

# Career challenges in smart cities: A sociotechnical systems view on sustainable careers

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## Abstract

Smart cities are a modern reality in an increasingly digitized and fast changing world; and, as multidimensional, multilayered and interconnected career ecosystems they bring a number of challenges for the development of sustainable careers. What are the systemic roots of these challenges, and how can we deal with them to support the emergence of sustainable careers? We draw on a sociotechnical approach, supplemented by a dynamic person–environment fit perspective, to describe two systemic challenges tied to the development of sustainable careers in smart cities, namely: (1) an unbalanced fit, in that the highly digitized context fits best with highly educated and information and communications technology (ICT) literate citizens working in knowledge intensive organizations; and (2) a volatility of fit, associated with the complex and fast-changing smart urban context. Based on the sociotechnical analysis, we put forth three suggestions for addressing these challenges and creating a sustainable career ecosystem focused on: (1) the continuous development of ICT literacy, knowledge, talents and skills; (2) citizen participation and career communities; and (3) network-centric organizing of

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sustainable careers that could alleviate some of the challenges associated with the parallel development of sustainable careers and smart cities.

### **Keywords**

career communities, networks, person–environment fit, smart cities, sociotechnical design, sustainable careers

## **Introduction**

In the aftermath of the Second World War, the recovering British economy heavily relied on coal to support industrial growth. In an attempt to boost production, mines were infused with new technologies that often failed to deliver on the promises of extracting abundant and cheaper coal (Trist, 1981). Pioneers of sociotechnical design (Eric Trist, Ken Bamforth) showed that it was the lack of synergy between the new technologies and related labor organization that explained the failed implementation of new mining technologies (Mumford, 2006; Pasmore, 1995). Mines, in which work was divided across three highly specialized yet interdependent shifts and where different occupational groups had to perform tasks for which they could not exercise full control, often failed to increase production. In contrast, mines in which work was organized around self-managed groups performed better (Trist, 1981). If organizations such as mining companies could so easily overlook the complex systemic interdependencies between technology, people and tasks, imagine the complexity created by co-existing, interdependent occupational groups in a modern city infused with technology.

In order to achieve synergy between the task, social and technical systemic components, the sociotechnical design promoted a participative labor organization, based on humane and democratic values, focused on the system as a whole to benefit the organization as well as the individual careers of its employees (Emery, 1982; Pasmore, 1995; Trist, 1981). Much in line with the original focus of sociotechnical thinking, modern career models focus on health, happiness and productivity as key indicators of career sustainability (Van der Heijden, 2005; Van der Heijden et al., 2020). Like the coal miners described in the early sociotechnical studies, citizens nowadays often perform their work and live their lives surrounded by technological innovations; they strive for meaningful work experiences and agency in shaping their careers. We build on the ideas of sociotechnical design to explore the complex interdependence between technology-driven developments in modern cities and people's related career development.

Smart cities strive to enable urban social and economic development and increase economic and governance efficiency through: (1) the intensive use of new technologies in networked infrastructures; (2) a strong entrepreneurial and business focus; and (3) a strong concern for social and environmental sustainability (Hollands, 2008). The interconnected technological infrastructure in smart cities generates urban resilience and helps cities cope with natural disasters and other emergencies like pandemics (DesRoches and Taylor, 2018; Inn, 2020). Therefore, the concept of smart city reflects a global tendency to infuse technology in urban environments in order to solve important urban

challenges (Norman, 2018). Although these urban challenges may vary in smart cities across the world, they tend to cluster in the same categories – urban safety and quality of life, infrastructure and economy, society and governance, new resources and energy, mobility and the environment (Carvalho, 2015; Joss et al., 2019).

In order to achieve sustainable development, to cope with the persistent nature of these urban challenges, and given the fast pace of technological developments, cities across the world tend to embrace technology as a universal panacea. Yet, the complex interdependencies between the technical and social dimensions are often overlooked (Martin et al., 2018). In line with sociotechnical design, the social and technical systems need to be jointly optimized (Emery, 1982) as their relationship is constrained by different systemic dynamics. In turn, “the distinctive characteristics of each must be respected, else their *contradictions* will intrude and their *complementarities* will remain unrealized” (Trist, 1981: 37). In sociotechnical terms, synergy describes a systemic state in which the complementarities between the social and the technical systems foster economic growth in cities and the well-being of its citizens (Meijer and Bolívar, 2016; Pasmore et al., 2019).

In systemic terms, smart cities are complex systems that acquire, store and process information aiming to generate economic wealth, as well as well-being for their citizens (Martin et al., 2018; Silva et al., 2018). Given their focus on information processing, knowledge and the effective processing of knowledge are crucial for the sustainability of these complex systems (Shelton and Lodato, 2019). Because “careers are constructed at the boundary between the individual and the social world in which the individual participates” (Barley et al., 2017: 115), smart cities are digitized and knowledge-centered career ecosystems (Baruch, 2015; Kennedy and Chan, 2020) that provide a good fit especially for information and communications technology (ICT) literate individuals working in knowledge-intensive organizations. However, other occupational groups, including less educated workers, may experience a lack of fit with these smart urban environments. Moreover, a lack of fit in the near-term may endanger further economic growth, as well as prospects for social equity and a healthy urban environment (Martin et al., 2018).

As a result, an important further challenge for smart cities is to become sustainable career ecosystems. So far, no integrative framework has been put forward to systematically explore the challenges to career sustainability in smart cities. It is our aim to use sociotechnical thinking (Cherns, 1976, 1987; Trist, 1981), complemented by insights from a dynamic person–environment fit perspective (Muchinsky and Monahan, 1987) to explore potential challenges likely to affect sustainable career development in smart cities. Based on this sociotechnical analysis we suggest three potential solutions that can help smart cities to achieve their sustainable development aims and help citizens to build sustainable careers.

## Striving for sustainable development in smart cities

What drives cities to become smart(er)? Contemporary literature asserts that the most important external factor in urban digital transformation is the rapid technological progress witnessed during the last decades (Harrison et al., 2010). In contrast, the most important internal drivers for cities to become or remain smart are: (1) demographic

changes and challenges (increased urbanization); (2) urban environmental challenges (mainly pollution and waste management); and (3) scarce natural resources (including water and land) (Hollands, 2008; Ramaswami et al., 2016). Examples of smart cities can be found in indices such as the Cities in Motion Index (Berrone and Ricart, 2019), which ranks cities on dimensions related to technology, sustainability, governance and other factors. Examples include Shanghai, Beijing and London (high on mobility and transportation), Singapore, Hong Kong and San Francisco (technology), and Toronto, New York and Vancouver (urban planning). More recent urban development initiatives like Fujisawa Sustainable Smart Town introduce the idea of smart city through design, a concept that encapsulates all technological promises attached to smart cities from the lifestyle and well-being of its citizens, to sustainable energy sources, environmental protection and economic prosperity. Sociotechnical synergy belongs at the core of designing smart cities as it is illustrated by other experimental projects such as the Songdo district (South Korea) and the PlanIT Valley (Portugal) (Carvalho, 2015; Meijer and Bolivar, 2016).

Harrison and colleagues (2010), in their triple “I” framework, provide one of the most compelling and concise overviews of the systemic characteristics of smart cities. Cities are first of all *instrumented*; that is, they use near real-time collection of real-world data through various meters, sensors and cameras that collect data on the physical environment and software in ICT systems that extract meta-data in the virtual environment. Next, smart cities are *interconnected*, in that the agents and urban subsystems are connected in functional webs that allow the efficient transfer and distribution of resources (including data) and services. Furthermore, smart cities are *intelligent* systems, characterized by the extensive use of powerful information processing tools, complex analytics and modeling, optimization methods and algorithms as well as visualization techniques to make sense of the data. Smart cities are therefore information processing systems with entwined technological and social components.

Artificial intelligence-based systems like BlueDot (Toronto) predicted the global spread of the COVID-19 pandemic by processing in real time a massive amount of information scraped from sources like media, airline flight data and ticketing as well as healthcare organizations (Inn, 2020). In an attempt to control the pandemic, some smart cities like Seoul and Singapore used their interconnected technological infrastructure to gather and process data in real time to generate maps of the virus spread and disseminate to the public information related to pandemic management. Also, smart technologies allowed citizens to shop online during the pandemic, thereby reducing their exposure to the virus and its wider spread. Such initiatives reflect the preparedness of smart cities to cope with emergencies in an attempt to protect the health and well-being of their citizens.

In economic terms, the platform economy (online structures and systems that enable a variety of economic activities) makes entrepreneurial opportunities widely available to the smart city citizen (Knee, 2018). Smart services (retail, healthcare, education or business services) are dominant now in the context of smart cities and offer ample entrepreneurial opportunities for citizens (Anttiroiko et al., 2014). Such smart services successfully integrate the functioning of state-of-the-art information processing tools (including artificial intelligence) and social subsystems (people, groups, organizations, networks). Entrepreneurship is essential for any functional economy and in the context

of smart cities, increasingly accessible entrepreneurial opportunities shift the career focus from production towards smart services (Anttiroiko et al., 2014; Martin et al., 2018).

Urban digitization has also been criticized for a variety of reasons (Krivý, 2018; Shelton and Lodato, 2019), especially those linked to unfair competition and user data commercialization introduced by the platform economy. In some cases, ICT-driven companies fill a market niche with services (Uber, Airbnb, etc.) and derive substantial network benefits that may exclude competitors and lead to monopoly positions that could eventually work to the detriment of the end-consumer (Knee, 2018; Morozov and Bria, 2018). This consumer market power also extends to labor markets, with such companies able to exert control over careers by emphasizing flexibility and contingent employment relationships (Barley et al., 2017). These challenges to the independence of smart cities and individual careers within them invite a sharper focus on career ecosystems, and on the multi-dimensional nature of career development within them.

### **Striving for sustainable careers in smart cities**

The idea that careers change along with the changes in the environment is certainly not new (Arthur, 1994) and career theorizing has moved beyond “organizational careers” to consider job sequences that transcend organizational boundaries (Arthur, 2014) and to include non-work-related experiences as well (Parker et al., 2004; Sullivan and Baruch, 2009). Various career theories and concepts explaining how careers change in the modern globalized and digital world have been put forward, such as the protean career (Hall, 1976, 2004), boundaryless career (Arthur, 1994, 2014), multidirectional career (Baruch, 2004) or kaleidoscope career (Mainiero and Sullivan, 2005), to name just a few.

The protean career concept emphasizes agency, identity and adaptability, arguing that career development is a self-directed process and depends on internal values and interests (Hall, 2004; Sullivan and Baruch, 2009). Given the dynamic nature of smart cities, the protean career framework becomes especially relevant as workers need to continuously adapt by acquiring new, transferable skills and knowledge. However, career development agency in smart cities may be constrained by digital illiteracy, unequal access to technology, as well as by the lack of awareness about various entrepreneurial opportunities and lack of supportive facilities.

The boundaryless career emphasizes the volatile physical (time and space, job mobility) and psychological (identity, roles, socialization) boundaries that shape career development (Arthur, 2014). Boundaryless careers may naturally emerge in smart cities as interconnected ecosystems (Harrison et al., 2010). Interorganizational and inter-sectoral workforce mobility in smart cities raises important challenges for (boundaryless) career options that are skewed towards knowledge-intensive rather than low-skilled jobs and entrepreneurial opportunities in services rather than production. In their Entrepreneurship–Professionalism–Leadership (EPL) model of career development, Kennedy and Chan (2020) extend the boundaryless career model to explicitly consider career development across the EPL dimensions in cities as career spaces. Central to the EPL model, entrepreneurial careers focused on value and capacity creation (Kennedy and Chan, 2020) are

most certainly aligned with the entrepreneurial nature of smart cities (Florida and Mellander, 2016).

In his framework of multidirectional careers, Baruch (2004) argues for a shift in career theorizing from careers seen as secure employment trajectories (usually unfolding in a single organization) to careers as multidimensional developmental paths through life. Emerging at the interface between the individual and the social environment in which they navigate, multidirectional careers are certainly fostered in the dynamic and complex context of smart cities. In other words, multidimensional careers develop in multidimensional careers spaces defined by the different levels of social organization from group and organizational to city and national levels (Kennedy and Chan, 2020). For example, through the platform economy the smart city offers ample opportunities for career development and various employment options for high-skilled as well as low-skilled workers. The kaleidoscope career framework defines three parameters that shape career decisions, namely the pursuit of authenticity, the balance of the work–non-work domains and the pursuit of work challenge (expectation that work is engaging and meaningful) (Mainiero and Sullivan, 2005). The informed (intelligent) career choices are at the core of intelligent careers that ultimately reflect a self-directed information search process, aimed at identifying opportunities for career development that span various life domains (Arthur et al., 1995). Finally, the responsible careers model builds on the protean and boundaryless career models to include job choices with a direct impact on societal and environmental challenges (Tams and Marshall, 2011). Such responsible careers focused on engaged citizenship and social change could fit well in the context of smart cities and tackle some of the challenges to their sustainable development.

We build on these career models and posit that career development should be understood in a larger context (career ecosystem; Baruch, 2015), not circumscribed by organizational boundaries, and should be based on a systemic analysis of the larger urban context in which people spend their working lives. As career ecosystems (Baruch, 2015), smart cities are *multidimensional* (reflect the complex interplay of technological, social, environmental and economic dimensions), *multilayered* (involve individual citizens, organizations, communities) and *interconnected* systems. In smart cities, the strong focus on entrepreneurship (Florida and Mellander, 2016), fast technological advancements (Harrison et al., 2010) and the involvement of multiple stakeholders in career development (Baruch, 2015) create a career ecosystem for citizens that is both complex and dynamic (Kennedy and Chan, 2020). In such complex career ecosystems, career theories and concepts – implicitly or explicitly – focus on three core elements: (1) in a constantly changing ecosystem individuals have to become and remain employable (employability); (2) given the turbulent modern times individuals have to be resilient throughout their careers and be able to swiftly recover from setbacks (flexibility and adaptation); and (3) they have to make intelligent career choices in order to establish viable long-term career paths in a richly interconnected social context (connectivity). These key elements of career development in smart cities are also important features of sustainable careers.

Theorizing about sustainable careers (De Vos and Van der Heijden, 2015; De Vos et al., 2020; Newman, 2011) builds rather fluently on developments in both the literature on contemporary careers and the sustainability debate, which concerns not only the

preservation of our planet and economy, but also the health and well-being of people (Parkin Hughes et al., 2017). Sustainable careers are defined as “sequences of career experiences reflected through a variety of patterns of continuity over time, thereby crossing several social spaces, characterized by individual agency, herewith providing meaning to the individual” (Van der Heijden and De Vos, 2015: 7). Sustainable careers serve as the means towards individual health, happiness and productivity (De Vos et al., 2020) and towards more systemic outcomes in the economic, social and environmental domains (Parkin Hughes et al., 2017).

Although it focuses on individuals as central career actors, the sustainable careers model takes into account a variety of contextual influences that shape career dynamics (De Vos et al., 2020). Taking the smart city as a context in which sustainable careers (may) develop and in line with De Vos et al. (2020) and Newman (2011) we propose that sustainable careers are (1) *mutually beneficial* for the person and the smart city and (2) should be addressed in a *systemic and developmental, long-term perspective*. In order to jointly achieve this sustainability synergy, smart cities as career ecosystems should facilitate long-term employability, nurture flexibility and adaptability in terms of career choices as well as foster intelligent career choices by keeping citizens connected with all the stakeholders involved in career development.

Career dynamics in smart cities, especially when considering their synergetic sustainability, require a systemic approach, in which the dynamic fit or match between person and environment is a central element. In line with the conservation of resources theory (Hobfoll, 2001) as applied to the career development context (Spurk et al., 2019), the most important resource in smart cities is knowledge. In turn, long-term benefits for both citizens and the smart city can be achieved only to the extent to which this resource is available in ample supply. Striving to achieve long-term mutual benefits for the worker and the smart city therefore involves a continuous balancing act between workers’ skills, talents and needs (including their well-being) and the more general systemic needs of the smart city (at least in terms of human resources). In theoretical terms this balance can be conceptualized as a search for systemic fit. Sociotechnical design (Cherns, 1976, 1987; Trist, 1981) and dynamic person–environment fit theories (Edwards, 2008) could shed light on how these mutual benefits and sustainability synergy could be achieved. In the next section we present such a systemic analysis of smart cities and point towards two key challenges related to the dynamic fit between the smart city and the sustainability of the career paths of its citizens.

## **A sociotechnical analysis of sustainable careers in smart cities**

In the multi-level perspective of sociotechnical systems analysis, Trist (1981) calls for a multi-level approach to such a complex system and argues that sociotechnical integration or synergy should be studied at three levels: primary work systems or groups; whole organizations; and macro-social systems (including cities). Building on the concept that smart cities are career ecosystems (Baruch, 2015), we use a multi-level perspective on sociotechnical transitions (Geels, 2010) to scale up the sociotechnical systemic analysis from the group and organization level (Cummings, 1978; Curşeu,

2006) to the city level of analysis (Meijer and Bolívar, 2016; Pasmore et al., 2019). Such sociotechnical systems that acquire, store and process data for smart cities serve two primary systemic goals: economic wealth and citizen well-being (Martin et al., 2018; Silva et al., 2018). In line with Hollands' (2008) conceptualization, a smart city is essentially entrepreneurial and business oriented, while more recent conceptualizations portrayed modern cities as concentrations of venture capital (Florida and Mellander, 2016). The generation of (sustainable) economic wealth is therefore the first aim of the smart cities. A second important aim attributed to smart cities is that they should be a safe environment for citizens, and create the conditions for high quality of life through an efficient use of urban resources and services (Meijer and Bolívar, 2016; Silva et al., 2018).

One of the key tenets of sociotechnical design is sociotechnical synergy; that is, the successful integration of the social and technical systems in the context of the aims attributed to the system (Meijer and Bolívar, 2016; Mumford, 2006; Trist, 1981). With the above two main aims in mind, we will further explore the way in which the sociotechnical synergy could be achieved in such a complex career ecosystem. In line with the principles of sociotechnical design (Cherns, 1976, 1987), such an ecosystem should not be fully prescribed (minimal critical specification) and it cannot be fully specified (the incompleteness principle). Nevertheless, one should create conditions for effective knowledge exchange, learning and development for citizens, and redistribute power in order to stimulate citizen engagement and participation (the power and authority principle) (Cherns, 1976). Moreover, if systemic variances are expected, these variances should be controlled as close to their source as possible (Cherns, 1987). The variances are deviations from normal system functioning or instances in which the compatibility between the systemic aims and social and technical components are perturbed and these systemic discrepancies should be reduced (Cherns, 1976).

Given the reliance on advanced information processing and their focus on innovation, smart cities attract highly educated people, usually employed in the knowledge-driven high-tech sector and creative industries (Anttiroiko et al., 2014). Although highly educated people seem to be the trademark of smart cities, an essential element that needs to be addressed when exploring the sociotechnical synergy is the fact that parts of the urban population have rather low educational achievements, rather limited access to technology, low ICT literacy and they do not work in knowledge-intensive organizations (Ramaswami et al., 2016; Silva et al., 2018). The social segregation in smart cities is one of the most important challenges for career sustainability, especially because it is multifaceted, including economic inequality, spatial separation, as well as social and cultural segregation of urban communities (Hollands, 2008; Martin et al., 2018). In order to achieve its entrepreneurial, developmental (innovation) and social goals, the smart city needs to strive towards a higher degree of inclusion and integration of a wide range of social groups by fostering sustainable careers for all citizens. After all, smart cities can only become wise and sustainable if their citizens can fit in, thrive and have sustainable career paths in the digitized urban context (Ramaswami et al., 2016). Therefore, we complement our systemic analysis with a dynamic person–environment fit perspective to further explore the intricate relationship between career sustainability in the context of smart cities.



Person–environment fit theories are a subset of interactionist theories that explain human behavior and adaptation as a result of the dynamic interaction between personal attributes and environmental characteristics or constraints (Muchinsky and Monahan, 1987). Of particular importance for (sustainable) career dynamics are the situational congruence models stating that individuals achieve ideal performance, well-being and adaptation in environments that are congruent with their personalities, skills, knowledge, abilities and aspirations (Edwards, 2008). More recent studies extended the rather static view on person–environment fit by arguing that the notion of fit should be seen as multidimensional and dynamic, because individuals and their environments may change in time and they are interrelated in multifaceted ways (Vleugels et al., 2018). In particular, smart cities as complex career ecosystems need to provide enough work-related opportunities to their citizens, as well as to provide resources and opportunities for non-work-related activities (leisure, education facilities for children, family activities) that match the aspirations of their citizens. In our systemic analysis we consider that the person–smart city fit reflects a continuous search for a *dynamic* and *multidimensional* equilibrium between citizens and their urban environment. Such a dynamic and multidimensional equilibrium is a key antecedent of sociotechnical synergy and ultimately of joint career and smart city sustainability.

In terms of careers one could think of ICT literate individuals, who feel comfortable in the context of a smart city, adding to and further developing its features through the nature of their knowledge-intensive work. The fact that smart cities attract highly educated individuals (Martin et al., 2018) is an illustration of supplementary fit (Muchinsky and Monahan, 1987), because certain individual attributes (in this case high education level and high ICT literacy) fit the characteristics of other individuals living in such smart urban areas. Less ICT literate individuals may also perform important work for the city, such as plumbing, housekeeping, elderly care and support, thus reflecting complementary person–smart city fit (Muchinsky and Monahan, 1987). Their careers are as important for (smart) cities as the ones of people working in knowledge-intensive organizations, because they offer complementary skills and competencies that are key to sustaining the functioning of the smart city (demand–ability fit; Edwards, 2008).

Given the multidimensional nature of the person–smart city fit however, although people with low ICT literacy experience good fit in a demand–ability perspective, they may experience misfit with respect to the need–supply fit, as for example the smart city will be more geared towards fulfilling the needs of those with high ICT literacy. The plausible tension arising from the career paths tied to supplementary fit and complementary fit may generate social segregation that endangers career sustainability and consequently the sustainability of smart cities. The question therefore is: to what extent are jobs and careers that reveal complementary fit within the smart city context also comfortable (enough) for other workers and enable them to remain sustainably employable, flexible and connected in the smart city in the longer run?

### **Systemic variances: The unbalanced and volatile person–smart city fit**

In terms of career dynamics, the fit between highly educated individuals and smart cities is well established (Shelton and Lodato, 2019). In line with the person–environment fit

rationale, urban areas labeled as smart cities tend to attract especially highly educated individuals for two reasons (Glaeser and Resseger, 2010; Meijer and Bolívar, 2016). First, smart cities as career ecosystems tend to attract highly educated individuals because organizations operating in these urban contexts need higher qualified people who possess the knowledge and skills to sustain their functioning (i.e. demand–ability fit) (Martin et al., 2018). Second, they attract highly educated individuals (as high education tends to be a shared population attribute; i.e. supplementary fit) because smart cities offer services and a lifestyle that fulfills the needs of highly educated and digitally literate individuals (i.e. need–supply fit) (Shapiro, 2006; Silva et al., 2018). In contrast, the smart urban environment generates various incongruences for the lower educated and ICT illiterate urban population (Graham, 2002). With respect to career advancement opportunities, lower or more practically educated individuals tend to fit less well in smart cities given the lower job supply for this demographic category than for highly skilled labor (demand–ability misfit).

Empirical evidence shows that employment growth, work productivity, quality of life and percentage of college graduates in cities are factors that are strongly and positively entwined (Glaeser and Resseger, 2010; Shapiro, 2006). Therefore, the person–city incongruences for the lower educated and ICT illiterate individuals extend beyond the issue of a career misfit. The opportunities for recreation offered by the smart city (i.e. mostly commercial leisure spaces which exclude the poorer individuals through pricing and access policies) seem aimed to supply the recreational needs of the richer middle class alone (need–supply misfit) (Graham, 2002).

The search, sometimes almost quest, for supplementary fit might also be responsible for the social and spatial fragmentation documented in smart cities (Graham, 2002; Krivý, 2018; Lees, 2008; Martin et al., 2018) in that highly educated individuals tend to cluster and live in particular urban areas that tend to be prohibitive for people with low education. In the more general urban context that includes among others, migration and the challenges associated with it, this demographic and spatial separation in urban environments has important limitations for social harmony and individual well-being (Lees, 2008). Smart cities are by definition integrated and interconnected (Harrison et al., 2010). Given this high level of interdependence in urban spaces, such negative social dynamics (discrimination, marginalization, social ostracism) (Graham, 2002; Martin et al., 2018; Ramaswami et al., 2016; Silva et al., 2018) would in the end perturb the harmonious cohabitation among various urban communities and ultimately disrupt supplementary congruence. These trends (i.e. social segregation, discrimination) (Lees, 2008) are likely to continue and become even more prominent with the increasing reliance on technology, as digital literacy and access to technology might unequally foster the accumulation of individual wealth and other socially valued assets. For instance, compared to low-educated workers, highly qualified individuals enter the job market receiving higher financial rewards (i.e. better wages and fringe benefits) (Elman and O’Rand, 2004; Pasmore et al., 2019). In addition, highly skilled, digitally literate individuals occupy higher (more intrinsically motivating, challenging) functions which allow them to engage more easily in sustainable personal and professional development, often resulting in professional growth and wage increases (Boeren et al., 2010; Martin et al., 2018). The higher pay at the job-entry level and the broader margin of wage

increases for highly educated digitally literate individuals enables them to accumulate more wealth across the span of their careers (Elman and O’Rand, 2004). Adding to the considerable income inequality, generating wealth altogether might be more challenging for people with low digital literacy, because they might benefit less from online availability of cheaper goods and services (Shapiro, 2006). In sociotechnical terms, this segregation is one of the “variances” to be expected from the idealized “technology that benefits all” discourse often encountered in the literature on smart cities. This first systemic variance builds on the multifaceted nature of person–smart city fit and is summarized as: the negative consequences for career sustainability associated with the lack of fit between the smart city and its citizens are expected to *decrease* with citizens’ educational achievements and their ICT literacy. For people with low education, this lack of fit is therefore rather permanent in nature and their careers are under substantial pressure, especially referring to those careers’ qualitative meaning and value. We consider this variance the most important to be addressed as it has some critical consequences to the future sustainability of smart cities.

***Variance 1: Person–smart city fit is unbalanced; that is, it disadvantages the less ICT literate and lower educated individuals, and it favors the ICT literate, highly educated citizens that work in knowledge-intensive organizations***

Next to this important challenge, associated with the unbalanced person–smart city fit, we argue further that the fit between highly educated individuals and the smart city context involves some volatility as well. In order to adapt and thrive, social systems need to achieve a state of dynamic equilibrium in which their subsystems interact in a synergistic way under changing environmental conditions (Pasmore, 1995; Pasmore et al., 2019; Trist, 1981). Digital transformations will shape the careers of the future and most certainly a substantial number of jobs will disappear by being robotized, or becoming obsolete, while new ones will emerge (Stromquist, 2019). These transformations, if poorly managed, will tend to further increase the digital skills gap and economic inequality in smart cities. Such economic inequality will stagnate the personal and professional development of the disadvantaged individuals, increasing further the need–supply and demand–ability misfit. From a conservation of resources perspective (Hobfoll, 2001; Spurk et al., 2019), loss of resources among individuals with scarce resources, often triggers further (accumulated) loss of resources resulting in downwards “loss spirals”. Conversely, resource-rich individuals are more likely to use their resources in a way that will allow them to further accelerate the gain of resources (i.e. “gain spirals”; Hobfoll, 2001).

In addition, insights from experimental smart city projects (Carvalho, 2015) show that learning and development is often hampered by the divide between knowledge producers and knowledge users. The widening gap concerning access to resources (e.g. information, money) is however not the only challenge in smart cities. Fast-paced digitization may create a degree of volatility for highly educated and ICT literate citizens as well (Martin et al., 2018). In terms of services (need–supply fit), digitization has certainly delivered on its promises so far, and smart city citizens benefit from access to various

services and products in a business model in which (currently) access to communication networks is virtually costless. In a digital utopian perspective, the consumer in the smart city pays with his/her own data to get access to the communication environment, although this business model might not be sustainable in the long run (Morozov and Bria, 2018). Important questions arise concerning citizens' access to valued services and resources that in time might be mediated (in a worst-case scenario controlled) by ICT companies with monopoly positions in the labor market.

The second systemic variance refers therefore to the fast-changing socio-economic context in smart cities, where some researchers have argued that continuous economic growth acclaimed in smart cities is unsustainable (Martin et al., 2018; Pasmore et al., 2019). As long as strategic decisions made by large companies are primarily driven by economic interests (and not by the citizens' needs and well-being) the companies will often choose to relocate to countries where the economic climate is most favorable. The geographic mobility of these companies impacts the career dynamics of the urban population. In addition to the influence that highly flexible businesses might have on the career ecosystems in the city, global trends (e.g. digitalization and robotization) are reflected in continuously evolving career dynamics as well. That is to say, global trends and innovation-driven changes give rise to emerging new job types and work relations, and as a result old occupations and outdated ways of working can change drastically, or completely vanish. In light of these global trends (i.e. highly mobile businesses and increasing location-independent labor), organizations have far better opportunities to search for and recruit talents across the planet (Arthur, 2014). A global (geographically boundaryless) job market that allows a world-wide supply of talents implies a high degree of competition among the highly skilled and highly educated individuals. The global job and talents' market might be seen as one of the reasons why the demand–ability fit between the smart cities and also higher educated individuals might be less stable. Moreover, while the rapidly changing and intellectually challenging urban context might offer favorable conditions for the personal development of the educated and ICT literate individuals, this highly demanding environment can at the same time drain individual resources (Hobfoll, 2001). Based on the arguments presented so far, the systemic fit between the smart city context and all of its citizens can therefore be unstable. The second systemic variance builds on the dynamic nature of person–smart city fit and it refers to the continuous change, redesign and redistribution of jobs and skills in the context of smart cities.

### *Variance 2: Person–smart city fit is volatile as technology and organizations are continuously changing the career context in smart cities*

By endangering sociotechnical synergy in smart cities, the two systemic variances described above (the unbalanced and volatile person–smart city fit) prevent the joint achievement of the two systemic aims in smart cities (wealth through innovation and well-being). Our analysis so far points towards the fact that the sustainability of smart cities can be achieved only to the extent to which the emergence and development of sustainable careers is facilitated. From our sociotechnical and systemic fit analysis, we argue that there are three strategies to generate sociotechnical synergy and eventually achieve and maintain a dynamic person–smart city equilibrium.

First, is a focus on continuous development and learning, as knowledge, expertise and intelligence are key resources in the context of smart cities. As forecasted in the socio-technical tradition, “*the knowledge revolution may be in the release of human capabilities rather than in micro-processors, optical fiber and satellites*” (Emery, 1982: 1108, our emphasis). Therefore knowledge, talents and skills should take the central stage in policies aimed at stimulating the synergy between career and smart city sustainability. Second, the flexibility and adaptability of career paths in the dynamic career environment created by smart cities will push citizens to engage in frequent career shifts. The multi-functionality principle in sociotechnical design (Cherns, 1987) focuses on the flexible adaptation of the sociotechnical systems to their environment (Mumford, 2006; Trist, 1981), and in the context of smart cities, flexibility and adaptability can be achieved only to the extent to which wide citizen participation in the co-creation of careers as well as smart city governance is facilitated. Other sociotechnical design principles refer to boundary location, information flows, power and authority (Cherns, 1987) emphasizing that systemic boundaries and unequal power distribution should not prevent knowledge transfer and information flow. Therefore, the final strategy refers to connectivity as a way in which valuable resources (in particular human talent and knowledge) are effectively exchanged in smart cities so that the smart city–person fit can be maintained.

Based on these reflections inspired from sociotechnical design (Cherns, 1987; Trist, 1981), we put forward three plausible solutions to control these systemic variances, generate sociotechnical synergy, foster a dynamic person–smart city fit and ultimately lead to sustainable careers and sustainable development in smart cities. These solutions are: (1) the centrality and continuous development of ICT literacy, knowledge, talents and skills; (2) citizen participation in the co-creation of sustainable careers and career communities; and (3) the network-centric organizing of sustainable careers in smart cities.

### **(Solution 1) Continuous development of ICT literacy, knowledge, talents and skills**

Although educational degrees have traditionally been thought of as reflecting the talents and qualities that people possess (Ilies et al., 2019), this criterion falls short of recognizing people’s potential for development that extends far beyond the initial (early-life) education. Adult professional development is more often realized in informal, rather than formal educational settings (Emery, 1982), which means that much of the professional competences acquired during one’s career often remain undetected or insufficiently acknowledged and used. To overcome this undesirable situation of under-utilization of skills (Houston, 2005), and in line with the sociotechnical ideas (Emery, 1982) we argue that a shift from the rather static focus on education to a focus on continuous development of talents and skills that are sought after in smart cities will ultimately facilitate the emergence of a dynamic person–smart city fit.

ICT literacy is a crucial skill for all who live and work in a smart city. This is because the urban ICT and data infrastructure are not always within reach for all citizens living in smart urban areas (Shelton and Lodato, 2019). Thus, to close the segregation gap created by unequal access to ICT, active support for digital literacy is required from the smart city policy makers. Some best practices on supporting individual learning and

involving the traditionally more difficult to reach “low-educated mature-aged” groups in ongoing training and learning practices, especially focused on digital skills development, stem from the Nordic countries (Tikkanen and Nissinen, 2018: 615). Studies thus far have shown that Nordic welfare states are particularly effective in dealing with barriers to participation in learning and have succeeded in effectively fostering life-long learning and development through the combined efforts of the trade unions and employers’ confederations by continuously following up on the education and training needs of the working population (Boeren et al., 2010; Tikkanen and Nissinen, 2018).

Continuous education in smart cities need not focus on ICT literacy alone. Helping the smart city face its economic, environmental and social challenges also requires a continuous updating of knowledge and skills across all three domains. In order to seize the entrepreneurial opportunities generated by the infusion of technology into the urban space, specialized educational programs could focus on the development of entrepreneurial skills (Hollands, 2018). Moreover, education could play an important role in dealing with some smart city challenges (air pollution, congestion, sustainable living) by raising awareness of these challenges and disseminating effective ways of tackling them at the individual (“green skills”) and community level. An illustrative example of such educational practices is the German initiative of developing skills for sustainable development at various educational levels, including post-initial education (Singer-Brodowski et al., 2019). Public participation in urban governance is universally praised, yet social barriers often make participation skewed towards particular communities and social groups. Citizens in smart cities not only need access to the ICT infrastructure that allows participation in governance, they also need the knowledge and skills as well as the authority that make such participation effective.

Because people differ in their learning capacities and preferences, educational strategies need to be diverse as well. In practice, city governments could therefore provide budgets for ICT literacy training and other specific workshops (entrepreneurship, public governance, environmental or green skills) that are available to all workers, with special interest and attention paid to vulnerable groups. An illustrative example is how Singapore capitalizes on its cross-level nimbleness as a city-state and excels in digital inclusive policies supporting life-long learning and the development of digital skills among its inhabitants (Kennedy and Chan, 2020; Mehta, 2020). To conclude, the smart city as a socio-cognitive system requires (1) the development of policies that place talents and skills at the core of career development for citizens and (2) the continuous updating of ICT skills in order to support accurate and complete data access, storage and processing and foster a dynamic person–smart city fit.

## **(Solution 2) Citizen participation and career communities**

Central to the resolution of dilemmas and complexities associated with the emergence of smart cities is the culture of citizen participation. Citizen participation is required both in production and service delivery (or the transition from consumers to prosumers; Humphreys and Grayson, 2008), as well as in the governance of the smart city (from data providers to decision makers; Shelton and Lodato, 2019). A smart, entrepreneurial city brings various opportunities for individual careers, especially in the field of

smart services (Anttiroiko et al., 2014; Pasmore et al., 2019), therefore in such career ecosystems, the entrepreneurial orientation and personal pro-activity are key elements for career development (Kennedy and Chan, 2020). Citizen participation in the collaborative governance of smart cities is key for the joint optimization of their social and technical systems (Meijer and Bolívar, 2016). Active participation in smart city governance is also fully aligned with the sociotechnical design principles and one of the key mechanisms through which sociotechnical synergy can be achieved. Therefore, in a dynamic and fast-changing environment like the smart city, people have to take ownership of the process of finding and/or generating career support.

Previous research on career communities emphasized their role in generating career support for their members (Parker et al., 2004). In such career communities people become co-creators of career paths and mutually generate career support, especially through shared sense-making activities that disseminate relevant knowledge and insights that will ultimately support individual career adaptation and learning (Parker et al., 2004). Such communities provide continuous learning environments, foster timely information sharing and also provide career support to the vulnerable (Bechky, 2003; Kennedy and Chan, 2020). Career communities are therefore an important part of the career ecosystem that allows the development of sustainable careers in smart cities as socio-cognitive systems.

One critical step in the emergence of such communities is to create a context that makes self-organizing possible. Citizens should be encouraged to exercise agency in their career development and offered participative opportunities. According to Pasmore (1995: 16), the sociotechnical approach has at its core public participation and democratic principles, stating that “humanism and effectiveness can and must be thought of as linked together in the design of work and work systems.” Therefore, we argue that this is a useful approach for understanding and steering the process of co-creation of sustainable careers in smart cities and we urge policy makers to explore ways in which to realize the transition to such career communities.

Career communities offer a suitable environment in which alternative career paths can be continuously reconsidered (Parker et al., 2004). For example, occupational communities are social structures that create a context in which people can share information and support each other in planning their career paths within and across occupations (Bechky, 2003; Parker et al., 2004). Moreover, industry-specific career communities could provide external coaching (Parker et al., 2004) that ultimately supports career sustainability in particular industries, especially for careers in less knowledge-intensive industries. Through their sense-making and knowledge-sharing functions (Parker et al., 2004), career communities in knowledge-intensive industries could alleviate the volatility of person–smart city fit in these industries as well. They might for example create opportunities for the development of scientist-entrepreneur career paths (Kennedy and Chan, 2020) that are essential for smart city sustainable development.

Finally, a more complex type of career community can be envisaged in which public authorities and citizens collaboratively search plausible ways to promote career sustainability in smart cities. Through this, smart cities could create opportunities for various career communities to emerge. As noted earlier, such participatory practices are reported

to be successful in Scandinavian countries, in which various stakeholders collaborate to deal with the changing demands of the labor market (Andersen et al., 2014). As the governance of these career communities is based on informal mechanisms, it is essential that policy makers and organizations actively facilitate and support these communities, if they are to help the development of sustainable careers for citizens.

### **(Solution 3) Network-centric organizing of sustainable careers in smart cities**

A key question in the context of smart cities is how career communities, co-creation and the centrality of skills and talents can be optimally governed, while the dynamic adaptation and maintenance of the systemic fit between the smart city and its citizens is preserved. In such a dynamic context the joint optimization of the social and technological subsystems (Emery, 1982) is an iterative process that could be encouraged through network-centric organizing (Pasmore et al., 2019). The network-centric organizing of relevant stakeholders (organizations, local authorities and representatives of career communities) could generate a flexible social structure that could bring together all relevant stakeholders to create an ecosystem conducive to sustainable careers. Power and authority could be more equally distributed in these networks (Cherns, 1976) in order to stimulate civic engagement and participation in career communities (with possibilities for exchange and development of skills and talent, across organizational, occupational and sectoral boundaries; Parker et al., 2004) as well as urban governance (with possibilities to contribute to the decision-making process related to technological developments in the smart city; Meijer and Bolívar, 2016).

Such network initiatives have been successful, for example Forum Virium Helsinki brings together local companies, public authorities, citizens and users in a collaborative network that supports new business opportunities, product and service development in its smart city initiative (Anttiroiko et al., 2014). Similarly, the One-North cluster in Singapore brings together high-tech, bio-medical and media companies with educational institutes and communities to create a knowledge-intensive and innovative urban ecosystem (Kennedy and Chan, 2020).

However, such networks are often not easily maintained, as network collaboration is great until someone has to endlessly pay for it. For example, in experimental smart city projects like PlanIT Valey (Portugal), networks created at the onset of the project, connecting governmental organizations with local companies and knowledge institutes, lost momentum due to shrinking political and financial support (Carvalho, 2015). Building on insights from network-centric organizing literature, we discuss several pre-conditions necessary for such career-supporting networks to emerge.

First of all, sustained *collaboration* between city governance and private employer parties is key (Meijer and Bolivar, 2016; Silva et al., 2018). The network-centric way of organizing talents and careers can thereby form a more structural solution to preserve the centrality of talents and skills and help citizens in smart cities to cope with the constant change and redesign of jobs and skills. Moreover, the network-centric way of organizing talents and careers can be helpful in reducing segregation in the smart city as well. More vulnerable (low-educated and low IT literate) groups will be included in the web of



knowledge exchange, will become part of the flexible and dynamic process of career co-creation, decreasing job market exclusion based on their educational degree. We acknowledge however that network collaboration is a costly endeavor, therefore continuous financial and political support are essential for such collaborative relations to become and remain successful.

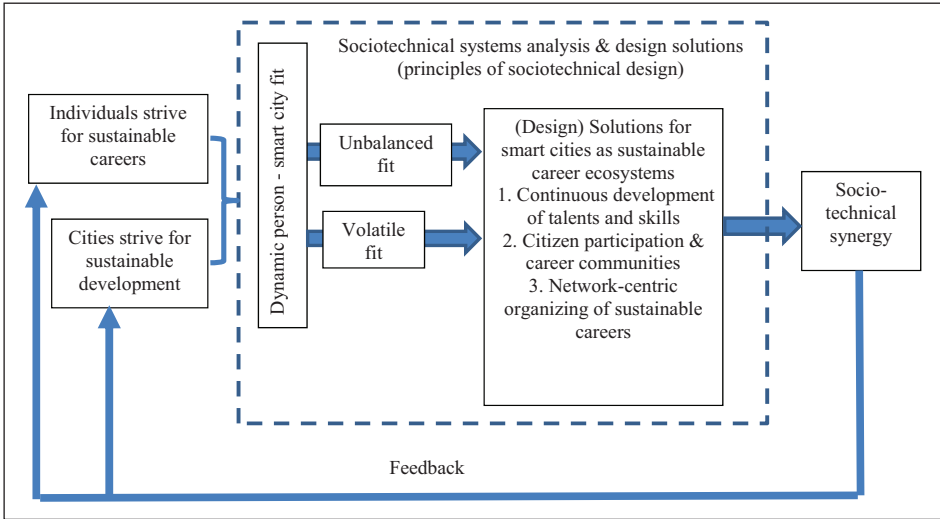
Second, and to make it feasible for those involved, the collaboration requires a sufficient level of *trust* between the partners and stakeholders of the network (Provan and Kenis, 2008). Without trust, participation and commitment of the parties involved is hindered and collaboration is jeopardized. Trust is not a given at the onset of interorganizational collaboration and in order to nourish and sustain trust among the parties and stakeholders involved, continuous reflection on the collaborative process and outcomes is required (Schruijer, 2020). Moreover, the governance and management of such networks has to be based on transparent principles, network leadership should “practice what they preach”, to initiate and nourish the trust-emerging process.

*Leading* this type of network means to organize, facilitate and exchange the talents and skills of people. In the context of a smart city, the network administrative organization (NAO) model seems most appropriate for this leading role (Provan and Kenis, 2008). This model seeks to deal with common goals, complex issues and the strategy of the network in an effective manner, and to safeguard financial and administrative processes that will also emerge through the network’s development. Network leaders or facilitators can create a reflective space (Schruijer, 2020) in which the continuous monitoring of relational dynamics and network outcomes is possible in order to swiftly anticipate or restore variances regarding unbalance between different groups of workers.

In all, network-centric organizing of talents and careers can create room and possibilities for a more integrative and inclusive approach in sustaining a dynamic demand–supply relationship for work in smart cities. In this way, career transitions may become co-governed, co-created and, last but not least, an explicit shared responsibility for all stakeholders involved. The low level of unemployment and high level of employability in Nordic countries (Erlinghagen, 2008; Esser and Olsen, 2012) is attributed, among other factors, to a more centralized approach to managing industrial relations (the human–resources need–supply fit) as these relations are rooted in a well-developed corporatist structure, involving continuous communication and collaboration between state, employers and unions (Tikkanen and Nissinen, 2018).

## Summary

Sustainable smart cities need sustainable careers. We have argued that smart cities are a modern reality in which urban digitization brings forth opportunities as well as challenges for the emergence of sustainable careers. Much like the mine workers in the early sociotechnical studies (Trist, 1981), citizens of smart cities are both supported and threatened by modern urban technologies. Building on a sociotechnical analysis (Cherns, 1987; Pasmore et al., 2019) and a dynamic person–environment fit perspective we explain the systemic challenges to sustainable careers, based on an *unbalanced* and *volatile* person–smart city fit. Given these two (systemic) characteristics of the smart city, we provided three solutions, inspired by sociotechnical thinking, that could support the



**Figure 1.** Overview of the sociotechnical analysis of sustainable careers in smart cities.

development of a career ecosystem to alleviate these problems. We suggested that smart cities as multidimensional, multilayered and interconnected career ecosystems should: (1) make individual skills and talents central to career dynamics; (2) create support for public participation in the co-creation of careers and the emergence of career communities; and (3) stimulate network-centric organizing for career support. An overview of our sociotechnical analysis is presented in Figure 1.

The continuous development of knowledge and skills, career communities and network-centric organizing of careers may herewith provide both a flexible context to balance the supply and demand of skills and talent and provide a humane, safe context in which work and well-being are managed collectively, as also advocated by the sociotechnical thinkers (Emery, 1982; Trist, 1981). The last principle of sociotechnical design states that no design is ever complete, while the multi-functionality one states that different designs may lead to similar outcomes (Cherns, 1987). Therefore, these three solutions may not be the only ones, yet when used in combination they could help control the systemic variances and support the creation and maintenance of sociotechnical synergy.

It may be that the COVID-19 pandemic has accelerated a transition from a face-to-face interaction society towards interaction and collaboration in virtual space. Emery (1982: 1097) claimed that new forms of social organization were likely to emerge during crises and to further steer joint technological and social transformations. In a context of ongoing social transformation, we have argued for the use of sociotechnical design principles to understand the dynamics of sustainable careers in smart cities. Such understanding could lead to policies that support the creation and maintenance of a dynamic synergy that is at the core of smart city and career sustainability.

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