Identifying Sources of Innovation: Building a Conceptual Framework of the Smart City through a Social Innovation Perspective

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Abstract

A comprehensive theory of Smart Cities continues to elude scholars. This seems to result from ontological uncertainty surrounding the Smart City and who it serves. Such uncertainty has led to the techno-centric versus human-centric debate currently dominating the Smart City discussion. This paper adopts a systems approach to stratify society into three strata: the individual(micro), organizational(meso), and system(macro). I implement a systematic review of the Smart City literature to examine how Smart Cities are conceptualized. From an analysis of 41 papers, this research identifies a dualistic phenomenon occurring at all points in the stratified city system: sources of innovation (SOI) and Loci of change (LOC). Here, SOI refers to the perceptions of deficiencies which initiate the learning curve of innovation, while LOC refers to the structures which allow the learning curve to disseminate through the system. This analysis highlights an overemphasis on the organizational stratum and insufficient attention to the individual and system strata. To address this shortfall, I introduce the Social Innovation Cycle. This multi-level social innovation framework incorporates the interdependencies of SOI and LOC to link all strata, mitigate power asymmetries, and reduce marginalization. In so doing, I delineate where policy implementation can be directed for holistically developing the Smart City. I recommend that Smart City policy should target the intersection of SOI and LOC in pursuit of human-centricity.

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INTRODUCTION

The 21st century economy is characterized by rapid urbanization and a reversal of a 20th century trend of industry and resident suburbanization (Future Cities Catapult 2017; Engel, Berbegal-Mirabent, & Pique, 2018). By 2025, it is projected that 60% of the world's GDP will be generated by 600 cities (Piva, 2017). Furthermore, cities currently house 55% of the global population despite only covering 2% of geographic space, and this number is expected to increase to 68% by 2050 (UN DESA, 2018). As such, cities are vital centers of growth. Successful management of their infrastructure and services is crucial to ensure that the benefits of urbanization are inclusive for all of the city's inhabitants.

Practitioners, academics, and policymakers involved in the urban planning discussion are searching for the economic and social inclusivity necessary to develop their cities for all inhabitants. The Smart City emerged from this discussion and academic interest in it has grown exponentially since 2009 (Mora, Bolici, & Deakin, 2017). Despite this, it lacks a central definition and remains a topic of debate (e.g. Matos, Vairinhos, Dameri, & Durst, 2017; Yigitcanlar et al., 2018). Yet, it is recognized that a Smart City should address the problems of slow growth, rising inequality, and environmental degradation (e.g. Neirotti, De Marco, Cagliano, Mangano, & Scorrano, 2014), which I will henceforth refer to as the 'sustainability objectives'.

The implementation of Information Communication Technology (ICT) is a necessary condition for Smart City development, but the extent to which it is a sufficient condition to meet the sustainability objectives continues to fuel debates (Albino, Berardi, & Dangelico, 2015; Llacuna, 2016) between techno-centric (e.g. Greenfield, 2013; Kitchin, 2014) and human-centric proponents (e.g. Castelnovo, Misuraca, & Savoldelli, 2016; Cowley, Joss, & Dayot, 2018). A techno-centric perspective holds that ICTs feed into the Internet of Things (IoTs), thereby increasing the efficiency of city operations to the benefit of the local economy (e.g. Hollands, 2008; Yigitcanlar & Lee, 2014). Human-centricity embraces the growth potential of IoT interventions but holds that holistic development engaging the human element

of technology and the city is vital to avoid pitfalls of technological determinism. In fact, recent literature has partially embraced this latter view and adopted a technologically focused, but human-driven conceptualization for developing the technological dimension of the city (e.g. Kummitha & Crutzen, 2017, 2019).

A lack of synthetic analysis regarding the mutual objectives of techno/human centricity (e.g. Hatuka, Rosen-Zvi, Birnhack, Toch, & Zur, 2018) has significant implications for policy implementation. Smart City policies purport to enable efficient use and organization of urban systems in pursuit of socially and economically desirable deliverables. However, marginalized areas are often overlooked in such policy interventions (Shelton, Zook, & Wiig, 2015; Wiig, 2016; Martin, Evans, & Karvonen, 2018). I argue that in order to overcome this shortfall, social innovation is crucial for addressing social exclusion in the urban context by creating new access routes to resources for marginalized groups and developing their socioeconomic capabilities (Moulaert et al., 2005; Moulaert and MacCallum, 2019). I argue that a multi-tiered system approach which incorporates the micro, meso, and macro strata of society (c.f. Bhaskar, 2008; Luhmann, 2013) contextualizes economic growth within a prosocial (e.g. Branzei et al., 2018) framing necessary to achieve human-centricity. The multiple strata at which social innovation operates (e.g. Mulgan, 2006: Choi & Majumdar, 2015) offers a conducive lens to analyze how the sustainability objectives can be achieved inclusively and holistically. This research thus aims to understand how the reconceptualization of the Smart City through a social innovation lens can inform policy intervention which positions the urban environment towards human-centricity.

To this end, I conduct a systematic literature review (SLR) of the Smart City literature to examine the dominant strata within the Smart City discussion and analyze emerging themes of innovation. Identifying the prominent stratum of focus sheds light on how the Smart City is conceptualized. I dissect the literature and introduce insight from social innovation in four steps: (i) I examine which strata of society gives prominence to innovation within the Smart City literature; (ii) I analyze the underlying interactions that promote innovation within these strata; (iii) I introduce how these interactions can be informed by injecting a social innovation

perspective; and (iv) I reconceptualize the Smart City by contextualizing a multi-level model of social innovation within the urban context.

Through the analysis of 41 articles, I contribute to research in three ways: (i) I distinguish between Sources of Innovation (SOI) and Locus of Change (LOC) as dualistic phenomena within each stratum, which influence the Smart City direction; (ii) I reconceptualize the Smart City by analyzing the relationship between SOI and LOC through a social innovation lens; (iii) I develop a conceptual model of the Smart City, which places the onus for development on all three strata of society. Practically, this reconceptualization presents a clear delineation of where policy interventions can be directed to be most effective in pursuit of human-centricity.

The following section provides an overview of the current state of the Smart City discussion and its key assumptions. Section 3 then illustrates how the social innovation perspective can inform these assumptions and contribute to the Smart City debate. Section 4 outlines the steps which comprise the systematic literature review process. Section 5 presents the results of the SLR, and section 6 discusses the findings, their implications for the Smart City debate, and implications for practice.

THE STATE OF THE SMART CITY

The Smart City represents an attempt to design a city through the implementation of a technical dimension to support the socioeconomics of urban life (Santangelo, 2016; Acedo, Painho, Casteleyn, & Roche, 2018). This paper identifies Smart Cities as "territories with high capacity for learning and innovation, which is built-in the creativity of their population, their institutions of knowledge creation, and their digital infrastructure for communication and knowledge management" (Hollands, 2008, p. 305). An operational Smart City should leverage the technical dimension to address the sustainability objectives— slow growth, rising inequality, and environmental degradation (Neirotti et al, 2014). Currently, there is no city that fulfils all the criteria for a Smart City (Wang, 2018). This is due to the prioritization of economic growth (Goodspeed, 2015; Hollands, 2015; Wiig, 2016) over environmental and

social concerns (Ahvenniemi, Huovila, Pinto-Seppa, & Airaksinen, 2017; Yigitcanlar et al., 2018) in cities that label themselves a Smart City.

Critics of the Smart City have asserted that the smart label is self-congratulatory (e.g. Wang, 2018), self-attributed (e.g. Hollands, 2008), and has shifted away from the principles of the 1990s' Smart Growth movement, which advocated sustainable urbanization, to which the modern Smart City's conceptualization can be traced (e.g. Yigitcanlar et al., 2018); Albino, Berardi, & Dangelico, 2015). Instead, the Smart City, in practice, has embraced a neo-liberal ethos emerging from a combination of the smart urbanism movement (e.g. Harvey, 1989; Kitchin, 2014) and Thatcher and Reaganism politics of the 1980s (Grossi & Pianezzi, 2017).

A direct result of these policies was the entrepreneurial city (Jessop, 1997). The underlying logic of the entrepreneurial city, which promotes entrepreneurial behavior by city governments for economic growth, still permeates the current urban development discourse (e.g. Acs, Szerb, & Autio, 2017). This neo-liberal understanding of urbanism promotes the city primarily as an attractor of business and, subsequently, a fertile ground for economic development, wherein social value is a by-product of economic growth (Hollands, 2008). Indeed, the 2008 banking crisis saw a solidification of this trend in governance, through promotion of a technologically advanced future and the aim of municipal savings via efficient use of resources (Hollands, 2015).

The Smart City narrative purports to be sustainable, inclusive, efficient, and technologically advanced (Santangelo, 2016). In this regard, the Smart City is a hybrid model of urban development combining innovation sourced from multiple strata and governmental support (Letaifa, 2015). This requires adaptation to the context specificity of individual cities, dynamic interactions among stakeholders, and, consequently, ad hoc pursuit of the sustainability objectives (c.f. Nicholls, Simon, & Gabriel, 2015). However, many Smart City initiatives are corporate led, manifest through partnerships between technology companies and local governments, and represent adoption of global policy interventions within local contexts (e.g. Soderstrom et al 2014). In a bibliometric analysis of the 10 most cited Smart City publications, Mora et al (2017) found that two major interpretations of the Smart City have

emerged since 2000: "[one] that can be defined as holistic… [and one which] provides a techno-centric interpretation of smart cities" (p. 12).

State of Human-Centricity

The Smart City concept is utilized in two overlapping ways. Firstly, the Smart City represents a goal for urban development projects. Secondly, the Smart City is used by political and urban elite to support specific development policies (Vanolo, 2014). Vanolo (2016) notes that this latter use is more prevalent, stating that the Smart City discourse has "been firstly (and mostly) developed by a small number of multinational companies" (p. 3), evidenced by IBMs increasing role in urban development initiatives (see Söderström, Paasche, & Klauser, 2014; Murray, 2016).

Since Caragliu et al's (2011) seminal work, an increasing amount of literature has emerged promoting holistic interpretations of the Smart City (e.g. Kourtit & Nijkamp, 2012; Yigitcanlar, 2015; Lara, Da Costa, Furlani, & Yigitcanlar, 2016) with human-centricity as a fundamental principle. Human-centricity refers to promoting human agency for co-developing and creating city services to shape the institutional framework, rather than passive recipients of services within the dominant institutional environment (c.f. Joss, Cook, & Dayot, 2017; Cardullo & Kitchin, 2018). The institutional framework refers to a dynamic interlay of humanly devised rules that structure human interaction, guide organizational behaviour, and provide rationale for individual behaviour (see North, 1990, 1993).

In the case of technological interventions, citizen involvement promotes cohesion between the development and effective use of technology (see Kummitha, 2020). Similarly, the role of social reality in technological adoption is often overlooked (Azevedo Guedes, Alvarenga, Sgarbi Goulart, y Rodriguez, & Pereira Soares, 2018) and promotes a gap between what a Smart City claims to achieve and the reality of these claims (e.g.Valdez, Cook, & Potter, 2018;Wiig, 2016). Despite the extant literature identifying the need for citizen involvement in urban development, (e.g. Giffinger, Fertner, Kramar, & Meijers, 2007; Gibson et al 2015; Kummitha & Crutzen, 2019; Kummitha, 2020) the dominant institutional framework within the urban context continues to engender a neo-liberal focus on economic growth.

Cowley et al (2018) examined human focused smart initiative practice across six UK cities. They found that a dominant method of public smart initiatives undertaken in the UK adopted a view of the public as relatively compliant rather than imbued with agency for co-development. Similarly, Kummitha and Crutzen (2019) illustrate the extent to which a society's institutional framework impacts agency by demonstrating how the institutional environment can inhibit citizen engagement. Indeed, many 'citizen-oriented' smart initiatives promote market-led solutions and practices of civic paternalism (Cardullo & Kitchin, 2019). Despite claims of human prioritization, it remains empirically unclear whether the neoliberal underpinnings of economic growth are promoting human-centricity. Indeed, until the dominant institutional framework in the urban context is understood and changed, human-centricity will remain elusive.

Pitfalls of Techno-Centricity

Despite the emergence of human-centric rhetoric in the literature, cities continue to strive for competitiveness by emulating the focus on economic growth of other cities in pursuit of the 'smart' label (Castelnovo et al., 2016). This emulation allows for the dominance of corporate models of the Smart City (e.g. Hollands, 2015; Wiig, 2016) which tend to emphasize technological implementation and economic growth over environmental protection and creation of social equality. Proponents of the techno-centric Smart City suggest that through implementation of technology, specifically ICT and IoT (e.g. Kitchin, 2014; Goodspeed, 2015;Park, del Pobil, & Kwon, 2018), the Smart City will promote the collection and implementation of city data and improve residents' quality of life. Such technological implementation is further propagated by large corporations (Kummitha, 2018). As a result, public-private partnerships between large corporations and local governments dominate the current Smart City practice (e.g. Neirotti, De Marco, Cagliano, Mangano, & Scorrano, 2014; Cugurullo, 2016). Indeed, many techno-centric smart initiatives do not come from citizens living in the city, but corporations or local government (Hollands, 2015). Subsequently, inhabitants are made passive, rather than active creators within the city (c.f. de Waal & Dignum, 2017).

Techno-centricity thus only partially achieves what the Smart City rhetoric promises (Saiu, 2017) and overemphasizes particular demographic groups in pursuit of a neo-liberal agenda (Martin et al., 2018). With a focus on economic growth, inequality is not only unaddressed, but social issues that underpin inequality can be exacerbated rather than solved. For example, economic rhetoric which ignores place-based realities (see Wiig, 2016; Martin et al., 2018) or failure to achieve technological affordance as a consequence of technocratic technological push (see Kummitha, 2020) can exacerbate inequality.

Similarly, corporate-driven technological implementation overlooks the role of citizen-led technological interventions, inhibits technological adoption, and tacitly ignores the role of the institutional framework in wider urban services (e.g. Hollands, 2015). Furthermore, evidence suggests that within Smart Cities which engender these techno-centric approaches, amelioration of environmental degradation and income equality are often presupposed as by-products of economic growth (e.g. Anthopolous, 2017; Cugurullo, 2016; Yigitcanlar et al., 2018). This leads to insufficient attention to income inequality and environmental degradation (e.g. Mahzouni, 2015; Yigitcanlar & Kamruzzaman, 2018). Examples of this can be seen in the Smart Cities of New Songdo, in South Korea and Masdar City, in Abu Dhabi. Presented as the 'quintessential' smart cities, their promise of implementing transformative technology has not been upheld (Greenfield, 2013), and thus they are not the Smart Cities they purport to be (Wang, 2018). New Songdo and Masdar City are strong examples of the Smart City's focus on economic growth and its counterproductivity. Indeed, one decade after New Songdo's birth, the city still struggles to attract businesses and residents; "Everything is expensive… it's just so focused on attracting foreigners that they forget normal people live here too" (White, 2018). Similarly, sustainability in the city of Masdar is synonymous with profitability; in this context, urban development is "purely in economic terms" (see Cugurullo, 2016, p. 2428).

Innovation within the Smart City discourse seems to revolve around economic conceptualization of innovation and growth (e.g. Sarma & Sunny, 2017). Indeed, the neoliberal underpinnings of techno-centricity endure because the discussion lacks in-depth engagement with systems thinking and social innovation. To address this, I adopt a social innovation

perspective to contextualize economic growth within a framework of sustainable systems change which promotes human-centric pursuit of the sustainability objectives.

SOCIAL INNOVATION AND THE SMART CITY

This section will shed light on how a social innovation perspective can reconcile models of the Smart City with its sustainability objectives and bring environmental degradation and inequality to equal standing with the slow growth objective. In practice, Smart Cities differ from their conceptualizations due to significant misunderstanding of how agents of social innovation can be integrated into the Smart City context (e.g. Richter, Kraus, & Syrja, 2015). For example, the concept of social innovation varies across sociological (e.g. Howaldt & Schwartz, 2010), entrepreneurship (e.g. Dees & Anderson, 2006; Schumpeter, 1939), urban development (e.g. Moulaert et al. 2005), and practice-led research (e.g. Mulgan, 2007, 2012). Indeed, social innovation manifests in a variety of forms ranging from technologies, business models, to ideas. Through a synthesis of literature from seven streams of research, Choi and Majumdar (2015) identify multiple levels at which social innovation operates due to its multiplicity of form (see p. 28). Irrespective of form, against the backdrop of the human-centric Smart City, the fundamental principles of social innovation involve: i) addressing needs neglected by the market or state, ii) creating new institutional relations, and iii) empowering people to transform existing structures (Moulaert et al., 2013). Combining these elements enables the system-level change necessary to reconcile existing conceptualizations of the Smart City with the sustainability objectives.

The Smart City discussion often overlooks micro-level initiation of innovation in deference to such technocratic innovations alluded to in the previous section. However, there is significant untapped potential for micro-level innovation in developing Smart Cities (e.g. Kummitha, 2019). Indeed, the sustainability objectives represent deep-rooted relationships between social change and economic development, which social innovation is uniquely qualified to address (c.f. Kummitha, 2020). Examining citizenship in the Smart City, Calzada

(2021b) adopts a social innovation perspective which advocates for multi-stakeholder engagement with social entrepreneurs and other transformative agents.

The social innovation perspective positions a human-centric Smart City as both an outcome and a platform for facilitating social and technological innovation by enhancing and emphasizing socialization among various agents of change. Costales and Zeyen (2021) illustrate the capacity of such agents to empower actors from various groups to engage in innovative activity. Social innovation is not limited to any particular type of actor (c.f. Schumpeter, 1942); indeed, it involves a multi-strata approach to actualize and combine elements of social value into social change. Social value refers to the provision of new products and services within existing institutions (e.g. Bloom & Chatterji, 2009) and impacts individuals and groups of individuals. In contrast, social change is felt by society at large and involves reconstruction of existing institutions (see Hietschould et al 2019). Adopting the social innovation perspective serves to enable human-centric policy making by delineating the ways in which social innovation manifests as a means and an end in order to operationalize social innovation as a theoretical explanation of the multi-tiered process of social change.

The Social Innovation Model

The Social Innovation Model (Nicholls, 2010) emphasizes social change (e.g. Nicholls and Murdock, 2012) as its primary end and social innovation as its primary means; it holds that social market failures should be addressed through systems reconfigurations and changes (Mulgan, 2012). This model layers social innovation by the societal stratum at which it operates — the individual, organizational, and system stratum — and positions social innovation as both a means and an end. Social innovation is thus contextualized as a multi-tiered process of actualization, initiated at the micro-level. Here, organization and social value creation represent means (e.g., Zeyen et al 2014) through which social innovation manifests at the organizational level. Social innovation is actualized, and social change emerges at the system level when the unification of groups and blurring of sectoral boundaries initiates a change in additional market actors' behavior and existing institutions, which sets the stage for further innovation (e.g.

Schaltegger, Hansen, & Lüdeke-Freund, 2016). This systematic merging of existing elements requires social innovation to operate at multiple societal strata (Moulaert et al., 2013)

Muhammad Yunus' Grameen Bank illustrates this process of social innovation (see Yunus, Moingeon, & Lehmann-Ortega, 2010). Through micro-lending to the poor as an individual, Muhammad Yunus discovered their untapped capacity for entrepreneurial behavior when given the opportunity (see Yunus et al., 2010; London School of Economics, 2017). To widen his individual impact, he founded the Grameen Bank, which scaled to become the Grameen Group: a revolution of the micro-finance industry. Yunus' personal lending represents the individual level initiation of the social innovation process — addressing needs neglected by the market or state. Creation of the Grameen Bank represents social innovation at the organizational level — creating new institutional relations —, while the Grameen Group and subsequent widespread emergence of microcredit represents actualization of social innovation at the systems level — empowering people to transform existing structures. The entrepreneurial behavior these loans permit holds the potential for further individual level initiation of social innovation and human-centric development.

The social innovation model stratifies society to illustrate the ways in which the relationship between structure and agency influences and is influenced by the actualization of social innovation at each level of society (e.g. Westley and Antadze, 2010). In the context of the Smart City, such a relationship can manifest in the distance between technological development and human adoption of technology (see Kummitha, 2020). Innovation is subject to placed-based realities and contextual differences in social processes and value (Novy and Leubolt, 2005). That is, a value for one demographic is not per se a value for another. The implication for the Smart City discussion is that a social innovation perspective introduces a multi-level reflexive lens to highlight place based deficiencies at each stratum, and how social innovation can be stewarded at each strata to promote inclusive Smart Cities.

Social innovation is influenced at each level and is a reflection of the context within which the innovation emerges (c.f. Archer, 1995; Kerlin, 2012; Schumpeter, 1939). The diffusion of these innovations in new contexts allows for distinct implementation of the

innovation (e.g. Shane, 2000), which subsequently allows for further innovation. Due to the dynamic relation between action and structure, an initial innovation at one level may become a different innovation as it moves to a higher level. Innovative potential alters as the initial innovation is exapted, expanded, and/or accepted (Dew, Sarasvathy, & Venkataraman, 2004; Leonardi & Barley, 2010) within varying social processes.

A social innovation perspective is thus well positioned to examine the phenomena of the Smart City in three fundamental ways: (i) social innovation couples the notion of social value and economic growth; (ii) a social innovation perspective rejects the notion that social value creation is exclusive to one of society's strata; (iii) it highlights the multi-faceted relationships between citizens and the institutional framework of the Smart City. Thus, social innovation is adopted as a critical lens to analyze the existing Smart City literature and where the current discussion places sources of innovation. This highlights how the discussion can be refocused to identify sources of innovation necessary for human-centricity.

METHODOLOGY

This paper examines the state of the Smart City literature to analyze how the Smart City can be reconceptualized by integrating insight from a social innovation perspective. Through a social innovation lens, I implement a systematic literature review (SLR) to consider assumptions surrounding innovation within a Smart City. These assumptions, I argue, underpin how Smart Cities are understood and pursued. The multiplicity of interactions and context specificity of the Smart City make it a complex social phenomenon, which is often examined through a case study method (e.g. Caragliu, Del Bo, & Nijkamp, 2011; Giffinger et al., 2007; Nierotti et al, 2014; Yin, 2014). The following section showcases the approach implemented to conduct the SLR.

Method: Systematic Literature Review

Traditional literature reviews often precede position papers, where studies are chosen to advocate the writer's point of view. The SLR aims to minimize this bias by providing readers with a perusal of the reviewer's literary decisions and opening their findings to dissection

(Rousseau, Manning, & Denyer, 2008; Maier, Meyer, & Steinbereithner, 2016). The contextual contingency of the Smart City signifies a need to examine multiple components of the Smart City. A SLR is therefore appropriate because it reflects the steps taken to identify which elements were analyzed. This provides a comprehensive picture of what was selected and why. To properly undertake the SLR, established processes were adopted (Tranfield, Denyer, & Smart, 2003; Rousseau et al., 2008; Colicchia & Strozzi, 2012; Maier et al., 2016) and the following steps, in table 1, were implemented.

Step 1: Plan the review	**Step 2: Conduct the review**	**Step 3: Report Findings**
- Scoping Study of existing literature - Develop Research Question(s) - Develop protocol for review, key words and search strings - Identify literature databases - Develop inclusion/exclusion criteria.	- Identify publications through database search - Screen Literature through abstract and title according to criteria from step 1 - Create A-B-C list - Export data to MAXQDA	- Report entire review process - Conduct Quantitative analysis of the publications with MAXQDA (i.e., Journal, methods, etc) - Conduct Qualitative analyses with MAXQDA to address research questions (i.e., theories implemented & categorical themes) - Presentation und discussion of the results

Table 1 Overview of Implemented SLR process

Databases Used

The systematic review was conducted via the Web of Science Core Collection, and the research search engine Google Scholar was used in an ancillary capacity to cross check the number of citations attributed to the literature selected. Although papers are cited for multiple reasons, this provided insight into the distribution of papers.

Initial Search

A scoping study was conducted in the Web of Science Core Collection with the Boolean terms: Topic (Smart City*) OR (Smart Cities*) between 1970-2019, to determine the state of the existing Smart City literature. 1970 was the earliest date available on the Web of Science, and my search ended in May of 2019. Utilizing the ‘topic’ field assured that titles, abstracts, author

keywords, and ‘keyword plus’ were included. The scoping study output 10,749 results, the majority of which fell under the hard science categories; Engineering Electrical Electronic (31.58%), Computer Science Information Systems (18.99%), Computer Science theory methods (17.31%), and Telecommunications (17.31%). It is not until 9th place that Urban Studies emerged (6.23%) and 20th place that Management emerged (2.38%).

Search Strings

Following Tranfield et al. (2003) the following search strings were informed by the scoping study and readings conducted prior to the scoping study. Utilizing the Web of Science’s advanced search option, a Boolean search (TS=("Smart City") OR TS=("Entrepreneurial City") OR TS=("Intelligent City") OR TS=("Creative City") OR TS=("Sustainable City") AND TS=(Model OR Framework)) was conducted between 1970-2019, which led to 2,415 results. These results were limited to the English language and peer reviewed academic journals. These results were then refined again with (Model OR Framework) and produced 293 results. The additional ‘City’ strings were introduced to account for common overlapping nomenclature within the Smart City discussion (Bifulco et al 2015; Yigitcanlar et al., 2018).

Manual examination of titles and abstracts, and exclusion of papers whose focus was outside of North America and the European Union, led to 103 results. This geographic focus was to maintain an element of homogeneity as it pertained to the collective socio-economic efforts and narratives surrounding the Smart City (e.g., Europea, 2012). The Smart City vision in Europe and North America is similarly critiqued for maintaining techno-centric and neo-liberal focuses (Martin et al., 2018). Further reading of abstracts and papers led to 41 papers comprising the final A-list, with 59 papers making up the B-list.

Coding and Categorization

The 41 papers were analyzed quantitatively and then subjected to a qualitative analysis as laid out by Seuring and Müller (2008) and Assaroudi, Heshmati, Armat, Ebadi, and Vaismoradi (2018). The coding software MAXQDA was utilized to organize the papers and emerging code strings. The individual, organizational, and system categories were implemented as deductive categories, aligning with the SIMoSE (Hsieh & Shannon, 2005). Deductive categories were

identified as a first step in order to leverage a feedback loop (Seuring & Müller, 2008) and account for potentially missed trends relating to the categories, thereby enhancing validity of the findings (Assarroudi, Heshmati Nabavi, Armat, Ebadi, & Vaismoradi, 2018). Emergent coding was then utilized in an iterative process, in order to identify interactions between the three strata. Over 1,000 coded segments emerged, from which the 'inter' stratum was introduced. This led to four 'stratum' categories: the 'individual', 'organizational', 'system', and 'inter' stratum. Within these categories, an additional iteration of inductive coding was conducted for process trends, out of which, Source of Innovation (SOI) and Locus of Change (LOC) emerged as higher order codes. For example, papers with the code 'living lab' were moved from the 'organizational stratum' to the 'inter-stratum' to illustrate the multi-strata influence on innovation and change.

RESULTS AND ANALYSIS

Two analyses were conducted on the identified literature: (i) a descriptive analysis addressing key journals, years of publication, and area of study; (ii) a thematic analysis examining key trends and conceptualizations that underpin Smart City frameworks. Table 2 illustrates which of the stratum categories the literature fell within as well as their higher order categories.

Descriptive Analysis

A quantitative evaluation of the literature includes i) the distribution of journals over time, ii) the occurring journals, and iii) the research categories of the literature. The articles in the A-list ranged from 2006-2019, with the majority published between 2016 and 2018.

The journals publishing research in the area of Smart City are a good indicator of the sources of knowledge informing Smart City development. The journals with the highest concentration of publications in this area were: *Sustainability (5), Technological Forecasting and Social change (4), Cities (4), Technology Innovation Management Review (4), and European Planning Studies (3)*. Similarly, the review has identified a rather wide array of academic disciplines, based on the department of the author. These consist of urban studies,

environmental studies, regional urban planning, business, and management, among others (see Figure 2).

Reference (by date)	Model/ Framework Implemented	Individual	Organizational	Inter	System	(Emergent) Source of Innovation-Individual	(Emergent) Source of Innovation-Organizational	(Emergent) Source of Innovation-System	(Emergent) Locus of Change-Individual	(Emergent) Locus of Change-Organizational	(Emergent) Locus of Change-System
Kenworthy (2006)	Eco Cities Planning Model			x			x			x	
Russo et al (2007)	Sustainable City-University relationship Model			x		x			x		
Lombardi et al (2012)	Quadruple Helix Model & Analytic Network Process Model			x			x			x	
Tranos & Gertner (2012)	Smart City Policy Framework				x			x		x	
Girard (2013)	Historic Urban Landscape Model			x			x			x	
Mahzouni (2013)	Hammarby Model			x			x			x	
Lee et al (2014)	Index Model & Case Framework for Smart City Analysis			x			x			x	
Scott (2014)	Cognitive-Cultural Capitalism Framework		x				x			x	
Trip & Romein (2014)	Analytical framework of the creative production and consumption milieu		x				x			x	
Calzada & Cobo (2015)	Integrated Critical Social Innovation Framework			x		x				x	
Carrasco & Sobrepere (2015)	OECD Framework for Open Government Data Initiatives			x			x			x	
Dameri & Ricciardi (2015)	SC-IC Framework			x			x			x	
Veeckman & van der Graaf (2015)	Living Lab Model			x			x			x	
Walravens (2015)	Expanded Business Modelling Framework		x				x			x	
Anttiroko (2016)	City-as-a-platform model			x			x			x	
Bifulco et al (2016)	Refined Triple Helix Model			x			x			x	
Castelnovo et al (2016)	Smart City Governance assesment framework			x			x			x	
Damurski (2016)	E-Planning			x			x			x	
Kontokosta (2016)	Quantified Community Model			x		x			x		
Manitiu & Pedrini (2016)	DPSIR Model			x			x			x	
Ojasalo & Tahtinen (2016)	Open Innovation Platform Model for decision making			x			x			x	
Rochet et al (2016)	Urban Lifecycle Management Framework		x				x			x	
Russo et al (2016)	Smart City as a model for European EIP-SCC			x			x			x	

Table 2 SLR Paper Clusters

Reference (by date)	Model/ Framework Implemented	Individual	Organizational	Inter	System	(Emergent) Source of Innovation- Individual	(Emergent) Source of Innovation- Organizational	(Emergent) Source of Innovation- System	(Emergent) Locus of Change- Individual	(Emergent) Locus of Change- Organizational	(Emergent) Locus of Change-System
Scuotto et al (2016)	Open Innovation Model			x		x				x	
Garcia-fuentes & Torre (2017)	Urban Regeneration Model			x		x			x		
Grimaldi & Fernandez (2017)	City Anatomy Model			x			x			x	
Leminen et al (2017)	Living Lab Networks Model			x			x			x	
Pierce et al (2017)	Conceptual Model of mapping ocnfiguration of specific Smart Cities			x			x			x	
Sarma & Sunny (2017)	4P Framework			x		x				x	
Claudel (2018)	Innovation Ecosystem Hub Model			x		x			x		
Della & Trunflo (2018)	Creative City Model			x		x			x		
Errichiello & Micera (2018)	Smart Open Innovation			x		x				x	
Flores et al (2018)	Open Innovation Funnel Model			x			x			x	
Lim et al (2018)	4 Reference Models of Data Use			x			x			x	
Meijer & Thaens (2018)	Living Lab Model			x		x				x	
Nilssen (2018)	Framework of SC Initiative Typology			x		x				x	
Paskaleva & Cooper (2018)	SmartiP Open Innovation			x		x				x	
Yigitcanlar et al (2018)	Multidimensional System of Systems Smart City Development Framework			x				x		x	
Yun et al (2018)	Tacit-knowledge-based open innovation research framework		x				x			x	
Andreani et al (2019)	Threefold design research model			x			x			x	
Sepasgozar et al (2019)	Urban Services Technology Acceptance Model	x				x				x	

Table 2 Continued

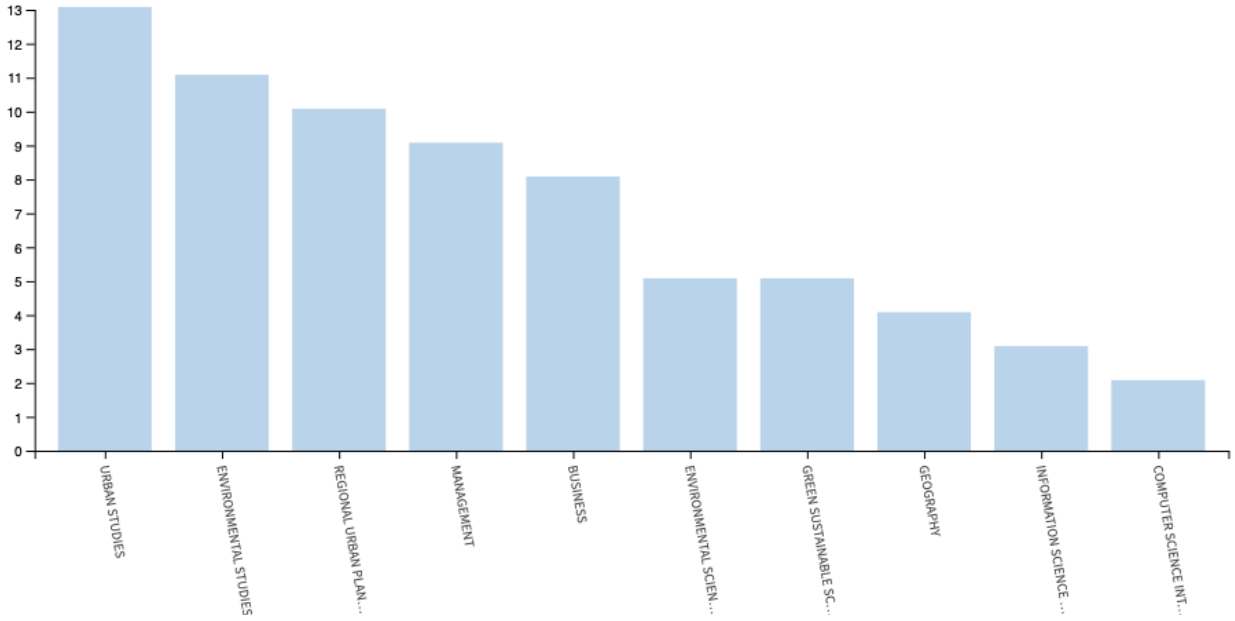

Figure 2 Articles by discipline

Thematic Analysis

A thematic evaluation of the literature includes i) its distribution among the three deductive categories and emerging 'inter' category; ii) the themes emerging within each of these categories; and iii) how Source of Innovation (SOI) and Locus of Change (LOC) manifest and interact. The SOI and LOC emerged as higher order categories, which exist at all points in the stratified city system and represent interdependencies with the institutional framework whose interaction give rise to value and change. The SOI refers to the deficiency perception which initiates the learning curve of innovation, while the LOC refers to the constructs which allow the learning curve to expand through the system.

Returning to the Grameen bank example, the SOI can be attributed to Muhammad Yunus (individual stratum) and the indwelling which led to his recognition of the entrepreneurial ability of the poor. The LOC, here, can be attributed to Grameen Bank's formal status (organizational stratum) in 1983.[1]

[1] It took 7 years for the Grameen Bank to become a formal bank (1976-1983) between which time the LOC can also be attributed to the individual stratum (Yunus and his colleagues).

Individual stratum

The individual-level stratum refers to citizens and independent persons. Activities, behaviors, and roles of individual actors were coded here. This category was only utilized to identify models of Smart City development which focused on individual level behavior as the source of innovation. Models of development which focused on interactions with individuals and other strata of society are coded in the Inter Stratum.

Only 1 of the 41 papers (Sepasgozar, Hawken, Sargolzaei, & Foroozanfa, 2019) approached the Smart City from the individual level. This paper examines a conceptual tool to develop a human centric Smart City. The authors proposed an empirical model (Urban Services Technology Acceptance Model-USTAM) to bring attention to factors influencing user behavior – the authors deem this behavior as necessary to understand how new technology is adopted in the urban context. The focus here is not on the invention of technology, but the innovative use of technology.

The authors implemented the Technology Acceptance Model and Social Cognitive Theories to study and measure user perceptions regarding Urban Services Technologies and how these perceptions influence technology integration in the urban context. Sepasgozar et al. (2019) illustrate the pliability of technology adoption and demonstrates potential difficulties for the Smart City that can emerge from a top-down techno-centric approach. In this framework, the SOI sits within the individual stratum by way of leveraging inhabitants' tacit knowledge to analyze the implications of local context and social processes for identifying 'culturally appropriate' technology that can address needs neglected by the market or state. LOC, however, sits within the organizational stratum as the USTAM is intended to be utilized as a tool to ensure technological rollout is undertaken effectively at the municipal level.

Organizational Stratum

The organizational-level stratum encompasses private, public, and third-sector organizations. Activities, behaviors, and roles of these actors were coded in the organizational stratum. Although the role of local government is widely acknowledged, I found it is seldom

explicitly distinguished between the city system itself. This paper recognizes government as an entity separate from the system.

5 of the 41 papers (12%) adopt frameworks which position the organizational stratum of society as the SOI within the Smart City. Among the papers in this group, the Smart City is presented as an ecosystem whose economic base is dominated by clusters of technology-intensive and service industries (e.g. Scott, 2014; Trip & Romein, 2014). Thus, innovation in this stratum is represented by provision of services and amenities, which promote positive social and economic impacts on society. Within this category, technology is a tool to promote efficient collaboration among the city's organizational actors.

This collaboration is intended to create a business ecosystem, which promotes movement towards the sustainability objectives. Among these frameworks, however, inhabitants of the city are incorporated as sensors of data, from using services (e.g. mobile service apps) and amenities (e.g. architecture of built environment) to be used at the organizational level to guide restructure, behavior, and policy. The organizational-focused frameworks promote the notion that such services require new ways of interaction between companies and local government. Without holistically sourced innovation, new institutional relations remain elusive and a true ecosystem cannot be formed (c.f. Sarma & Sunny, 2017). Thus, SOI sits within the organizational stratum by way of leveraging organizational resources to enhance inter-organizational practices. The LOC sits within the organizational stratum by way of the implementation of policy to encourage the use of innovative services and amenities. Indeed, where governance is identified as a fundamental element (Walravens, 2015), it is directed at involving public actors as collectors of information to influence organizational behavior and policy.

System Stratum

System was utilized here as a plurality of interactions between actors that comprise it, whose whole is more (or less) than the sum of its parts. I conceptualize a city as an open system comprised of multiple sub-systems, which are themselves the result of construction and de-

construction due to dynamic communication between the (sub)systems and their environment (c.f. Luhmann, Baecker, & Gilgen, 2013).

While most papers acknowledge the city as a system, the system-strata was on the fringe of examination. Only 1 of the 41 papers examines the city operating in an environment of other systems (other cities) (Tranos & Gertner, 2012). In this context, the existing system-to-system competition explicitly contributes to the system's behavior. The authors illustrate the need for a Smart City to look outward and examine its position in relation to other cities. Here, the SOI is situated within the system strata by way of system versus system competition as a causal mechanism for emphasis on economic growth and the pervasiveness of neo-liberal logic. That is, the system is shaped by external competition and aims to balance economic allure with citizen quality of life, with the purpose of attracting people and businesses to the city. This engenders a deep-rooted focus on economic objectives. The LOC, thus, sits within the organizational stratum by way of responding to the environment through organizational behavior.

Inter Stratum

The Inter stratum emerged as a category which reflects interaction between strata. This stratum refers to groups of individuals and interactions between the individual-stratum, organizational-stratum, and the system stratum. As such, activities, behaviors, and actor roles that promote interaction between these strata fell within the 'Inter' code.

34 of the 41 papers (83%) promoted the space between stratum as the SOI. Papers within this cluster present technology as a tool to promote efficient collaboration between these strata. Here, the Smart City is also presented as an ecosystem where goods and services are available for all inhabitants. Within this category, open innovation and co-development emerge as vehicles for SOI and LOC to move through the strata, highlight needs neglected by the market or state, create new institutional relations, and empower people to transform existing structures. Open innovation refers to involvement from multiple actors within a city (c.f. Flores, Javier Carrillo, Guadalupe Robles, & Alicia Leal, 2018). Co-development refers to the

creation of goods and services resulting from this open innovation (e.g. Errichiello & Micera, 2018).

Open Innovation. Innovative digital services and participatory social interactions are often strategies to promote human-centered Smart Cities (e.g., Dameri & Ricciardi, 2015; Calzada & Cobo, 2015 Bifulco, Tregua, Amitrano, & D'Auria, 2016), and illustrate the value of local participation and social processes to the sustainability objectives. Participation refers to active contributions from individuals, communities and civil society to shape their environment. Participation can occur at a local level (e.g. neighborhood initiatives) or extend to the entire city (e.g. voting or providing feedback regarding urban transportation through apps). The scope of participation depends on the city sub-system in-question and is a factor of available platforms and citizen satisfaction: representing a complex, but often demand-oriented phenomenon.

In the urban context, platforms function as vehicles of innovation between the platform owner (often a company, university, or the city) and other actors (citizens or the local community) (e.g Anttiroiko, 2016; Leminen, Rajahonka, & Westerlund, 2017). A platform is any operating environment whose development is open to collaboration and aimed at producing benefits for its users (Raunio, Nordling, Kautonen, & Rasanen, 2018). The living lab[2] model is a popular method for providing platforms (e.g., Veeckman & van der Graaf, 2015; Sarma & Sunny, 2017). Sub-systems of the city have different aims and, as such, multiple platforms can be offered aligning with multiple different goals. For example, a transit sub-system may offer a platform through an app that allows citizens to contribute to an intelligent traffic control pilot. On the other hand, an administrative subsystem may provide a platform, through a physical open space, that allows citizens to come together and offer solutions for local crime. Similarly, a university may open up problems to its students or local residents, thereby using the university itself as a platform. Platforms exist at multiple levels and participating actors are subject to the aims and constraints imposed by an initiating party. These parties often possess

[2] A living lab is a platform for open innovation in a particular area, initiated to simulate a lifelike environment (see Leminen, 2014).

a disproportionate level of control over a city's co-development pathway, and therefore influence how co-development emerges.

Co-development. Of the 34 papers, 27 models emerged reflecting different approaches to co-development within the city. Elements of the living lab model are present in each. Leminen et al (2017) expanded on this model and identified four archetypes of collaborative innovation. These archetypes are: *City as a provider, City as a neighborhood participator, City as a catalyst, and City as a rapid experimenter*. Each archetype reflects a mechanism of innovation which can be found within the 34 papers.

City as a provider sees the entire city as a platform while the city pursues strategic aims (e.g. processes or services provided to inhabitants). In pursuit of these aims, city stakeholders provide expertise, which is often sourced from companies and research institutions. In this archetype, the SOI and LOC are located in the organizational stratum. 16 papers align with this archetype. *City as a catalyst* also adopts the city as a platform in order to develop a business ecosystem. Businesses are encouraged to participate to develop services and processes ranging from land use to healthcare to education. In this archetype, the SOI and LOC also sit in the organizational stratum. 6 papers align with this archetype.

City as neighborhood participator adopts the platform at a smaller level (e.g. neighborhoods or among a particular demographic) where the city acts as enabler of locally initiated activities for improving local conditions. A city can support such initiatives through its own participation in the initiatives and removing barriers. For example, a city government can support a local farmer's market by providing an expedited process for receiving a permit for public land use. Within this archetype, the SOI and LOC are located at the individual level. 5 papers align with this archetype. The platform is also at the smaller level in the *city as rapid experimenter* archetype to act as an enabler of small companies/start-ups to develop an entrepreneurial ecosystem. Support can manifest in arranging competitions or growth events such as hackathons or Startup festivals (see Murray, 2016) to identify those companies that address Smart City characteristics (e.g. energy efficiency or mobility) (see Giffenger et al.,

2007). Within this archetype, the SOI sits at the individual stratum and LOC at the organizational stratum. 7 papers align with this archetype.

The following sections discuss how Smart City scholarship can build upon these results in combination with insights from a social innovation perspective to conceptualize a path towards human-centricity. I further engage with the social innovation model and incorporate the relationship between SOI and LOC to develop a conceptual framework for a human-centric Smart City which addresses the sustainability objectives.

BUILDING THE SOCIAL INNOVATION AND SYSTEMS CHANGE FRAMEWORK

This section builds a conceptual framework for the development of a human-centric Smart City which achieves the sustainability objectives and offers a practical framework for effective policy implementation. I do so in four steps: firstly, I introduce the role of systems theory in the social innovation model to highlight the interdependencies within the social innovation and systems change framework; secondly, I inject social entrepreneurship within this framework to illustrate the importance of the individual stratum; thirdly, I expand on the four co-development archetypes by removing them from the living lab framework and identifying their SOIs and LOC; lastly, I introduce the conceptual model for the human-centric Smart City within this multi-tiered framework.

The results of the SLR reflect the value of collaboration within the Smart City discussion, which can be seen from the number of papers that emerged in the ‘inter’ category. However, 87% of the frameworks reflect an organizationally oriented LOC. This echoes literature which highlight the paternalistic nature of many co-development approaches (e.g. Cowley et al., 2018; Cardullo & Kitchin, 2019) and demonstrates a dominant institutional framework which engenders these top down approaches.

Social innovation calls attention to the importance of agency (e.g. Moulaert et al., 2013; Moulaert & MacCallum, 2019; Nicholls et al., 2015) and therefore understanding the role of

individuals within a city system is vital. The social entrepreneurship process[3] illustrates how agents of social change at the individual level initiate a dynamic process of interaction within the system. The system is elaborated as a consequence of said interaction, which involves a dynamic interrelation between SOI and LOC with significant implications for actors within an urban context. The 4 archetypes of collaborative innovation from the previous section will be contextualized within the social entrepreneurship process, and adapted to incorporate the interrelations between SOI and LOC. The social entrepreneurship process illustrates the influence of the individual level on impacting system level change and demonstrates how policy could be practically targeted towards agents to promote social innovation within the Smart City.

In doing so, strategic organizational behavior is decoupled from collaborative innovation which may emerge in a given archetype. This lays the groundwork of a new conceptual framework for analyzing how innovation can be sourced from multiple strata and permeate through the system. Thus, it examines the interactions between the micro, meso, and macro, rather than overemphasis on one particular level. Within this new framework, social entrepreneurs are introduced as key sources for systems change in the urban context as stewards of social innovation and agents of social change.

The Social Innovation Model and Systems Theory

The social innovation model builds on systems theory (c.f. Buckley, 1967; Westley & Antadze, 2010; Mulgan, 2012*)*, and the Smart City is recognized as a dynamic system which is defined by the difference between itself and its environment, with communication[4] as its basic process of differentiation (Luhmann et al, 2013). Indeed, human actors make up the systems' environment; systems change is therefore interwoven with altering constellations of power within the system (Lewin, 1948). With social change as its objective, social innovation enables individual-level experience and placed-base realities to be learned by the system (e.g.

[3] For a detailed discussion of how social innovation can emerge from non social entrepreneurship actors see Plowman et al., 2007 and Le Ber & Branzei, 2010.
[4] Commuication defined by Luhmann as the unity of utterance, information, and understanding (see Luhmann et al, 2013).

Moulaert & MacCallum, 2019). This alters power structures by identifying deeper-level changes necessary for human-centricity. As Wiig's (2016) example of IBM's involvement in Philadelphia highlighted, system-level change cannot be attained without structural change. Designed to solve unemployment, IBM created an app which was unsuccessful as it did not adequately alter the structure of the job market (this is explored further in the discussion section of this paper).

The social innovation model follows a Schumpeterian logic of innovation in that it recognizes the capriciousness of the system, due to the cyclical nature of the innovative process (Schumpeter, 1942) and emergence of further innovation as a result. This volatility is, in part, due to the fact that agents of change emerge from all corners of society (Schumpeter, 1939). Indeed, innovation exists on a learning curve which involves repeated contextualization of an idea, where learning becomes increasingly tacit until the innovation manifests as 'complete' (c.f. Mulgan, 2006). Innovation is therefore a function of tacit knowledge and perceived differently across contexts. Social innovation is a similarly dynamic process which requires collaboration between actors from each of the three strata (e.g. Mulgan, 2007) to operationalize empirical realities of those involved, through multiple feedback loops. General systems theory holds that feedback loops highlight the dynamics of social system structure due to the duality of structures and individual action (e.g. Archer, 2010; Raworth, 2017).

Social Entrepreneurship: Reflexivity in the City System

Gregory Dees' seminal (1998) work identified the pursuit of social improvement over profit as a distinguishing characteristic of social entrepreneurship. Nicholls (2006, p. 43) defines social entrepreneurship as "innovative and effective activities that focus strategically on resolving social market failures and creating new opportunities to *add social value systematically* by using a range of resources and organizational formats to maximize social impact and bring about *change*" (*emphasis added*). Social entrepreneurship always begins as a response to perceived deficiencies in the social dimension of society's institutional framework (e.g Beckmann, 2009; Kummitha & Crutzen, 2019). Consequently, the defining aspect of social entrepreneurship is engaging with social innovation in pursuit of positive social change.

Social entrepreneurship involves innovative methods of articulation to translate social problems into business problems through economically viable win-win semantics, which serve to systematically recalibrate mental models, encourage collective action (see Beckmann, 2011) and address underlying causes of these issues rather than the symptoms (e.g. Dees, 1998). These methods often manifest in the formation of social organizations (e.g Yunus et al, 2010). Three paths can determine the motivation of a social organization: the normative, pragmatic, and formally descriptive approaches (see Beckmann et al., 2014). These approaches underpin the venture's function. Examining the motivation of a social organization illuminates place-based failures within the system. Furthermore, the methods of translation highlights the system's responsive to varying aspects of social value.

Social organizations often adopt hybrid identities to manage tensions between financial and non-financial goals, and balance social value creation with self-sustaining ventures (Austin et al., 2012; Nicholls, 2006; Zeyen et al, 2014). Indeed, the type of hybridity (see Beckmann et al., 2014 for a detailed discussion of mission, organizational, and innovation hybridity) adopted by a social organization is a function of the system's values (c.f. North, 1990; Battilana & Dorado, 2010). That is, the system's response to certain elements of an organization reflects the value the system places on the sustainability objective(s) addressed by that organization, and the method it adopts. For example, those who need the goods or services of a social organization often cannot pay full price for them (Nicholls, 2010); thus, the system's response can be seen through the type of support it does, or does not, provide. Indeed, the extent to which a system empowers social organizations to deliver such goods or services is a function of the system's responsiveness to the place based failure the organization addresses.

Social entrepreneurial activity represents the individual-stratum's ability to enable the system to see itself. This is the first step in changing and understanding the system (c.f. Lewin, 1948). Within the social innovation model, a process is initiated at the individual-level stratum which 'ends' with systems-level change, in a way that allows future agents of social change to more seamlessly work towards such change. Figure 1 illustrates this process.

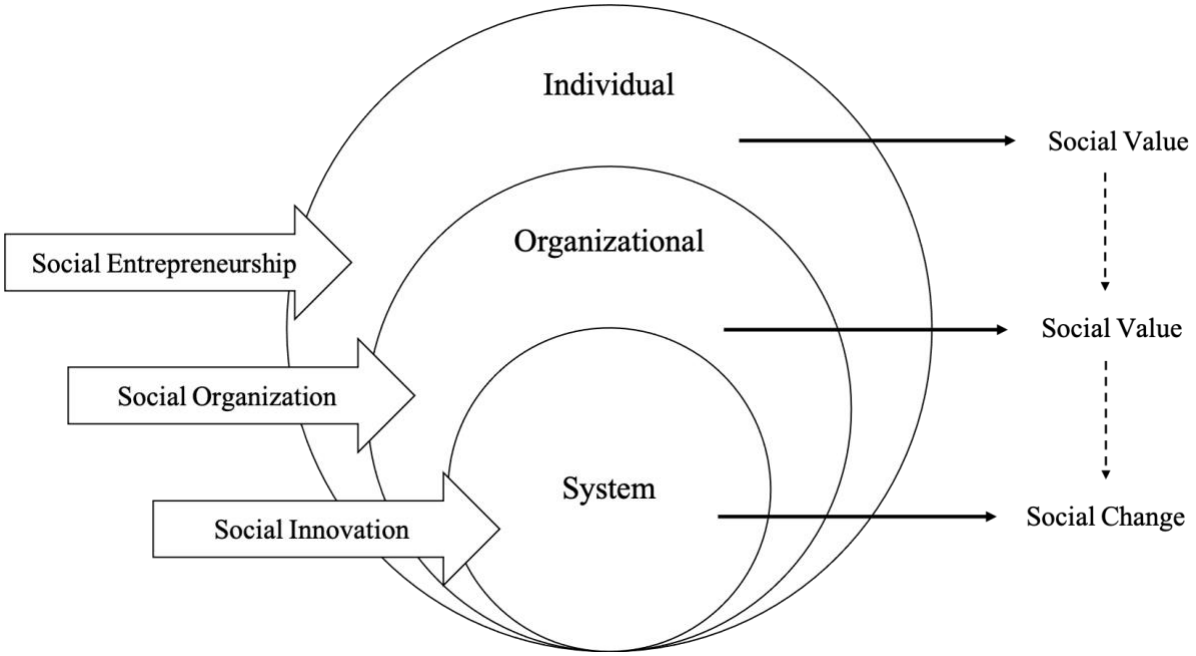

Figure 1 Overview of the Social Innovation model, the strata under inspection, and the initiators of social innovation at each strata

Below, I discuss the archetypes of innovation that emerged from the analysis, the assumptions which underpin their emergence, and how reconceptualizing them enables the city system to learn from place-based deficiencies and move toward human centricity.

Re-thinking the Co-development Archetypes

The 4 archetypes identified in the analysis are adopted from an organizationally dominated to the multi strata Sources of Innovation (SOI) and Locus of Chance (LOC) that emerged from the SLR. Open innovation initiatives such as living labs and hackathons are often strategic behaviors from the organizational stratum, aimed at providing platforms in pursuit of democratized innovation (e.g. Perng, Kitchin, & Mac Donncha, 2018). Adopting the city as a platform (see Bollier, 2016; Kim et al., 2021) allows the archetypes to be reinjected into the discussion and the Smart City to be conceptualized as one which shifts the focus from allowing inhabitants to play a greater role in building the city, to empowering inhabitants to live sustainably with their environment and increase the systems' capability to learn. Allowing citizens to play a greater role maintains a static LOC within the organizational stratum, while empowering citizens to increase the system's capability to learn extends the LOC to all strata. The Smart City as an open platform contextualizes the LOC in the city within a bottom-up-

middle-out hybrid approach. This approach places the onus for development on the individual-level ability to teach through action and the system-level capability to learn. Indeed, within this approach, agents of social change can enhance a system's ability to learn and actors' ability to teach through multi-level engagement with social innovation.

Re-thinking the archetypes as pathways positions the archetypes as tendencies[5] of the interactions between SOI and LOC rather than the result of strategic organizational behavior. As a result, the role of directed policy implementation in influencing these interactions becomes clearer. Below, I conceptualize how these pathways can manifest within a multi-tiered model and encourage development of the human centric Smart City.

The Emerging Pathways

Traditionally, open innovation is the result of efforts from organizational level actors to promote co-development (e.g. Leminen, 2013; Tukiainen, Leminen, & Westerlund, 2015; Leminen et al., 2017). The *city as a community learner* pathway, which emerges from the *city as neighborhood participator* archetype, sees the city adopted by local residents to promote their needs, with the city acting as gatekeeper and enabling local initiatives (e.g. through easing the permit allocation process). Local initiatives are often in response to a market failure to provide a good or service (c.f. Dees, 2008) and thus agents of social change may emerge at this level by facilitating first-instance interaction between the individual and organizational strata. The SOI and LOC in this pathway sit in society's individual stratum, with the organizational-level participating as a relatively passive enabler, and the system-level experiencing the learning curve of innovation.

The *city as an investor* pathway, emerging *from city as rapid investor* archetype, sees the city as an active participant with social organizations in their early stages by helping to identify best practices for service/product development, thereby promoting value and sustainability. Agents of social change who are scaling their venture may be found in this pathway; it is crucial in this pathway to promote organizational level social value. The city can

[5] Tendencies is used here following the Critical Realist's interpretation of observable phenomena as 'tendencies' rather than causation (see Bhaskar, 2008).

encourage such social value through initiation of events such as hackathons to identify and connect social organizations with the potential to address the sustainability objectives. Indeed, this pathway enables the city to promote trust between strata. For example, PB Scotland enables community involvement regarding the use and investment of public funds (SCDC, 2019). This sources innovation from the individual stratum and enhances community capacity to articulate and address place-based social market failures. The SOI in this pathway is located at the individual stratum, however, the organizational interaction between social organizations and local government allows innovation to diffuse further through the system. Thus, the LOC is located in the organizational stratum. Through trial and error, the system learns to recognize and support social value.

The *city as a neo-liberal seeker* pathway, emerging from *city as a catalyst archetype*, encourages businesses and research institutes to test their services and product development in the field with social organizations. Agents of social change seeking agglomeration effects would be found in this pathway. The SOI within this pathway is located in the organizational stratum through cross-sector fertilization, and novel products and services that arise from these interactions. The LOC within this pathway is located in the organizational stratum through the implementation of products and services promoting the social value which manifested in the previous pathways. This pathway signifies the culmination of social value towards social change and represents the beginning of systems change (e.g. shareholder value replaced with stakeholder value).

Similarly, the *city as organizational learner* pathway, emerging from *city as provider archetype*, encourages the city's actors to adopt best practices from social organizations, businesses, and research institutions, which emerge in the other pathways. This increases the city's capability to operate with newfound internal logics that it would otherwise not have (Pierce et al., 2017). Indeed, the SOI within this pathway is located in the system stratum. This pathway represents a metaphysical shift and promotes a system wide alteration in the perceptions which underpin structure and behavior (Lewin, 1948; Buckley, 1967). The LOC sits at the interaction between the organizational and individual strata. Indeed, system-level

change is perpetuated as the organizational and individual strata implement learned behavior from the altered perceptions of the system, which themselves emerged as a result of behavior in the system's environment.

This cycle, which I henceforth refer to as the *Social Innovation cycle* (depicted in figure 3) contextualizes the emerging pathways as actualization of social innovation at each stratum. It illustrates how the city system absorbs, acts on, and learns from feedback of its parts. Within this cycle, micro-level actors initiate a process of change which simultaneously shapes and is shaped by the system within which they exist. Below, I illustrate how the system is affected by the social innovation process and introduce *the Social Innovation cycle (SI Cycle)*.

Constructing the Social Innovation Cycle

The SI Cycle illustrates underlying interaction within the city system by identifying interdependencies between SOI and LOC within each pathway, the interdependencies of these pathways, and how system awareness is iteratively advanced in each pathway. System awareness is a fundamental aspect of creating social change. Indeed, social change requires deep-rooted institutional change, which emerges from addressing social market failures (Hietschould et al, 2019) and enabling the system to recognize the cause of these failures. If the system does not learn from the placed-based deficiencies that initiate the social innovation process and actively repair these deficiencies, then many initiatives will continue to operate within structures that themselves can be the cause of the market failures they seek to address (Mulgan, 2012; Westley and Antadze, 2010). Thus, completion of a cycle necessitates a shift in the cognitive barriers that inhibit actionable feedback from the individual stratum.

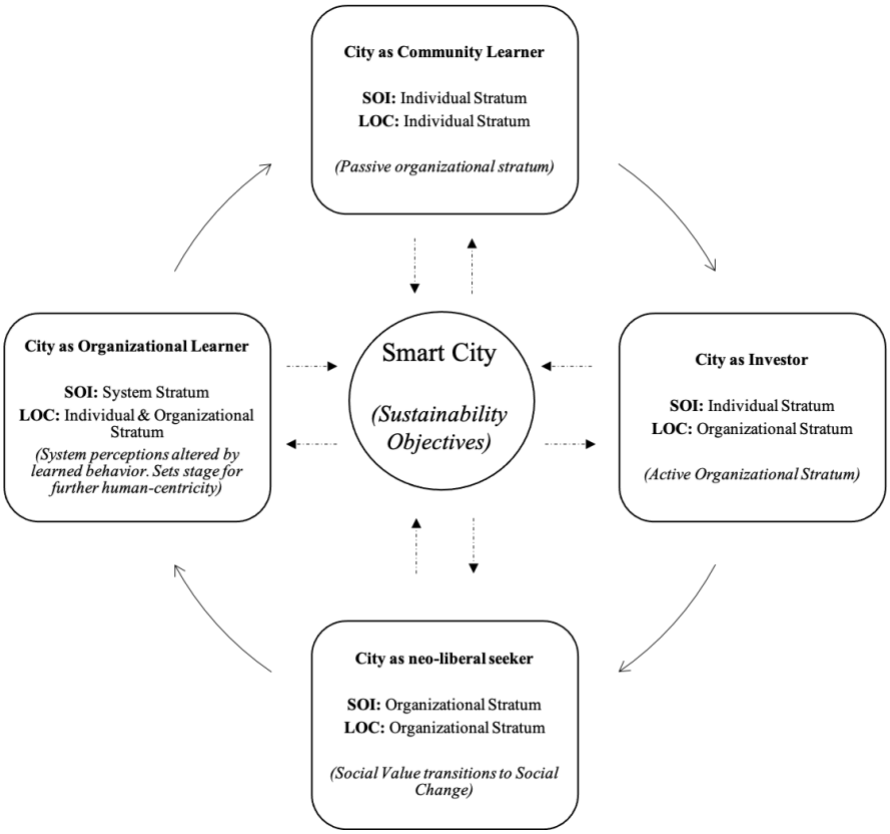

Figure 2 Social Innovation Cycle

The distinguishing aspects of this cyclical model are its initiation at the individual stratum in response to perceptions of placed-based deficiencies, and its advocacy for incremental system reflexivity in an iterative process of system awareness. Within this framework, micro-level actors and social organizations shape the consciousness of the city system by identifying the extent to which the system reflects holistically sourced value. Indeed, this conceptual model introduces a fluid *ad hoc* human centered approach to the sustainability objectives by adapting value sourced from placed-based realities within the individual stratum to the entire system. Two immediate implications for research emerge from this *ad hoc* approach: i) historically embedded structures and social processes preceding Smart City initiatives inhibits (or enables) inclusive Smart City development to the extent that it restricts (or promotes) micro level agents of social change; ii) *ad hoc* cannot be conflated with *ad libitum*. That is, policy intervention must echo placed-based realities from the individual stratum rather than perceptions of these realities from urban elites.

Policy Implications Takeaways

There is extensive literature acknowledging the strong interconnection between technological and social innovation for the implementation of human-centric policy (e.g. Calzada, 2021b; Kim et al., 2021; Sabri, 2021; Kummitha & Crutzen, 2019; Kummitha, 2020). Although city governments may typically engage in policy implementation purported to promote organizational level behavior for the benefit of the individual stratum, it is imperative to source innovation and change from the individual stratum. This ameliorates place-based dissonance that restricts the potential of individual level benefits. The social innovation and systems change framework identifies how supporting micro-level initiatives can instigate a dynamic process towards multi-strata development. The SI cycle identifies leverage points of the system, where innovation and change interact, whereby small policy interventions can have enormous impact on subsequent pathways and human-centricity (Meadows, 1999). In so doing, the social innovation and systems change framework advocates for practitioners to adopt a final cause[6] perspective (see Sarasvathy, 2001), which enables policymakers to develop an ordered set of multi-strata sourced values and how best to attain these values for a holistic benefit.

Consequently, policymakers can ensure place-based realities are not overlooked but fed back into the system. Policy should be directed at promoting articulatory capabilities within underserved communities to effectively identify and translate deficiencies across demographics and between strata. Such policy can manifest in mechanisms such as participatory budgeting, telecenters, or local government positions to break down silos, promote stakeholder engagement, and navigate complex political landscapes. This allows for policymaking rhetoric that is cohesive with stratum specific deficiencies and context specific social processes, clearly articulates the pathways they aim to address and the actions that are implicit in enforcing these policies.

[6] Final Cause posits that an innovation's causative mechanism is those who own and use it, and how it is used will determine the *de facto* identity of the innovation.

Returning to Wiig's (2016) case study of IBM's involvement in Philadelphia, as an example, we see how such holistic involvement can shape strategic policy intervention. In principle, the initiation of the *Digital On-Ramps* program emerged in response to place-based deficiencies. In practice, it emerged in response to an organizationally oriented desire to attract exogenous enterprises. As a consequence of this exogenous focus, the policy discussion surrounding *Digital On-Ramps* was directed at hypothetical technological solutions rather than the dynamics of individual-level realities. Subsequently, a reductionist view of the complexities of Philadelphia's issues promoted adoption of an insufficiently straightforward solution — technological adoption. The result was an inability to deliver on the promises of the program, a consolidation of the benefits in select members of the organizational stratum, and the reality that 'expert policy knowledge' is insufficient to address place-based realities (see Wiig, 2016, p. 547). Addressing such inefficiencies requires movement away from the reductionism that often accompanies techno-centricity (e.g. Calzada & Cobo, 2015; Calzada, 2021a) towards multi-stakeholder Smart City policy which move beyond technocratic public-private partnerships (see Calzada, 2021b pp.94-96).

Without a holistic understanding and articulation of system wide problems, Smart City policies will fail to achieve the human-centric solutions necessary to meet the sustainability objectives. The social innovation and systems change framework highlights the need to adopt policy that aligns with values sourced from each strata.

CONCLUDING REMARKS

This paper set out to examine the dominant strata of focus within the Smart City literature and the extent to which a social innovation perspective can re-direct this focus. The results of the SLR demonstrate the prevalence at which SOI and LOC currently manifest at the organizational level. This suggests that the dominating institutional frameworks engender a focus on development oriented towards the organizational stratum. The complexity of the urban context necessitates stronger involvement of the system and individual strata.

As I have shown, a social innovation perspective has the potential to reel the system and individual strata into the heart of the Smart City discussion by highlighting the interdependencies of SOI and LOC. The social innovation and systems change framework serves to illustrate social change as a complex cyclical phenomenon involving dynamic interaction at each level of society. This conceptual model highlights that the individual level stratum can be operationalized to initiate an innovative process with the potential to change the system.

This paper contributes to the discussion through its implementation of a multi-level framework which identifies the nuanced interdependencies of sources of innovation and loci of change, and how they interact within and between strata. The emphasis on individual-level deficiency perception and articulatory capabilities accounts for context specificity and is thus suitable for adoption in multiple settings. This paper contributes to Smart City methodology by looking at how the Smart City is conceived, holistically, rather than how it is undertaken in particular cases. As such, it calls for the need to step away from a Newtonian cause and effect perspective and engagement with a complexity perspective for examining the Smart City phenomenon.

Future Research

This research is limited in that it emerges from analysis within the context of the global north. To further refine and verify this framework, future research could apply it to Smart City interventions in a developing context. For example, future analysis can adopt a Penta Helix knowledge production model (see Calzada 2021b) to examine the extent to which innovation is systematically prevalent in these contexts and examine the impact of varying deficiencies within the institutional framework on the 4 pathways. Indeed, the Penta Helix Model allows further research to examine the role of multilevel stakeholder involvement on the emergence of agents of social change in a given institutional context. This could be achieved through comparative ethnography with actors in multiple sectors that align with the sustainability objectives to empirically examine how they engage with the built environment in cities which already adopt or are moving towards the ‘smart’ label. Such research would enable empirical

analysis of the extent to which policymakers can influence the institutional framework in pursuit of inclusive Smart Cities. Building on the findings of this paper will demonstrate a greater role for people in determining a city's values.

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