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Towards a Frame of Reference for Smart City Strategy Development and Governance

Zineb Korachi and Bouchaib Bounabat

ALQUALSADI Team, ADMIR Laboratory Rabat Information Technology Center ENSIAS/
Mohamed V University, Rabat, Morocco

Abstract: Despite the importance of the smart city concept, few works address how to define and implement smart cities in a clear manner. Furthermore, the smart city literature provides heterogeneous studies and solutions; this heterogeneity creates misunderstanding regarding the smart city definition and strategy. Moreover, stakeholders have multiple and conflicting interests and concerns, which also increase the ambiguity regarding the smart city concept and approach. To meet this challenge and fill this gap, a smart city frame of reference is needed to frame and guide smart city strategy formulation and implementation. In this perspective, the current research conducts a quantitative analysis of various smart city frameworks and strategies, in order to find and demonstrate the common building blocks of a smart city framework. Based on the quantitative analysis, this work proposes a clear and integrative smart city framework. This framework aims to reduce the misunderstanding and ambiguity regarding smart city definitions and strategies by providing a standard smart city approach that fits all smart city contexts. To this effect, the proposed framework considers all smart city concerns and it is composed of the following blocks: Strategic awareness, business strategic planning, IT investment decisions, IT organizational structure, steering committee, IT prioritization process, IT strategic planning, IT budgeting, marketing plan, IT reaction capacity, IT reporting and management strategy.

Keywords: Smart City, Smart City Strategy, Frame of Reference, Smart City Governance

Introduction

The world's urban population will double from 2010 (2.6 billion) to 2050 (5.2 billion) (Letaifa, 2015). In this regard, cities will face challenges concerning growth, performance, competitiveness and residents' livelihoods; therefore, leaders must design new strategies to enhance city performance and sustainability (Letaifa, 2015). Smart city strategies play a decisive role in how cities will choose to take advantage of technology to favor the development of innovation networks, healthy societies and dynamic economies (Angelidou, 2015a). Therefore, it is essential to study them methodically and cohesively, both on policy design and on a policy implementation level (Angelidou, 2015a).

Smart cities have attracted extensive and increasing interest from both science and industry with an increasing number of international examples emerging from across the world (Anthopoulos *et al*., 2015). However, despite the significant role that smart cities can play to deal with recent urban challenges, the concept has been criticized for being influenced by vendor hype (Anthopoulos *et al*., 2015).

Strategic planning for smart city development remains a rather abstract idea for several reasons, including the fact that it refers to-as yet-largely unexplored and interdisciplinary fields (Angelidou, 2014). Moreover, stakeholders are often driven by conflicting interests (Angelidou, 2014); stakeholders' concerns are multiple and diverse and there are a high interdependency and heterogeneity of technologies and solutions (Bastidas *et al*., 2017). Therefore, there is currently a great misunderstanding and ambiguity about what smart cities are, let alone how they can be realized (Angelidou, 2014). Furthermore, strategic planning for the development of smart cities is still a largely unknown field (Angelidou, 2014).

In this regard, despite the ongoing discussion of the recent years, there is no agreed definition of a 'smart city', while strategic planning in this field is still largely unexplored (Angelidou, 2015a). Therefore, there is a great challenge in developing and implementing smart city strategies in an integrated and meaningful way, with so much unstructured and disorienting information available (Angelidou, 2015b).

Various organizations and scholars have approached smart cities with different models (Anthopoulos *et al.*, 2015). The overview of these models shows the heterogeneity of the smart city concept; the broadness of these aspects increases the unclarity of the concept (Anthopoulos *et al.*, 2015). In this perspective, despite the relevance of the topic, still few studies investigate how to define and implement a smart city in an integrative and clear manner (Agbali *et al.*, 2019).

Many of the smart city strategies efforts are fragmented, stressing only some aspects of the smart city, rather than approaching them in an integrated way (Angelidou, 2015a). Some of these frameworks focus on city goals, objectives and indicators whereas others emphasize solution architectures and technical details (Bastidas *et al.*, 2017). This enhances the misunderstanding and ambiguity of the smart city idea and strategy further, rather than resolving it and enabling actionable smart city planning (Angelidou, 2015a). To meet this challenge, there is a need for a smart city frame of reference that frames and guides smart city strategy definition and implementation.

Smart city implementations differ according to the city characteristics but the frame of reference for smart city implementation is the same. A universal fixed smart city strategy may be difficult to define with the variety of characteristics of cities worldwide (Albino *et al.*, 2015). However, this work aims to build a holistic smart city frame of reference that facilitates and guides smart city strategies development.

The literature is suggesting that the Smart City concept requires further investigation and values directing the outcomes of smart technologies (Allam and Newman, 2018). Rather than just allowing as much ICT investment as possible, commentators have suggested ICT can be directed into creating a much more inclusive governance system (Allam and Newman, 2018). Further studies could deep the analysis of smart cities applying a glocal approach, to design a worldwide panorama of global-local smart city features (Dameri *et al.*, 2019). Some other interesting smart city themes to be also deepened for further works are presented by Dameri as follows: Identification of a clear definition of a smart city; definition of the smart city goals and the measurements; collection of best practices (Dameri and Rosenthal-Sabroux, 2014).

The current paper aims to address the further studies suggested above by (Allam and Newman, 2018),

(Dameri *et al.*, 2019) and (Dameri and Rosenthal-Sabroux, 2014). In this regard, this work defines the concepts shaping the smart city definition and strategy in order to reduce the misunderstanding and ambiguity regarding smart city strategies and to assist smart city leaders in formulating, implementing and governing smart city projects and transformations. To this effect, the current study commences by reviewing, comparing and analyzing different smart city strategies, approaches, frameworks and components. Then, it analyzes their strengths and weaknesses, in order to provide a "one-size fits all" smart city framework that answers the following research question: What are the main components of the frame of reference for smart city strategy formulation and implementation?

The paper is structured as follows: Literature Review, followed by Research Methodology, followed by Results, Discussion and Conclusion.

Literature Review

A systematic review of smart city strategies literature was performed, leading to a discussion of smart city definitions and smart city strategy components.

Smart City Definition

Despite the extensive discussions regarding the smart city concept, no agreed definition of 'smart' and 'intelligent' cities exists; in the smart cities' arena, there is a multitude of definitions and solutions without an existing prevalent or universally acknowledged definition (Angelidou, 2014; Saraju *et al.*, 2016). Table 1 illustrates a list of smart city definitions; the most relevant concepts of the below smart city definitions are summarized and factorized in the following definition:

A Smart City is an urban innovation ecosystem where knowledge easily flows among different stakeholders to create wealth, supported by a flexible institutional structure, based on an integrated-participative governance model (Camboim *et al.*, 2019). This ecosystem is a complex system based on a conceptual development model that use ICT and centralize data integrating the management of all the critical city infrastructure for increasing urban sustainability; achieving an ideal future; optimizing the resources; keeping an eye on the security issues; developing a greener, safer, faster and friendlier city; providing more flexible, efficient and sustainable networks and services; improving competitiveness, quality of life, efficiency and sustainability of urban operations and services; meeting the needs of present and future generations; respecting economic, social and environmental aspects.

Table 1: Smart city definitions

Definition	Source
A smart city is a place where **networks** and **services** are **more flexible**, **efficient**, and **sustainable** with the **use of ICT**, to improve its operations for the benefit of its inhabitants; **smart cities** are **greener**, **safer**, **faster**, and **friendlier**.	(Mohanty *et al*., 2016)
Smart cities represent a **conceptual development model** that aspires to **use ICTs** for the development of a city's human, collective and technological capital, with the ultimate scope of **increasing urban sustainability** and **achieving an ideal future** of an urban settlement that harnesses technology.	(Angelidou, 2016)
Smart cities are an endeavor to **make cities more efficient, sustainable, and livable;** a smart city is a city that can **monitor and integrate the functionality of all the critical infrastructure** like roads, airways, railways, waterways, railways, etc., **control maintenance activities** and can help in **optimizing the resources** while **keeping an eye on the security issues** as well.	(Joshi *et al*., 2016)
A smart city is an **innovative city** that **uses ICTs** and **other means** to **improve quality of life**, the **efficiency of urban services and competitiveness,** while ensuring that it **meets the needs of present and future generations** with **respect to economic, social and environmental aspects**.	(Mohanty *et al*., 2016)
The Smart City concept embraces more than just the **use of ICT**, where ICT often is seen as a means to **achieve better city services** and/or more **efficient city administration**.	(Anthopoulos, 2017)
Smart Cities must **encourage technology**, but the overarched dimensions must be **focused on people**; hence aimed towards **improving urban livability with three key dimensions: Culture, metabolism, and governance**.	(Allam and Newman, 2018)
A Smart City must include key components that allow **data centralization**, components that can take many forms, starting from a **simple website** to **complex applications**, supported by **specialized hardware**; the **accessibility of the data** should be guaranteed in a way that the system can be freely accessed by citizens, allowing them to propose changes and corrections in an **interactive way**.	(Rotună *et al*., 2019)
A Smart City is an **urban innovation ecosystem** where **knowledge easily flows among different stakeholders** to **create wealth**, supported by a **flexible institutional structure**, based on an **integrated-participative governance model**.	(Camboim *et al*., 2019)

Smart City Strategies and Frameworks Review

This section analyzes different smart city frameworks and strategies, and it organizes them chronologically to present what each research has added in comparison to older studies. To this effect, this section presents and discusses the relevant blocks, strengths, and weaknesses of these frameworks.

Rudolf *et al*. (2007) suggest six domains of smart city implementation: Smart economy, smart governance, smart people, smart living, smart mobility, smart environment. Further, they provide a list of smart city characteristics, factors and indicators. However, they do not address processes on how to implement a smart city.

Chourabi *et al*. (2012) contribute to the smart city strategy literature by providing a list of elements that should be highlighted by the smart city strategy, namely: Smart city goals (Natural resources management and protection, Economic competitiveness…), challenges (Manager's attitudes and Behavior, Resistance to change, Unclear vision of IT management, Politics…), smart city main components (leadership and champion, collaboration, service and application integration) and smart city critical factors (Management and organization, Technology, Governance, Policy context, People and communities, Economy, infrastructure and Environment).

Dameri and Rosenthal-Sabroux (2014) analyze smart city architecture and suggest four smart city dimensions: Land, infrastructure, people and government. These dimensions overlap with the domains proposed by (Rudolf *et al*., 2007).

Angelidou (2014) presents different policies of smart city strategies (National versus local strategies, urban development stage, hard versus software-oriented strategies and economic sector-based versus geographically based) and discusses the advantages and disadvantages of each one. It also provides a list of cases of applied smart city strategies for each type (ex: National strategy - Malta, Local strategy - New York City, New City - Songdo IBD…). Angelidou (2014) provides the following recommendations for the development of smart cities: See what is already in place and how it can be improved; selecting a few domains or areas that need to be improved urgently; selectivity, synergies and prioritization are three standard core values in planning a smart city; stakeholder engagement; …etc. The smart city elements proposed by Angelidou (2014) in this research are relevant for smart city implementation, but cities need a clear process for city transformation into a smart city.

Angelidou (2015a) describes and discuss the strategic approach of the following smart city cases:

- New York's Digital Roadmap of 2011 is composed of 4 dimensions: Industry, citizen engagement, internet connectivity for all, open government (Angelidou, 2015a).
- Smart Barcelona's vision outlines are urban mobility more efficient and sustainable, business-friendly and attracting capital, environmental sustainability, communication and proximity with people, knowledge, creativity, innovation, integration and

social cohesion, transparency and democratic culture, universal access to culture, education and health (Angelidou 2015a).

- Smart London Plan of 2013 is based on Citizen life improvement, open data and transparency, technology and innovation, efficiency and resources management, collaboration and engagement (Angelidou, 2015a).

Based on the study and analysis of these smart city strategies cases, (Angelidou, 2015a) proposes a smart city framework composed of a conjuncture of four forces: Urban futures, knowledge and innovation economy, technology push and application pull. This framework is not clear and it does not provide guidelines for smart city implementation.

Angelidou (2015b) presents a relevant framework for smart city development; the framework is composed of the following phases: Situation analysis, strategy development, strategy implementation, strategy control. Angelidou (2015b) provides a lot of important details about the building blocks of these phases, but it does not provide clear processes for how to implement these phases and their building blocks. Furthermore, Angelidou (2015b) describes the strategy control, but it does not provide how to perform it. In this regard, it suggests the following future research: Smart city KPIs, Innovative Business and Governance Models, user engagement in smart cities -especially planned ones, privacy and security in smart cities.

Petrolo *et al*. (2017) explain that in the context of smart cities, it makes sense to consider the scenario of the various and heterogeneous devices, the wireless sensor networks interconnected to each other and to exploit these 'interconnections' to activate a new type of services using Internet of Things. In this regard, Petrolo *et al*. (2017) present a list of relevant smart city concerns:

- Smart city challenges: Interoperability, processing of a huge amount of real-time data, heterogeneous resources mashup.
- Domains that are impacted by IoT platforms and applications: eHealth, smart environment, home automation, smart water, …etc.
- Smart city requirements, namely: Service, application and operational.
- Smart city stakeholders: Citizens, educational institutions, health care and public safety providers and governmental organizations.
- Smart city network infrastructure characteristics: Highly interconnected, cost-efficient, energy-efficient and reliable.
- Smart city dimensions: Governance, people, economy, living, environment and mobility.

- Smart city platform components: Devices, applications, services, data management services, IoT platforms and data sources.
- Smart city devices: Sensors, smartphones, RFID, NFC.

Petrolo *et al*. (2017) is a very rich study that enables to identify the smart city concerns and components. However, it does not address a clear smart city implementation approach.

Letaifa (2015) conducts an inductive qualitative analysis in three major smart cities (Montreal, London and Stockholm) to describe that these cities follow a similar strategizing process. However, each city has a distinctive strategy corresponding to the city's identity and values. This comparison identifies key factors in the different stages of a city transformation process into a smart city. These factors and stages are organized in a SMART model for city transformation into a smart city. the SMART model is composed of 4 elements: Strategy levels (Macro, Mezzo, Micro), Strategic steps (Strategy definition, Mobilizing multidisciplinary actors and resources, actors appropriation of the project, Strategy implementation, identification of required technologies), dimensions (objectives, mission, vision, values, resources, political sponsorship, leadership, actors, collective intelligence, integration of resources, users co-creation, legitimacy, integration, iteration, convergence, action plan, projects, objective achievement) and strategic steps focus (scope, mindset, agility, rigor, transformation). This model contains clear steps for strategy development, but it is not an integrative model; for example, it does not address financial management.

Albino *et al*. (2015) conduct a literature review and analysis regarding smart city definitions, components and performance measures. Albino *et al*. (2015) is a useful study to assist policymakers in learning how to identify the relevant elements to consider in smart city development. However, it does not identify clear steps for smart city strategy elaboration.

Hamza (2016) provides a smart city implementation framework for developing countries (Egypt case) composed of the following elements: Smart city structure, smart city factors and smart city strategy. Hamza (2016) does not provide clear guidelines for smart city strategy development; however, it is an important framework that can contribute to the building of a standard smart city approach.

Khatoun and Zeadally (2016) present a list of Smart city projects around the world, their goals, characteristics and partners. Furthermore, they present a list of smart city components (Broadband infrastructure, E-services, Sustainable infrastructures, E-governance, Fundamental technologies) and challenges (Lack of investment, High

energy consumption, Smart citizens, Privacy, Cyberattacks). Khatoun and Zeadally (2016) claim that most smart city models consist of the following six components: Government, economy, mobility, environment, living and people.

Mohanty *et al.* (2016) present and describes smart city components and characteristics; the smart city components are: Infrastructure, building, transportation, energy, health care, technology, governance, education, citizen; the smart city characteristics are: Sustainability, quality of life, urbanization and smartness.

Joshi *et al.* (2016) identify six relevant pillars for smart city development: Social, management, economy, legal, technology and sustainability. Furthermore, Joshi *et al.* (2016) throw light upon how these pillars can make the smart city initiative a successful project. However, they do not provide information and processes on how to implement them or involve them in a smart city strategy. In this regard, Joshi *et al.* (2016) propose a vague framework, rather than providing clear guidelines for assisting the smart city strategy development.

Angelidou (2016) provides a list of smart city strategic objectives and characteristics, namely: Central role of technology, human and social capital advancement, business sector advancement and networking. Furthermore, Angelidou (2016) presents the status of four European smart city cases (Amsterdam Smart City, Barcelona Smart City, Smart London Plan and Stockholm Smart City) regarding the proposed smart city characteristics.

Bastidas *et al.* (2017) propose to view a city as an urban enterprise to achieve alignment between the city business strategy and the smart city solutions and to support its development and transformation. In this regard, Bastidas *et al.* (2017) use the Open Group Architecture Framework (TOGAF) to compare selected smart city frameworks; this comparison indicates that few frameworks are just concentrated on the business layer (goals, objectives and city indicators), whereas the majority are focused on data, application and technology layers (i.e., solution architecture and technical details).

The results of (Dameri *et al.*, 2019) study presents that the smart city is not a global strategy, to be implemented in the same way and with the same processes all over the world; however, there are some common standard aspects, namely:

- Smart city standard components: Land, infrastructures, people, government
- Common aspects in global cities: Role of ICT, technologies to produce clean energy from renewable sources, smart mobility, technologies for building heating and cooling…, etc.
- Shared goals: CO_2 emission reduction, digitalization of public and private services

Despite their contribution to extending the literature on smart cities' strategies, Dameri *et al.* (2019) do not aim at delivering practical indications of best practices in implementing technical smart solutions (Dameri *et al.*, 2019).

Reiber and Huang (2018) present a comparative study on smart city strategies in Berlin and Shanghai. The comparison is performed based on a smart city model and index. The model is composed of six dimensions (smart governance, economy, environment, mobility, living and people) and 16 factors assigned to those dimensions (smart city strategy, participation, online services, open government, innovation, access to real-time information, smart cards, smart resource management, smart healthcare, individual safety, public safety, smart education, creativity, internet connection, sensor coverage, integrated public operations). The smart city index is calculated based on 29 smart city indicators (ex: % commercial and industrial buildings with smart meters, % education institutions that provide smart education services, etc…); the proposed index is calculated based on a fixed list of smart city KPIs, for this reason, it cannot be used by all smart cities' contexts.

Hämäläinen and Tyrväinen (2018; Hämäläinen, 2020) propose a smart city framework composed of four dimensions-strategy, technology, governance and stakeholders. The framework aims to improve and develop the sustainability and governance of smart city projects. However, it is not a well-detailed framework and it does not provide clear steps and processes of how to implement those smart city dimensions or how to involve them in a smart city strategy. Furthermore, this framework does not discuss how to evaluate the management and success of smart city projects.

Allam and Newman (2018) propose a smart city approach composed of the following values: Culture, metabolism and governance. This approach places the human values dimension at the core of urban smart city policy but it is far from the "one-size fits all". The proposed approach aims at redefining the smart city paradigm by focusing on the three pillars of metabolism, culture and governance. However, this approach does not provide clear and consistent steps for implementing technical smart solutions.

Kesswani and Kumar (2018) propose a smart city model called Smart-X which combines various smart city features suggested by different smart city works. The Smart-X model is based on the following elements: Smart living, smart economy and smart safety. The Smart-X model doesn't provide a clear smart city strategy; however, it is an important model that can help in the definition of smart city dimensions and parameters.

Alizadeh and Irajifar (2018) expose a relevant list of elements and best practices (organizational and

operational capital, economic and financial capital, human and social capital, infrastructure and physical capital) that should be highlighted in a smart city strategy, however, they do not address clear guidelines and processes to implement a successful digital transformation strategy.

Taamallah *et al*. (2018) propose a design process of the smart city strategy; this process aims to guide stakeholders in designing smart city strategies in a generalized manner. The process is composed of the following seven steps: City problems identification and analysis, vision identification, mission and values definition, goals identification, objectives identification, strategies definition and projects definition. This process is not clear and does not contain sufficient information and details for helping city leaders developing an integrative smart city strategy. Moreover, it does not address all smart city concerns for example it does not provide processes on how to manage financial issues.

Haller *et al*. (2018) propose a smart city strategy framework composed of four dimensions: City context, governance, implementation and infrastructure. To practice and evaluate the proposed framework, Haller *et al*. (2018) conduct a comparison of six smart cities (Amsterdam, Murcia, Sapporo, Tokyo, Yokosuka, Zurich) using the dimensions of this framework. This comparison demonstrates that the proposed framework does not address all smart city dimensions and concerns; for example, it doesn't address maturity levels and cultural differences.

Komninos *et al*. (2019) present a general roadmap for smart city planning which is composed of the following steps: Challenges and assets definition, governance, strategy development and strategy implementation. However, this roadmap does not contain clear and well-documented steps for strategy development.

Smart city projects have many benefits, but the security risks of data and services cannot be avoided (Alam and Ibrahim, 2019). In this regard, Alam and Ibrahim (2019) highlight an important smart city dimension, which is smart city security. To this effect, Alam and Ibrahim (2019) describe a cybersecurity strategy for the development of secure smart cities; the proposed cybersecurity strategy is based on three dimensions: People, technologies and institutions; It is a relevant strategy that can be incorporated into a smart city strategy for enabling a secure smart city.

Asri *et al*. (2019) present a rich literature review about smart city components and models; they discuss a list of relevant smart city elements namely:

- Smart city components: Infrastructure, citizen, building, transportation, energy, healthcare, technology, governance and IoT.

- Smart city characteristics: Smart people, smart governance, smart mobility, smart environment and smart living.
- Smart city layers: Infrastructure, Management, Application and Stakeholder.
- Smart city dimensions: Strategy, technology, governance and stakeholders.
- Smart city architecture levels: Data collection, data processing, data analysis and integration, production and use of information.

Furthermore, Asri *et al*. (2019) provide a new smart city model composed of the following elements: Infrastructure, Environment, IoTs and culture. However, this model is not integrative and does not provide clear guidelines for implementing a smart city approach.

Taamallah *et al*. (2019) identify a generalized smart city development process which is composed of four phases (Pre-Design, Design, implementation, evaluation) and nine steps (learn from smart city initiatives at the international level, collect information about the city and identify problems, define the vision, define missions and values, define goals, define objectives, define strategies, plan and implement projects, evaluate and make decisions). Further, they propose a web-based platform that allows stakeholders to communicate, design and share strategies for smart city development. The smart city development process proposed by Taamallah *et al*. (2019) is not holistic (ex: Financial management and IT governance are missing) and it contains redundant steps (ex: "Goals Definition" should be incorporated in the "Strategy Design" phase).

Maestre-Gongora and Bernal (2019) propose a conceptual model for developing smart cities and analyzing the level of IT management capacity in smart cities projects. The model is composed of five domains (e-government strategy, Public Innovation, Data Management, IT Services and Infrastructure) that are described in terms of key domain areas, objectives and questions. It is a relevant model, but it does not define evaluation mechanisms as maturity levels, indexes, or rankings. Moreover, it does not present clear processes for smart city development.

Korachi and Bounabat (2019a) provide an approach for leading the digital transformation of cities into smart cities. This approach contains the following processes: Strategic vision definition, action plan elaboration and management strategy definition. This approach is not addressing all smart city strategy concerns for example the financial management and the IT governance are missing.

Kadhim (2019) highlights smart cities' components, characteristics, aims, requirements and

key challenges. Further, presents the experience of Dubai along with key pillars (telecoms, tourism, utilities, education, buildings, public safety, transportation and healthcare) and phases (Smart Life, Smart Economy and Smart Tourism). Therefore, this work highlights an important list of smart city elements that can help in the elaboration of the frame of reference for smart city development.

Picardal *et al.* (2020) present the transformation of Bellevue city in Washington to a Smart city. This transformation is started by testing a water module in its new City Portal, starting with a dashboard that would organize and optimize data for a better customer, utility and city experience. Further, two KPIs were used to assess the City Portal: (1) The total number of water quality complaints each month and (2) the average time to respond to water quality complaints. Picardal *et al.* (2020) present a Software Module Development approach based on the following features: Extract-Transform-Load (ETL) scripts, Long-term storage, Short-term storage, Application Programming Interfaces (APIs) and web interfaces.

Ngan and Khoi (2020) conduct a qualitative analysis using the Partial Least Squares Structural Equation Model to validate the following smart city factors: Smart economy, smart governance, smart environment, smart citizens, smart traffic and smart living. These factors are also presented in (Rudolf *et al.*, 2007).

Noori *et al.* (2020) classify the pathways for smart city development via comparing the implementation pathways of four smart cities: Smart Dubai, Masdar City, Barcelona Smart City and Amsterdam Smart City. The comparison is done using an Input-throughput-Output model for smart city development. It is a model that characterizes inputs (resources), throughputs, outputs (applications) and outcomes (externalities) of the smart city development process. Noori *et al.* (2020) do not address strategic guidelines for smart city development; however, they present relevant smart city elements that contribute to the smart city strategy development. These elements are:

- Smart city main drivers: Innovation, inclusion, visionary-ambitious leadership, technological optimism.
- Smart key features: Competition, entrepreneurial Innovative, Citizen empowerment…., etc.
- Smart city applications: Smart mobility, smart energy, smart health, smart citizens, smart governance.
- Smart city inputs: Human resources, entrepreneurship, ICT, data and financial resources.

- Smart city throughputs: Governance, knowledge and innovation management, data management and financial management.

There is an interference between the smart city studies cited above, this creates an ambiguity regarding smart city definition and strategy. Hence the need for a clear, holistic and standard smart city approach. Few frameworks are indeed concentrated on providing clear guidelines for smart city strategy development; the majority are focused on providing smart city components, elements, or dimensions. Researches are more concentrated on defining business strategic planning elements especially smart city goals and objectives and they forget defining actions and processes to achieve these goals and govern the transformation of the city into a smart city. Even researches that mention action plans do not mention their steps and details, they only mention the action plan concept in a general manner. In this regard, the current research tries to take advantage of all these studies to build a general smart city framework that fits all smart city contexts and assists smart city leaders to build and manage smart city strategies.

In order to synthesize the works cited above and give a global and concise view of these studies, the next sections present a comparative study of these works, which helps to describe the weaknesses of the existing literature in a clear manner and identify the solution.

Research Methodology

To answer the research question, this work supposes that the smart city approach proposed by (Korachi and Bounabat, 2019a) is integrative (Table 2) and it conducts a comparative study to test the validity of this hypothesis. In this regard, the following hypotheses have been defined:

Hypothesis 1: Strategic Vision Definition is an important block of the smart city strategy.

Hypothesis 2: Action Plan Definition is an important block of the smart city strategy.

Hypothesis 3: Management Strategy Definition is an important block of the smart city strategy.

Hypothesis 4: The Smart City Approach proposed by Korachi and Bounabat (2019a) is integrative.

To test these hypotheses and evaluate the smart city approach proposed by (Korachi and Bounabat, 2019a), a quantitative analysis was adopted and presented in the following sections.

Table 2: Korachi and Bounabat (2019a) smart city approach components

Processes	Steps (Korachi and Bounabat, 2019a)
Strategic Vision (SV)	Determine why the city need smart transformation (**SV01**)
	Gather Information on the internal et external environment of the city (**SV02**)
	Identify stakeholders and their engagements (**SV03**)
	Identify and describe strategic goals (**SV04**)
	Identify challenges (**SV05**)
	List smart city trends (**SV06**)
	Lead benchmarking (**SV07**)
	Determine city strengths and weaknesses (**SV08**)
	Identify the main components that will be highlighted through the transformation strategy (**SV09**)
	Define desired outcomes, changes and impact of the smart transformation (**SV10**)
	Identify the required components and resources for achieving desired goals and outcomes (**SV11**)
	Identify gaps (**SV12**)
	Identify opportunities (**SV13**)
Action Plan (AP)	Determine existing success potentials (**AP01**)
	Establish a list of city departments and business processes (**AP02**)
	Identify the engagements (activities) of each city department for achieving strategic goals (**AP03**)
	Establish the list of activities, define their input and output and determine dependencies between activities (**AP04**)
	Identify the programs list (**AP05**)
	Identify the projects list (**AP06**)
	Establish the list of resources required to achieve the activities, programs and projects (**AP07**)
	Elaborate a time-sheet for the smart strategy implementation (**AP08**)
Management Strategy (MS)	Define appropriate KPIs (**MS01**)
	Evaluate the maturity level of the digital transformation (**MS02**)
	Representation of KPIs in a dashboard (**MS03**)
	Control the smart city evolution and rank (**MS04**)
Others	New smart city strategy blocks

Results

To test the above hypotheses, an analysis and comparison of the cited smart city strategies were conducted and presented in Tables 3 and 4. The comparison is done using the components of the smart city approach proposed by (Korachi and Bounabat, 2019a).

The analysis of the cited smart city strategies and frameworks has identified new smart city blocks; the number of new smart city blocks is presented in the last column of Tables 3 and 4.

Figure 1 shows that the elements of the smart city approach proposed by (Korachi and Bounabat, 2019a) are important and they are present in several works in the literature, but according to the literature analysis, most of these works focuses on the smart city elements, components and dimensions (SV09), rather than addressing a clear and consistent smart city implementation process; studies are more focusing on defining business strategic planning elements, especially smart city objectives and they forget defining the required actions and processes to achieve these goals and govern the smart city implementation for a successful city transformation into a smart city. Some studies mention action plans in their smart city approaches; however, they do not mention how to define them.

In this regard, few studies offering a clear process with clear steps that helps cities to develop their strategies to transform a city into a smart city. However, these studies are not addressing all smart city concerns,

they are focusing on smart city components, applications and technologies and they are missing the other aspects that can contribute to the success of a smart city strategy like IT Strategic Planning, IT Organizational Structure, IT Reporting, IT Budgeting, IT Investment Decisions, Steering committee, IT Prioritization Process, IT Reaction Capacity. To fill this gap, the current study defines an integrative smart city strategy frame of reference based on the analysis of the different smart city components and frameworks proposed in the literature.

Table 5 shows the new smart city strategy concepts extracted from the literature analysis. These new concepts are presented as follow:

- Angelidou (2015a) proposes the following five new concepts: Strategy Phases (Situation Analysis, Strategy Development, Strategy Implementation, Strategy Control), Marketing Plan, Corrective Action, Success Factors (The most important critical success factors in smart city strategies and the Principles for a successful smart city transformation) and Weaknesses of smart city strategies
- Noori *et al.* (2020) propose two new concepts: Smart City Input-Output, Financial management
- Korachi and Bounabat (2020b) proposes the following new concepts: Strategic Awareness, IT Strategic Planning, IT Organizational Structure, IT Reporting, IT Budgeting, IT Investment Decisions, Steering committee, IT Prioritization Process, IT Reaction Capacity and Strategy phases.
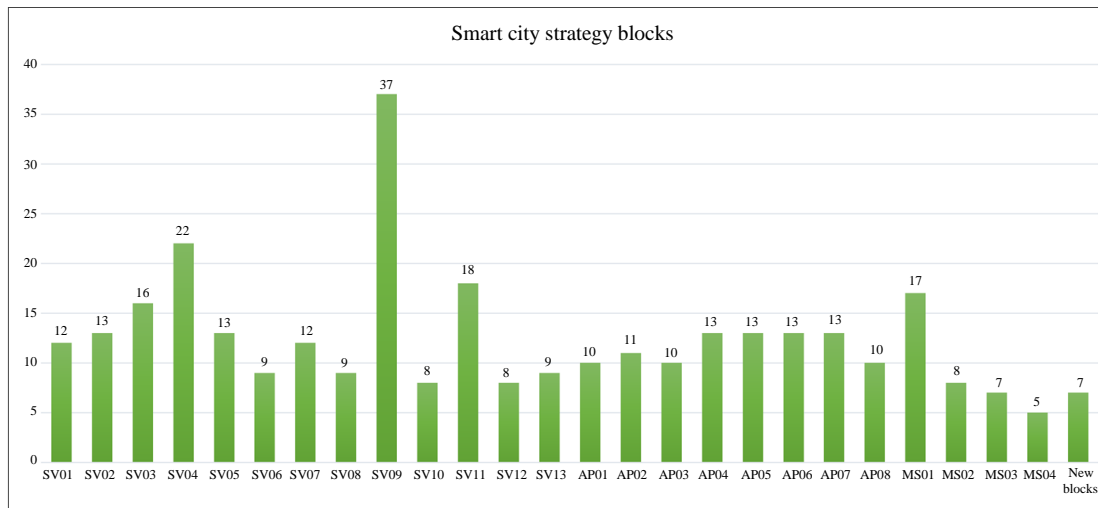
Fig. 1: Smart city strategy blocks

Table 3: Comparison of smart city approaches

No.	Title and source	SV01	SV02	SV03	SV04	SV05	SV06	SV07	SV08	SV09	SV10	SV11	SV12	SV13	AP01	AP02	AP03	AP04	AP05	AP06	AP07	AP08	MS01	MS02	MS03	MS04	Numbers of new blocks
1	Understanding Smart Cities (Chourabi *et al.*, 2012).				♦	♦				♦		♦															0
2	Understanding smart cities as a glocal strategy (Dameri *et al.*, 2019).		♦							♦		♦															0
3	Four European Smart City Strategies (Angelidou 2016).			♦	♦			♦																			0
4	Towards a smart city based on cloud of things (Petrolo *et al.*, 2017).			♦	♦	♦	♦			♦		♦															0
5	Bellevue Smart: Development and Integration of a Smart City (Picardal *et al.*, 2020).	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦		0
6	Comparing Study on Smart City Strategies in Berlin and Shanghai (Reiber and Huang, 2018).									♦													♦			♦	0
7	Cybersecurity Strategy for Smart City Implementation (Alam and Ibrahim, 2019).									♦																	0
8	Designing a Model for Smart City through Digital Transformation (Asri *et al.*, 2019).				♦					♦																	0
9	How to strategize smart cities: Revealing the SMART model (Letaifa, 2015).	♦		♦	♦				♦	♦		♦			♦	♦	♦	♦	♦	♦	♦	♦					0
10	Everything You wanted to Know about Smart Cities (Mohanty *et al.*, 2016).				♦					♦																	0
11	Developing Smart Cities: An Integrated Framework (Joshi *et al.*, 2016).									♦																	0
12	Smart city policies (Angelidou, 2014).									♦																	0
13	Smart cities: A conjuncture of four forces (Angelidou, 2015a).									♦																	0
14	Strategic Planning for the Development of Smart Cities (Angelidou, 2015b).	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦			♦		5
15	Redefining the Smart City: Culture, Metabolism and Governance (Allam and Newman, 2018).									♦																	0
16	The Smart-X Model for Smart Cities (Kesswani and Kumar, 2018).									♦																	0
17	Classifying Pathways for Smart City Development (Noori *et al.*, 2020).	♦			♦					♦													♦				2
18	Smart City Implementation Framework for Developing Countries (Hamza, 2016).	♦	♦		♦					♦					♦	♦	♦	♦	♦	♦	♦	♦					0
19	Gold Coast smart city strategy: Informed by local planning priorities and international smart city best practices (Alizadeh and Irajifar, 2018).									♦																	0
20	Smart Cities: Definitions, Dimensions, Performance and Initiatives (Albino *et al.*, 2015).							♦		♦													♦				0
21	Smart cities: ranking of European medium-sized cities (Rudolf *et al.* 2007).									♦																	0
22	Smart City and Value Creation. (Dameri and Rosenthal-Sabroux, 2014).			♦						♦		♦															0
23	Cities as Enterprises: A Comparison of Smart City Frameworks Based on Enterprise Architecture Requirements (Bastidas *et al.*, 2017).			♦	♦					♦		♦					♦										0

Table 4: Comparison of smart city approaches (continued)

No.	Title and Source	SV01	SV02	SV03	SV04	SV05	SV06	SV07	SV08	SV09	SV10	SV11	SV12	SV13	AP01	AP02	AP03	AP04	AP05	AP06	AP07	AP08	MS01	MS02	MS03	MS04	Numbers of new blocks
24	Case study of Dubai as a Smart City (Kadhim, 2019).				♦	♦			♦		♦																0
25	Smart cities: Concepts, architectures, research opportunities (Khatoun and Zeadally, 2016).			♦	♦	♦		♦		♦		♦	♦											♦			0
26	A web-based platform for strategy design in smart cities (Taamallah et al., 2019).		♦		♦			♦							♦	♦	♦	♦	♦	♦	♦	♦					0
27	Perspectives on smart cities strategies (Haller et al., 2018).		♦						♦		♦				♦	♦	♦	♦	♦	♦	♦	♦					0
28	Determinants Influencing to Smart City (Ngan and Khoi, 2020).								♦																		0
29	Conceptual Model of Information Technology Management for Smart Cities (Maestre-Gongora and Bernal, 2019).								♦																♦		0
30	A Framework for a Smart City Design (Hämäläinen, 2020).			♦	♦				♦		♦				♦	♦	♦	♦	♦	♦	♦	♦					0
31	Smart City Planning from an Evolutionary Perspective (Komninos et al., 2019).			♦		♦			♦															♦			0
32	Towards a Maturity Model for Digital Strategy Assessment (Korachi and Bounabat, 2020a).	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦					♦	♦	♦	♦						8
33	Integrated Methodological Framework for Smart City Development (Korachi and Bounabat, 2019a)	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	0
34	Data Driven Maturity Model for Assessing Smart Cities (Korachi and Bounabat, 2018).								♦															♦			0
35	Towards a Platform for Defining and Evaluating Digital Strategies for Building Smart Cities (Korachi and Bounabat, 2019c).	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦				♦	♦	♦	♦		♦	♦	♦		0
36	Integrated Methodological Framework for Digital Transformation Strategy Building (IMFDS) (Korachi and Bounabat, 2019b).	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦		8
37	General Approach for Formulating a Digital Transformation Strategy (Korachi and Bounabat, 2020b).	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	10
38	Building Agile Data Driven Smart Cities (Kumar, 2015).	♦		♦	♦				♦															♦			0
39	National eHealth Strategy Toolkit (ITU and WHO, 2012).	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦					♦	♦	♦	♦		♦		♦	♦	6

Table 5: Distribution of the new smart city strategy blocks

No.	Title and Source	Strategy Phases	Marketing Plan	Corrective Action	Success Factors	Weaknesses of smart city	Smart City Input-Output	IT Strategic Planning	IT Organizational Structure	IT Reporting	IT Budgeting	IT Investment Decisions	Steering committee	IT Prioritization Process	IT Reaction Capacity	Strategic Awareness
1	Strategic Planning for the Development of Smart Cities (Angelidou, 2015b).	♦	♦	♦	♦	♦										♦
2	Classifying Pathways for Smart City Development (Noori et al., 2020).						♦				♦					
3	Integrated Methodological Framework for Digital Transformation Strategy Building (IMFDS) (Korachi and Bounabat, 2019b).							♦	♦	♦	♦	♦	♦	♦	♦	♦
4	General Approach for Formulating a Digital Transformation Strategy (Korachi and Bounabat, 2020b).	♦		♦		♦		♦								♦
5	National eHealth Strategy Toolkit (ITU and WHO, 2012).							♦	♦		♦	♦		♦	♦	
6	Towards a Platform for Defining and Evaluating Digital Strategies for Building Smart Cities (Korachi and Bounabat, 2019c).							♦	♦	♦	♦	♦	♦	♦	♦	

Figure 2 and Table 5 show that these new smart city strategy blocks are cited by other works; the most cited is the IT budgeting. However, there is not a work that addresses all these blocks in an integrated approach.

Tables 3 to 5 illustrate that the cited studies are not integrative and there is a need for an integrated smart city approach. Based on this analysis it is concluded that the strategic vision, the action plan and the management

strategy are important blocks of the smart city strategy, but, the smart city approach proposed by (Korachi and Bounabat, 2019a) is not integrative. This conclusion demonstrates that **hypotheses 1, 2 and 3** are approved, whereas **hypothesis 4** is rejected (Table 6). To fill this gap, this study proposes a new integrated smart city approach; this approach is considered as a smart city frame of reference and it is presented in Figs. 3 and 4.

Table 6: Hypothesis testing result

| Hypothesis	Rejected/approved
Hypothesis 1: Strategic vision definition is an important block of the smart city strategy.	Approved
Hypothesis 2: Action plan definition is an important block of the smart city strategy.	Approved
Hypothesis 3: Management strategy definition is an important block of the smart city strategy.	Approved
Hypothesis 4: The Smart city approach proposed by (Korachi and Bounabat, 2019a) is integrative.	Rejected
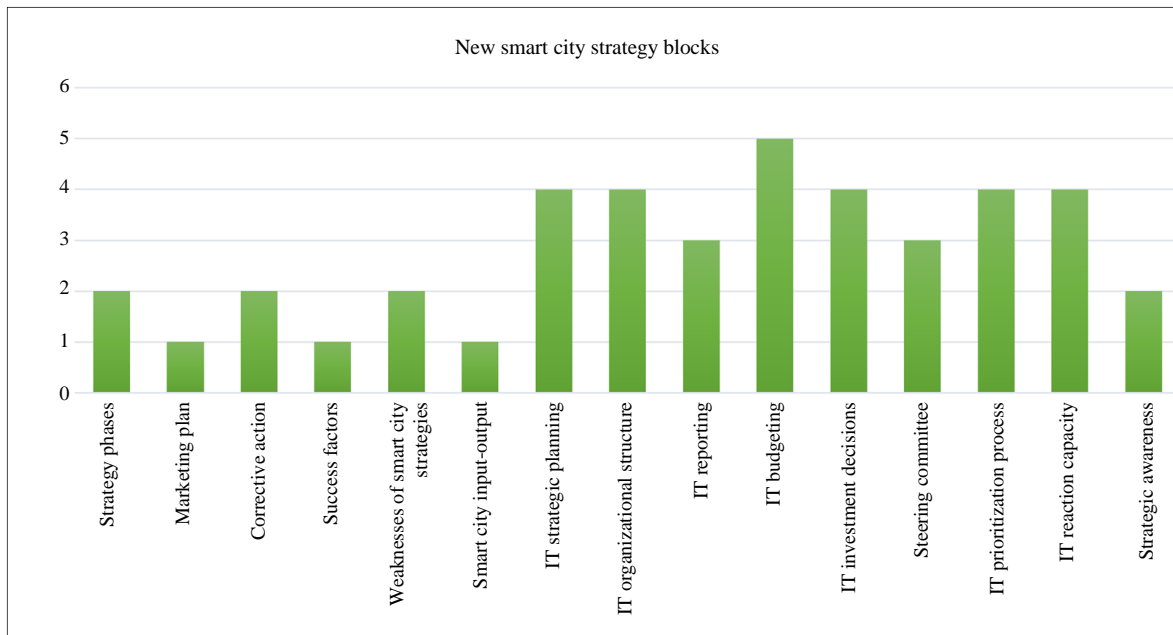
Fig. 2: New smart city strategy blocks
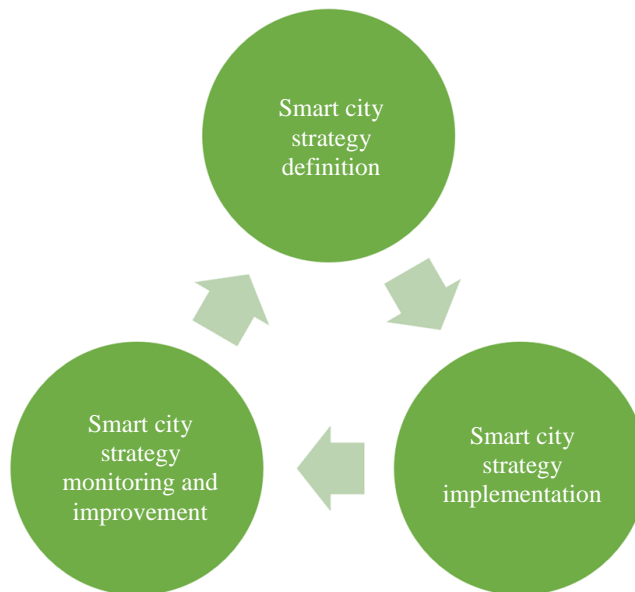
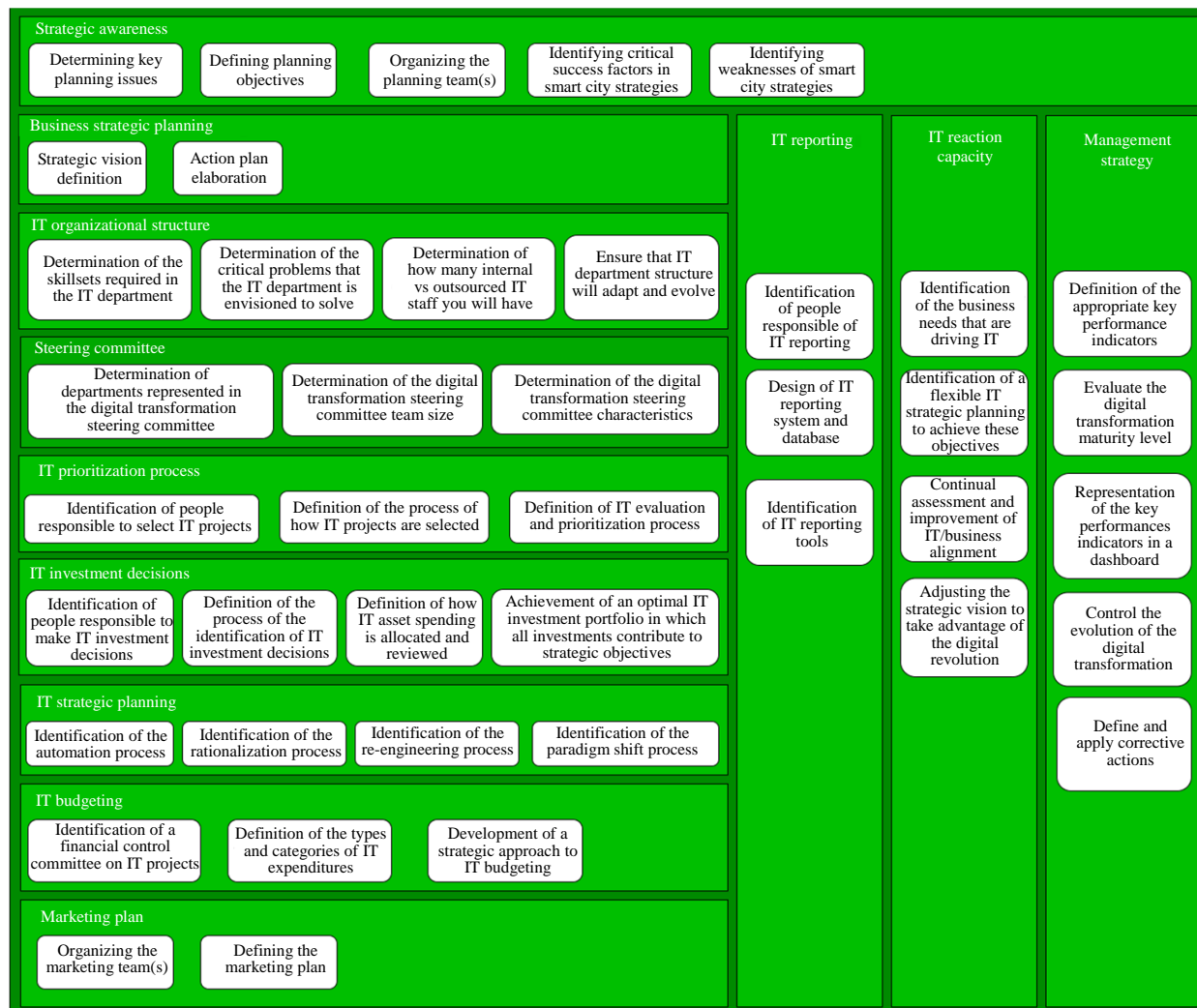

Fig. 3: Smart city implementation phases

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Fig. 4: Smart city strategy frame of reference

Figure 3 shows the most relevant smart city implementation phases. These phases are smart city strategy definition, smart city strategy implementation, smart city strategy monitoring and improvement. Figure 4 illustrates the proposed smart city frame of reference, its building blocks and their sub-processes.

Discussion

Various studies address smart city strategies and frameworks, but they study smart city concepts, definitions, components and dimensions more than addressing a clear smart city implementation process. In this regard, few studies are just focusing on approaching integrated and clear smart city guidelines for city transformation into a smart city. The majority focus on producing a large content about smart city components, dimensions and technologies, rather than providing a holistic approach addressing all smart city implementation concerns. Moreover, smart city frameworks in the literature are not aligned, which creates ambiguity and interference. To fill this gap, this paper provides a framework that centralizes all smart city concerns. In this perspective, this research conducts a quantitative analysis of a huge number of works of literature regarding smart city frameworks, to demonstrate the building blocks of a smart city framework. To this effect, the present paper compares and analyzes various smart city models and frameworks in order to exploit them for producing an integrative smart city implementation solution. Based on this quantitative analysis, this work proposes a clear and integrative smart city framework. The purpose of this framework is to reduce the misunderstanding and ambiguity regarding smart city definitions and strategy by providing cities with a standard smart city approach that can be used by city leaders to formulate a specific smart city strategy that fits the studied context.

Conclusion

This paper offers a smart city frame of reference composed of the following blocks: Strategic awareness, business strategic planning, IT investment decisions, IT organizational structure, steering committee, IT prioritization process, IT strategic planning, IT budgeting, marketing plan, IT reaction capacity, IT reporting and management strategy. This framework is based on an integrative approach for guiding and framing city transformation into a smart city. It aims to reduce the ambiguity regarding smart city strategies and to help city leaders to define, implement and improve their smart city strategies. To demonstrate findings, this work adopts a comparative study and a quantitative approach.

The current study is limited by the number of analyzed works. Further works can investigate more models and frameworks for proposing a rich and well confirmed smart city frame of reference. Future studies can produce more details, aspects and processes for extending and developing the blocks of the proposed framework.

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Author's Contributions

Zineb Korachi: She conducted the literature review and analysis. She defined the proposed smart city frame of reference. She defined the research plan and wrote the paper.

Bouchaib Bounabat: He supervised, organized and validated the study.

Ethics

The authors confirm that this article has no ethical problem.

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