

TOWARDS A CITIZEN CENTERED SMART CITY: INTEGRATING LEAN THINKING AND SOCIAL WELLBEING

Nada Ismail¹ , Mayssa Kalach² , and Yorgo Kleib³

ABSTRACT

Smart Cities have long been viewed from the triple bottom line of the environmental, social, and economic sustainability dimensions paired with an overemphasis on technology adoption. Recently, researchers started to unveil the importance of the social aspect as a core “smartness” indicator on the one hand, and the synergy between “smartness” and lean thinking on the other hand. While lean philosophy aligns well with the sustainability context, it (more importantly) places people at the root of its practices. This paper argues for a Lean Smart City model that elevates the citizens’ social wellbeing and places their values at the core of decision-making to establish for a Citizen-Centered Smart City (CCSC). This is achieved through: (1) investigating the Smart City concepts through a thorough literature review, (2) synthesizing a comprehensive list of social wellbeing indices and mapping them with the underlying lean management principle(s) and (3) developing a framework for a CCSC implementation plan. The framework considers citizens’ social wellbeing indices as key values in implementing smart city principles.

KEYWORDS

Lean thinking, smart city, collaboration, integration, social sustainability.

INTRODUCTION

The earliest form of human civilization started off thousands of years ago at our ancestors’ discovery of agriculture. The new ability to cultivate crops allowed them to give up on hunting and form settlements. The location of these settlements relied on the availability of natural resources such as fertile land and water and the decisions and lifestyles of people were centered around securing basic needs for survival. Later on, people started seeking trade to widen the variety of available resources. As trade, economic activity, and opportunities for education and cultural exchange became more attractive, people started to migrate from traditional rural areas to relocate in busy hubs and urban areas (Sandvick et al., 2021). However, since cities have always been prone to threats by invaders who aimed to take control of their available resources or strategic geographic locations, they have become conventionally designed to protect the economic activities (particularly trading) of their citizens. This would be primarily achieved through securing safe and continuous development and growth for their citizens through pre-emptive architecture designed in ways that would guarantee the systematic flow of both the economic and social activities within their boundaries.

¹ ME Student, Department of Industrial Engineering and Management, Maroun Semaan Faculty of Engineering and Architecture, American University of Beirut, Beirut, Lebanon, noi01@mail.aub.edu

² Lecturer, Maroun Semaan Faculty of Engineering and Architecture, American University of Beirut, Beirut, Lebanon, mk314@aub.edu.lb, orcid.org/0000-0002-8997-3911

³ ME Student, Department of Industrial Engineering and Management, Maroun Semaan Faculty of Engineering and Architecture, American University of Beirut, Beirut, Lebanon, yfk04@mail.aub.edu

Post the French revolution in 1789, different cities started to be integrated into one single entity and nation states started to emerge and grow roots. This new system provided an edge for the central states, but cities maintained a degree of autonomy and certain unique privileges (Torpey, 2015). Development, growth, and planning existed significantly not only on the national level, but also on the level of cities. This has been fostered through tailoring national policies to be aligned with the historical ongoing role of different cities, achieved through the adoption of certain administrative systems that provide a margin of freedom for cities (could vary from one country to another) known as decentralization (Shao et al., 2020).

Despite the great evolution that cities witnessed over the course of multiple centuries, the fundamental human needs of safety and security to conduct daily activities remain unchanged (Collins et al., 2021). However, key historic events such as the industrial revolution in the late 18th century, followed by great technological advancements, exacerbated urbanization and cultural shifts, elevating people's expectations in what cities should offer. Upon having their basic needs secured, people started evolving in pursuit of higher standards of living and an elevated set of psychological needs relating to forming and expanding social interactions, experiencing social integration, cooperating towards securing survival and sustenance, achieving a sense of belonging, and contributing back to society.

The concept of Smart Cities started gaining massive popularity in the past decade with the anticipation of an even greater population shift to cities by the year 2050 (Lara et al., 2016). This popularity came along an ever-increasing concern for the environment, whereby Smart Cities are expected to be a solution to sustainability problems in a technologically advanced way (Toli & Murtagh, 2020). Namely, as the world's resources are scarce and limited, cities need to adopt sustainable policies and strategies to be able to cater for the basic demands of the occupants and maintain a solid ground for future growth and development (Collins et al., 2021). Therefore, we find governments either investing or planning to invest in today's cities to transform them into sustainable and technologically oriented spaces.

In order to successfully build, operate, govern, and optimize such arising smart entities, applying lean practices becomes a very appealing proposition. Lean thinking was found to be highly compatible with Smart City principles from economic, social, environmental, and democratic viewpoints, and as such, can serve as guidelines towards achieving and evaluating "smartness" (Herscovici, 2018). Lean focuses on creating value systems through *holistic* approaches, while the concept of a smart city could evidently facilitate for such approaches since it hosts networks of interconnected systems operating in real-time through the integration of Information and Communication Technology (ICT). Additionally, Lean aims to abolish traditional organizational hierarchies and "open up the work process" (Hanna, 2007), while Smart Cities require exactly that, wherein systems are ideally decentralized and set to be bottom-up to better engage citizens and consider their needs. Furthermore, a smart city community is potentially most harmonic when its residents share a unified set of values and principles, and lean management proves most effective when it is promoting a "culture" rather than a mere set of tools and techniques. This evident compatibility between the general smart city model and the core of lean thinking shows that pre-established lean principles and practices have promising potentials in delivering Smart City objectives of optimizing processes and elevating the social wellbeing of citizens. Namely, a smart city model, being an aggregation of different public and private institutions operating in different sectors of industry, could benefit from lean thinking as a standardized process applicable across many industries and aiming for excellence and perfection when it comes to delivering value to customers based on their exact definition of it. To this end, this paper promotes lean thinking as one of Smart Cities' fundamental pillars and, as such, presents a framework for an implementation plan to create a lean culture centered around citizens to help elevate their social wellbeing as part of establishing for a Citizen-Centered Smart City (CCSC).

LITERATURE REVIEW

Different studies tackled the concept of smart cities from different angles, however, one prominent and recurring theme among references is related to the vagueness that revolved around defining a smart city (Lara et al., 2016 & Özdemir et al., 2019), and the lack of a commonly agreed upon definition (Bouzguenda et al., 2019). While most of the definitions found in the literature revolve around the intensive use of ICT, a more comprehensive human-centered characterization of smart cities emphasizing on the importance of the social dimension and placing people at the heart of smart cities (Lara et al. 2016) emerged. For instance, Toli & Murtagh (2020) reveal that the most prevalent sustainability definition of smart cities includes the focus on the social dimension as opposed to the economic or environmental dimensions. An environmentally Smart City is viewed as a city that implements systems to optimize processes (by levelling resources, recycling, creating waste plans, and utilizing renewable energy) and reduces carbon footprint (by decreasing emissions through the infrastructure and buildings constructed); which in turn enhances the quality of life (QoL) of its residents (Collins et al., 2021). A socially Smart City has “a high level of citizen engagement and participation aimed at improving the well-being quality of life of its citizens” (Collins et al., 2021).

All these definitions share the common objective of placing people at the heart of Smart Cities by (1) enabling them to participate and take empowering actions and (2) focusing on elevating their social wellbeing and QoL. Leveraging the role of citizens in the Smart City (primarily by creating interlinks between all citizens and other private and public institutions) becomes essential not only for the sake of achieving social wellbeing but also to create a sustainable Smart City which self-generates solutions (Trencher, 2019). It is critical to understand that focusing on the social dimension in smart cities is not intended to undermine the economic, environmental, or technological dimensions. Rather, by doing so, cities will directly and indirectly contribute positively to developments in all other sustainability dimensions. Moreover, people often mistake social smartness with citizen-centered smart cities; the two do not map each other. Social smartness reflects the concept of having individuals that are technologically educated and aware yet does not necessarily imply high levels of community engagement in significant processes (Bouzguenda et al., 2019).

Quality of life, wellbeing, satisfaction, and happiness in urban contexts are interchangeably used terms that refer to the common and consistent objectives that people seek across cultures with some subjective discrepancies attributed to a specific culture or circumstance. The foundation of this paper is based on that the core of Smart Cities should no longer be about the integration of disruptive technology without the proper evaluation and consideration of whether people derive a sort of value from the use of the technology. What’s almost certain is that the universal goal that humans seek in urban and social contexts is happiness and the elevation of their social wellbeing and quality of life. The first underlying assumption is that almost all people have similar preferences when it comes to defining a good QoL. Even though there are no clear and common key performance indicators (KPI)s identified in relation to QoL and social wellbeing in smart cities, there is a good record of indices which identify some key factors related to objective and subjective social wellbeing. Daniel Kahneman, economics Nobel prize winner, argues that subjective factors are more predictive of happiness and social wellbeing (Lara et al., 2016), as such, it is essential that both objective and subjective indices are equally considered by smart city initiatives.

On the one hand, despite that Smart City definitions and proposed frameworks reveal a good awareness about the importance of social sustainability and wellbeing, Smart City initiatives seem to lag behind on implementing social agendas related to improving citizen livelihood as they are faced with immense difficulty predicting and deciding what promotes and elevates people’s objective as well as subjective social wellbeing. This is due to current literature lacking in the proposing of a unified framework that outlines what a quality life

encompasses to citizens, and how it can be achieved in an urban context (Toli & Murtagh, 2020). On the other hand, the literature review reveals that lean thinking can be used to assess the performance of smart cities and outlines key principles that can be used in developing practical management strategies for accomplishing smart city objectives. Lean management contributes positively to all three triple bottom line sustainability; however, results indicate that the wider body of knowledge is focused on the economic dimensions of lean and calls researchers to investigate further into the social and environmental dimensions, emphasizing that the social dimension is the most difficult to quantify (Solaimani & Sedighi, 2020).

When it comes to defining specific services expected to be delivered by Smart Cities and indicators to achieving elevated QoL, followed by measuring and assessing the “smartness” of a smart city, experts may find themselves facing a “wicked problem”. Whelton & Ballard (2002) define a wicked problem as one that poses itself as ill-structured or ill-defined, has multiple objectives, and is viewed differently from the perspective of different stakeholders due to the complexities and uncertainties present in it. In reference to this, it is safe to consider many aspects of a smart city as wicked problems due to (1) the limited and fragmented implementation of smart city services, (2) their innate socio-economic and socio-technical complexities, and (3) the stakeholders’ and policy (and decision) makers’ uncertainty towards smart city objectives and initiatives. However, based on the propositions made by Whelton & Ballard (2002), acknowledging the nature of problems, identifying decision agents, involving key stakeholders, understanding diverse interests, empowering users to make decisions, adopting an interconnected process view, and seeking critical and reflective feedback may help planners and decision makers pave their way towards more defined solutions.

In the case of Smart Cities, constant criticisms have been directed towards initiatives which intend to install technology based on top-down approaches, making governments and corporations the primary beneficiaries. Alternatively, administrators could better devise technology and the power of Big Data to collect information about residents for the purpose of better understanding their needs and delivering services accordingly. Such approaches could address aspects of smart cities (i.e., social sustainability) from a wicked problem perspective by identifying key users (citizens) and key agents (government authorities and private institutions), attempting to understand and fulfil citizens’ interests (i.e., needs and objectives), and empowering citizens to participate in the decision-making process. That said, and as part of resolving the Smart City “problem”, this study aims to establish for a Citizen-Centered Smart City (CCSC) that elevates the citizens’ social wellbeing and places their values at the core of decision-making with the help of lean thinking and management.

METHODOLOGY

The methodology of work includes three main stages. First, a thorough literature review is performed to extract the various social wellbeing indicators on the one hand, and the various lean principles and practices that addressed social wellbeing on the other hand. Then, the extracted indicators were synthesized and categorized into “objective” and “subjective” indices according to their social wellbeing category. The former includes the indices that are generally applicable to a good portion of the population and in different cultures, whereas the latter includes the indices that require deeper understanding and analysis in relation to each individual and every culture. The result of this stage is a comprehensive list of social wellbeing indices, each brought in parallel with the underlying lean management principle(s) and defined (as such) from a lean thinking perspective. Finally, a framework for a CCSC implementation plan is presented. The suggested framework (1) considers devising questionnaires to address both subjective and objective categories of the indices based on the presented definitions and (2) calls key agents or decision makers to answer to these indices through suitable policies and services. The following sections elaborate on each of those stages.

SOCIAL WELLBEING INDICES

A synthesis of the social wellbeing indices related to social sustainability in cities retrieved from the reviewed literature is displayed in Table 1. The indices are categorized into Objective and subjective indices according to their social wellbeing category. Namely, the “Material”, “Physiological”, “Human Capital”, “Environment”, and “Governance” wellbeing categories are regarded as objective since they are generally applicable to a good portion of the population and in different cultures. “Psychological”, “Work”, and “Community” wellbeing categories are regarded as subjective since they require deeper understanding and analysis in relation to each individual and every culture. The categories, their corresponding indices, and the underlying lean principle(s) are explained in the following subsections.

OBJECTIVE WELLBEING

Material

Income and financial security are indices relating to material wellbeing and have been continuously proven to have a positive relationship with social wellbeing even though the exact value of these varies based on citizens’ subjective needs and standards of living (work “compensation” implies the same and is listed under subjective indices). Lean practitioners are aware of this as they pay their employees relatively high wages while remaining efficient, reliable, and competitive. Pay scales are thoroughly studied and workers are paid well and offered job security. Furthermore, in reference to Toyota’s practices (as a Lean founder), workers are rewarded through semi-annual bonuses based on the performance of the entire company which is also ensured through unmatched optimization practices (Liker, 2005).

Physiological

Physiological wellbeing is related to maintaining physical health as well as basic underlying psychological health. It includes relief from mental and physical stress, freedom, mobility, a sense of safety and security, and the fulfilment of basic needs and wants. Taiichi Ohno, founder of Lean, emphasizes that safety is at the core of any lean activity. These are ensured through training and improved work conditions paired with methodologies that protect workers’ health and reduce accidents. Visualization (includes visual management and control) is a practice that ensures safety as it reveals hidden problems in a clear and concise manner. *Jidoka* (equipment automation) and *andon systems* (manually operated cords or buttons that halt entire production line) are also key to ensuring safety and are paired with workers’ empowerment to monitor and use these anytime an abnormality is detected. Stress is relieved through fair practices, fatigue policies, and balance of workload as the elimination of *Muri* (overburdening of people) suggests. When it comes to the fulfilment of needs and wants, both internal and external customers are considered in Lean and are focused on to be offered exactly what they want, when they want it, with the desired quality and price.

Human Capital

Lean management is keen about encouraging, challenging, and investing in its people to unleash their creativity; allowing them to take initiatives, learn, and experiment continuously. This is emphasized through the 5S (sort, stabilize, shine, standardize, sustain) waste elimination methodology, in which the *S* in *sustain* is core and is achieved through educating, training, and rewarding employees. When it comes to empowering people, *standardization* in Lean allows work standards to be specific enough to guide employees, yet flexible enough to allow for improvement, innovation, and growth. In addition, lean philosophy, based on Toyota practices, seeks to hire internal and external mentors (*sensei*), to educate and transform by doing, and promote an intrinsic lean culture willing to self-sustain and grow.

Governance

Participatory governance is a democratic system frequently highlighted as key to establishing for a citizen-centered city whereby citizens are engaged in the decision-making process as part of increasing their political and social participation. Participatory governance requires that authorities are honest, competent, transparent, trustworthy, and open to different views. Lean management seems to understand this as it reflects commitment to *consensus decision making (nemawashi)*, engaging all stakeholders, considering their different views, and weighing all pros and cons before taking any decision as part of avoiding *backtracking*. Lean promotes *nemawashi* to be part of the organizational culture across all managerial levels and project life cycles. On a community level, Toyota documents one of its successes in extending its consensus decision making process and reaching a *win-win* agreement for all parties in an external development project that was taking place near its Arizona base, threatening the long-term water supply for the surrounding community (Liker, 2005). Cross-sectorial partnerships is mirrored in Lean practices through *cross-functional teams* who solve problems collaboratively through a unified vision that prioritizes the company's best interest.

SUBJECTIVE WELLBEING

Psychological

Psychological health has been argued by many physicians to be as important as physical health. It is related to a person's sense of pleasure, achievement or accomplishment, and purpose. Often times it is achieved through work-life balances and can be better understood by considering a person's emotional intelligence (emotional regulation and problem-solving abilities), motivation, and self-efficacy. In Lean, practitioners realize the importance of securing their employees' psychological wellbeing and 'work by the book' by referring to Abraham Maslow's hierarchy of needs, Frederick Herzberg's theories of motivation, and Taylor's scientific management, behavior modification, and goal setting; all these achieve intrinsic motivation by improving work conditions and fostering for continuous personal growth and improvement. Additionally, a core pillar that lean principles abide with, is the respect for people through valuing their mental and physical capabilities and entrenches mutual respect and trust among internal and external stakeholders.

Work

Productivity, autonomy, and fair compensations are important indicators of social wellbeing experienced at work. The Toyota Production System (TPS) on which Lean thinking is based, is considered a master at achieving the highest levels of productivity and getting the best out of their employees. This is done by constantly redesigning and enriching jobs through job rotation and feedback loops, challenging employees granting them a degree of autonomy, and helping them become proactive problem solvers. Accordingly, employees are rewarded both financially and non-financially and placed in a safe and healthy working environment.

Community

A community which contributes for an elevated social wellbeing is one that nurtures for the prosperity of different people through incorporating similar values. According to Maslow's hierarchy on needs, social belonging is essential, so, in reference to this, Lean strives to build a culture of consistent principles and approaches to be firmly adopted by all teams. Achieving this is possible by fostering for diversity through fair and equal social opportunities, training and building people towards becoming exceptional leaders and team players who dedicate their energy into bettering the organization as a whole. Mutual trust and respect are further emphasized as the backbones of collaboration and teambuilding.

Table 1: Synthesis of Social Wellbeing Indices and Lean Management Principles and Practices

Description	Social Wellbeing Category	Social Wellbeing Indices*	Lean Management Principles/Practices**
Objective Wellbeing	Material	Income [1]	Equal Remuneration [6]
		Financial Security [2]	
	Physiological	Health [1,2]	Occupational Health & Safety [6]
		Mobility [1,2]	Ergonomic Workstations Design Standards [6]
		Freedom [1,4]	Autonomation [8]
		Safety & Security [2]	Decrease working accidents [7]
		Fulfilment of Needs & Wants [1,5]	Fostering Customers' Macro Necessities [8]
	Human Capital	Education [1,2]	Education [6]
		Qualification [3]	Coaching [6,8]
		Empowerment [3,5]	Empowerment [7,8]
		Digital Engagement [4]	
	Environment	Access to Nature [2]	
		Reduced Pollution [2]	
	Governance	Participatory [3]	Employees Participation in Decision-Making [7]
		Competent [2]	Quality Management [8]
Trustworthy [2]		Fair Labor Practices [8]	
Cross-Sectorial Partnerships [5]		Cross-Functional Teams [8]	
		Customer/Client Centricity [8]	
Subjective Wellbeing	Psychological	Sense of Purpose [2]	Employees Value & Respect [8]
		Accomplishment [2]	Continuous Improvement Opportunity [8]
		Sense of Leisure [2]	Optimal Working Hours [8]
	Work	Compensation [2]	Intrinsic Motivation [8]
		Autonomy [2]	Improved Working Conditions [7,8]
		Productivity [2]	Responsible Autonomy [6,8]
	Community	Civic Participation [4]	Productivity [7,8]
			Collaborative Learning & Experimentation [8]

Social Interaction [1,3]	Collaborative Problem Solving [7]
Sense of Belonging [1,2]	Equal Opportunity [6,8]
Mutual Trusting [2,5]	Diversity [6]

*[1] Lara et al., (2016), [2] Musikanski et al., (2017), [3] Özdemir et al., (2019), [4] Collins et al., (2021), [5] Kim et al., (2021)

**[6] Resta et al., (2016), [7] Varela et al., (2019), [8] Solaimani & Sedighi, (2020)

SUGGESTED FRAMEWORK

The suggested framework places citizens at the center of processes by creating interlinks between them and the other decision agents as part of ensuring their engagement, as shown in Figure 1. Citizen engagement, established to be core to achieving a CCSC, aligns with the identified social indices namely “digital engagement”, “participatory governance”, and “civic engagement”. According to Herscovici (2018), citizen engagement can be achieved through “Physical Infrastructure” and “Applications Infrastructure”, both focused on the integration of ICT. Application Infrastructure is a software platform used to address “specific needs” through designed apps, whereas the Physical Infrastructure connects people to the internet providing a public virtual space for citizen participation and data exchange (Herscovici, 2018). Of course, as highlighted in the literature review, smart citizens who are technologically educated and aware are required, however, this alone is not sufficient to achieve citizen engagement. Similarly, citizen participation and empowerment cannot be achieved without the facilitating infrastructures. On the other hand, since *specific needs* must be identified in order to feed into the physical and applications infrastructures proposed by Herscovici (2018), the suggested framework in Figure 1 benefits from the previously defined objective and subjective social wellbeing indices to better identify citizens’ preferences. Objective social wellbeing categories (material, physiological, human capital, environment, and governance) and their corresponding social wellbeing indices are demanded by all citizens irrespective of their subjective preferences. Consequently, these are meant to be considered by government authorities and other acting agencies to design and issue questionnaires that would ultimately guide social policies and public initiatives. These might include (1) generating funds to support individual and social initiatives, (2) providing key public facilities such as education and healthcare and other supporting infrastructure, (3) accommodating for work and growth opportunities, (4) providing training to engage and empower citizens, and (5) ensuring public safety and security among other policies which can contribute to reducing social inequality and elevating social wellbeing. The management systems of these public initiatives shall be designed by lean practitioners before they are executed upon as means to ensure their optimization and their success in fulfilling the citizens’ exact perception of value.

Subjective social wellbeing categories (psychological, work, and community) are concerned with citizens’ emotions, personal experiences, and preferences. Identifying these is essential for private institutions to better evaluate and fulfil the citizens’ needs. The same procedure would apply to private institutions wherein they would issue questionnaires and answer to citizens’ subjective social indices and needs by proposing initiatives as well as innovative products and services to further elevate social wellbeing. Prior to executing upon their initiatives, optimized management systems shall be proposed by lean experts.

Besides planning and designing optimized management systems, lean experts and practitioners shall offer government and public institutions, as well as private institutions, adequate training to ensure all processes abide by lean standards. They shall also raise awareness about lean thinking to be integrated daily by providing citizens with well-designed and engaging training programs, such as workshops, competitions, games, and activities.

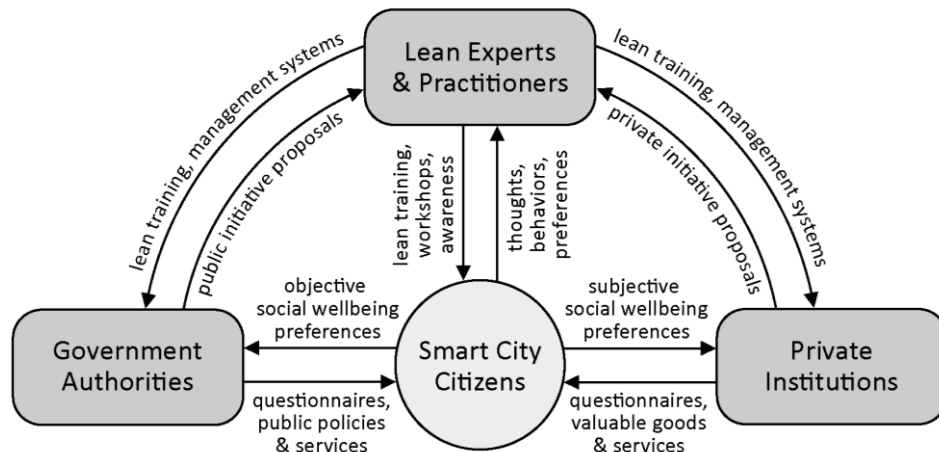


Figure 1: Framework for Citizen Centered Smart Cities (CCSC) implementation plan

Questionnaires are effective research tools which help measure and understand respondents’ values, thoughts, behaviors, attitudes, and preferences particularly if properly designed and worded. For this reason, they are fit for understanding citizens’ preferences in relation to their social wellbeing and the proposed smart city initiatives. For instance, government authorities who wish to tackle citizens’ objective “physiological” need of “mobility”, and plan on building a new transportation system for the citizens, could start by collecting data about the method of transportation used by these citizens (e.g., to go to work), the time, cost, and effort required to reach their destinations, their rating of the journey, and the alternative transportation methods of preference. Post collecting all relevant data, government authorities would consult lean experts to develop an optimized user experience through proposed value management systems. Ideally, follow-up questionnaires are continuously issued to citizens to guide relevant decisions and reaffirm the “righteousness” of decisions taken towards the betterment of citizen’s day-to-day standards of living. A company concerned for the social wellbeing of its employees and dedicated to ensuring that they are working and living up to their full capabilities (harnessing maximum energy and creativity) may address subjective “psychological”, “work”, and “community” needs by conducting surveys which help better understand employees interests inside and outside work. Lean experts would come to play in creating systems that would situate people in optimal environments, while better assisting them to fulfil their “sense of purpose” and “accomplishment” and accordingly create customized plans for a better work-life balance.

Value stream mapping (VSM), a key lean methodology used here, is meant to track, and document every activity in the process of delivering value to customers (i.e., citizens) from start to end, eliminating any type of waste they are not willing to pay for. Such methodology makes every activity well studied and deliberate, encouraging planners to innovate and think deeply. From a lean perspective, waste includes any activity which incurs extra cost, time, and effort. Such activities include overproduction, waiting, unnecessary transportation, over processing or incorrect processing, excess inventory, unnecessary movement, and defects (Liker, 2005). If the concept of eliminating waste is extended onto the citizens of the Smart City through the integration of lean thinking and the developing of a lean culture, then waste will be eliminated in all institutions and among all individuals, elevating the city culture, leaving citizens with more time, energy, money, and resources to perform activities that they view core to their satisfaction and wellbeing.

CONCLUSION

This study aims at establishing for a citizen centered smart city (CCSC) through integrating lean thinking and social wellbeing. The literature review stresses on the significance of the

social sustainability dimension, but reveals a lack of clear, concise, and universally adopted social indices that could help in evaluating the social smartness of Smart Cities. On the other hand, given the complexity of smart city systems and its proved compatibility with lean thinking, it is only fair to integrate a pre-established mechanism (i.e., lean management principles, tools, and practices) that would help guide and govern its initiatives. Similar to smart cities, lean management has been explored against the triple bottom line of sustainability, however the social facet of lean remained relatively obscure. As a result, this paper focuses on the social dimension of Smart Cities and Lean thinking as part of establishing for a Citizen-Centered Smart City (CCSC). Based on a thorough literature review, a synthesis of social wellbeing indices was generated and mapped along with the underlying lean management principle(s). Such an alignment helps in defining the social wellbeing indices and, more importantly, offers pre-established guidelines to deliver Smart City objectives of optimizing processes and elevating the social wellbeing of its citizens. To this end, this paper suggests lean thinking as a core mechanism for Smart City initiatives and proceeds to present a framework for an implementation plan that would help in creating a lean culture centered around citizens' needs, and as a result, establishing for a Citizen-Centered Smart City (CCSC).

According to lean practitioners, lean practices, tools, and techniques are rendered ineffective if integrated in isolation or randomly. Instead, it is mandatory that lean promoters view the “big picture” and plan thoroughly to integrate all lean practices in ‘tightly knit’ systems. This concept is key because it emphasizes the importance of promoting and facilitating for the creation of a Lean culture when promoting Lean thinking in Smart Cities. From a proposed smart city perspective, authorities and institutions have a mutual responsibility in becoming Lean promoters and playing the role of human resource managers in creating a city scale lean culture. Lean promoters should 1) respect people and be consistent in placing them at the center of all initiatives, 2) tailor the lean culture around citizens' thoughts and behaviors, 3) build close relationships with citizens and reflect full transparency in policies and practices, 4) leverage on people's trust place and help them realize the mutual communal benefits from adopting lean, 5) set up systems that allow for clear and concise two-way communication, 6) empower citizens to become effective members in the decision making process, 7) train citizens to become continuous lean learners and problem solvers, and 8) recognize efforts and achievements of successful lean adopters.

Unfortunately, it is difficult to achieve a total lean buy-in from all stakeholders particularly on a city scale, because despite lean management proving to be revolutionary across many industries, it entails a radical behavioral change which requires extensive training and experience. Constant efforts are usually placed in communicating both the “why” and the “how” of lean to motivate buy-ins in organizations; however, this is certainly not sufficient on a city scale. Exhaustive studies on behaviorism and different perceptions towards lean must be conducted in order to devise hard core strategies to compel people to shift to lean thinking. Moreover, creative, and interactive training methods must be developed to make the process of learning about lean and adopting it seamless and exciting.

REFERENCES

- Bouzguenda, I., Alloush, C., & Fava, N. (2019). “Towards smart sustainable cities: A review of the role digital citizen participation could play in advancing social sustainability”. *Sustainable Cities and Society*, 50, 101627. doi.org/10.1016/j.scs.2019.101627.
- Collins, D., Johansen, A., Kalsaas, B. T., Temljotov-Salaj, A., and Hamdy, M. (2021). “Brought by Degrees: A Focus on the Current Indicators of Lean ‘Smartness’ in Smart Cities”. Proc. 29th Annual Conference of the International Group for Lean Construction (IGLC29), Alarcon, L.F. and González, V.A. (eds.), Lima, Peru, pp. 167–176, doi.org/10.24928/2021/0156, online at iglc.net.

- Hanna, J. (2007). "Bringing 'Lean' Principles to Service Industries". HBS Working Knowledge, Harvard Business School, <https://hbswk.hbs.edu/item/bringing-lean-principles-to-service-industries>.
- Herscovici, A. (2018) "New development: Lean Thinking in smart cities". *Public Money & Management*, 38:4, 320-324, doi.org/10.1080/09540962.2018.1450924.
- Kim, H. M., Sabri, S., & Kent, A. (2021). "Smart cities as a platform for technological and social innovation in productivity, sustainability, and livability: A conceptual framework". *Smart Cities for Technological and Social Innovation*, 9–28. <https://doi.org/10.1016/B978-0-12-818886-6.00002-2>.
- Lara, A.P., Moreira Da Costa, E., Furlani, T.Z. & Tan. (2016). "Smartness that matters: towards a comprehensive and human-centered characterization of smart cities". *J. open innov.* 2, 8. doi.org/10.1186/s40852-016-0034-z.
- Liker, Dr. Jeffrey K. "Toyota Way: 14 Management Principles from the World's Greatest Manufacturer". *McGraw-Hill*, 2004.
- Musikanski et al., (2017). "Happiness Index Methodology". *Journal of Social Change*. Volume. 9, Issue 1, Pages 4–31 ©Walden University, LLC, Minneapolis, MN doi.org/10.5590/JOSC.2017.09.1.02.
- Özdemir, A. & Kourtit, K. & Nijkamp, P. (2019). "Social policy in smart cities: the forgotten dimension".: doi.org/10.4337/9781789907056.00020.
- Patel, Y., & Doshi, N. (2019). "Social implications of smart cities". *Procedia Computer Science*, 155, 692-697. doi.org/10.1016/j.procs.2019.08.099.
- Resta B., Dotti S., Gaiardelli P., Boffelli A. (2016). "Lean Manufacturing and Sustainability: An Integrated View". *Springer, Cham*. In: Nääs I. et al. (eds) *Advances in Production Management Systems. Initiatives for a Sustainable World. APMS 2016. IFIP Advances in Information and Communication Technology*, vol 488. https://doi.org/10.1007/978-3-319-51133-7_78.
- Sandvick, C., Altaweel, M. & Lambrecht, E.(2021) "What Factors Led to the Creation of the First Cities". *Amazon*, https://dailyhistory.org/what_factors_led_to_the_creation_of_the_first_cities.
- Shao, S., Wang, Y., Yan, W., Yang, L., & Yin, J. (2020). "Administrative decentralization and credit resource reallocation: Evidence from China's "Enlarging Authority and Strengthening Counties" reform. *Cities*, 97, 102530. doi.org/10.1016/j.cities.2019.102530.
- Solaimani, S. & Sedighi, M. (2020). "Toward a holistic view on lean sustainable construction: A literature review". *Journal of Cleaner Production*. Volume 248, 119213, ISSN 0959-6526, <https://doi.org/10.1016/j.jclepro.2019.119213>.
- Toli A. M & Murtagh N. (2020). "The Concept of Sustainability in Smart City Definitions". *Frontiers in Built Environment*. vol.6, p. 77, ISSN 2297-3362. doi.org/10.3389/fbuil.2020.00077.
- Torpey, J. (2015). "American and French Revolutions: Impact on the Social Sciences. Graduate Center, City University Of New York". *International Encyclopedia of the Social & Behavioral Sciences* (Second Edition), New York, p. 597-601.
- Trencher, G. (2019). "Towards the smart city 2.0: Empirical evidence of using smartness as a tool for tackling social challenges". *Technological Forecasting and Social Change*, vol. 142, p. 117-128, ISSN 0040-1625. doi.org/10.1016/j.techfore.2018.07.033.
- Whelton, M. & Ballard, G. (2002). "Wicked problems in Project Definition". *Proceedings of the International Group for Lean Construction 10th Annual Conference, Brazil, August 2002*.
- Varela, L., Araújo, A., Ávila, P., Castro, H., Putnik, G. (2019). "Evaluation of the Relation between Lean Manufacturing, Industry 4.0, and Sustainability". *Sustainability*. 11(5):1439. <https://doi.org/10.3390/su11051439>.