success (as measured by the liquidity, solvency, profitability, and operation efficiency of companies within an Innovation District) (29). Detailed analyses of how investments were used and the extent to which they resulted in their expected goals were generally absent in the literature, bar a few exceptions. In a study of Suzhou Dushu Lake Science and Education Innovation District, Sun and colleagues (38, p110) participants reflected on the gulf between investment and utilisation in some cases: *"All our research labs and platforms were designed to be open access to firms in SEID and society at large. However, we find that not many firms use it, maybe because of a lack of industry demand."* Similarly, few studies evaluated the extent to which Innovation Districts were successful in attracting further R&D investments (of any kind, e.g. capital, innovation etc). In their study of Oklahoma City's Innovation District, Andes (35) provide data suggestive that the district successfully attracted a disproportionate share of R&D investment – with three quarters of the whole of Oklahoma state's National Institutes of Health investments being channelled into the district. Despite this positive indicative evidence, they also further contextualised the evidence, finding overall R&D expenditure to be at a substantially lower level than in peer districts (for example, three times lower than in Cortex Innovation District (St Louis)) (35).

4.4 Examining the economic performance of Innovation Districts – longer-term outcomes

4.4.1 Job creation

As outlined earlier, Innovation Districts are hubs for job creation. A number of studies present compelling descriptive data demonstrating that their creation is associated with tens of thousands of new roles (for example, 5,000 new roles over approximately six years in Boston (39); 34,000 new roles over 12 years in Barcelona (40), and 4,000 and more in Oklahoma Innovation District over ten years and at a pace twice as fast as the citywide rate (35). There are also indications that many roles within Innovation Districts are highly skilled and well paid (35), although there are concerns about the extent to which roles are accessible to the broader community surrounding Innovation Districts (35, 36, 45). In Oklahoma Innovation District, for example, "*while more than 75 percent of workers in the district are white and nearly 70 percent have some type of postsecondary education, over 70 percent of residents in the surrounding communities are African American and more than half have only a high school diploma or less*" (35, p33).

Data from the Atlas of Innovation (11, 12) allow for further exploration of the contribution of Innovation Districts towards job creation and the expected reduction of local unemployment rates. In terms of unemployment rates, with few exceptions, Innovation Districts tended to have low unemployment rates. Among 50 prominent US Innovation Districts, two thirds had an unemployment rate under 5% (12). Low levels of unemployment are theorised as being a result of the concentration of innovation-focussed employment. As Burke and Gras (12, p15) observe: "*areas with an Innovation Intensity of 30% and above have a remarkably low unemployment rate of 2-4% At this macroeconomic scale, we observe a noteworthy inverse correlation between the concentration of innovation activities and a community's unemployment level. Areas with an Innovation Intensity [the proportion of all employees within an Innovation District working on knowledge intensive activities; see earlier analysis] of around 10% have an average unemployment rate of around 10-14%; however, areas with an Innovation Intensity of 30% and above have an unemployment rate of 2-4%. The average United States community has an Innovation Intensity of less than 15%.*"

Our own meta-analysis of data presented for 25 in-depth case studies of US Innovation Districts presented within the atlas finds that the overall unemployment rate stands at 5% (95% CI: 4-7%) and that there was little variation between different types of innovation district (although there was substantial variation within these groups; see Appendix 4). However, three Innovation Districts had an unemployment rate of over 10 per cent (Ames Research Centre (NASA) (13%); Downtown Detroit (14%); and Research Triangle Park (North Carolina) (18%)) (12). Ames Research Centre (NASA) stands as an outlier to the patterns observed by Burke and Gras, having relatively high unemployment (13.0%) and a high innovation intensity (96.3%). This example does perhaps emphasise that while Innovation Districts can be highly successful, and on the whole may have beneficial effects on the economic fortunes of the broader community, these wider benefits are not a certainty in each case. This is underscored by evidence comparing the differential performance of San Diego, Cortex (St Louis), Boston and Detroit Innovation Districts

in triggering reductions in unemployment rates between 2000 and 2015-19 (32). While unemployment rates in St Louis and Detroit Innovation Districts had dramatically declined compared to neighbouring areas, those for Boston showed little difference with neighbouring areas, and in San Diego unemployment rates within the Innovation District appear to have fallen at a considerably slower pace than in neighbouring areas.

Another way of understanding the broader contributions of an Innovation District is to examine the number of jobs created around the Innovation District among the wider community (referred to as induced employment by Burke and Gras (12). Data from the Atlas of Innovation Districts (11, 12) emphasise the variation in levels of induced employment among 50 prominent US Innovation Districts, from 885 new jobs created in the local economy in Cornell Tech through to 670,760 in Silicon Alley. Across the 50 Innovation Districts, through re-analyses of the data we estimate for each job within the Innovation District, 1.67 additional support jobs are created in the economy (95% CI: 1.25-2.09), see (Table 2). Innovation Districts led by Local Government initiatives record the lowest number of additional jobs in the economy; this is a direct function of lower levels of Innovation Intensity in these areas (see section 4.3.1).

The developers of the atlas estimate that across all Innovation Districts, each **innovation-related role** consistently generates five additional support jobs in the broader economy[7].

Table 3: Number of support jobs created in the broader economy per one job (innovation-related and non-related) in an Innovation District – Secondary Analysis of Data from the Atlas of Innovation based on 50 prominent US Innovation Districts

Mean	1.67
Lowest	0.2 (Cornell Tech)
Highest	4.78 (Ames Research Centre (NASA))
Type	
Entrepreneurial	1.48
Industry cluster	2.16
Local Government	1.28
Research & Academia	2.04
Strategic Governmental	2.36

Overall, the evidence suggests that most Innovation Districts appear to be associated with low unemployment rates, substantial job creation rates, and to induce substantial levels of employment in the broader community.

Some important caveats around the impacts of Innovation Districts remain however in that:

(i) not all Innovation Districts, even among the most prominent examples, lead to low levels of unemployment even when they are seemingly performing well on other measures of Innovation Districts' success;

[7] No clear explanation is provided to support the assumption that each innovation-related role generates five additional support roles across each Innovation District.

(ii) there is variation in the impact of Innovation Districts on the broader local labour market and the number of jobs created, and some evidence that they have negligible impacts and do little to mitigate inequalities in some cases, and the underlying causes of this variation are not well understood;

(iii) the evidence presented around the success of Innovation Districts is broadly correlational and not longitudinal (and we are therefore not able to understand if and precisely how designating an area as an Innovation District leads to lower unemployment/job growth), lacks a comparison group (we are not able to speculate on the success of Innovation Districts relative to other forms of urban development), and the measures are not always well explained or transparently calculated.

4.4.2 Changes in Local GDP

Few studies have attempted to estimate the contribution of an Innovation District to the local economy, or made comparisons across Innovation Districts. Australian data from Melbourne (Monash Technology Precinct) and Sydney (Macquarie Park Innovation District) find that they 'contribute approximately AUD 9 billion to their state's economic output' (51), equivalent to £4.9 billion in the UK in July 2024.

Adjunct analysis of case study data from the Atlas of Innovation Districts (11, 12) shows that among 25 US Innovation Districts, the weighted mean sales for innovation per employee stood at $183,299 (95% CI: $130,561-$236,037), and there was large variation in sales ranging from $10,732 per employee (Purdue Innovation District) through to $507,033 per employee (Boeing Aerospace Cluster (Seattle)).

This data also allows for exploration of how innovation sales correlate (or not) with an indicator of meritocracy (12). This indicator is a measure of the ratio of income earned to net worth of individuals (12); as was the case earlier we interpret that a higher value is indicative of income being generated through active participation in the economy and that these opportunities are accessible. Exploration of this data shows that as the sales per employee increase, values of the indicator of meritocracy decrease; with respect to sales from innovation per employee, high performing Innovation Districts may not be the most meritocratic.

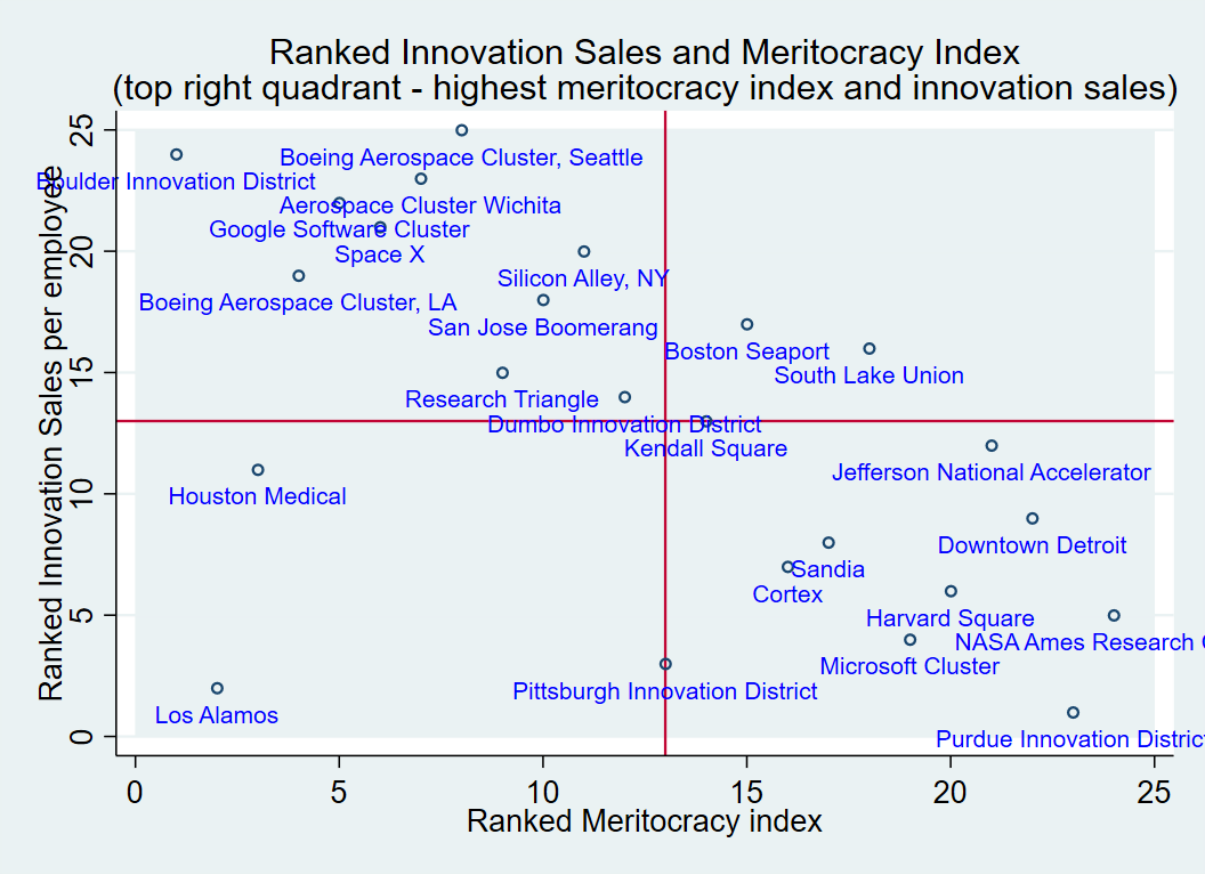

Figure 5: Ranked Innovation Sales per employee and Ranked Meritocracy – data from (12)

We show this by relative rank above in Figure 5, where a higher rank represents a higher value in terms of meritocracy and/or innovation sales per employee; quadrants are added for interpretation with the top right quadrant being those districts who perform well in terms of innovation output and meritocracy. The figure shows few districts perform strongly in both output and meritocracy simultaneously (Boston Seaport and South Lake Union are possible exceptions) and instead Innovation Districts appear to have the capacity to either generate high output *or* generate meritocratic employment opportunities. As was the case earlier, caveats surround these results and the conclusion drawn in terms of study design, metrics, and substantial variation in the performance and levels of meritocracy between Innovation Districts. In particular, the absence of comparable data from other forms of development (e.g. Science Parks) hinder interpretation of these data.

4.4.3 Patents issued

The number of patents issued as a measure of the success of an Innovation District in creating new products and practices is examined infrequently within studies. A small number of studies provide evidence that Innovation Districts are hubs for generating new knowledge that can be further commercialised (12, 29, 35, 44), although questions are raised about their comparative performance in some cases (35). In their analysis of case study data from the Atlas of Innovation Districts, Burke and Gros (11, 12) explore the percentage of sales that are derived from patents among 25 US Innovation Districts, finding that this ranged from 20.3% (Purdue

Innovation District) through to a high 82.3% (Research Triangle). However, we also note the analyses presented earlier that identified that Research Triangle Innovation District also had the highest unemployment level. Similarly, Hegyi and colleagues also question the link between patent creation and broader economic metrics (29). They conclude from their analyses of the economic performance of seven European Innovation Districts that 'the correlation between patents and the economic success of the clusters is not obvious' (29, p37).

4.4.4 Overarching indices of economic performance of Innovation Districts

A complex array of quantitative data is used to assess the success of Innovation Districts (11, 12, 17, 20, 29, 52). These variously focus on different domains including the utilisation of space within an Innovation District (52), the success of companies operating within an Innovation District (29), and the success of the Innovation District in generating jobs in innovation and profits from innovation (11, 12, 20).

Bajada and colleagues (17) offer a comprehensive framework for understanding the success of innovation precincts which includes: (i) examining innovation drivers (including the diversity of industries, number of research organisation, and the innovation sales and patents); (ii) innovation cultivators (including mentorship and support, funding opportunities, and the educational and occupational profile of employees); (iii) innovation infrastructure (including transport links and digital infrastructure); and (iv) innovation networking (including trust, collaboration and knowledge sharing). They analysed data for a sample of fourteen Innovation Precincts in Australia, calculating indices for each domain, finding that Innovation Precincts differed widely across all domains but that average scores were generally lower for innovation infrastructure than other domains, and highest for Innovation Drivers.

This could suggest that while Innovation Districts within Bajada and colleagues' study (17) are set up as hubs of diverse industries, that offer collaboration opportunities, and attract funding for highly skilled employees; that this success is achieved despite comparatively weak innovation infrastructure. They also find that emerging precincts tend to score lower across all domains than active precincts (17). However, they also find that the scores for institutional anchors was higher in active rather than emerging precincts, and rather than the nascency of the Innovation District, the results may instead reflect the different stakeholders involved and types of Innovation District (see earlier section on typologies of Innovation District). Bajada and colleagues' (17) evidence from Australia relating to the relationship between the nascency and success of an Innovation District also stands in contrast to evidence from European Innovation Districts, that suggests the most successful districts tend to be established more recently (29). In addition, findings described earlier based on the @22 Barcelona experience (31, 40) also suggested that Innovation Districts experience more rapid growth early on in the life of an innovation district, with the pace slowing down thereafter, although in the case of Barcelona at least part of this slowdown could also be attributed to the broader macroeconomic crisis of the late 2000s (31).

Beyond exploring the nascency of Innovation Districts, others have attempted to examine other common characteristics of economically successful Innovation Districts. Drawing on data from the Atlas of Innovation Districts (11, 12), some have speculated that future Innovation Districts should be modelled on those driven by dominant corporations (Industrial Innovation Districts) and those developed organically through interactions between entrepreneurs and start-ups

(Entrepreneurial Innovation Districts) due to their higher technical efficiency (20). Both types are characterised as being led by the activities of corporations, albeit of different scales, as opposed to being driven by the activities of Local and National Governments and Universities. In other studies, it is the success of an Innovation District to attract organisations of different scales to create an innovation ecosystem that was a crucial factor aligned with a productivity leap (53) and offered Innovation Districts a competitive advantage over other types of innovation areas (e.g. science parks (47)).

However, several studies also emphasise that many Innovation Districts are not created solely because of their economic potential, and question whether a focus on economic measures alone is sufficient to understanding their success (12, 20, 35, 47, 54). Perceptions of success could vary, even among organisations involved in establishing Innovation Districts, and as one participant in a study of Melbourne's Innovation District observed, a reliance on solely economic measures of success has its limitations for an intervention with a broader set of social goals: *"There are these very [...] American approaches that looked primarily at measures of buildings, collected the number of square meters of building or the number of patents or jobs in the area [...] which, I guess, is an approach that is often taken to measure success in the US. But that was only part of the point of MID [Melbourne Innovation District] which has much more of a focus on well-being and broader goals. So, using those measures was not going to capture everything"* (54, p7). Therefore, a reliance on economic measures alone is unlikely to capture the full extent to which Innovation Districts succeed (or not). Moreover, quantitative measures of success are difficult to interpret between different Innovation Districts given their heterogeneity in terms of form and function (17).

4.4.5 Poverty and educational and economic opportunities

4.4.5.1 Educational opportunities and capacity building

Innovation Districts are not only frequently led by Research and Academic institutes, their creation can also lead to the development of new academic clusters. In an atypical example, Suzhou Innovation District was said to have attracted 24 new or existing higher education institutes to establish campuses within the district who engaged over 70,000 students within the district (38). More commonly, Innovation Districts were **active in terms of making links with children, young people and schools, as well as undertaking broader lifelong learning capacity building** among community members (for example (36, 42, 48). In one case, Querétaro (Mexico), there was an explicit strategy for capacity building, in this case supported by four pillars of (i) educational innovation; (ii) skills development; (iii) digital transformation; and (iv) lifelong learning (26). Activities aligned with these pillars could be observed taking place across other Innovation Districts: for example, in Medellin, local high school students were invited to participate in exercises to create innovative prototypes (42); in West Philadelphia, university students mentored local high school students to expose students to STEM subjects (36); while in Chattanooga Innovation District there was a focus on lifelong learning and building entrepreneurial skills among underrepresented groups (42). Other activities were also reported to be taking place to build capacity among resident entrepreneurs and start-ups ((36, 55); see also section on innovation networks). The success and impact of any of these activities was generally not reported, although some studies noted an overall lack of initiatives to build capacity, particularly among community members, and attributed this to a lack of organisation

(48), and perhaps a lack of strategy driving capacity building. In addition, we did not identify any study in this rapid review that explored the impact of Innovation Districts on graduate opportunities and trajectories, and the extent to which local Innovation Districts could help with the brain drain of graduates from local areas.

4.4.5.2 Poverty and economic inequalities

Innovation Districts may be commonly established within areas of deprivation, although there were few studies that evaluated if and how they helped to address broad economic inequalities and poverty rates. More commonly, **studies appeared to suggest that Innovation Districts could exacerbate levels of perceived local inequality** through introducing further disparities between new employees and residents drawn to the Innovation District, and existing residents (32, 42, 56-58). In one study conducted on Boston's Innovation Districts, some inequalities were attributed to historic patterns (30), although more commonly studies provided evidence to suggest that the Innovation District itself appeared to exacerbate levels of inequality through, for example, skewing income distributions. For example, in a study of Chattanooga Innovation District, the number of households in the highest income bracket (over ~$75,000) increased from 5% to 25% of households while the number of the households in the lowest income bracket (under $10,000) stayed stable (42). As observed by one resident of an Innovation District in Brisbane, persisting inequalities cast questions about the broader purpose of an Innovation District: "*To me, it seems to be cultivating a new elite. It increases the value of nothing. It feeds off its over-inflated ego*" (58, p11). One potential explanation for these patterns could be the tensions that exist between private and public sectors. While stakeholders in the public sector may be clear about the social responsibilities of the Innovation District with respect to enhancing equity (42, 59), other stakeholders were less clear about these responsibilities (47, 50), even if they were in receipt of public funding (50). Despite imposing workforce participation requirements to ensure equitable hiring policies (47), those involved in developing the Cortex Innovation District in St Louis appeared to be initially reticent to implement these, citing private developer categorisations (50). This possibly speaks to a broader point that social dimensions of Innovation Districts are not always at the forefront of discussions during the planning processes and therefore do not influence outcomes substantially (47).

Nevertheless, despite potentially exacerbating levels of inequality, a study of areas in Melbourne found evidence that the employment income distribution within Innovation Districts was more balanced than in other areas of planned employment (e.g. other forms of industrial zone) (28). This is one of the few studies to explore the differential effects between Innovation Districts and other types of area of innovation and planned employment areas. Overall, much of the literature suggests that many Innovation Districts operate under the assumption that equitable economic growth follows from economic growth. As noted in Read and Sanderford (47), those involved in the development of Innovation Districts seem to believe that the agglomeration of socially responsible companies within Innovation Districts is sufficient to generate social equity. There is little evidence to support this hypothesis, or even investigation to explore its validity.

4.5 Examining the broader impacts of Innovation Districts

4.5.1 Innovation Districts and the creation of communities invested in innovation

4.5.1.1 Innovation Districts as communities with economic resources and civic amenities

While we examined the ways in which Innovation Districts created collaborative networks among innovators earlier, the ambitions of Innovation Districts are often – and arguably should be – broader than economic development alone. Innovation Districts can be regarded as a form of urban intervention that aims to change the character of an existing community, and a number of studies offer insights into the extent to which Innovation Districts interact with and are shaped by the communities in which they develop.

A number of studies speculate that **where Innovation Districts are able to develop community or civic amenities, or develop links with existing amenities, that this may lead to economic benefits**, and conversely the absence of community and civic amenities was economically detrimental (35, 46, 55, 56, 60, 61). This was often tied to the notion that Innovation Districts should be mixed use communities (58), and a desire to avoid creating sectorally and culturally homogenous areas with weak links with more diverse neighbouring areas (56, 58). Innovation Districts that were successful in creating vibrant communities were thought to be at a competitive economic advantage (60, 61), and as expressed by a participant in one study: *"Quality of place is utmost importance while planning and developing knowledge precincts as without high standards it's not possible to compete with other overseas locations, particularly the emerging economy precincts"* (61, p739). Incorporating urban revitalisation within Innovation District strategy was also viewed as a means of garnering political support (55).

In contrast, a lack of civic amenities within an Innovation District, or connections with areas with neighbouring areas with stronger amenities, has implications for the quality of daily life of residents (35, 39, 48, 62). Spaces for social interaction and community spaces were viewed as important contributors to a feeling of integration. Such facilities also needed to reflect the character of the community, and even Innovation Districts set up as 'creative precincts' could lack vibrancy and identity, and be perceived by residents as 'boring', without displays of arts and creativity threaded within them (48). The importance of amenities is not only confined to arts and leisure amenities for example, but also include basic amenities such as grocery stores (39, 62), and in one example Innovation District in Boston Seaport, residents had been living without basic amenities for a considerable amount of time and were described as effectively living in "food deserts" with poor access to grocery and healthy food options (39). In addition, while Innovation Districts can ostensibly offer opportunities for improving infrastructure and civic amenities such as local schools, these 'improvements' can instead unintentionally disrupt the social fabric of areas and lead to unanticipated displacement effects (36). In an example from West Philadelphia, Wolf-Powers (36) provides a detailed account of how the closure of a school to make way for Innovation District development led to the dispersal of children to different schools outside the district and disrupted a core part of the identity of the district.

One reason why the 'improvements' that are integrated within Innovation District developments lead to such unanticipated effects may revolve that **economic 'placemaking' and civic 'placemaking' can reflect opposing goals** (24, 32, 47, 50, 53, 62, 63). Consequently, Innovation Districts that are perceived to be economically successful do not necessarily have a wide array of social amenities (63). Several factors could explain such disparities. For example, mixed function characteristics (for example, residential and commercial premises) can mean that start-ups are challenged in finding suitable premises in mixed use areas (24), but that conversely mixed function areas can mean that residents are challenged in finding suitable amenities in areas with a more commercial focus (62) or are left isolated by the existing infrastructure (such as legacy railways or canals) which may not be considered an economic regeneration priority (53). Moreover, some of the evidence illuminates a tension between creating areas that are attractive to start-ups and innovators and those that meet resident needs ((32, 50); see also sections below) and that economic investments (e.g. in the tech economy) erroneously start to become conflated with investments in the community (50). This can mean that the social value of an Innovation District can become entirely obscured, and any harmful effects regarded as fateful, and as one participant in (32, p7) reflected on the creation of an Innovation District in San Diego: *"The overarching strategy has become more about crafting a location attractive to entrepreneurs and innovators, instead of finding support to create or financially subsidize entrepreneurial and innovative businesses. In this setting, the originators and proponents of the IDEA district argued that gentrification was inevitable."*

A common point of tension between civic placemaking and economic placemaking was in the extent to which Innovation Districts represent 24-hour communities (43, 52, 61, 62, 64). While an Innovation District in Turku, Finland provides an example where efforts to create a 24-hour community are reported to be successful (52), and an Innovation District in Brisbane (Kelvin Grove Urban Village) appeared to have successfully dismantled the boundary between the district and the wider city (61), in several other settings efforts to expand the perceptions of Innovation Districts beyond areas solely for working and learning appears to have faltered (see examples in (43, 61, 62, 64)). This may also be tied the extent to which employees within an Innovation District are drawn from the local community. As an employee involved with an Innovation District in Brisbane (Diamantina Knowledge Precinct) reflected, where social amenities are scarce and/or employees have a weak connection with the local area, it can be uncommon for Innovation District employees to leave their offices beyond arrival and departure from work.

4.5.1.2 Innovation Districts as Social Enclaves

Several studies considered the social distance between Innovation Districts and their existing and immediate neighbouring communities (32, 36, 41, 42, 45, 48, 53, 57, 58, 64, 65). **In some cases the social distance seemed to be such that Innovation Districts seemingly created 'enclaves'** of highly skilled knowledge workers and residents. In the absence of meaningful community engagement, among existing residents, Innovation Districts could be perceived as a deliberate and long-term strategy to erase the existing identities of communities and develop new identities commensurate with the needs and goals of new residents with socially advantaged characteristics (Daniels, Wolf Powers). As a resident and business owner in West Philadelphia reflected on an Innovation District being spearheaded by Drexel University: *"What you have is the foundation to the infiltration to the neighborhood and they're all talking*

about education, [how it] will be for the next gentrified families that move into these communities, so they're planning for the Drexel teachers, the Drexel students, the Drexel people that will move to this community in the next 10 to 20 years" (45). More broadly, several studies reflected on, and presented data to support, the mismatch in the needs of local people and the opportunities provided by Innovation Districts (35, 57, 58, 64). In some cases, this mismatch reflected not only socioeconomic opportunities and disparities, but also racial disparities. As both Daniels (45) and Wolf Powers (36) argue, Innovation Districts could be viewed by local communities as the latest in a series of policies that have served to marginalise ethnic minority communities.

Some studies emphasise the challenge facing Innovation Districts, as an ambitious form of social intervention seeking to unite 'disparate worlds' (41) and ultimately to reduce social distance and ameliorate social inequalities. Even where good intentions exist among the planners of Innovation Districts, interactions between districts and neighbouring residents can be rare (41). This can be compounded by the topography, walkability, and physical infrastructure of Innovation Districts (48, 53, 65), although could be mitigated, in part, by attempts to convert the spatial characteristics of existing institutions to more extrovert models (65).

Innovation Districts are often pitched as community building initiatives, but this perception often negates and further marginalises existing communities, ignores their histories, and devalues the work of existing community-based organisations (36, 45). Rather than seeking to build communities afresh, the evidence indicates that socially-driven Innovation Districts should seek to support existing community infrastructure and link existing communities and areas with their broader settings. However, the success of policy in encouraging linkages between Innovation Districts and neighbouring communities is highly context dependent (36). In addition, as a participant in Pancholi, Yigitcanlar and Guaralda (48) observed, such efforts don't *"happen by osmosis, you need an organisation or a group to take responsibility for actually making community happen. Building community doesn't just happen magically"*.

An underlying reason why the evidence points towards some Innovation Districts forming enclaves rather than inclusive districts with porous borders, is that **redevelopment is shaped according to the lens of those with socially advantaged characteristics, and obscures the lens of existing and marginalised communities** (36, 45, 56). In some cases this redevelopment is described as being pitched towards a 'gentrified aesthetic' that eschews the skills and legacies of existing and neighbouring communities (56), and which results in fewer opportunities for participation for people with marginalised sociodemographic characteristics (57, 58, 64). As a resident in West Philadelphia observed, Innovation District developers often have a very poor understanding of the lives of local residents: *"I probably couldn't understand their world, and they probably couldn't understand my world," (45, p91)*.

Even when consulted about the development of Innovation Districts, community concerns around displacement and exclusion are not heard, and are overshadowed by conversations about built environment features such as the provision of parking or trees (36). Far from being co-produced or co-designed with communities, some studies highlight that efforts to engage communities in the design of Innovation Districts can advance little beyond communities being informed about new developments (32, 36). In some cases information about new developments was provided to local communities after decisions were made, leaving **little**

scope for meaningful collaboration and where engagement becomes tokenistic as best (36). In her ethnographic research, Wolf-Powers (36) explores the role of community organisations in shaping an Innovation District in Philadelphia. She highlights that in an area that was historically marginalised, there was a long history of community activism although this was often stretched. Alongside extensive efforts towards community development with respect to, for example, youth development or poverty alleviation, the introduction of an Innovation District meant that community organisations were expected to assume new duties and find the resources to enter into negotiations with property developers. She also underscores the disparity between the resources held among community groups and those of property developers, as articulated by one interviewee: *"The politicians are happy to let us fight it out, let the volunteers go up against the developers. There is nothing inherently wrong with developers; they're not terrible people. But there needs to be somebody other than schoolteachers and artists to line up against these people."*

4.5.1.3 Innovation Districts and Experiments in Urban Lifestyles

The evidence throughout this review overwhelmingly reinforces that Innovation Districts are heterogeneous areas that differ in terms of industry, governance, scale and location. In addition to characteristics that unify Innovation Districts, such as multifunctional spaces that operate under theories of agglomeration, two other themes emerge in the literature. Firstly, that Innovation Districts are locations of experimentation. In some cases, they can take the form of testbeds within urban laboratories where new technologies and new ways of working are trialled (33, 54, 66). Moreover, the language of innovation is deliberate way of communicating their potential as urban laboratories that can develop interventions to address society's 'ills', and triggers the financial, political and popular incentives to back these developments (4).

However, this focus on development and improvement is not confined solely to Innovation Districts, and could also be applied to other areas of innovation (10). Rather than providing solutions to defined problems, some of the literature emphasises that **Innovation Districts instead offer new ways of living, and that their distinguishing feature is the promise of an 'urban lifestyle'(43)**, with new residents being attracted by the promise of an idealised lifestyle (e.g. the 'Barcelona lifestyle' (34) or the promise of 'hipster friendly' amenities (25). This lifestyle is crafted around the tastes and aesthetic of highly skilled newcomers to the area (25, 36, 43, 47, 66), and Innovation District developers in some instances have focussed on "…satisfying the unique and discerning consumer demands of highly-skilled and highly-educated people working in knowledge-based industries. Bars, restaurants, entertainment venues, and specialty retailers targeting this market segment were therefore incorporated into mixed-use environments" (47). The ambitions around creating a hub for an idealised 'urban lifestyle' mean that community involvement and participatory design exercises have focussed on the look and feel of Innovation Districts (36, 66) rather than fundamental questions about their function, and particularly their social function.

From the perspective of residents, the focus on the look and feel of Innovation Districts in the pursuit of developing an infrastructure commensurate with an urban lifestyle, rather than their function, represents a missed opportunity to create impactful social change (36). It also means that the adverse impacts of Innovations Districts are either deprioritised or neglected altogether

by developers (32, 36, 45). These processes can take place across socioeconomic and racial lines and include gentrification, studentification (where students rather than wealthy workers amass in lower-income neighbourhoods (see Daniels)), increasing social inequality, marginalisation, social isolation, and consequent displacement. Some of the evidence clearly outlines how gentrification isn't solely a benign process resulting in increasing numbers of 'hipster-friendly' amenities. Gentrification and studentification results in new residents moving into an area who can exhibit high levels of mistrust, hostility, and racism towards existing residents (see (45)). It also results in areas simply becoming unaffordable for existing residents. Two examples from West Philadelphia document how rising property prices impacts on existing residents and triggers the risk of displacement (36, 45). In settings where property taxes (akin to council tax in the UK) are reviewed on a frequent basis[8], and are calculated based on an estimate of the current property's value, local increases in house prices have a direct impact on the affordability of an area (32, 36, 45).

4.5.1.4 Ways of enhancing the embeddedness of Innovation Districts within communities

Although developers may view gentrification and displacement as an inevitable, and even necessary, part of creating Innovation Districts (32), the literature does provide a number of examples of strategies that could be deployed to enhance the embeddedness of Innovation Districts within communities. These success of these strategies and recommendations has generally have not been formally evaluated within the studies, and often they appear to have been deployed with mixed levels of success (33, 36, 37, 41, 42, 45, 47, 48, 52, 53, 56, 57, 59, 67). Strategies and recommendations identified in the evidence include:

1. **Identifying the ways in which Innovation Districts can impact communities and track their impact comprehensively:** Daniels (45, p149) provides a framework for tracking the social impact of Innovation District in Philadelphia that includes measuring the following aspects: "(a) culture, (b) sense of belonging, (c) changes in architecture, (d) reduction in block parties, (e) preservation of historic sites, (f), retention of houses of worship, (g) preservation of murals, (h) density, (i) changes from multi-unit to single-family ratio, (j) increase in students moving into the neighborhood, (k) physical environment, (l) affordable housing to market rate housing ratio, (m) reduction in on-street parking, (n), rising land values and property theft, and (n) reduction in vacant lots." This framework was developed based on extensive research with residents in the local area and reflects specific concerns around, for example, the preservation of cultural heritage (e.g. block parties and murals). Creating such a framework for other Innovation Districts involves first developing an in-depth knowledge of local priorities.
2. **Scrutinise the success of approaches to community involvement and adopt co-design and co-production principles:** Not all policies and practices intended to create inclusive communities succeed (41, 56), indicating a need to scrutinise and evaluate policies. Some districts have implemented extensive programmes of engagement (48, 59), that include door-knocking entire communities in an effort to be transparent about developments (48), and some go as far as claiming to have co-created plans for districts with residents (42, 52, 59). However, the extent to which the principles of co-creation

[8] Unlike in the UK, where the valuation of property is based on values as of April 1st 1991.

were upheld, and the views of communities were actually reflected in the final plans in all instances, is unclear. Co-creation can also extend beyond the design phase and into the implementation and governance of Innovation Districts (for example (36)).

3. **Develop inclusive housing and land zoning policies:** We explore the impacts of Innovation Districts on housing elsewhere in this report, although a number of studies stress the importance of creating inclusive housing policies that involve, for example, promotion of housing stock diversity (42) and provide for a variety of land use types (57); the targeted use of zoning laws (33, 36, 57); employer-assisted housing programmes linked with 'hire local' policies (56); the incorporation of multifamily housing into development plans (55); the use of annual building fees and service charges for established corporations within an Innovation District to fund social programmes including housing (67); and targeted strategies to support residents who may be experiencing rapid rises in property taxes to facilitate them to remain within and maintain their homes (36).
4. **Recognise that organisations involved in regeneration can have a poor reputation:** For example, Dublin City Council had acquired a poor reputation among residents; creation of a new development authority helped to facilitate meaningful engagement beyond tokenistic consultation (53); other studies also reflect on the reputation of organisations involved in the creation of an Innovation District and its influence on meaningful engagement (36).
5. **Address gaps in basic and civic amenities and implement programmes that foster social connection:** Innovation Districts can provide stimulus to enhance the basic infrastructure of an area which may be more aligned with the needs of current residents – from expanding access to healthy food to making toilets more available (42, 68). Alongside enhancing basic amenities, investment in an area could also stimulate investment programmes aimed at enhancing social connectivity, through for example mentoring interventions aimed at fostering intergenerational solidarities (68).
6. **Adopt an ecological approach and tailor examples of successful practice to the needs of the local community:** Two studies discussed how either the wholescale approach or a specific intervention that had been trialled elsewhere had been adapted to reflect the local context (52, 68). For example, in Turku, Finland: "the development process of the TSP [Turku Science Park] area did not involve direct adoption of any foreign models. It took an explicitly bottom-up and participatory approach, which was important partly because the resources of a wide pool of public and private actors were needed to realize the ambitious vision. Yet, the process corresponds to international trends of promoting innovation-led urban and regional development, including most recently the creation of IDs" (52, p87). A further study advocated an approach to designing Innovation Districts that adopted a 'whole ecosystem perspective' that could better anticipate crunch points in inclusion.
7. **Community autonomy in spending decisions through community trusts** was identified in two studies of the same District (36, 45) as a means of enhancing the embeddedness of Innovation Districts within communities and ensuring meaningful engagement of organisations to tackle issues around, for example, housing and inclusion. In addition, within this Innovation District, a new dedicated site had been created to foster neighbourhood partnerships (36).

4.5.2 Housing

Housing is a strategic priority in the creation of most Innovation Districts (for example (31, 32, 36, 37, 42, 45, 47, 48, 52, 67)). Often this was a deliberate strategy to increase the overall number of housing units, as well as the number of affordable housing units available. However, the level of units designated as affordable is ostensibly low in some cases (for example 15% of 12,000 new units in Boston (39)), and there are other concerns about whether affordable units are truly affordable, and whether they are accessible to existing residents or being made available only to new residents (e.g. students) (45). In some Innovation Districts however, the provision of new housing of any type may not considered a priority (e.g. Cortex (St Louis) (32)) and in other districts that are developed for commercial reasons alone, even if new housing is incorporated within the strategy for the district, there may be little attempt to ensure new housing remains affordable to existing residents (e.g. IDEA (San Diego) (32)). In some districts, there were examples where, despite ambitious commitments around the provision of new housing, there was evidence that housing targets had been delayed. Evidence from Barcelona suggests that after fourteen years, approximately 35% of the social housing target had been met (31). In other settings, **housing commitments changed to reflect the evolving nature of the Innovation District** (37). There was some speculation that housing commitments could be linked to funding raised through the revenue that was generated in the early stages of an Innovation District (47, 53).

Although public housing targets in @22 Barcelona may have been missed (31), other evidence underscores that mechanisms exist within Barcelona's strategy for future development and equitable housing growth. These mechanisms took the form of a set of **'value capture' policies, where funds were secured through increased taxes and fees for higher-density development rights and land was ceded for public housing**. In retrospect, the ambitions and targets for affordable housing have been viewed as lacking ambition, although such a model could be adopted elsewhere with a more ambitious set of targets determined early on (67). Chattanooga's Innovation District (Tennessee, USA) also uses a form of 'value capture' to incentivise the provision of affordable housing; here real-estate developers are offered property tax breaks on new or redeveloped housing if they guarantee a proportion of properties are made available to renters who earn less than 80 percent of the area median income (42).

Despite ambitions and efforts within many Innovation Districts to develop inclusive housing, **ultimately, the literature suggests that Innovation Districts have tended to exacerbate housing pressures particularly around affordability** (4, 32, 36, 45, 48, 58, 68). These concerns are foreseen as inevitable by developers (32), residents, and community leaders (48) alike, as articulated by one community leader in Sydney's Macquarie Park Innovation District: *"because this area is in high demand, the prices are going up, up, up. And it just pushes people out further."* (48, p19). These concerns are exacerbated in areas where property taxes are regularly reviewed and rise in line with neighbourhood property prices, putting pressure on residents wishing to move within the Innovation District as well as those who are staying put (36, 45).

Not only were Innovation Districts viewed as becoming unaffordable for local residents, but some studies also suggested that housing provision was not meeting the needs of innovators and start-up owners, some of the very new residents Innovation Districts were hoping to attract (4, 56). Evidence indicated that even when housing was designed with the needs of start-up

owners and innovators in mind, that this housing was consumed by a richer demographic (4). Evidence from entrepreneurs in Australia working in and around Innovation Districts highlights the link between good quality, affordable, and flexible housing for innovators, and productivity and economic success (56), and as articulated by one interviewee, poorer quality housing has an impact on productivity: *"Being able to sleep is massive for productivity, and like at that period… I was turning up at the coworking space seven days a week for six weeks straight or something… So, you do need the sleep part. So therefore, yeah, share-houses, Airbnb, hostels, that all can all be a cost to you. You might save money but you're actually losing physical values like productivity"* (56, p34).

Some studies provided quantitative evidence on the rise of housing costs within Innovation District areas and the extent to which Innovation Districts were meeting local housing needs (Table 4).

Table 4: Change in Housing Affordability for Selected Innovation Districts

Study	Location	Change/Affordability Measure	Comparison
Daniels (45)	West Philadelphia	**Change in availability:** Between 2007-2019, 823 new units built within Mantua District (neighbouring district): Overall 23% designated as affordable	**Change in availability:** 45% of units built 2011-2019. 0% of these are affordable housing units.
Kayanan, Drucker and Renski (32)	San Diego	**Change in rent:** Mean rent increased by $894 in the Innovation District between 2000 and 2019	**Change in rent:** Mean rent increased by $602 in neighbouring districts between 2000 and 2019
	St Louis	**Change in rent:** Mean rent increased by $213 in the Innovation District between 2000 and 2019	**Change in rent:** Mean rent increased by $239 in neighbouring districts between 2000 and 2019
Lee (68)	West Philadelphia	**Change in rent:** Median rent increased by 51% in the Innovation District between 2000 and 2013	**Change in rent:** Median rent increased by 9% in the Philadelphia as a whole between 2000 and 2013
Wolf-Powers (36)	West Philadelphia	**Change in rent:** Gross Median rent increased by 107% in within East Mantua District (neighbouring district) and 30% in West Mantua between 2000 and 2014-18	**Change in rent:** Gross Median rent increased by 22% in Philadelphia as a whole between 2000 and 2014-18
		Change in property value: Median home value increased by 218% in within East Mantua District (neighbouring district) and 92% in West Mantua between 2000 and 2014-18	**Change in property value:** Median home value increased by 77% in Philadelphia as a whole between 2000 and 2014-18
		Change in real estate tax: Median real estate tax increased by 66% in within East Mantua District (neighbouring district) and 46% in West Mantua between 2000 and 2014-18	**Change in real estate tax:** Median real estate tax increased by 8% in Philadelphia as a whole between 2000 and 2014-18

Further exploration of Table 3 shows that while perceptions and observations of the impact of Innovation Districts suggest that housing affordability is a widespread concern in the literature, quantitative data clearly showing this derives from a comparatively small number of Innovation Districts. In addition, while the evidence above and within the table is overwhelmingly suggestive that Innovation Districts trigger disproportionate rises in housing costs and present pressures for new and existing residents, at least one Innovation District (Cortex, Table 3) appears to have experienced more moderate rises in housing costs in line with neighbouring districts.

4.5.3 Environmental impact and transport

There was comparatively little evidence tracing the environmental impacts of Innovation Districts. Two studies appeared to indicate that Innovation Districts had the potential to become testbeds for the development and/or implementation of new technologies (54, 69), with conspicuous commitments and demand for impactful sustainability measures thought to be on the rise among prospective tenants of Innovation Districts (47). Despite increasing enthusiasm, studies suggest that efforts to promote sustainability were opportunistic and not explicitly embedded within strategies with sufficient detail (47, 54).

Although the evidence indicated that overall sustainability strategies were lacking, it also showed that several Innovation Districts were taking measures to promote active travel (39, 47, 48, 50) and public transport (39, 52) within their areas. For example, in the case of Macquarie Park Innovation District (Sydney), initiatives to improve sustainable and active forms of transport included setting up a bike committee, offering discounts and equipment, and creating purpose-built tools and apps (48). Moreover, walkability and public transport were viewed as desirable features across a number of Innovation Districts (for example (47, 52)), and there was some evidence that members of the public perceived the creation of Innovation Districts as improving the walkability of local areas (58). One feature often discussed as impeding walkability was the presence of large roads or railways that bifurcate several Innovation Districts at key points (35, 52, 53, 61). These contributed to perceptions of the Innovation District being cut off from neighbouring districts and city centres, and perhaps contributing to the impression that Innovation Districts can form enclaves. In Turku, the future vision includes plans to tunnel a highway that currently bifurcates the Innovation District (52).

While not discussed extensively in empirical studies, the architectural character of new buildings could also influence the environment within Innovation Districts. In a study of West Philadelphia's Innovation District, new buildings within the Innovation District lacked the distinctive architectural features of existing building stock and presented a visible and divisive sign of development (45).

4.6 Identifying characteristics of successful Innovation Districts

An initial goal of this rapid review was to identify characteristics that are aligned with successful Innovation Districts. we did not define success; evidence suggests it varies significantly across Innovation Districts, depending on their initial goals. For example, some of the existing literature in this area marks a distinction between mission-oriented Innovation Districts (1) – those that involve a diversity of organisations collaborating on place-based, socio-technical innovation (1) – and others. We might also contrast mission-oriented Innovation Districts with commerce-oriented Innovation Districts – those where innovation to address a social challenge is not a core ambition. Our exploration of the literature showed little relationship between sets of studies that assess economic performance, and those that assess their broader impacts. However, our earlier analyses of data from the Atlas of Innovation Districts (11, 12) also examined the correlation between selected economic indicators, and an indicator of meritocracy. We observed that several Innovation Districts appeared to struggle to create areas that were both economically productive and meritocratic in nature. Here, we extend the re-analyses further.

4.6.1 Identification of successful Innovation Districts: Reanalysis of the Atlas of Innovation (31)

Our interest here is in identifying areas that strengthen economic performance *and* stimulate equitable opportunities. We use proxy indicators to explore this drawing on those presented by Burke and Gras (12) (see descriptions in table 5). The data is based on ranking the Innovation Districts against one another; we acknowledge that this approach does have its limitations, and not least that it may fail to convey that all Innovation Districts may be performing well compared to other areas of innovation (e.g. Science Parks). We note a negative correlation between the two indicators of equitable opportunities, emphasising that meritocracy within a district is not always commensurate with the creation of job opportunities beyond an Innovation District.

Table 5: Indicators of successful Innovation Districts

Domain and measure	**Indicators used**
Economic performance: The top 40% based on the average rank of ranked indicators	Ranked Innovation Intensity: based on the proportion of employees engaged in innovative employment
	Ranked Innovation Performance: based on the proportion of sales generated of all sales
	Ranked Innovation Sales per Employee
Equitable opportunities: The top 40% based on the average rank of ranked indicators	Ranked Meritocracy Index: based on the ratio of income earned to net worth of individuals (NB: a higher value is indicative of income being generated through active participation in the economy and that these opportunities are accessible).
	Ranked Ratio of Additional Job Opportunities: the ratio of induced employment (additional support jobs created in the economy) to the Innovation District's total employees

From the full list of 50 Innovation Districts, we highlight the following (Table 6) as examples that ranked highly for both economic performance and equitable opportunities (excluding one, Oak Ridge Innovation District, with missing data for meritocracy).

Table 6: Innovation Districts identified as highly ranked in economic performance and equitable opportunities – data from (12)

Type of Innovation District	**Name**	**State; US Region**	**Included in Qualitative Comparative Analysis (QCA)**
Entrepreneurial	Downtown Houston	Texas; Southwest	No
Entrepreneurial	Google, Silicon Valley	California; West	Yes
Entrepreneurial	Apple, Silicon Valley	California; West	No
Entrepreneurial	South of Market (SOMA)	California; West	No
Entrepreneurial	San Jose Boomerang, Silicon Valley	California; West	Yes
Industry	Microsoft Software Cluster	Washington; West	Yes
Industry	Facebook, Silicon Valley	California; West	No
Local Government	Downtown Detroit	Michigan; Midwest	Yes
Research & Academia	Harvard Square	Massachusetts; North East	Yes
Research & Academia	Kendall Square	Massachusetts; North East	Yes
Research & Academia	Research Triangle	North Carolina; Southeast	Yes
Strategic Governmental	Ames Research Center, NASA	California; West	Yes
Strategic Governmental	Sandia National Laboratories	New Mexico; Southwest	Yes

We explore the evidence further through analysing the data for those Innovation Districts included within 25 case studies of the total 50 Districts included within the Atlas of Innovation. These case studies provide a wider range of characteristics to consider and of the 13 areas above, nine are also included within the case studies. We also identify areas that were ranked within the 40% lowest for both economic performance and equitable opportunities, and matched six of them to the 25 case studies, we regarded these as the least successful (see earlier caveat).

4.6.2 Factors explored in examining why some Innovation Districts succeed more than others and analytical method

Our dataset, which was analysed using Qualitative Comparative Analysis (QCA), contains observations from nine Innovation Districts considered most successful—performing well economically and providing equitable opportunities—and six considered least successful. QCA has its basis in set-theoretic logic, and is well-placed in synthesizing data from a small number of cases to uncover complex configurations of conditions observed to overlap with an outcome

(70). We followed guidance provided elsewhere in creating our QCA solution (71), and ran a series of diagnostic tests to ensure the quality of our solution[9].

We are limited in the scope of the analyses by the range of factors available, which tend to focus on the physical and commercial characteristics of the Innovation Districts, as opposed to the broader social and contextual characteristics or characteristics reflecting the way the Innovation district is run (e.g. governance arrangements). The characteristics we considered include those reflecting the scale, location, type, employment ecosystem, and the extent to which the Innovation District included a high concentration of residents and the extent to which it was a mixed function area (table 7).

Table 7: Characteristics of Innovation examined as predictors of success – data from (12)

Characteristic	**Measures**
Scale	Whether the Innovation District is under 5 square miles (small district)
	Whether the Innovation District is over 15 square miles (large district)
Location	Whether the Innovation District is located in the West of US
Type	Whether the Innovation District is led by Research and Academia
	Whether the Innovation District is led by Commerce (start ups (Entrepreneurial districts) and larger organsations (Industrial) combined)
	Whether the Innovation District is led by Government (Local Government and Strategic Government Investment combined)
Employment ecosystem	Whether the Innovation District has a high concentration of employees (over 12,000 per square mile in high concentration areas or lower)
	Whether the average business size is equivalent to small business definitions (under 30 employees per company)
Mixed function – residential density	Whether the Innovation District has a high concentration of residents (using a threshold of 3,882 per square mile as an indicator of a high density cluster, based on EEA thresholds (see (72)))
Identity	The extent to which the area is identified as an Innovation District within sources beyond the Atlas of Innovation Districts

As we have a relatively limited set of cases (Innovation Districts; 16 in total), we are only able to examine the way that 4-5 of these trigger the outcome (being most or least successful) simultaneously. Our data table, table 8 below, shows the distribution of selected characteristics from the Atlas of Innovation Districts by the classification of most and least successful.

[9] No contradictory configurations were detected and no contradictory simplifying assumptions were made in accounting for logical remainders (combinations of conditions not supported by observed cases

Table 8: Data table used for Qualitative Comparative Analysis – data from (12)

	Location	Type			Scale		Employment ecosystem		Mixed Use	Identity	Outcome
ID	West	Research & Academia led	Commercial led	Government led	Area under 5 square miles	Area over 15 square miles	Average business size under 30 employees	High density employment (over 12,000 per square mile)	High density residential area (over 3,000 residents per square mile)	Self-identify as an Innovation District	Success Indicator
Harvard Square	0	1	0	0	1	0	1	1	1	0.8	1
Kendall Square	0	1	0	0	1	0	1	1	1	1	1
Pittsburgh Innovation District	0	1	0	0	1	0	0	1	1	1	0
Purdue Innovation District	0	1	0	0	1	0	0	1	1	1	0
Research Triangle	0	1	0	0	0	1	0	0	0	1	1
Google Software Cluster	1	0	1	0	0	1	0	0	0	0.2	1
San Jose Boomerang	1	0	1	0	0	1	1	0	0	0.2	1
Microsoft Cluster	1	0	1	0	1	0	0	1	0	0.2	1
Cortex	0	0	0	1	1	0	0	1	1	1	0
Downtown Detroit	0	0	0	1	1	0	1	1	0	1	1
South Lake Union	1	0	0	1	1	0	1	1	1	1	0
NASA Ames Research Centre	1	0	0	1	1	0	0	0	0	0.8	1
Jefferson National Accelerator	0	0	0	1	1	0	1	0	0	0.8	0
Los Alamos	0	0	0	1	0	1	0	0	0	0.8	0
Sandia	0	0	0	1	0	1	0	1	0	0.8	1

Key: All 0 indicate characteristic is absent (No); All 1 indicate characteristic is present (Yes). Exceptions:
Success Indicator: 0= Least Successful, 1 = Most Successful; West: 1= Located in one of the 9 states in the US West Region, 0= Located in another US region;
Self-identify as an Innovation District: 1=Evidence identified; 0.8=Area discussed within context of Innovation District within sources beyond the Atlas of Innovation Districts; 0.2=No evidence identified that area is viewed as an Innovation District within sources outside the Atlas of Innovation Districts

4.6.3 Analysis and solution

From the data table, we examined selected characteristics that aligned with the most successful Innovation Districts, and identified a set of characteristics emerged that helped to explain most successful Innovation Districts. A 'truth table', where each row represents a configuration of Innovation Districts with a specific set of characteristics, was created to explore the characteristics that align with the most successful districts (those that had comparatively high economic performance and high equitable opportunities, see table 9, below). This contained five conditions (factors) that helped to explain the outcome – we note that the condition:case ratio here is slightly higher than might be desired and is borderline acceptable (70)[10].

Table 9: Truth table for Qualitative Comparative Analysis (QCA) exploring factors explaining most successful Innovation Districts – data from (12)

Average business size under 30 employees	Government led	High density employment (over 12,000 per square mile)	High density residential area (over 3,000 residents per square mile)	Area under 5 square miles	Most successful	Number of Districts	Consistency Score[1]	Proportional Reduction in Inconsistency[2]
0	0	0	0	0	1	2	1	1
1	0	1	1	1	1	2	1	1
0	0	1	0	1	1	1	1	1
0	1	0	0	1	1	1	1	1
0	1	1	0	0	1	1	1	1
1	0	0	0	0	1	1	1	1
1	1	1	0	1	1	1	1	1
0	0	1	1	1	0	2	0	0
0	1	0	0	0	0	1	0	0
0	1	1	1	1	0	1	0	0
1	1	0	0	1	0	1	0	0
1	1	1	1	1	0	1	0	0

Key: All 0 indicate characteristic is absent (No); All 1 indicate characteristic is present (Yes). Exceptions:
Least Successful: **1= Most Successful, 0= Least Successful;**
[1]for crisp-set QCA, consistency scores are expected to be as close to 1 as possible (perfect consistency)
[2]PRI Proportional Reduction in Inconsistency – a measure of how well a configuration distinguishes between the outcome and its negation

Boolean minimisation of this table generated a solution that identified four pathways – or causal recipes – that are aligned with the characteristics of the most successful Innovation Districts (table 10).

[10] While this ratio is likely to provide a consistent result, there is a risk that the solution generates results on random data 73. Marx A, Dusa A. Crisp-set qualitative comparative analysis (csQCA), contradictions and consistency benchmarks for model specification. Methodological innovations online. 2011;6(2):103-48..

Table 10: (Intermediate) Minimised Solution – data from (12)

Pathway	Pathway Characteristics	Inclusion Score	Raw Coverage	Cases
1	Higher Density Employment AND Lower Residential Density	1	0.33	3
2	Smaller Area AND Lower Residential Density AND Larger Business Size	1	0.22	2
3	Lower Residential Density AND Not Government-led AND Larger Area	1	0.33	3
4	Higher Density Employment AND Not Government-led AND Small Sized Business Areas AND Not Government-led	1	0.22	2
	Total solution	1	1	1

Pathway 1 – Innovation cluster: The first pathway aligns with the characteristics of three diverse cases – Microsoft Cluster, Sandia Laboratories, and Downtown Detroit. These Innovation Districts have higher density of employees but have a lower density of residents. This pathway is indicative of an Innovation Cluster – where there is clustering of innovative employment but not necessarily within a multifunction area composed of a high resident: employee ratio.

Pathway 2 – Innovation cluster driven by large business: The second pathway aligns with the characteristics of two cases – Microsoft Cluster, and Ames Research Centre (NASA). These Innovation Districts have a lower density of residents and a large business size, but remain concentrated within small geographic areas. This pathway is indicative of an Innovation Cluster driven by large businesses – both cases supporting this pathway are named after the largest organisation in the district.

Pathway 3 – Science park hybrid: This third pathway is supported by three diverse cases – Research Triangle, Google Software Cluster and San Jose Boomerang. All three cases occupy larger land areas, with low residential density, and do not involve local or strategic government involvement. Consequently, this pathway is indicative of Innovation Districts that may be in transition, and retain some of the geographic characteristics of Science Parks.

Pathway 4 – Classic Innovation District Model: This fourth pathway is supported by two similar cases – Harvard Square and Kendall Square – and located within proximity of one another in the Boston area. Both are characterised as having small businesses concentrated within small geographic areas with a high concentration of employees. Both districts are also led by Research and Academia (and not strategic or local government-led).

The results of the QCA underscore three elements:

1. Several successful Innovation Districts may, in fact, share characteristics with Innovation Clusters. We define Innovation Clusters as sharing several characteristics with Innovation Districts, but without the emphasis on mixed functionality combining commerce, innovation, industry and residential areas within a single district. Innovation Clusters focus on creating concentrations of interconnected industries usually with a view of creating a competitive advantage. The cases here appear to suggest that in doing so, such a model can also create equitable opportunities.

2. Our solution highlights that Innovation Districts are not discrete entities, but are areas of transition. Context matters in the interpretation of these data, and we are unable to ascertain how far into the journey towards becoming an Innovation Districts any of the areas included in the analysis actually are. In pathway 3, we speculate that Innovation Districts may be in transition away from science park models. From a planning perspective, the emergence of this pathway also underscores that Innovation Districts need not be exclusively small areas or, consequently, be located within very dense areas of workers and employers.
3. We note the identification of Harvard Square and Kendall Square as two areas which are successful and appear to closely match our original conceptualisation of Innovation Districts as predominantly urban areas, characterised by high residential and employee density and with a concentration of small to medium sized businesses. However, context does matter in this interpretation. For example, Downtown Detroit is also included as an example of a successful Innovation District (in a different configuration). Here, since the 1950s there has been substantial depopulation taking place, and while there is relatively low population density within the Innovation District, the absence of change data means we are unable to explore further whether the presence of an Innovation District has slowed or even reversed local trends around depopulation and low density, based on the evidence included in this rapid review.

5 Conclusions

5.1 Summary

Table 11: Summary of evidence from synthesis

Domain	Summary of review findings	Volume of evidence	Quality of evidence	Breadth of Innovation Districts	Additional notes
Short-term economic outcomes	Innovation Districts are hubs for the *creation* of highly skilled jobs related to Research and Development A meta-analysis of the proportion of roles within an innovation district that are directly linked to innovation stands at 34%;95% CI: 29-40%. These proportions are higher in Districts led by Strategic Government Initiatives than Local Government Initiatives.	2 studies (32, 33) 2 main sources (12, 28)	Unclear	Evidence from 2 Innovation Districts Evidence from 50 Innovation Districts and a city-wide analysis	There is little evidence available that demonstrates to what extent and how Innovation Districts Lead to Job *Creation*. A high proportion of employment in innovation is not necessarily aligned with opportunities for all.
	Studies emphasise that the diversity of businesses and organisations, and not just the absolute numbers, may be more important as indicator of the success of an Innovation District. On average, companies within an Innovation District employ 23.4 staff, corresponding with a 'small' sized enterprise.	7 studies (4, 39, 40, 42-45)		Studies examining single case studies or fewer than 5 within a study Evidence from 50 Innovation Districts	Some Innovation Districts supported very small organisations (average 14.5 employees per company) through to much larger organisations (average 129.8 employees per company)
	Co-location alone is not sufficient to trigger collaboration between companies. The physical design of an Innovation District, the balance of companies (a mixture of sizes), and the coordination of formal networking events helps to foster collaboration.	9 studies (29, 34, 35, 38, 39, 43, 46-48)		Studies examining single case studies or fewer than 5 within a study	

Long-term economic outcomes	Some studies present compelling descriptive data demonstrating that the creation of an Innovation District is associated with tens of thousands of new roles Among 50 Innovation Districts in the US, the unemployment rate stood at 5%;95% CI: 4-7%, although there was substantial variation and evidence suggested that some Innovation Districts make little difference to unemployment rates. Secondary Analysis of data for 50 Innovation Districts in the US shows that for every job created within an Innovation District, 1.67 support jobs are created in the broader economy[11].	3 studies (35, 39, 40) 2 sources (12, 32) Analysis of 1 source (12)		Studies examining single case studies or fewer than 5 within a study Evidence from 50 Innovation Districts and study examining four case studies Evidence from 50 Innovation Districts	There was wide variation across this indicator, with the number of additional jobs ranging from 0.2 to 4.78 additional support jobs created.
	Studies suggest that the roles created within an Innovation District are largely inaccessible to local residents.	3 studies (35, 36, 45)		Studies examining single case studies or fewer than 5 within a study	
	Innovation Districts were active in terms of making links with children, young people and schools, as well as undertaking broader lifelong learning capacity building among community members. However the success of these activities is unclear	4 studies (26, 36, 42, 48)		Studies examining single case studies or fewer than 5 within a study	
	Evidence suggested that Innovation Districts could exacerbate perceived levels of local income inequality.	5 studies (32, 42, 56-58)		Studies examining single case studies or fewer than 5 within a study	
	One study provided indicative evidence that Innovation Districts provided more equitable employment than other types of areas of planned employment (e.g. industrial zones)	1 study (28)		Single study examining Innovation Districts in a single city	
	Where Innovation Districts are able to develop community or civic amenities, or develop links with existing amenities, this is perceived to lead to economic benefits. Conversely the absence of community and civic amenities was perceived to be economically detrimental.	6 studies (35, 46, 55, 56, 60, 61)		Studies examining single case studies or fewer than 5 within a study	
	A number of Innovation Districts struggle to form 24-hour communities (i.e. areas where people work and live).	4 studies (42, 60, 61, 63)		Studies examining single case studies or fewer than 5 within a study	

[11] This is a function of the number of innovation-related jobs. The developers of the atlas estimate that across all Innovation Districts, each innovation-related role consistently generates 5 additional support jobs in the broader economy

	Long-term residents of Innovation Districts and the areas immediately bordering Innovation Districts are likely to be socially distanced from new residents and employees. Social distance occurs across socioeconomic and racial lines and evidence suggests that there is little understanding of the local context and patterns of repeated and sustained marginalisation experienced by communities in some Innovation Districts.	11 studies (32, 36, 41, 42, 45, 48, 53, 57, 58, 64, 65). 2 studies (36, 45)		Studies examining single case studies or fewer than 5 within a study Studies examining the same Innovation District	
	Engagement with residents can appear tokenistic with a tendency to avoid conversations about what residents need. There exists a mismatch between the resources that developers hold to engage with communities, and the resources that communities have to enter into negotiations.	2 studies (32, 36)		Studies examining single case studies or fewer than 5 within a study	
	Strategies have been recommended and/or deployed to enhance the embeddedness of Innovation Districts within local areas. These appear to have mixed success and not to have been fully evaluated.	14 studies (33, 36, 37, 41, 42, 45, 47, 48, 52, 53, 56, 57, 59, 67)		Studies examining single case studies or fewer than 5 within a study	
	The literature suggests that Innovation Districts have tended to exacerbate housing pressures particularly around affordability	7 studies (4, 32, 36, 45, 48, 58, 68)			
	'Value capture' policies, where funds are secured through increased taxes and fees and then reinvested to offer subsidised housing and/or tax relief to lower income residents could help address housing pressures. The success of such measures is unclear and such measures have not to have been fully evaluated.	2 studies (31, 67)		Studies examining single case studies or fewer than 5 within a study	
	Several successful Innovation Districts may, in fact, share characteristics with other areas of innovation. Examples of those that resemble Innovation Clusters, Hybrid Science Parks as well as those the resemble a 'classic' model were identified as successful.	Analysis of 1 source (12)		Evidence from 50 Innovation Districts	

Innovation Districts offer an opportunity to address economic and social issues in primarily urban areas. The evidence in table 11 highlights that there is strong, although not conclusive, evidence to support the assertion that Innovation Districts help to improve the economic performance of local areas through creating highly-skilled employment opportunities as well as increasing the number of jobs in the broader economy. However, the evidence also indicates that many Innovation Districts operate under assumptions of co-location and trickle-down economics alone. With respect to the first, Innovation Districts appear to operate under the assumption that co-location – both in terms of agglomeration of high-tech companies being located next to each other and next to areas of social inequality – is sufficient to stimulate collaborative networks of socially conscious companies that also engage with local communities. The evidence included in this rapid review underscores that co-location alone is not sufficient to ensure collaboration between organisations within an Innovation District or sufficient to ensure engagement with broader communities. Similarly, the assumption that economic opportunities trickle down to local communities is also not borne out in the evidence, which appears to indicate that Innovation Districts risk becoming enclaves characterised by unequal distributions in the production and distribution of wealth. Despite this pessimistic summary we also note that:

(i) examples exist of Innovation Districts that appear to perform well economically and appear to have more equitable distributions of labour market opportunities and these are identified in section 4.5. More in-depth understanding of these through further primary research could help to develop a deeper understanding of how future Innovation Districts should be planned; and

(ii) measures have been identified that could help to address some of the issues raised including:

Aim	**Potential strategies**
Better theorising and evaluation of the relationship between Innovation Districts and communities	Identify the ways in which Innovation Districts can impact communities and track their impact comprehensively
	Adopt an ecological approach and tailor examples of successful practice to the needs of the local community
Address housing pressures early in the life cycle of Innovation Districts	Develop inclusive housing and land zoning policies
	Explore the value of ‘value capture’ policies
Better community engagement strategies	Scrutinise the success of approaches to community involvement and adopt co-design and co-production principles
	Provide community autonomy in spending decisions through creating community trusts

Address gaps in basic and civic amenities and implement programmes that foster social connection

Recognise that organisations involved in regeneration can have a poor existing reputation; consider if they are the right organisation to lead on engagement

5.2 Strengths and limitations

This review presents a rapid review of the evidence on Innovation Districts. While we followed the guidance around conducting rapid reviews (74), we note some departures from this guidance below and some further limitations:

- We were unable to involve key stakeholders during the process of developing this rapid review.
- We were unable to employ a stepwise approach to inclusion and place a higher emphasis on higher quality studies (see discussion point below).
- The guidance suggests to limit grey literature searches, although several key findings in this review derive from grey literature. A potential risk of the rapid review approach is that empirical studies published in the grey literature were missed.
- A single reviewer extracted data using a pilot form, although we did not consistently use a second reviewer to check for correctness or completeness of extraction.
- We used a valid risk of bias tool, the MMAT tool (21), although found this challenging to implement across the study designs included in this review. We observed that:
    - Several studies could not be assessed using the tool as we were unable to satisfy the screening criteria, particularly with respect to assessing whether the collected data allow for addressing the research questions. Several studies named methods – such as interviews – although did not provide any further data on number, analysis plan, or provide any indication of how the data contributed to the findings.
    - Several of the studies could not be assessed through the MMAT tool as their design could not be assessed using the tool. For example, we found it challenging to attempt to assess GIS-based studies using this tool.
    - One important source of data was from a database.
- While not recommended within the guidance, this review did not include a subject specialist within the review team, and there may be instances where the reviewers could have misinterpreted the meaning of concepts and/or data.
- Finally, given the rapid nature of this review, some studies were identified as being potentially eligible but were not accessible within our timeframes (these were (75-82))

A protocol for this review was published (9) and we note the following departures:

- Although our protocol deemed it unlikely that a meta-analysis would be possible, we were able to conduct meta-analyses of proportions where the data supported these. In several other cases, however, meta-analyses were not possible either because of missing sample size or because there was no measure of precision available.

- We were not able to create a logic model based on the results in stage 1, and given the heterogeneity in Innovation Districts encountered, we decided not to attempt to create a model based on the results in stage 2.
- We did not anticipate that the contents of a database – the Atlas of Innovation – would be available for secondary analysis.

Finally, we highlight three major limitations related to the evidence in this review:

(i) We restricted the evidence to empirical evidence on self-defined or researcher-identified Innovation Districts. However, the inclusion of researcher-identified Innovation Districts is somewhat problematic, given that these areas may have been identified through different approaches, and may not have shared the same goals as Organised Innovation Districts.

(ii) Secondly, our ability to interpret comparisons across different Innovation Districts is hampered by limited analysis and reflections within several studies of how characteristics influence impacts. For example, the date and stage of the Innovation District, as well as the context before the implementation of plans to develop an Innovation District, are often not discussed in relation to the impacts.

(iii) Thirdly, we observed a disconnect between studies that evaluated to economic impacts of Innovation Districts, and those that evaluated broader social impacts (including, for example, on housing) and levels of community engagement. There is a need for research that explores the impact of Innovation Districts from a systems perspective.

5.3 Implications

Based on the summary of evidence, we highlight the following as potential policy and research implications.

The need for guidance around parameters, stages, expected outcomes, and theory for the development of Innovation Districts.

The evidence in this review emphasises the heterogeneity in Innovation Districts. While this may represent a degree of flexibility to those interested in establishing Innovation Districts, this also means that the notion is subject to conceptual drift without further parameters. There is a need to clarify the aims of Innovation Districts, and in some cases distinguish between those that are more mission focussed (1) and those that emerge from agglomeration for commercial benefit. Umbrella Organisations such as UK Innovation Districts and policy organisations such as the Brookings Institution could play a role in addressing the following points:

1. Innovation Districts encompass a spectrum of models, and purposes. To ensure that Innovation Districts and their potential can be better understood through comparative studies, there is a need to develop more concrete dividing lines to understand when an area represents an Innovation District, an emerging Innovation District (i.e. where a plan for an Innovation District is being enacted but is not fully implemented), and when an

area represents a different model altogether. Based on the evidence, it is not clear what the early stages of implementing a strategy to develop an Innovation District might look like, and even when developers might be able to identify that they have created an Innovation District.

2. The role of Innovation Districts as social interventions needs further clarification. Some of the evidence suggests that Innovation Districts are developed without a mission to address inequalities and deprivation, alongside missions to stimulate economic growth. The extent to which this type of area should fall within the scope of an Innovation District is unclear. While this may seem a tautological point, it does have a practical implication around where future Innovation Districts should base their learning.
3. There is a need to consider developing a core outcomes framework for current and future Innovation Districts to better facilitate comparisons between Innovation Districts. The Atlas of Innovation Districts provides a hugely valuable blueprint for metrics that could be used (12). We would advocate for umbrella organisations and others to support expansion of this type of resource to (i) encompass social indicators; (ii) expand to include global Innovation Districts; (iii) to include a plan for regular updates of the data. From our own perspective, a UK Atlas of Innovation Districts would have represented a valuable resource to better understand if and how Innovation Districts 'work'.

Innovation Districts appear to trigger economic benefits, although without deliberate strategies put into place, these benefits are unlikely to diffuse to wider areas.

Without mitigations, Innovation Districts could trigger adverse impacts, notably displacement and exclusion. Among planners and developers of Innovation Districts, the following emerge as implications:

1. Housing is a nexus of tension in the development of several Innovation Districts. In this report we identify the development of inclusive housing and land zoning policies and exploration of 'value capture' policies as potential ways of ameliorating housing pressures. In addition, anecdotal evidence also indicated that commitments to accessible or affordable housing, and the development of accompanying community infrastructure, were often watered down during the development process. Developers could be requested to provide clearer evidence-based assurances when submitting plans and attracting public investment around how their housing targets will be met.
2. A concern with the development of Innovation Districts is around the engagement of communities, and how they were often involved in terms of being 'informed' rather than being engaged in more meaningful ways (83). Developers, planners, investors and other stakeholders may need to be more ambitious in their approach to community engagement, for example in co-designing Innovation Districts to better meet community needs and reflect communities' histories and cultures. Similarly, they should not assume that communities are a resource that can be involved without being compensated for their input, and marginalised communities may need resources and support to be able to participate equitably within planning processes. Moreover, more ambitious plans for continuous community engagement and community-based governance could help to ensure that Innovation Districts remain embedded within

local communities. This could also include ensuring community autonomy in spending decisions through creating community trusts.

3. Innovation Districts represent large investments, although the scale of this investment does not appear to be matched by investments in a comprehensive evaluation programme that tracks the social and economic impacts. Umbrella bodies could make a recommendation around how much developers should invest in evaluating the implementation and outcomes of their districts.
4. Innovation Districts are a form of intervention and as such need to be supported by a programme theory that traces the links between inputs and expected outputs, outcomes and impacts. This programme theory needs to describe the expected relationship between the Innovation District and the broader community. Some of the evidence suggested taking an ecological approach to better understand how an Innovation District influences different ecological levels from individual employees, residents, organisations, community-based organisations through to wider sociopolitical institutions. Without a clear articulation of the goals of a given Innovation District, it becomes challenging to evaluate the district.

The evidence base in this area has some gaps that future researchers could address.

1. There is an absence of longitudinal designs employed in understanding the impacts of Innovation Districts. We encountered few designs that involved repeated measures within the same Innovation District except for detailed ethnographic research studies.
2. There is an absence of study designs that compare groupings of different *types* of Innovation District with each other and designs that compare Innovation Districts to other types of areas of Innovation.
3. There were few studies that involved collecting data from local residents (exceptions included (36, 45, 64)). Given that Innovation Districts ostensibly have social and economic missions, this is a significant gap in the evidence base.
4. Studies assess social impacts or economic impacts of Innovation Districts but frequently do not attempt to examine both simultaneously.
5. Several substantive questions and areas remain. For example, we are unclear on the contribution of Innovation Districts towards drives towards sustainability and unclear on the success of efforts/activities undertaken to develop training and skills capacity among community members.
6. Context matters in the interpretation of Innovation Districts although few studies traced how context influenced the outcomes of an Innovation District.
7. Finally, and related to the evidence gap around context and longitudinal studies, the evidence was generally unclear about the value *added* by Innovation Districts. For example, while Downtown Detroit is an Innovation District with high levels of unemployment (12), the evidence included here did not indicate the extent to which this level has declined since the implementation of an Innovation District.

5.4 Conclusions

Innovation Districts represent a policy with potential to develop areas economically. The policy is also intended to enhance social outcomes, although the evidence here suggests that several

adverse social outcomes can occur without mitigation. Specifically, while the evidence is suggestive of job creation being a potential mechanism through which communities can benefit, the extent to which opportunities are distributed evenly is unclear. This means that local residents may not feel the benefits of new well-paid employment opportunities but do feel the impacts of other changes reflecting increased housing demand and higher costs of living. Ameliorating housing pressures and meaningful engagement with communities may help offset some of these impacts, but as others have noted, interventions that equalise educational and employment opportunities may also be a core direction through which Innovation Districts can better engage the communities within which they are nested. Within the UK, Local Authorities have responsibilities around all three areas (housing, communities and education) and may be pivotal in creating Innovation Districts that fulfil both economic and social objectives.

Conflicts of interest

The authors have no personal conflicts of interest. The funder is not involved in the design of the systematic review and the review is independent research undertaken through the International Public Policy Observatory.

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Appendices

Appendix 1 – Detailed methods

Searches

We drew on the search strategy employed by Yigitcanlar, Adu-McVie and Erol (2) and conducted searches for terms around innovation district, innovation precinct, innovation cluster and knowledge precincts and restrict the search to titles and abstracts; in addition we included the term 'innovation neighbourhood' as used in (1).

Searches were conducted on Web of Science and Scopus following Yigitcanlar, Adu-McVie and Erol (2); in addition we searched for literature on EconLit and International Bibliography of the Social Sciences (IBSS) and Applied Social Sciences Index and Abstracts (ASSIA). We also searched key sources of grey literature for additional evidence (e.g. the Global Institute of Innovation Districts, Brookings Institute, and Nesta).

An example search to be conducted on Web of Science is below (note this also incorporates the term Knowledge Quarters, which is also a favoured term in the UK (6)):

AB=(("Innovation district*" OR "Innovation precinct*" OR "Innovation cluster*" OR "Knowledge precinct*" OR "Innovation neighbo*" OR "Knowledge Quarter*")) OR TI=(("Innovation district*" OR "Innovation precinct*" OR "Innovation cluster*" OR "Knowledge precinct*" OR "Innovation neighbo*" OR "Knowledge Quarter*"))

Further details on types of study to be included

No restrictions on types of study design were implemented, although studies that were not empirical (e.g. comments, editorial, book reviews) were excluded as were abstracts, posters and conference papers where the full paper is unavailable.

The review only included primary studies, although systematic reviews in the area will be examined to identify any further studies and to identify typologies of innovation district.

We included all types of study designs that evaluate the outcomes of Innovation Districts or that evaluate the processes of establishing Innovation Districts; we therefore included quantitative, qualitative and mixed methods studies although many will be in the form of descriptive case studies.

Examining inclusion and exclusion criteria regarding case studies

Only empirical studies about self-described 'Innovation Districts' and/or 'knowledge quarters' were included for detailed coding and synthesis (see inclusion/exclusion criteria, below). One feature of this literature was the preponderance of self-described case studies on Innovation Districts. Case studies were eligible for inclusion in this review, although during the process of screening we strengthened the criteria for inclusion through specifying that 'case study' alone was an insufficient descriptor of the methods alone, and needed to be accompanied by a description of how the case study had been assembled. A case study is a (social) research strategy or design that is used to study a social unit (84). Much like systematic reviews themselves, case studies can be used for different types of questions and purposes, including

descriptive, exploratory, and explanatory (85). However, a common feature of a case study is that draws on multiple methods of data collection (e.g. interviews, observation, documentary analysis), as it involves an in-depth study of a phenomenon (a case) (84, 85). In several studies of Innovation Districts, case studies had been assembled without a description of methods, making their eligibility as empirical studies – i.e. studies based on planned/systematic observation or measurement of an innovation district – unclear. To ensure consistency in inclusion, case studies were only included where they outlined the methods used to construct the case study.

Overall inclusion and exclusion criteria

The exclusion criteria for Stage 1 (mapping) are presented below. Further screening was conducted of the studies included in the map to identify eligible records for the synthesis where they either (i) included data on economic outcomes (see below) or on (ii) broader area-level factors (see below). In addition, evidence from systematic reviews of Innovation Districts was synthesised to identify different forms and types of innovation district (these were not included in the map of empirical primary studies).

- **Exclude - Not in English**
- **Exclude - Not about place-based intervention**
  Does not describe the set up or outcome of a geographic-based 'intervention' or policy
- **Exclude - Not focussed on Innovation Districts**
  Study focusses on other forms of place-based intervention or policies e.g. science parks, innovation clusters
- **Exclude - Commentary, Editorial or News article**
  Study does not contain empirical analysis of data collected about the set-up, perceptions of, or influence/impact of an innovation district. Studies that don't report research methods on if and how data were collected should be marked here.
- **Exclude - Review (incl Systematic Review) about Innovation Districts**
  Study is a review of Innovation Districts
- **Exclude - Theoretical paper/book**
  No empirical data. Study does not contain empirical analysis of data collected about the set up, perceptions of, or influence of an innovation district
- **Exclude - Abstract only**
- *Full record unavailable to the research team.*
- **Exclude - Case study without methods**
  Case study without clear methods for how the evidence was assembled (see above)
- **Exclude – Innovation district not started**
- *Includes where an ID has been considered or theorised but no clear plans developed or being implemented*
- **Include for coding**

Identification of relevant records

Records were screened based on their title and abstract before being screened on full text. After a moderation exercise, 17% of records were screened in duplicate including all that included terms for innovation district. High levels of agreement were recorded by the reviewers in title

and abstract screening. All records identified as potentially eligible were rescreened on full-text in duplicate.

All screening and data extraction took place through EPPI-Reviewer (86).

Risk of bias (quality) assessment

Stage 1: No quality assessment criteria was adopted for inclusion within the map beyond the exclusion criteria outlined above and individual studies were not be quality assessed; this mirrors the practice of mapping the literature described elsewhere (for example Haddaway, Brown (87)).

Stage 2: Studies included in the main synthesis were assessed using the Mixed Methods Assessment Tool (21).

Data extraction

Initial coding for mapping and methodological exercise

We coded the studies based on their characteristics and extracted data on their focus, main research question, country, study methodology, and nature of the businesses and organisations.

Given the rapid nature of this review, we undertook methodological testing of ways of automating the coding of items included in the map, using newly embedded Large Language Model (LLM) approaches incorporated into EPPI-Reviewers based on title and abstract (86). This involved:

(i) Developing the coding framework and a series of prompts.
(ii) Undertaking duplicate coding involving a review author and the LLM, and calculating level of agreement across each item. This was conducted on 10% of included full text records.
(iii) Revising the prompts based on (ii) and undertaking the coding in duplicate on a new set of items, and calculating level of agreement across each item. Based on (ii), at this stage we also checked the records for any without clear methodological details and appended this information to the abstract where needed. This was conducted on 10% of included full text records.
(iv) Given the high level of agreement between LLM and reviewer (see table below), all other records were coded initially by the LLM and checked by a reviewer.

Coding round	Reviewer	Overall kappa for data extraction	Kappa range and number of papers (n)
1	1	0.82	0.67-1.0 (n=4)
1	2	0.49	0.38-0.59 (n=3)
Kappa interpretation: Kappa > 0.8 suggests excellent agreement; 0.61 to 0.8 suggests substantial agreement; 0.41 to 0.6 suggests moderate agreement; 0.21 to 0.4 suggests fair agreement; 0.0 to 0.2 suggests slight agreement.			

Data Extraction for Studies included in Main Synthesis

Our data extraction approach was informed by the framework created by Yigitcanlar, Adu-McVie and Erol (2) and we extracted the following data from studies:

Study bibliographic details
Study details: date of publication, geographical location, study aims, study methodology
Characteristics of Innovation Districts
Type of innovation district (high-technology- intensive activities; creativity- intensive activities; Knowledge-intensive service activities); Physical attributes (size of Innovation Districts; location); Social features (composition of actors and stakeholders; type of businesses); Spatial design and configuration (scale of development); Governance
Data to support synthesis of economic output and economic impacts
Any data on the following: **Short-term economic outcomes** - R&D spending/capital investment - Number of R&D jobs - Number of companies/organisations setting up within innovation district - Density/size of social/innovation networks - Number of cross-institutional collaborations - Number of PhD students supported in Innovation District - Number of academic publications **Long-term economic outcomes** - Changes in Local GDP - Changes in Business success rates - New businesses started - Job creation - Unemployment rates - Patents issued - Receipt of business awards
Data to support synthesis of broader system-level impacts
Any data on the following: **System-level measures** - Place-based measures (perceptions and measures of accessibility, quality of life, inclusivity, community etc.) - Environmental impact - Number of graduates staying in region - Training opportunities for young people - Housing - Job creation (broader region) - Transport and connectivity

Strategy for data synthesis

Stage 1 – Mapping out empirical literature on Innovation Districts: The object of Stage 1 is to map out the variation in different types of innovation district. We used EPPI-Visualiser (86) to

further understand the features of the studies by generating frequencies, cross-tabs and matrices from the initial coding. The main features of the map are described narratively.

Stage 2 – Main synthesis on the impacts of Innovation Districts:

Our strategy for data synthesis changed to reflect the initial assessment of the results in Stage 1. In this rapid systematic review, our synthesis methods drew heavily on a narrative, configurative approach (88). We followed five stages (see (89, 90): (a) initial coding the text by producing preliminary textual descriptions of studies and their findings in a tabular format (see Appendix 2) to understand the characteristics of the body of literature and to observe emerging patterns in the data; (b) further inductive coding of the text extracted according to our initial framework and identifying key preliminary themes and their recurrence across studies; (c) developing a more fine grained framework for arranging groupings and clusters of studies according to the themes and exploration of these within and between the studies; (d) further generation of analytical themes through attempting to develop a common rubric to describe these findings; (e) finally, we considered the quality of individual studies and the body of evidence, as well as the completeness and applicability of evidence, and this is presented in our discussion. Due to the rapid nature of this review, the process was carried out initially by one of the authors (DK or CV) who then discussed their findings, choices and rationale with other authors in the team; any points of disagreement or ambiguity were investigated further and resolved by discussion.

In addition, we undertook meta-analysis of data where a proportion and sample size was provided (no studies presented data with an effect, precision, and sample size). Finally, we undertook Qualitative Comparative Analysis (QCA; Thomas, O'Mara-Eves and Brunton (91)), examining the components that underpin successful Innovation Districts. Use of QCA was intended to illuminate essential ingredients of successful Innovation Districts and how these relate to the broader context.

Appendix 2 – Flow of studies in the review

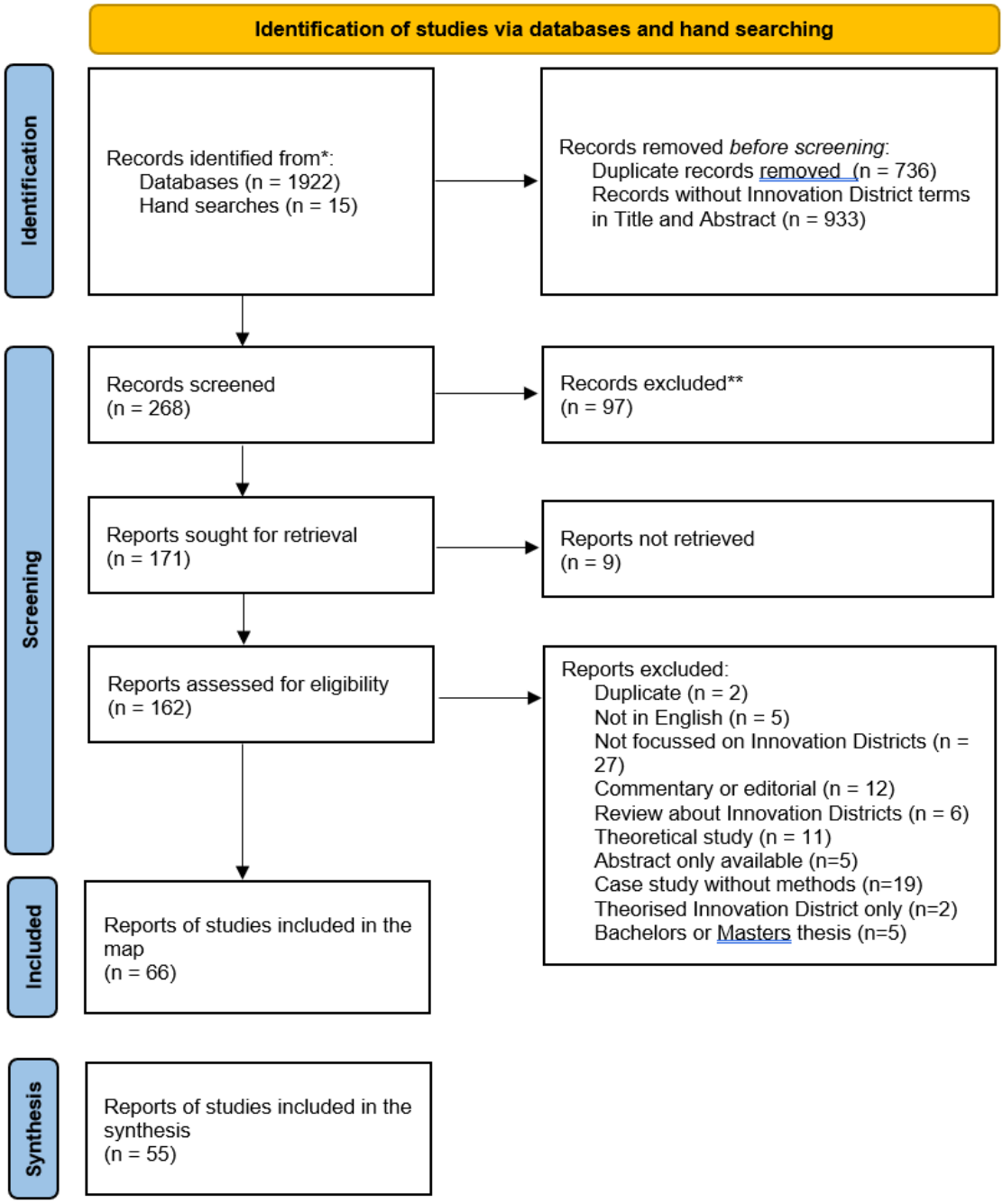

Figure 6: Flow of studies through the review (PRISMA flowchart)

Appendix 3 – Characteristics of studies

Cells shaded in blue were those included in the main synthesis. For MMAT ratings, green cells indicate that the study could be assessed for quality and/or few potential issues (0-1) with study quality, cells shaded amber suggest multiple issues (2-3), while cells shaded red indicate the study could not be assessed for quality or there were several potential study quality issues (4-5). Studies not included in the synthesis were not assessed using MMAT.

Short Title	Innovation district characteristics	Study characteristics	Could study be Assessed with MMAT	If assessed on Qual, Number of No/Can't Tell Ratings	If assessed on Qual, Number of No/Can't Tell Ratings	If assessed on Qual, Number of No/Can't Tell Ratings
Adu-McVie, Yigitcanlar (92)	**Country** N/A **When established** N/A **Function** N/A **Type of innovation district** N/A	**Year of publication** 2021 **Stage** N/A **Study methodology** Delphi survey **Focus** Gathering expert opinion on the main characteristics of Innovation Districts				
Adu-McVie, Yigitcanlar (51)	**Country** Australia **When established** 1981-1990 2011-2020 **Function** High tech sector; Creative; Knowledge; University	**Year of publication** 2022 **Stage** Established **Study methodology** Case study; Secondary data analysis; GIS map **Focus** Developing an innovation district typology matrix and evaluating its practicality with real case study data	**Yes**	**1**	**0**	**2**

	Type of innovation district Knowledge-intensive service activities; Other industry led					
Alarcón-Martínez, Güemes-Castorena and Flegl (20)[1] **[1]Linked studies**	**Country** USA **Function** High tech sector; Knowledge **Type of innovation district** High-technology- intensive activities; Knowledge-intensive service activities; Other industry led	**Year of publication** 2023 **Stage** Established **Study methodology** Secondary data analysis **Focus** Evaluate different Innovation Districts to determine output goals for a Tec Innovation District	**Yes**	**1**		
Alarcón-Martínez, Güemes-Castorena and Flegl (19)[1] **[1]Linked studies**	**Country** USA **Function** Various **Type of innovation district** various	**Year of publication** 2023 **Stage** Planned **Study methodology** Secondary data analysis **Focus** Setting goals for a nascent university-led innovation district using Data Envelopment Analysis	**Yes**	**1**		
Andes, Hachadorian (35)	**Country** USA **When established** 2011-2020 **Function** Knowledge **Type of innovation district** High-technology- intensive activities; Other industry led	**Year of publication** 2017 **Stage** Established **Study methodology** Case study; Documentary analysis, 'Audit' **Focus** Challenges and future strategies for Oklahoma City innovation district	**No**			
Asgari, Khorsandi Taskoh and Ghiasi Nodooshan (23)	**Country** USA; China; UK; Spain; Japan; South Korea **Function** University **Type of innovation district**	**Year of publication** 2023 **Stage** Planned **Study methodology** Interviews; Documentary analysis; Social media data				

	High-technology- intensive activities ; Knowledge-intensive service activities; Other industry led	**Focus** Developing a university-based innovation district framework under the anchor approach				
Bajada, Agarwal (17)	**Country** Australia **Function** Various **Type of innovation district** Various	**Year of publication** 2022 **Stage** Established **Study methodology** Secondary data analysis **Focus** Analysis of enablers of successful innovation precincts	**Yes**		**3**	
Battaglia and Tremblay (93)	**Country** Spain; Canada **When established** 2001-2010; 2011-2020 **Function** High tech sector; Creative; University **Type of innovation district** High-technology-intensive activities, creativity-intensive activities, and knowledge-intensive activities	**Year of publication** 2011 **Stage** Established **Study methodology** Case study; Interviews; Documentary analysis **Focus** Analysis of the governance strategy of 22@ District in Barcelona and its potential application to Montreal's future Innovation District				
Burke and Gras (12)	**Country** USA **Function** High tech sector; Knowledge **Type of innovation district** various	**Year of publication** 2019 **Stage** Established **Study methodology** Case study (Pittsburgh, Cambridge (MASS); Geospatial analysis **Focus** The impact of building Innovation Districts in cities on economic prosperity and distributed wealth	**Yes (although MMAT is not suitable to assess the use of the atlas as a database for further analysis)**		**1**	
Burke, Gras Alomà and Yu (11)	**Country** USA **Function** Knowledge	**Year of publication** 2022 **Stage** Established	**Yes**		**1**	

	Type of innovation district various	**Study methodology** Secondary data analysis; GIS map **Focus** Evaluating innovation performance within urban environments using geospatial analysis				
Chen, Nagakura and Larson (62)	**Country** USA **When established** 2001-2010 **Function** High tech sector; University **Type of innovation district** High-technology- intensive activities	**Year of publication** 2016 **Stage** Established **Study methodology** Social media data **Focus** Evaluating Innovation Districts in Boston using social media data	**Yes**	**1**		
Cohendet, Chenier (94)	**Country** Spain; Canada **When established** 2001-2010 **Function** Knowledge; University **Type of innovation district** Knowledge-intensive activities, technology-intensive activities, creativity-intensive activities.	**Year of publication** 2022 **Stage** Established **Study methodology** Case study; Interviews; Documentary analysis **Focus** Design and development process of Centech, a innovation incubator in Montréal's innovation district				
Daniels (45)	**Country** USA **When established** Planned **Function** University **Type of innovation district** Knowledge-intensive service activities	**Year of publication** 2020 **Stage** Established **Study methodology** Case study; Interviews; Documentary analysis; Ethnography **Focus** Assessing the social impact of Drexel University's expansion on Mantua and Powelton Village communities	**Yes**	**0**		
Davidson, Håkansson (54)	**Country** Australia **When established**	**Year of publication** 2023 **Stage**	**Yes**	**3**		

	2011-2020 **Function** Creative; Knowledge **Type of innovation district** High-technology- intensive activities	Established **Study methodology** Case study **Focus** Understanding the potential of Innovation Districts for transformative innovation policy in cities through urban experimentation				
Dowling, Maalsen (56)	**Country** Australia **When established** 2011-2020 **Function** High tech sector; Knowledge **Type of innovation district** various	**Year of publication** 2020 **Stage** Established; Planned **Study methodology** Case study, Interviews **Focus** The role of affordable rental housing in supporting innovation economies, productivity, and growth	**Yes**	**3**		
Drucker and Kayanan (43)	**Country** USA **When established** 2001-2010; 2011-2020; 2021- present **Function** University **Type of innovation district** various	**Year of publication** 2023 **Stage** Established **Study methodology** Case study (*Boston, St Louis, Detroit, San Diego);* Interviews (*119 semi-structured interviews*); Documentary analysis; Ethnography or observation **Focus** Assessing the potential of Innovation Districts as a strategy for urban economic development	**No**			
Esmaeilpoorarabi, Yigitcanlar (61)	**Country** Australia **When established** 1981-1990 **Function** High-tech sector **Type of innovation district** High-technology- intensive activities Various	**Year of publication** 2018 **Stage** Established **Study methodology** Case study (three cases in Brisbane); Interviews; Survey **Focus** Determining essential place characteristics of Innovation Districts in Brisbane's knowledge precincts	**Yes**	**1**	**4**	**3**

Esmaeilpoorarabi, Yigitcanlar (64)[2] [2]**Linked studies**	**Country** Australia **When established** 1981-1990; 2011-2020 **Function** Creative; Knowledge **Type of innovation district** various	**Year of publication** 2020 **Stage** Established **Study methodology** Case study; Survey **Focus** Societal impact assessment of Australian Innovation Districts	**Yes**	**0**		
Esmaeilpoorarabi, Yigitcanlar (95)[2] [2]**Linked studies**	**Country** Australia **When established** 1981-1990; 2011-2020 **Function** Creative; Knowledge	**Year of publication** 2020 **Stage** Established **Study methodology** Survey **Focus** Identifying features of Innovation Districts that can enhance public inclusiveness	**Yes**	**0**		
Esmaeilpoorarabi and Yigitcanlar (58)	**Country** Australia **When established** 1981-1990 **Function** High tech sector; Knowledge; University **Type of innovation district** various	**Year of publication** 2023 **Stage** Established **Study methodology** Case study; Interviews; Survey **Focus** User preferences and decision makers' perspectives in innovation district planning, design, and development	**Yes**	**2**	**5**	**4**
Gądecki, Afeltowicz (24)	**Country** Poland **When established** Unclear **Function** High tech sector; University **Type of innovation district** high-technology- intensive activities	**Year of publication** 2020 **Stage** Established **Study methodology** Case study; Interviews; Documentary analysis; Secondary data analysis **Focus** Explores selection of neighbourhoods to develop an innovation district in Cracow	**No**			

	*Naturally Occurring Innovation Districts					
Gandy, Baird (66)	**Country** USA **When established** 2011-2020 **Function** Knowledge; High-tech sector **Type of innovation district** high-technology- intensive activities	**Year of publication** 2015 **Stage** Established **Study methodology** Focus group; Ethnography or observation **Focus** Engaging urban communities through mobile innovation in Midtown Atlanta	**No**			
Gao and Lim (57)	**Country** Singapore **When established** 2011-2020 **Function** High tech sector; Knowledge **Type of innovation district** high-technology- intensive activities	**Year of publication** 2023 **Stage** Established **Study methodology** Case study; Geospatial analysis **Focus** Understanding how mixed-use design can promote social integration in Innovation Districts.	**Yes**	**0**		
Gianoli and Palazzolo Henkes (31)	**Country** Spain **When established** 2001-2010 **Function** High tech sector; Creative; Knowledge **Type of innovation district** high-technology- intensive activities various	**Year of publication** 2020 **Stage** Established **Study methodology** Case study; Interviews; Documentary analysis **Focus** The evolution and adaptive governance of the 22@ Innovation District in Barcelona	**No**			
Gómez and Oinas (41)	**Country** Colombia **When established** 2001-2010 **Function** Knowledge; High tech sector; Creative	**Year of publication** 2023 **Stage** Planned **Study methodology** Case study; Documentary analysis **Focus**	**No**			

	Type of innovation district high-technology- intensive activities	Exploring the landing process of traveling planning concepts in new places using a multidimensional conceptual framework				
Grodach, Currid-Halkett (96)	**Country** USA **Function** High tech sector; Creative; Knowledge; University **Type of innovation district** Creativity- intensive activities	**Year of publication** 2014 **Stage** Established **Study methodology** Secondary data analysis **Focus** Identifying location characteristics associated with artistic clusters.	**Yes**	**0**		
Grodach and Guerra-Tao (28)	**Country** Australia **When established** 2011-2020 **Function** Creative; Knowledge **Type of innovation district** various	**Year of publication** 2023 **Study methodology** Documentary analysis; Secondary data analysis **Focus** Comparative study of planned employment areas and industrial lands	**Yes**	**0**		
Hawken and Hoon Han (97)	**Country** Australia **When established** 2011-2020 **Function** Knowledge	**Year of publication** 2017 **Stage** Established **Study methodology** Secondary data analysis; GIS map **Focus** Investigating 3D heterogeneity in downtown Sydney's innovation district using GIS				
Heaphy and Wiig (53)	**Country** USA Ireland **When established** 2001-2010; 2011-2020 **Function** High tech sector	**Year of publication** 2020 **Stage** Established **Study methodology** Case study **Focus**	**Yes**	**3**		

	Type of innovation district high-technology- intensive activities; various	How do governance and spatial planning of waterfront Innovation Districts impact urban revitalisation				
Hegyi, Zhu and Janosov (29)	**Country** Europe **When established** 1981-1990; 2001-2010; 2021- present; Planned **Function** University **Type of innovation district** various	**Year of publication** 2021 **Stage** Established **Study methodology** Secondary data analysis; GIS map **Focus** Measuring the impact and success of urban Innovation Districts using quantitative methods.	**Yes**	**1**		
Hirtenkauf, Gurses and Thomas (98)	**Country** USA; Thailand; China; Spain; Colombia; Brazil; Russia **When established** 1981-1990; 2001-2010 **Function** High tech sector; Creative; Knowledge **Type of innovation district** various	**Year of publication** 2022 **Stage** Established **Study methodology** Interviews; Secondary data analysis **Focus** Understanding the construction of the names of Innovation Districts				
Jackson (99)	**Country** Canada **When established** 1991 - 2000 **Function** High tech sector	**Year of publication** 2020 **Stage** Established **Study methodology** Interviews; Ethnography or observation				
Kalliomäki, Oinas and Salo (52)	**Country** Finland **When established** 1981-1990 **Function** High tech sector; Creative; University **Type of innovation district** various	**Year of publication** 2024 **Stage** Planned **Study methodology** Case study; Interviews; Documentary analysis **Focus** The strategic spatial planning of Innovation Districts.	**Yes**	**4**		

Kayanan (4)	**Country** USA; Ireland **When established** 2001-2010; 2011-2020 **Function** High tech sector; Knowledge **Type of innovation district** various	**Year of publication** 2022 **Stage** Established **Study methodology** Case study; Interviews; Documentary analysis **Focus** Critically investigates the global trend toward urban Innovation Districts	**No**			
Kayanan (50)	**Country** USA Ireland **When established** 2001-2010; 2011-2020; Planned **Function** High tech sector; Knowledge **Type of innovation district** various	**Year of publication** 2019 **Stage** Established **Study methodology** Case study; Interviews; Documentary analysis; Secondary data analysis; Ethnography or observation **Focus** Comparative case study of Innovation Districts and their impact on public space and economic development.	**Yes**	**3**		
Kayanan, Drucker and Renski (32)	**Country** USA **When established** 2001-2010; 2011-2020; 2021- present **Type of innovation district** various	**Year of publication** 2022 **Stage** Established **Study methodology** Case study; Interviews; Documentary analysis; Secondary data analysis **Focus** Effectiveness of Innovation Districts in community economic development	**No**			
Leach and Burg (100)	**Country** USA **When established** 2011-2020 **Function** Knowledge; University	**Year of publication** 2023 **Stage** Established **Study methodology** Case study **Focus** Increasing participation by under-represented groups in an established innovation ecosystem through targeted training				

Lee (68)	**Country** USA **Type of innovation district** various	**Year of publication** 2017 **Study methodology** Interviews; Secondary data analysis **Focus** Exploring the benefits of older adults' participation in Innovation Districts	**No**			
Leon (34)	**Country** Spain **When established** 2001-2010 **Function** Knowledge **Type of innovation district** High-technology- intensive activities various	**Year of publication** 2008 **Stage** Established **Study methodology** Case study **Focus** Examining the transformation of Barcelona's historic cotton district into an international innovation hub	**Yes**	**4**	**5**	**3**
Adu McVie, Yigitcanlar (63)	**Country** Australia **When established** 1981-1990 **Function** Creative; Knowledge **Type of innovation district** various	**Year of publication** 2022 **Stage** Established **Study methodology** Case study; Secondary data analysis; GIS map **Focus** Assessing the performance of Innovation Districts	**Yes**	**1**		
Morawska, Anielska (25)	**Country** Poland **When established** 1991 – 2000; 2001-2010 **Function** High tech sector Knowledge **Type of innovation district** Other industry led	**Year of publication** 2021 **Stage** Established **Study methodology** Case study; Interviews; Ethnography or observation **Focus** Exploring the connection between urban morphology and the development of Innovation Districts	**Yes**	**2**		
Morisson and Bevilacqua (42)	**Country** USA **When established**	**Year of publication** 2019 **Stage**	**Yes**	**4**		

	2011-2020 **Function** High tech sector Knowledge **Type of innovation district** High-technology- intensive activities	Established **Study methodology** Interviews Documentary analysis Ethnography or observation **Focus** Investigating programs to mitigate negative externalities of Innovation Districts.				
Morisson and Bevilacqua (33)	**Country** Colombia **When established** 2001-2010 **Function** High tech sector; Knowledge **Type of innovation district** High-technology- intensive activities; Creativity- intensive activities; Other industry led; Various	**Year of publication** 2019 **Stage** Planned **Study methodology** Case study; Interviews; Documentary analysis; Ethnography or observation **Focus** Investigating programs to mitigate negative externalities in Medell innovation District	**No**			
Morisson (49)	**Country** Spain **When established** 2001-2010 **Function** High tech sector; Creative; Knowledge **Type of innovation district** High-technology- intensive activities	**Year of publication** 2020 **Stage** Established **Study methodology** Case study; Interviews; Documentary analysis; Ethnography or observation **Focus** Providing a framework for assessing Innovation Districts	**No**			
Oikonomaki and Belivanis (30)	**Country** USA **When established** 2001-2010 **Function** High tech sector; Knowledge; University **Type of innovation district** various	**Year of publication** 2023 **Study methodology** Secondary data analysis; GIS map; Geospatial analysis **Focus** Identifying innovation indicators through a data-driven methodology.	**Yes**	**0**		

Pancholi, Yigitcanlar and Guaralda (48)	**Country** Australia **When established** 2011-2020 **Function** High tech sector; Knowledge; University **Type of innovation district** Various	**Year of publication** 2018 **Stage** Established **Study methodology** Interviews; Documentary analysis; Ethnography or observation **Focus** Place making experience of Macquarie Park Innovation District	**Yes**	**3**		
Pancholi, Yigitcanlar (65)	**Country** Australia **When established** 1981-1990 2011-2020 **Function** Knowledge; University	**Year of publication** 2020 **Study methodology** Case study; Documentary analysis **Focus** Investigate the socio-cultural role played by anchor universities in facilitating placemaking in Innovation Districts.	**Yes**	**3**		
Parisi and Donyavi (39)	**Country** USA **When established** 2001-2010 **Function** Creative; Knowledge	**Year of publication** 2023 **Stage** Established **Study methodology** Interviews; Documentary analysis; Ethnography or observation **Focus** To explore the spatial hubs of transformation within the knowledge economy and to understand their impact on the whole ecosystem of innovation	**No**			
Pique, Miralles and Berbegal-Mirabent (101)	**Country** USA; Spain; Brazil **When established** 1991 – 2000; 2001-2010; 2011-2020 **Function** Creative; Knowledge; University	**Year of publication** 2020 **Stage** Established **Study methodology** Case study **Focus**				

		Understanding the revitalization projects of metropolitan areas and the evolution of ecosystems of innovation				
Ponce-Lopez, Peraza-Mues (26)	**Country** Mexico **When established** 2001-2010 **Function** Knowledge; University **Type of innovation district** Other industry led	**Year of publication** 2023 **Stage** Planned **Study methodology** Case study; Documentary analysis; GIS map **Focus** The role of higher education in developing Innovation Districts in developing countries.	**Yes**	**0**		
Pujol-Jover and Serradell-Lopez (40)	**Country** Spain **When established** 2001-2010 **Function** High tech sector; Knowledge; University **Type of innovation district** High-technology- intensive activities Various	**Year of publication** 2013 **Stage** Established **Study methodology** Interviews; Survey **Focus** Exploratory analysis of companies in the 22@ innovation district	**Yes**	**5**		
Rapetti, Pique (37)	**Country** Brazil **When established** 2011-2020 **Function** Knowledge **Type of innovation district** High-technology- intensive activities Creativity- intensive activities Various	**Year of publication** 2022 **Stage** Established **Study methodology** Case study **Focus** Key performance indicators for tracking and monitoring the progress of an innovation district.	**No**			
Rapetti, Pique (102)	**When established** 2001-2010 **Function** High tech sector; Knowledge; University	**Year of publication** 2023 **Stage** Established **Study methodology** Case study; Interviews; Secondary data analysis **Focus**				

		Performance assessment of Innovation Districts				
Read (55)	**Country** USA **When established** 2001-2010; 2011-2020 **Function** High tech sector; Knowledge; University **Type of innovation district** High-technology- intensive activities; Creativity- intensive activities; Knowledge-intensive service activities; Various	**Year of publication** 2016 **Stage** Established **Study methodology** Case study; Interviews; Documentary analysis **Focus** Factors contributing to the success and challenges of innovation district development	**No**			
Read and Sanderford (47)	**Country** USA **When established** 2001-2010; 2011-2020 **Function** Knowledge **Type of innovation district** various	**Year of publication** 2017 **Stage** Established **Study methodology** Case study; Interviews **Focus** Exploring the role of sustainability in Innovation Districts.	**Yes**	**3**		
Senarak (69)	**Country** Thailand **Function** High tech sector; Knowledge **Function** Knowledge **Type of innovation district** Other industry led	**Year of publication** 2020 **Stage** Established; Planned **Study methodology** Survey **Focus** Develops a model to assess how container ports collaborate with users in the business model within Innovation Districts to support ID objectives.	**Yes**	**3**		
Sun, Zhang (38)	**Country** China **When established** 1981-1990 **Function** Knowledge; University	**Year of publication** 2019 **Stage** Established **Study methodology** Case study	**Yes**	**2**		

	Type of innovation district High-technology- intensive activities	**Focus** The role of government in developing an innovation ecosystem in a university science park.				
Taecharungroj and Millington (103)	**Country** Australia; USA; Thailand; UK; Spain; South Korea; Singapore; Colombia; Ireland; Mexico; Israel; The Netherlands **When established** 1981-1990; 1991 – 2000 **Type of innovation district** Various	**Year of publication** 2023 **Stage** Established **Study methodology** GIS map; Geospatial analysis **Focus** Comparison and categorization of amenity mixes in Innovation Districts worldwide.	**Yes**	**2**		
Tan, Qian and Chen (60)	**Country** China **When established** 1991 - 2000 **Function** High tech sector; Knowledge **Type of innovation district** High-technology- intensive activities	**Year of publication** 2023 **Stage** Established **Study methodology** Survey **Focus** Evaluating the impact of informal communication space quality on innovation in Innovation Districts.	**No**			
Trillo (59)	**Country** USA **When established** 2001-2010 **Type of innovation district** High-technology- intensive activities Various	**Year of publication** 2021 **Stage** Established **Study methodology** Case study; Interviews; Ethnography or observation **Focus** The study focuses on how innovative entrepreneurs use spaces in cities and the dynamics that enable them.	**No**			
GID (67)	**Country** USA; Spain; Canada; Colombia **When established** 1991 - 2000; 2001-2010; Planned	**Year of publication** 2024 **Stage** Established	**No**			

	Type of innovation district various	**Study methodology** Case study **Focus** The study focuses on the role of land in the development and success of Innovation Districts.				
Wang, Tong and Hu (27)	**Country** China **When established** 2021- present **Function** High tech sector; Knowledge **Type of innovation district** High-technology- intensive activities	**Year of publication** 2021 **Stage** Established; Planned **Study methodology** Secondary data analysis **Focus** How planners can address economic, social and environmental sustainability through policy	**No**			
Wolf-Powers (36)	**Country** USA **When established** 2001-2010; 2011-2020; Planned **Function** University **Type of innovation district** Knowledge-intensive service activities	**Year of publication** 2022 **Stage** Established **Study methodology** Case study; Interviews; Documentary analysis; Ethnography or observation **Focus** History, race, and community in the era of the Innovation District in West Philadelphia	**Yes (Although challenge noted of use in an ethnographic study)**	**1**		
Wouters, Hunt (104)	**Country** Australia **When established** 2011-2020 **Function** Knowledge **Type of innovation district** Knowledge-intensive service activities	**Year of publication** 2018 **Stage** Planned **Study methodology** Case study **Focus** Design process of a media facade in a Knowledge and Innovation District				
Youwei, Qinglan and Xiaolan (46)	**Country** China **When established** 1991 - 2000	**Year of publication** 2023 **Stage** Established	**No**			

	Function High tech sector; Knowledge **Type of innovation district** high-technology- intensive activities	**Study methodology** Case study; Secondary data analysis **Focus** Establishing an innovation district identification framework.				
Zhang, Dong (44)	**Country** China **When established** 1981-1990 **Function** Knowledge; University **Type of innovation district** High-technology- intensive activities	**Year of publication** 2017 **Stage** Established **Study methodology** Case study; Interviews **Focus** Study of policy-led University Science Parks and Innovation Districts in China and their development.	**No**			

Appendix 4 – Further analysis of the impact of Innovation Districts on Research and Development Jobs

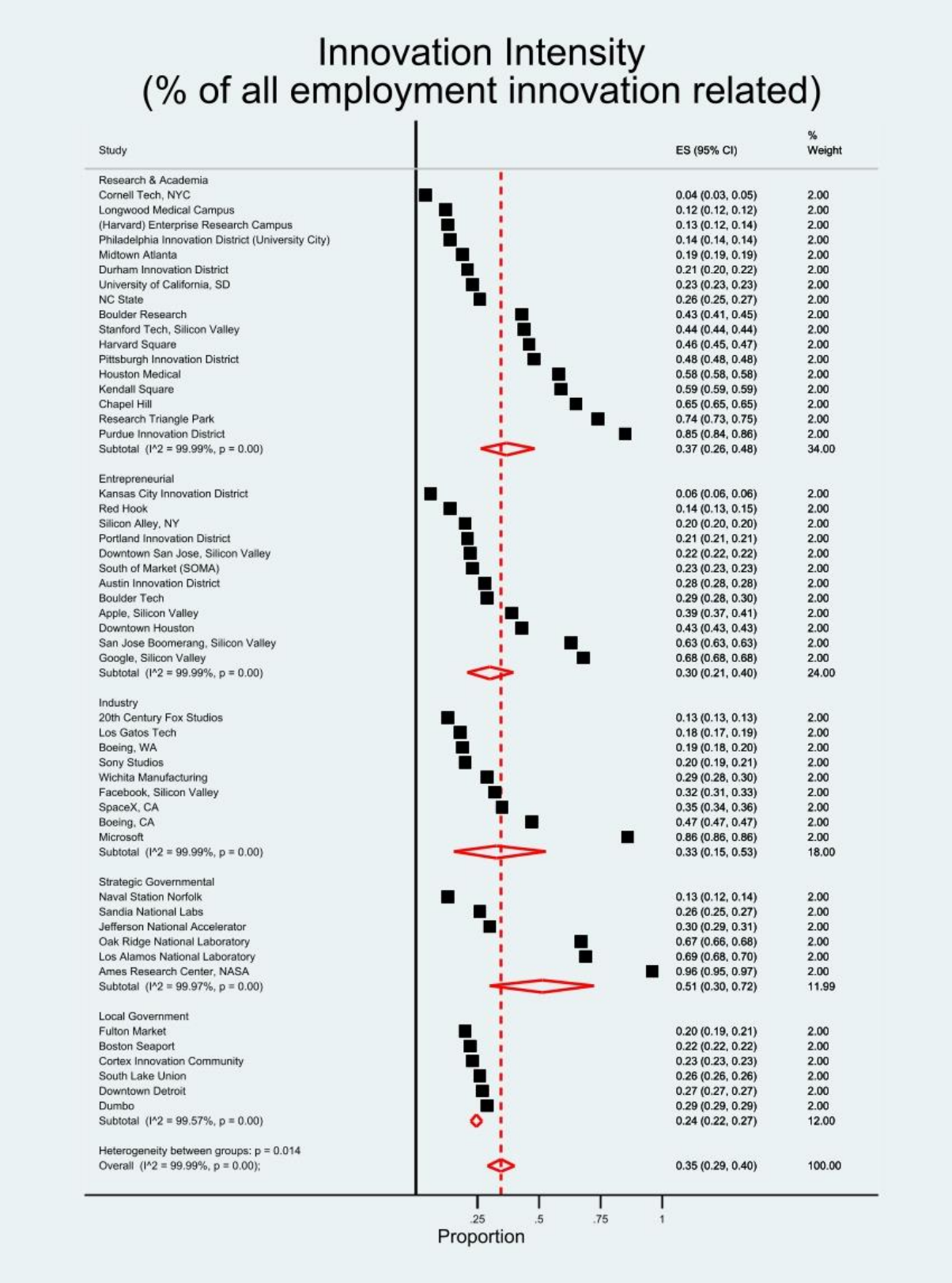

Figure 7: Innovation Intensity (the proportion of jobs within an innovation district that are classed as being involved in innovation roles) – data from (12) and sub-grouped by type of innovation district

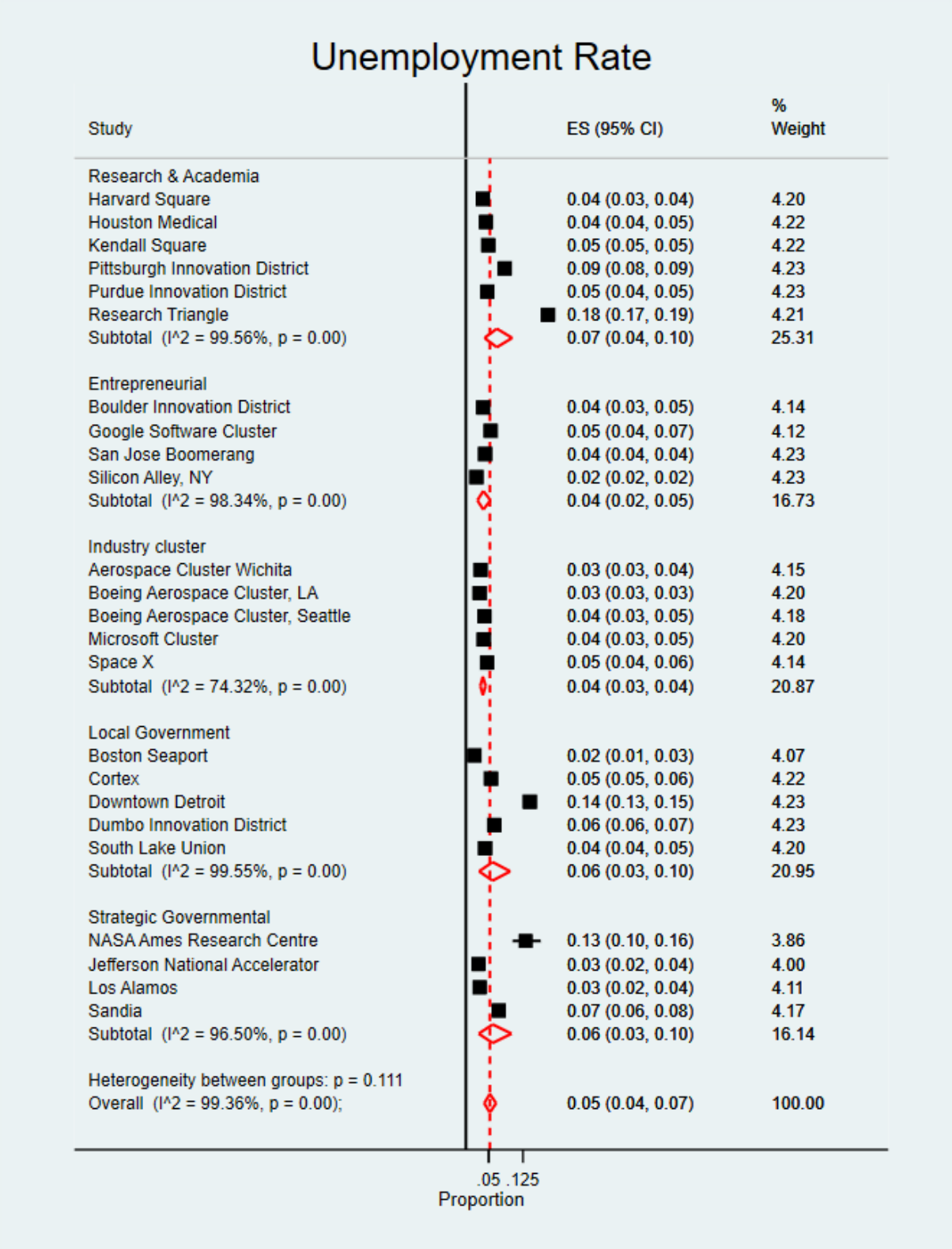

Figure 8: Unemployment rate within Innovation District – data from (12) and sub-grouped by type of innovation district

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