
Smart infrastructure by (PPPs) within the concept of smart cities to achieve sustainable development

Ahmed M. Selim*

Environmental Planning and Infrastructure Department,
Faculty of Urban and Regional Planning,
Cairo University,
Giza, Egypt
and
Housing and Building Research Centre (HBRC),
Giza, Egypt
Email: en_ams@hotmail.com
*Corresponding author

Pasent H.A. Yousef

Environmental Planning and Infrastructure Department,
Faculty of Urban and Regional Planning,
Cairo University,
Giza, Egypt
and
World Association for Scientific Research and
Technical Innovation (WASRTI),
Global Research & Development Services (GRDS), India
Email: pasentyousef@gmail.com
Email: Basant-hesham@cu.edu.eg

Mohamed R. Hagag

Environmental Planning and Infrastructure Department,
Faculty of Urban and Regional Planning,
Cairo University,
Giza, Egypt
Email: redahaggag@gmail.com
Email: redahaggag@hotmail.com

Abstract: The concept of smart infrastructure is derived from the idea of smart city which is described as a comprehensive system with different elements such as people, governance, environment, economy, mobility and living conditions of a given geographical space with efficient ICT that promote smart sustainable environment. The improvement of efficiency, quality and affordable costs of providing city services to be a smart city requires huge financial investments therefore; the cooperation between the public, private sectors and civil society become inevitable to cover the cost of this trend. This paper discusses the participation of public-private partnerships (PPPs) with the civil society to

provide the finance and (intelligent) technology for the infrastructure by innovative solutions according to the available recourses and technology in the countries to achieve social, environmental and economic sustainability. Smart infrastructure for cities is adapted by introducing technology and builds smarter solutions to meet the requirements of society to avoid exploding of the existing infrastructure because of the expected tremendous pressure on it. This paper focuses on the smart city infrastructure and PPPS process to achieve smart infrastructure.

Keywords: smart infrastructure; public-private partnership; PPPs; smart cities; sustainable development.

Reference to this paper should be made as follows: Selim, A.M., Yousef, P.H.A. and Hagag, M.R. (2018) 'Smart infrastructure by (PPPs) within the concept of smart cities to achieve sustainable development', *Int. J. Critical Infrastructures*, Vol. 14, No. 2, pp.182–198.

Biographical notes: Ahmed M. Selim is a PhD candidate at the Environmental Planning and Infrastructure Department, Faculty of Urban and Regional Planning, Cairo University, Egypt. He earned his MS in Electric Energy Rationalization in Housing by Computer Applications from the Ain Shams University, Egypt. He obtained his professional program (PRMG) in Project Management from The American University, Egypt. He earned his Diploma in Data Base Management, GIS and Remote Sensing from the Faculty of Geo-Information Science and Earth Observation, ITC, Netherland.

Pasent H.A. Yousef graduated from the Faculty of Urban and Regional Planning Cairo University in 2004. She obtained her Master in 2007 and PhD in 2011 from the Architecture Department, Faculty of Engineering, Cairo University. She is a member of the Egyptian Engineer Candidate, Arab Engineering Association, and Egyptian Society for Architecture Engineer. She is currently an Assistant Professor at the Department of Environmental Planning and Infrastructure, Faculty of Urban and Regional Planning Cairo University.

Mohamed R. Hagag is an honour degree graduate of Civil Engineering at the Cairo University (1972). He obtained his Master and PhD in Civil Engineering from the Faculty of Engineering, University of Windsor, Canada in 1980. He is a registered professional and consulting engineer in both Association of Professional Engineer, Ontario, Canada and member of the Egyptian Engineers Syndicate, Arab Engineering Association, and Egyptian Society for Civil Engineer. He is formerly with Meyer and Associates in Canada, USA ID, UNICEF, and PLAN International. He is currently an Emeritus Professor at the Department of Environmental Planning and Infrastructure, Faculty of Urban and Regional Planning Cairo University.

1 Introduction

The recommendations of the 2015 UN Summit under the title (Transforming Our World: Sustainable Development Plan 2030), which had 17 main objectives, focuses on two objectives:

- a Goal 9: build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation.
- b Goal 17: strengthen the means of implementation and revitalise the global partnership for sustainable development, from this point of view, the PPPs infrastructure approach become necessary but, “It is important to see PPP in establishing smart cities not only with private companies but also with civil society organizations” (Graff, 2015).

“Critical Infrastructures is closely linked to key resources and assets leading to the confronting of risks, vulnerabilities, and fragility in order to establish resilient and smart cities realising good governance tools through the smart conditions” (Gheorghe et al., 2018). PPP means something more than Public-private partnerships (PPPs): it also means people, participation and politics. There is a wide variety of scales and topics in which local governments may establish smart PPPs, as well as a wide range of legal arrangements available for different parties. Smart PPPs are thus not to be considered a specific and rigid type of PPP but rather understood as flexible institutional arrangements between the public body and private actors that are based on the introduction of technological innovations to more conventional municipal service delivery. The development and implementation of smart PPPs must therefore go hand in hand with the innovation in management processes and administrative procedures. This is particularly relevant given that technological innovation creates fast-changing contexts, which require responsive, and flexible administrative structures and legal frameworks.

2 Research objectives and methodology

2.1 Research objectives

- 1 Identifying the concept of sustainable development goals and objectives.
- 2 Studying smart city concept within the smart sustainable city (SSC) definition.
- 3 Explaining infrastructure projects in accordance of being digital, intelligent and smart.
- 4 Analysing smart infrastructure projects financing through (PPPs) concept.

2.2 Research methodology

First there will be an introduction identifying the concept of sustainable development goals and objectives, and presenting the smart city definition and concept, then mixing both concepts to conclude the SSC definition, using the inductive method. In the second stage there will be an analysis of the infrastructure projects in accordance of being digital, intelligent and smart, using the analytical method. Finally, reaching the smart infrastructure projects financing through (PPPs) concept with identifying the fields of application and institutional prerequisites process of (PPPs) for smart infrastructure projects, using the conductive method.

3 Sustainable development

The term ‘sustainable development’ was first coined at the United Nations Conference on the Human Environment in 1972 and later gained prominence by way of a report to the United Nations by the World Commission on Environment and Development (WCED, 1987), chaired by Norwegian Prime Minister Gro Harlem Brundtland (henceforth referred to as The Brundtland Report). The definition emerging from the report, “Sustainable development is development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs” (WCED, 1987).

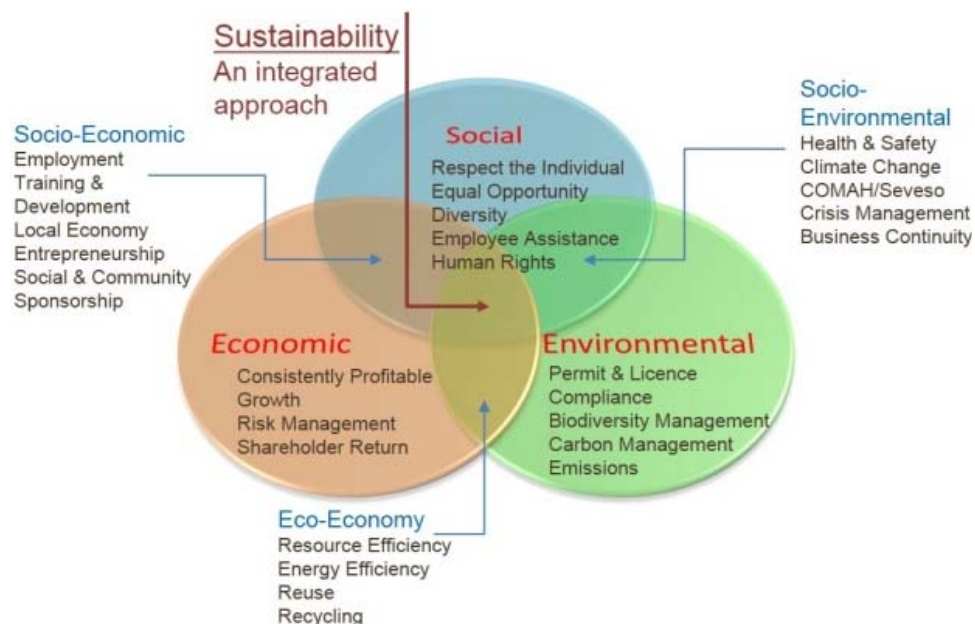
3.1 Sustainable development concepts and objectives

In 1987 after report of the World Commission on Environment and Development entitled ‘Our common future’, It contains within it two key concepts (Smith and Warr, 1991):

- The concept of needs, in particular the essential needs of the world are poor, to which over-riding priority should be given.
- The idea of limitations imposed by the state of technology and social organisations on the environment’s ability to meet present and future needs.

In 1992 after the UNCED conference in Rio de Janeiro, The objectives of sustainable development has crystallised down to entail three pillars: economic development, social development and environmental protection (Elkington, 1998).

Figure 1 The integrated nature of the concept of sustainability (see online version for colours)



Source: <http://www.environet.ie/news/sustainability>

4 Smart cities

There are many competing definitions of what a smart city; the paper adopted the definition as “Being a Smart City means using all available technology and resources in an intelligent and coordinated manner to develop urban centers that are at once integrated, habitable and sustainable” (UNCTAD, 2016a).

Smart city is distinguished by six conceptually distinct characteristics (Giffinger et al., 2007):

- Smart economy: an aspect which the authors link to a spirit of innovation, entrepreneurialism, flexibility of the labour market, integration in the international market and the ability to transform.
- Smart mobility: referred to local and supra-local accessibility, availability of ICTs, modern, sustainable and safe transport systems.
- Smart governance: related to participation in decision-making processes, transparency of governance systems, availability of public services and quality of political strategies.
- Smart environment: understood in terms of attractiveness of natural conditions, lack of pollution and sustainable management of resources.
- Smart living: involving the quality of life, imagined and measured in terms of availability of cultural and educational services, tourist attractions, social cohesion, healthy environment, personal safety and housing.
- Smart people: linked to the level of qualification of human and social capital, flexibility, creativity, tolerance, cosmopolitanism and participation in public life.
- “Smart adaptively: related to addressing the critical issues and situations that may face the city to establish a system which is fluid by its nature that will address among its challenges the critical infrastructure concept” (Gheorghe et al., 2018).

4.1 Smart sustainable cities

From the definition of the sustainable development, smart cities and six characteristics of the smart cities, we can conclude that smart cities and sustainable development are two faces for a coin, on the other hand, we can put a comprehensive definition for the SSCs as ‘A SSC is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social and environmental aspects’.¹

5 Infrastructure projects

Infrastructure projects are one of the pillars of achieving sustainable socio-economic and environmental development and a key indicator to the progress of countries. According to World Bank figures in 2015, the investment in infrastructure projects in the next five

years till 2020 will reach nine trillion dollars worldwide. The Middle East accounts for 9.2%, or about 830 billion dollars (World Bank, 2016).

5.1 Intelligent (smart) infrastructure

Infrastructure is the foundation for the development of a smart city. Smart infrastructure can be broadly divided into two categories:

- 1 physical
- 2 digital (UNCTAD, 2016b).

5.2 Physical (smart) infrastructure

It can be described according to Table 1.

Table 1 Physical Intelligent infrastructure

<i>Physical intelligent infrastructure</i>		
1	Smart buildings	A smart building integrates the different physical systems present in a building in an intelligent manner way to ensure that all the different systems in a building act together in an optimised and efficient manner. ¹
2	Smart mobility and transport	Smart mobility and transport are best described to be approaches which reduce congestion and foster faster, greener and cheaper transportation options. ² A smart city transport infrastructure aims to optimise those journeys that take place within a city, save energy and reduce carbon emissions. ³
3	Smart energy	Smart energy management systems are a potential solution to the energy issues, using sensors, advanced metres, renewable energy sources, digital controls and analytic tools to automate, monitor and optimise energy distribution and use. ⁴
4	Smart water management	System uses digital technology to help save water, reduce cost and increase reliability and transparency of water distribution. ⁵
5	Smart waste management	Will enable the monitoring of the movement of different kinds of waste. This technology can then be leveraged to better understand and manage the flow of the waste from source to disposal. ⁶
6	Smart healthcare	Refers to the provision of healthcare using intelligent and networked technologies which help monitor the health conditions of citizens. It is enabling a shift in focus to prevention instead of cure – with a broader view of overall care, healthy living and wellness management (UNCTAD, 2016b).

Source: ¹ <http://undocs.org/E/CN.16/2016/2>, ² <http://dupress.com/articles/smart-mobility-trends>, ³ http://www.smart-cities.eu/model_3.html, ⁴ <http://www.slideshare.net/IMDEAENERGIA/smart-energy-management-algorithms>, ⁵ <http://bluetechblog.com/2010/06/02/it%e2%80%99s-time-for-the-smart-water-grid/>, ⁶ <http://www.thecitiesoftomorrow.com/solutions/waste/challenges/circular-economies-sustainable-cities>

5.3 Digital (smart) infrastructure

A smart city makes optimal use of all the interconnected information available to better understand and control its operations and optimise the use of limited resources.² ICTs play an important role in this process, since they enable a digital platform from which an

information and knowledge network can be created.³ If the information is provided in real-time and accurately, cities can potentially take action before the problem begins to escalate. A smart city, therefore, can be understood a ‘predictive city’ (van den Dam, 2013). One way to look at the intelligent infrastructure is in the form of different digital supporting layers as Table 2.

Table 2 Digital intelligent infrastructure layers

<i>Digital intelligent infrastructure</i>		
1	Urban layer	This is where the physical and digital infrastructures meet. Examples include: smart buildings, smart grid (utilities – water, electricity, gas), smart waste and smart mobility.
2	Sensor layer	Smart devices which are measuring and monitoring different parameters fall into this category. The goal being to be able to sense multiple parameters such as humidity, water, energy, air quality, temperature, solar flux, occupancy, and state of equipment.
3	Connectivity layer	This layer deals with the ability to transport the data and information from the sensor level to data aggregators and storage for further analysis. A smart city will have the full range from low bandwidth sensor mesh networks all the way to high bandwidth wide area networks and everything in between.
4	Data analytics layer:	Data analytics solutions are of three principal types: <ol style="list-style-type: none"> 1 descriptive, which uses business intelligence and data mining to ask: ‘What has happened?’ 2 predictive, which uses statistical models and forecasts to ask: ‘What could happen?’ 3 prescriptive (includes cognitive), which uses optimisation and simulation to ask: ‘What should we do?’.
5	Automation layer	This is the digital enabling interface layer which enables automation and scalability for large number of devices across multiple domains and verticals. It enables the city as well and its ecosystem partners to develop smart services and initiatives.
6	Broadband connectivity	Implementing smart city technologies often requires a robust, reliable, affordable broadband network. This underlines the need to continue to focus on bridging the digital divides, in order to harness the benefits of smart applications.
7	The internet of things	Internet of things (IOT) as defined by Ashton is ‘where all objects and equipment in this world will be connected by internet. And the data generated by all these things will let the computers know so many things about people’. ¹
8	Big data	(IOT) with all the connected sensors and devices will result in enormous amounts of data. Big data refers to extremely large data sets collected in real-time. Cities will be able to use data to help improve the maintenance and sustenance of the urban environment.

Source: World Economic Forum (2015),
¹ <http://www.rfidjournal.com/articles/view?4986>

5.4 *Smart infrastructure challenges*

In applying these smart infrastructure concepts, especially in developing countries, city governments face with numerous challenges. The key themes which represent these challenges include:

- “1 adaptation of smart city concepts to local conditions
- 2 skills gap
- 3 financial constraints
- 4 applying suitable governance models
- 5 making smart city applications inclusive” (UNCTAD, 2016b).

The Science, Technology and Innovation (STI) community plays a key role in overcoming these challenges.

6 Smart infrastructure projects financing

Smart infrastructure projects financing have a special nature in terms of their size; complexity and high investment cost, therefore funding this type of projects require a huge amount of money. Sources of funding these projects are:

- a direct governmental finance
- b governmental funding by loans from local and international drains
- c funding from taxes
- d financing through tariff from the service
- e funding by the private sector (Tagen, 2007).

6.1 *Public private partnership*

PPP is one of the mechanisms which can be used to face the financial challenge for the smart infrastructure projects, PPP is “as a legally binding contract between a public sector entity and a private company – typically referred to as a concessionaire – where the partners agree to share some portion of the risks and rewards inherent in an infrastructure project” (Sabol and Puentes, 2014). Infrastructure projects are considered an effective partnership between the state and the private sector in medium and long-term projects through the implementation of the BOT system with various applications.

The BOT concept (UNCITRAL, 2001): UNCITRAL define the BOT system as, contractual arrangement between a public-sector agency and a private sector concerns whereby resources and risks are shared for the delivery of a public service or development of public infrastructure.

Several public private partnership models are shown in Table 3.

Table 3 Public-private partnership models

<i>Model</i>	<i>Description of model</i>
BOT	Build, operate and transfer
BOT	Build, own and transfer
BOO	Build, own and operate
BOOT	Build, own, operate and transfer
BLT	Build, lease and transfer
BRT	Build, rent and transfer
BT	Build and transfer
BTO	Build, transfer and operate
BOR	Build, operate and renewal of concession
DBO	Design, build, operate
DBOM	Design, build, operate and maintain
DBMF	Design, build, manage and finance
DBFO/M	Design, build, finance and operate/maintain
MOT	Modernise, own or operate and transfer
ROO	Rehabilitate, own and operate
ROT	Rehabilitate, own and transfer
O&M	Operate and maintain

Source: Summarised from Nassar (2004)

6.2 *Advantages of partnership systems*

The advantages of partnership systems can be defined as:

- a addressing the lack of government funding
- b sharing project risks with the private sector
- c increasing the efficiency of operation and maintenance
- d stimulate and develop the financial markets through offering the company's shares on the stock exchange
- e increase job opportunities
- f technology transfer
- g the ownership of the assets remains in the hands of the government
- h reducing administrative and financial corruption (Gahnem, 2009).

6.3 *PPPs for financing smart infrastructure projects*

While all cities are unique, they also have common objectives and face common challenges to achieve smart infrastructure projects as the paper mention above, one of these challenges is financing these projects. Actually the PPP for smart cities is

completely different from the traditional PPP for many reasons shown at the comparison in Table 4.

Table 4 Comparison between traditional and smart PPP

	<i>Smart PPP</i>	<i>Traditional PPP</i>
Time	Short time period.	Medium and long time period.
Type of projects	Represent small scale projects involving technological infrastructure and solutions	Large-scale physical infrastructure.
Funding and budget	Medium budget can be funded by the private sector (project company) or local banks due to the projects can be divided.	Huge budget and must be funded by international lenders or international banks.
Project company	Small and medium-sized local firms or start-ups, or engage in a technical partnership with local universities or research centres.	Big service and technology providers.
Flexibility	Flexible (ability for development and change) and innovated.	Specific and rigid.
Competition	Healthy competition and greater transparency.	Competition may depend on tender document only (a lot of constraints).
Technology	Innovation and intelligent solutions is required according to the available recourses within, Science, Technology, and Innovation (STI) concept.	Depend only in transfer the traditional technology.
Civil society participation	Civil society participation is necessary because the smart PPP projects reflect and effect directly on them, also due to the main target of these projects is to improve the quality of life for the citizens.	Private sector directly linked with the administrative institute, without any participation of the civil society.
Sustainable objectives	Innovated solutions must achieve economic, social, environmental objectives of the sustainable development in parallel.	Almost private sector concentrate in profit only without taking the social and environmental aspects in consideration.
Providing service	Private sector directly connected with the citizens by (ICT).	The state is mediator between the private sector and the user (citizens).

Source: Summarised from World Bank (2016), Uraia Workshop (2015)

6.4 Fields of application (PPPs) for smart infrastructure projects

PPP can be applied in urbanisation as (Vadgama et al., 2015):

- *City improvement (retrofitting)*: retrofitting envisions altering the existing build up area in a smart way such that it becomes more efficient and liveable. This will include improving the existing infrastructure and services to achieve the smart city objective.
- *City renewal (redevelopment)*: the existing build up infrastructure would be demolished to build entirely new structures in redevelopment. New layouts would be prepared with higher floor space index, high ground coverage and mixed land use.

- *City extension (green field development)*: introduces smart solutions in vacant areas using innovative planning, plan financing, plan implementation tools. The focus of green field would be on providing affordable housing especially for the poor.
- *Pan City*: envisages application of select smart city solutions to the existing city wide infrastructure by integrating design, technology, IT and data. Better data would mean better decisions.

6.5 The path for success (PPPs) for smart infrastructure projects⁴

Based on international case studies and the results of TM Forum Catalyst projects, we have been able to establish an agile way to define and establish PPPs. This method is applicable to any city, anywhere in the world. The path follows seven steps that will ensure the speed and success of a PPP:

- 1 *Contextualisation and assessment of needs*: each city has its own features, needs and problems. Everything should start with the understanding of the population's profile, management and local economy. After this understanding, it is necessary to address the needs and problems of citizens and public administration. This will give direction for the next steps.
- 2 *Definition of the focus and priorities*: once the needs are outlined, based on the profile of a city it is possible to identify the main focus of the PPP and organise the priorities to be addressed. Gathering the requirements with a specific focus makes it possible to draw a coherent work plan.
- 3 *Definition of the value propositions and actions to make them viable*: after focusing and understanding the needs, it is time to establish the value propositions – that is, what are the benefits, results, actions and solutions to the needs found? Each value proposition must include a set of actions required for its execution.
- 4 *Identification of the prerequisites to support the value proposition*: the actions of the value proposition may depend on certain prerequisites for its success. At this stage, such requirements must be identified. It must also be determined whether they will be part of the project scope or if they will be enabled by the city hall itself
- 5 *Establishment of the expected results and their metrics*: at this stage, it is already possible to define a set of results to be obtained from each value proposition. In order to assess such results, metrics and their indicators are required. These indicators will be used to assess the quality of services, as well as validation criteria of the deliveries.
- 6 *Indication of concession models and usage rights*: the PPP acts as a concession to the private sector for the provision of a service to citizens. This concession should act on well-defined models to allow the generation of accessory revenues capable of making the business viable. This requires that the City Hall clearly establishes the concession model and its practical and regulatory mechanisms.
- 7 *Creation of the reference project and the legal instruments*: the last one in this series of steps is the PPP's consolidation with all its necessary instruments.

7 The (PPP) development process for smart infrastructure agreements

The PPP development process enters a three-phased process

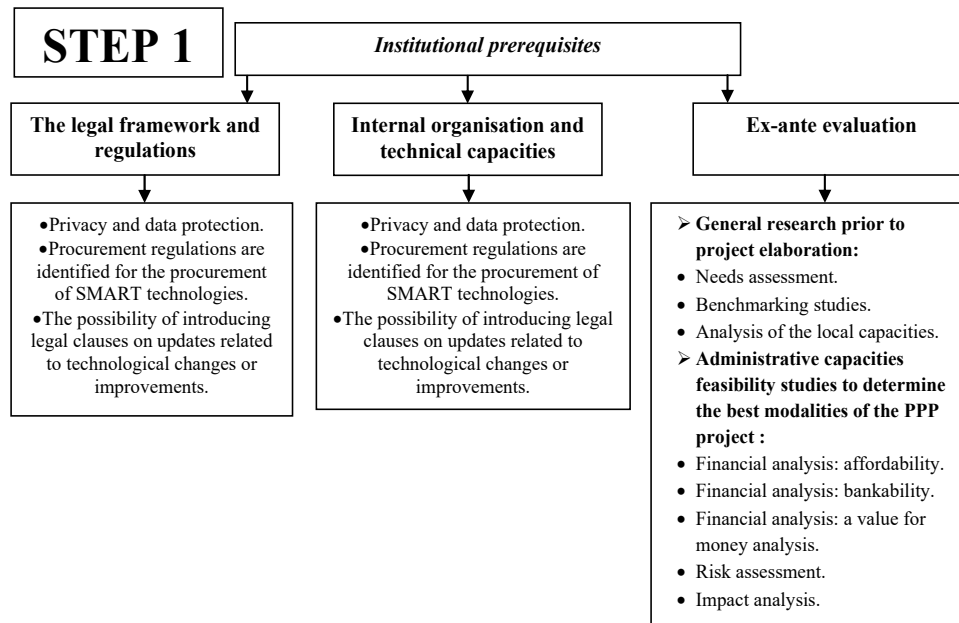
- 1 institutional prerequisites
- 2 preparation and negotiation
- 3 implementation and management.

7.1 Institutional prerequisites

Before setting the SMART PPP contract, local governments should make sure that:

- 1 The legal framework and regulations: are able to support the project, In order to avoid 'legal gaps' and problems in the project implementation.
- 2 Internal organisation and technical capacities: to avoid introducing highly sophisticated tools and developing legislative and financial complicated business models if they lack the capacity to deal with them.
- 3 Ex-ante evaluation: to elaborate the necessary studies to be sure to design the necessary evaluation requirements well beforehand.

Figure 2 Institutional prerequisites process



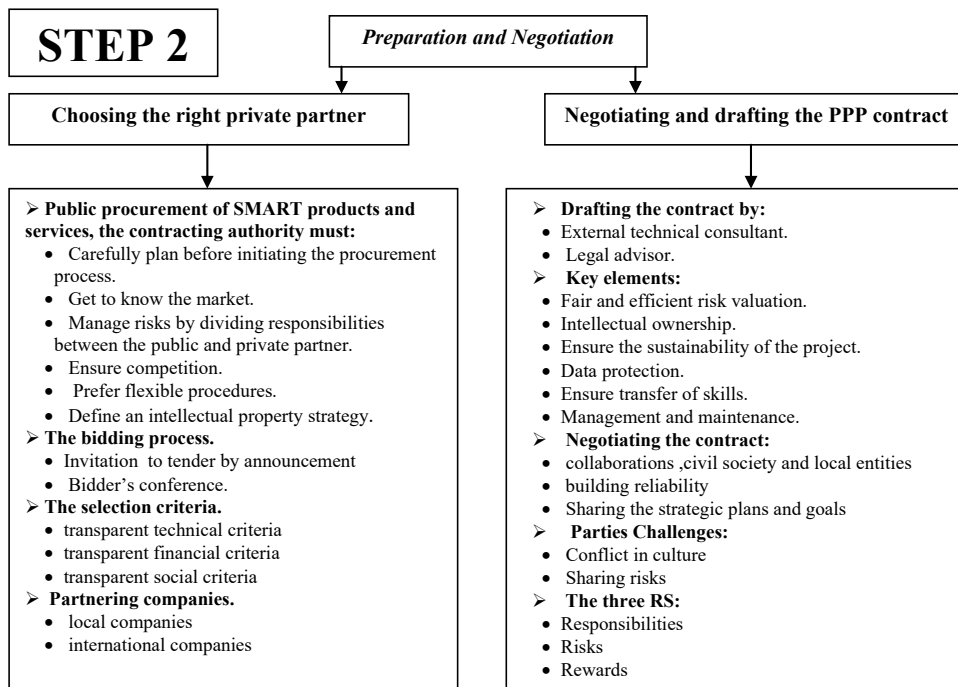
Source: Summarised from <https://inform.tmforum.org/features-and-analysis/2015/10/7-steps-to-a-successful-smart-city-public-private-partnership/>

7.2 Preparation and negotiation

The next stage relates to the public procurement that commences with the publication of the procurement notice and ends with financial close, the point at which project activities may start by:

- 1 *Choosing the right private partner* through identify public procurement of SMART products and services, the bidding process, the selection criteria, partnering with companies.
- 2 *Negotiating and drafting the PPP contract* through drafting the contract, negotiating the contract by the three Rs^{5,6,7}: responsibilities, risks and rewards, and should take into account the rights and obligations of the parties; risk allocation; service performance standards and targets; payment mechanisms; the conditions for revision, penalties, rewards and termination; among others.

Figure 3 Preparation and negotiation process



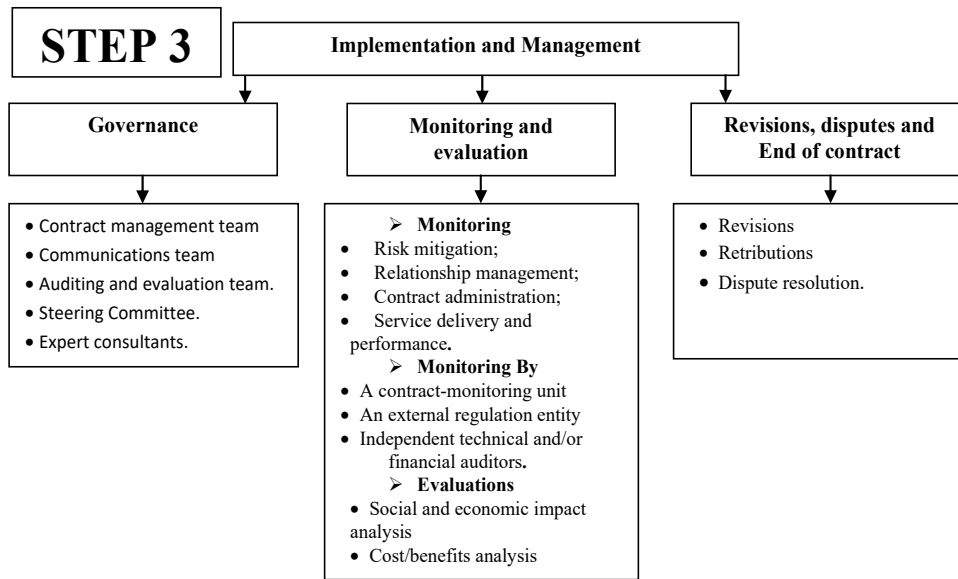
Source: Summarised from <http://ppp.worldbank.org/public-private-partnership/overview/practical-tools/sample-clauses>, <http://www.ppiaf.org/sites/ppiaf.org/files/publication/Public-Private-Partnerships-Reference-Guide.pdf>

7.3 Implementation and management

The implementation and management phase includes three key aspects: governance, monitoring and evaluation, and the revisions of the contract.

- 1 *Governance*: the organisational structure of a PPP contract.
- 2 *Monitoring and evaluation*: the type, the regularity and the indicators of the monitoring and evaluation must be defined during the procurement process and drafting of the contract.
- 3 *Revisions of the contract*: particularly in the case of PPPs for SMART projects, the contract must be flexible enough to respond to necessary revisions that arise from technological and political changes, and modifications of the institutional framework, among others.⁸

Figure 4 Implementation and management



8 Key performance indicators for evaluation (PPP) smart infrastructure process

As the research mention about the deference between the traditional (PPP) concept and the smart one, therefore, there is also difference in the key performance indicators (KPIs) for evaluation the success of each for many reasons:

- The smart (PPP) aims to improve the (quality of life), that mean the target is not to provide the basic needs, but enhancing the efficiency to achieve sustainable environmental, social and economical development.
- The smart (PPP) aims to strengthen the capacity of the local government to integrate smart technologies to their daily functions, therefore it assume that, there is a stable and transparent existing system.
- STI is the basic approach to achieve smart (PPP), not the value for many (VFM) as in the traditional (PPP).

- Smart (PPP) means something more than PPPs: it also means people, participation of the civil society and politics.
- Most of The smart (PPP) infrastructures projects are depend on the technology, and the technology is invisible, hence the civil society organisations and citizens participation in these types of projects is intuitive to collaborate and evaluate those needs.
- The smart (PPP), the local government position is at the same level of the private actor and perceive the relationship as a ‘win-win’ situation and not as one where the private actor has all the solutions.

As a result of these reasons and from the researches which discuss in deep the traditional (PPP) performance indicators through the agreement process, it can conclude that the main performance indicators for the smart (PPP) are which measure:

- 1 the civil society and citizen satisfaction
- 2 the interaction between the local government and citizens
- 3 the corresponds of the municipality for the citizens and civil society demands and needs
- 4 how the project will achieve sustainability
- 5 the participation of the citizens and civil society in the smart (PPP) process
- 6 the capability of the local government to deal with the technology
- 7 the social and environmental impact
- 8 cost/benefits (benefits are social, environmental and economic)
- 9 the ability of the agreement to be flexible.

On the other hand, the traditional (PPP) measure mainly the value for the many (VFM) indicators, due to the private sector concentrate in selling the product and looking for profit only, also the public sector concentrate in transfer the project risks for the private one.

9 Conclusions

Through the identification of the concept indicating the sustainable development goals and objectives and by linking it with the smart city concept, the conclusion was presented within the SSC definition as cities become smart when it uses the available resources and technology to achieve sustainability. And by analysing the infrastructure projects in accordance of being digital, intelligent and smart, it was found that especially in developing countries, city governments face numerous challenges. And concluding that Smart Infrastructure Projects Financing have a special nature in terms of their size; complexity and high investment cost, therefore funding this type of projects require a huge amount of money.

Then by studying some international case studies and the results of TM Forum Catalyst projects, an agile way to define and establish PPPs was concluded. There is a

huge difference between traditional (PPPs) projects and the smart one, STI which is the basic approach to achieve smart (PPPs).

The concluded frame work realised the smart (PPPs) agreements as a ‘win-win’ situation, the (KPIs) for measuring smart (PPPs) are used in measuring the civil society and citizens satisfaction, local government and municipalities which play a vital role in the success of smart (PPPs) agreements. The concluded concept reached the PPP development process for Smart Infrastructure Agreements with a three-phased process:

- 1 institutional prerequisites
- 2 preparation and negotiation
- 3 implementation and management.

And finally concluding the main performance indicators for the smart (PPP) with its identified measures.

Finally:

“Smart cities and sustainable development are two faces for a coin.”

“On the near future smart cities will be completely predictable.”

“Participation of civil society and citizens is the main pillar for smart (PPPs) agreements success.”

“In (PPPs) agreements, civil society and citizens are partners with public, private sector and sharing them responsibilities, risks and rewards.”

References

- Elkington, J. (1998) ‘Partnerships from cannibals with forks: the triple bottom line of 21st-century business’, *Environmental Quality Management*, Vol. 8, No. 1, pp.37–51.
- Gahnem, M. (2009) *Infrastructure Projects by BOT*, Alexandria.
- Gheorghe, A.V., Vamanu, D.V., Katina, P.F. and Pulfer, R. (2018) *Critical Infrastructures, Key Resources, and Key Assets*, Springer International Publishing, Cham, Switzerland.
- Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanovic, N. and Meijers, E. (2007) *Smart Cities – Ranking of European Medium-Sized Cities*, Vienna University of Technology [online] http://curis.ku.dk/ws/files/37640170/smart_cities_final_report.pdf (accessed 11 February 2018).
- Graff, G. (2015) ‘Public-private partnerships for SMART city management’, *Uraia Workshop*, Oslo, June.
- Nassar, G. (2004) *BOT Contracts and Modern Development of Concession Contract*, Dar el Nahda Elmasryia, Cairo.
- van den Dam, R. (2013) *Personal Communications, IBM Institute for Business Value*, ITU Telecom World.
- Sabol, P. and Puentes, R. (2014) *Private Capital, Public Good: Drivers of Successful Infrastructure Public-Private Partnerships* [online] https://www.brookings.edu/wp-content/uploads/2016/07/BMPP_PrivateCapitalPublicGood.pdf (accessed 11 February 2018).
- Smith, P. and Warr, K. (1991) *Global Environmental Issues*, Hodder & Stoughton Educational in association with the Open University, London.
- Tagen, R. (2007) *Partnership Contracts by PPPS*, Dar el Nahda Elmasryia, Cairo.
- The World Commission on Environment and Development (WCED) (1987) *Our Common Future*, Oxford University Press, New York.

- UNCITRAL: United Nations, Commission on International Trade Law (2001) *UNCITRAL Legislative Guide on Privately Financed Infrastructure Projects* [online] <http://www.uncitral.org/pdf/arabic/texts/procurem/pfip/guide/pfip-a.pdf> (accessed 11 February 2018).
- UNCTAD (2016a) *PPP for Cities, Inter-Sessional Panel on Smart Cities and Infrastructure and Foresight for Digital Development*, Washington, DC, January.
- United Nations Commission on Science and Technology for Development (UNCTAD), Inter-Sessional Panel (2016b) *Smart Cities and Infrastructure*, Budapest, Hungary.
- Uraía Workshop (2015) *Public-Private Partnerships for SMART City Management*, Oslo, June.
- Vadgama, C., Khutwad, A., Damle, M. and Patil, S. (2015) 'Smart funding options for developing smart cities: a proposal for India', *Indian Journal of Science and Technology*, Vol. 8, No. 34, pp.1–12.
- World Bank (2016) *Benchmarking Public-Private Partnerships Procurement 2017: Assessing Government Capability to Prepare, Procure, and Manage PPPs*, Washington, DC.
- World Economic Forum (2015) *Expanding Participation and Boosting Growth: The Infrastructure Needs of the Digital Economy*, March [online] http://www3.weforum.org/docs/WEFUSA_DigitalInfrastructure_Report2015.pdf (accessed 11 February 2018).

Notes

- 1 <http://www.itu.int/en/ITU-T/focusgroups/ssc/Pages/default.aspx>
- 2 <http://www-03.ibm.com/press/us/en/pressrelease/27791.wss>
- 3 <https://itu4u.wordpress.com/category/contributors/maria-paula-sartori/>
- 4 <http://ppp.worldbank.org/public-private-partnership/legislation-regulation>
- 5 <http://ppp.worldbank.org/public-private-partnership/overview/practical-tools/sample-clauses>
- 6 <http://ppp.worldbank.org/public-private-partnership/overview/practical-tools/sample-clauses>
- 7 <http://www.ppiaf.org/sites/ppiaf.org/files/publication/Public-Private-Partnerships-Reference-Guide.pdf>
- 8 <http://ppptoolkit.icrc.gov.ng/contract-management/contract-monitoring-framework>