# New development: Lean Thinking in smart cities

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*The smart city concept lacks a set of coherent criteria for evaluating its effectiveness as an urban management system, its compatibility with human rights principles, and its contribution to a democratic, participatory, social urban regime. The author explains why Lean Thinking principles can be applied to evaluate the 'smartness' of cities and serve as guidelines for improvement.*

**Keywords: Lean Thinking; smart city; Tel Aviv; urban management.**

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A smart city is a city that employs an array of information technologies for its urban management. These technologies gather, disperse, and use information to control different facilities and to facilitate communication and co-operation between its citizens. The smart city concept, however, lacks a set of coherent criteria for the evaluation of its effectiveness as an urban management system, of its compatibility with human rights principles, and of its contribution to a democratic, participatory, social urban regime. A clear set of criteria would also provide an aspiring smart city with practical guidelines and/or a roadmap to help it achieve its goals.

Lean Thinking is a method of designing, performing, and continuously improving the work process to produce better value for all stakeholders. The method is widely used by information and service organizations in both the private and public sectors.

This article shows that Lean Thinking principles can be applied to evaluate the performance of smart cities, and may serve as a practical management approach towards achieving smart city goals.

### What actually is a smart city?

The smart city concept has been promoted as the solution to most urban problems—a technology-led urban Utopia (Kirby, 2013; Townsend, 2013; Hollands, 2015). Yet, if such an information-rich city does not encourage 'people [to] think for themselves or communicate well with one another', then it is not really smart, since the use of technology by itself is not enough to qualify it as 'smart' (Sennett, 2012).

Some researchers have suggested that more human 'smartness' is manifested in the use of technology to collaboratively solve shared problems (de Lange and de Waal, 2012; Chatterton, 2013; Radywyla and Biggs, 2013). De Lange and de Waal (2013) use the term 'social cities' to refer to cases in which urban technologies are used in that manner. In addition, according to Harvey (2012): 'This will require new participatory urban technologies, greater social and economic inclusion, and a substantial shift in power from corporate business and entrepreneurial city leaders to ordinary people and communities that make up cities'.

A very significant interest driving smart city development is the huge profits that can be made by ICT firms, as well as by engineering, property development, and construction companies (Hollands, 2015). Firms are co-operating to get a foothold in this market, for example the Urban Intelligence Industrial Complex, involving IBM, Cisco, General Electric, Siemens, and Philips (Hill, 2013). Anttiroiko (2013) explains that: 'What is envisioned are futuristic cities which will offer a high quality of life for residents in terms of security, welfare, culture and entertainment, and other aspects of everyday life'. The underlying assumption is that we all have the same preferences and same the definition of 'high quality of life' (Hollands, 2015). Business influences are enhanced by the drift in city governance towards urban entrepreneurialism. Cities have begun to compete with one another to attract global capital, and are marketing themselves as 'creative' or 'smart cities'. Most smart city initiatives come from either corporations or urban governments (McGuirk, 2012). While citizens are essential to the crowd-sourcing model, which most smart city initiatives depend upon, they are also often perceived as an obstacle that needs convincing of the benefits of ICT (Hollands, 2015).

However, not all of a city's problems are amenable to technological problem-solving

(Hoornweg, 2011; Hill, 2013). Smart city capabilities should be used to empower citizens to act on complex collective urban problems (de Lange and de Waal, 2013), returning the focus to the *raison d'être* of cities—the people and citizens who inhabit them (Hill, 2013; Hollands, 2015).

Hollands (2008, p. 306) regards smart cities as 'territories with a high capacity for learning and innovation, which is built in to the creativity of their population, their institutions of knowledge production, and their digital infrastructure for communication…progressive(ly) smart[er] cities must seriously start with people and the human capital side of the equation, rather than blindly believing that IT itself can automatically transform and improve cities'. According to Hollands, a 'real' smart city might use IT to enhance democratic debates about the kind of city it wants to be and about the kind of city people want to live in.

**What is Lean Thinking?**

Lean Thinking was initially formulated by MIT's International Motor Vehicle Program research team. The goal was to enhance the competitiveness of the American car industry. The team's recommendations were based on Japanese managerial concepts, especially the Toyota Production System (TPS). Its findings were published in the watershed book *The Machine that Changed the World* (Balle, 2009; Womack and Jones, 1990).

Since its original development in the mid 1990s, Lean Thinking has migrated to the information, services, and public sectors, often with good results. The approach is based on the following set of simple principles and on an array of tangible, common sense tools used to implement them (Bhatia and Drew, 2006; Radnor, 2010):

- *Pull*—Value is always considered from the customer's point of view. This is the most important criterion for avoiding waste, since providing something that is not valued by the customer is a complete waste.
- *Respect for people*—Lean Thinking recognizes the intrinsic value inherent in each and every person; their unique talents, gifts, and abilities. Its goal is to enable each person to fulfill his or her potential through challenging assignments that align with the person's interests, the firm's goals and needs, and the customer's demands (Womack, 2007).
- *Kaizen*—A Japanese philosophy that focuses on continuous improvement through incremental changes based on constant learning.
- *Mura*—Refers to unevenness or irregularities. It impacts labour productivity and increases the burden on each worker as well as on the system.
- *Muri*—Overburdening often caused by Mura. It might lead to different types of waste, like defects and waiting.
- *Muda*—'Futility' in Japanese. Muda refers to seven types of waste (non value-adding activities): transportation, inventory, motion, waiting, over-processing, over-production, and defects.
- *Value stream mapping*—A Lean Thinking management method in which activities and processes are plotted on a chart—referred to as the 'current-state map'. The map is then analysed to identify Muda, Muri, and Mura, in order to minimize them, and the required changes are implemented under continuous measurement and evaluation.
- *Heijunka*—'Production leveling'. Heijunka refers to reducing of Mura, Muri, and Muda and improving production efficiency by leveling fluctuations in the operation.
- *Gemba*—The real place, the place where value is added. The mindset of Lean is 'go and see'. Managers should visit the worksites (Gemba) regularly in order to learn firsthand about problems and barriers to improvement. The 'Gemba walk' should not be threatening but, rather, it should be an empowering experience for everyone involved. The manager should 'ask questions, listen attentively, and show respect'.
- *5S*—The five components of 5S are: sort (Seiri), set in order (Seiton), shine (Seiso), standardize (Seiketsu), and sustain (Shitsuke). 5S is a method that reduces waste through better organization, visual communication, and general cleanliness.
- *Kanban*—Japanese for 'visual signal' or 'card'. Kanban communicates, in a clear and fast manner, what needs to be done, and when (Womack, 2010; Tsigkas, 2013).

**Using Lean Thinking to evaluate and guide a smart city**

As explained above, the smart city concept is of a dialectical nature, with both an entrepreneurial side and a social side. Lean Thinking can reconcile the two sides because it has its origins in the business sector, but it is also concerned with serving the interests of all stakeholders—owners, managers, workers, suppliers, and customers (May, 2005; Krings *et al.*, 2006; Suarez *et al.*, 2009).

Lean Thinking principles and tools can support the development of smart cities, with the strive for excellence by constant improvement (Kaizen), maximizing values for all stakeholders (Pull), offering tools to identify and eliminate waste (Muda), leveling the operation (Heijunka) by eliminating unevenness (Muri), and preventing overburden (Mura), maintaining visibility and clarity (Kanban), and tapping into the knowledge of the people in the field (Gemba). The case of Tel Aviv below explains how Lean Thinking relates to smart city goals.

**The case of Tel Aviv**
Tel Aviv was awarded the title of 'Best Smart City' at the Smart City Expo World Congress in Barcelona in 2014. The municipality explains why it began the smart city project in *Tel Aviv Smart City* (www.tel-aviv.gov.il/en):

> *Tel Aviv-Yafo, the Nonstop City, considers engagement a key value in implementing smart city principles. It actively involves residents in the urban experience and urban development…The city persistently acts to create a climate that facilitates the formation of collaborations between residents, business establishments, third sector organizations and the municipality…The technological and social tools available to the city enable better use of information and communication technologies to streamline the management of existing resources, save energy costs, provide improved service, enhance the quality of life, and fulfill the 'sustainable city' concept.*

> *A strategic plan was formulated for engaging residents [the model comprised]: Physical infrastructure —infrastructures that connect residents to the internet. Applications infrastructure—software infrastructures designed to be a platform for a wide variety of applications. The latter include the Residents Club, the Mobile App, iView, etc. Applications— applications and systems that aim to address a specific task/need. The latter include management and externalization of the information about a particular community center, messaging at the schools, etc.*

The following is a classification the smart city projects and initiatives as presented by the Tel Aviv municipality in *Tel Aviv Smart City* according to Lean Thinking principles and tools. The higher the resemblance between the initiative and Lean Thinking, the 'smarter' the project is. Quotations from *Tel Aviv Smart City*

are listed under Lean Thinking headings:

*Pull*
'Resident's Club and City Card—personalized digital communications network that is [based on] interest, site and life-situation…whose focus is our residents…they…become members of the Digi-Tel Club. Based on their unique profile, we are able to offer them information, a wide variety of special deals at cultural venues, sports arenas and other places'.

'Social Media—The Tel Aviv-Yafo municipality is…using social media to improve its communications with residents and visitors…the municipality has provided service to tens of thousands of residents through social media (Facebook, Twitter), thereby offering simple and easy access to municipal services [it] also utilizes social media as a platform for involving the public in municipal decision making'.

'Open Data—the municipality allows direct access to municipal databases that are not of a confidential nature. The environment enables the public and App developers to make use of information in municipal databases'.

'Open Archive—The engineering archive containing all the construction plans of the buildings in the city was made available to the public free of charge'.

'IView (GIS)—The municipal geographic information system, iView, makes spatial information available to the public'.

*Respect for people*
'Public participation has been part of the Tel Aviv-Yafo municipality's organizational culture for decades…In the past two years, this process has also been carried out through the digital channel. For example: involving residents and conducting a dialog with them about the design of the main beach strip; involving the public in a municipal master plan for young adults. Residents…are approached online, asking them to suggest ideas and have an impact on improving the quality of life in their neighborhood. For example: where and which trees to plant, where to install benches, whether the sidewalks need to be repaired? At the end of the process, the residents are informed about the decisions that were made'.

*Kaizen (ongoing improvement)*
'Measuring the implementation of Smart City

Principles in Tel Aviv—A number of indicators were developed comprising the picture of the future, aimed at examining the changes in the city's position. The indicators represent the main essence of the picture of the future, the strategic course of action and the Smart City vision'.

'Eco—Municipal composting program; community gardens; preserving open spaces; green construction; design and development plans; conserving water; producing solar energy on the roofs of the city's educational institutions; street lighting command and control center that conserves energy; use of green vehicles by municipal departments; use of recycled materials in municipal construction and infrastructure works'.

*Avoiding Muda (non-value adding work)*
'Mobile-Tel Aviv App…locate and navigate your way to cultural, recreational and sports events, films, and cafes throughout the city…The municipality offers a very wide range of online services that enable users to establish contact, obtain information and carry out transactions'.

*Heijunka*
'HopOn is a seamless mobile ticketing platform which allow hassle-free and real-time validations at mass transit networks'.

*Gemba*
'DCF* Advisory partners with governments, businesses and communities to accomplish nation transformation initiatives to align boardroom policy with grassroots action'.

*Kanban*
Although the project seems to score high marks as far as Lean Thinking criteria are concerned, the 'Partners' chapter of the plan raises some concerns; some of the partners are very large multinational companies, and the wording can often read very much like an advertisement, as opposed to real parameters that the kanban should show.

'Motorola supplies the communications, information gathering, Command and control and analytics infrastructure, crucial for creating a safe and secure urban environment'.

'Check Point provides a consolidated end-to-end cyber security infrastructure to the cameras

*The Municipality lists the DCF among its Smart City partners, but their actual role and status are not clear (http://www.deliveringchangefoundation.org).

that monitor the city transport routes, giving a real-time picture of the traffic. In addition, Check Point provides the entire security solution for the municipality's services connected to the Microsoft Azure Cloud Platform—so the City of Tel Aviv enjoys the most advanced and stable solution with the highest, uncompromising security level'.

'TSG has partnered with Tel Aviv-Yafo municipality in regards to the Digi-Tel program…TSG is the exclusive authorized distributer of its Digi-Tel project'.

'Microsoft CityNext is a people-first approach to innovation that empowers government, businesses, and citizens to shape the future of their cities'.

'Safer Place develops an innovative, award-winning video-based technology platform to enhance high-risk traffic and parking violations enforcement.

'The Tel-O-Fun service, executed by FSM, has changed the face of Tel-Aviv and its surrounding cities. With more than three million bike rentals a year, 200 stations, 25,000 subscriptions and more than five years of experience, FSM has established itself as an expert in the bike sharing market'.

'Gazpacho enabled flexible and affordable response to any mobile need that arises in the city'.

'DCF has joined hands with Tel Aviv municipality, the World's Smartest City and the Palladium Group, world's largest positive impacts solution provider'.

Co-operation between a municipality and the business sector is, of course, an inevitable and a positive characteristic of any smart city initiative, whether in Tel Aviv or elsewhere. Care should be taken, however, to avoid letting business interests dominate those of the city inhabitants. The way that the Tel Aviv municipality describes its business partners in *Tel Aviv Smart City* raises concerns about its ability to safeguard social and civic interests.

**Discussion and conclusions**
Since its introduction into the motor industry in the USA, Lean Thinking has migrated to different types of organizations, including in the public sector, notably in health care (Esain *et al.*, 2008), but also in other public services

(Radnor and Boaden, 2008; Radnor and Walley, 2008b; Radnor, 2010; Scorsone, 2008). However, it has rarely been employed in urban management. Urban management is experiencing profound changes as major cities strive to become 'smarter' and in doing so are using vast amounts of sparse resources with big corporations heavily involved. These developments need a coherent set of operational guidelines and a clear set of criteria for evaluation.

Lean Thinking is highly compatible with the smart city principles from economic, social, environmental, and democratic viewpoints. Its well-established methodology and tools can serve as a set of criteria for evaluating smart cities, as well as a set of guidelines for action.

The case study in this article was the Tel Aviv Smart City project as presented by the municipality. The actual implementation of the project, nor its outcomes, were evaluated. Further studies are needed with evaluations of smart city projects and to validate the use of Lean Thinking in these projects.

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**IMPACT**

The article shows that Lean Thinking can serve as a guideline and a base for evaluation for the rapidly evolving, but controversial, concept of a smart city.

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