The Study of City Functional System and Cross-cutting Trajectories in Transition to the Smart and Creative Tourism City in Phuket Province, Thailand

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Abstract

Cities are marked by uncertain and turbulent socioeconomic environments, complex social-ecological systems, and the co-evolution of human-society activities. Simultaneously, with the growing debate on the notions of an essential role of real-world Urban Living Labs (ULLs) studies to make the knowledge of co-creation for social change. This research showed a way to combine two fields of system science (SS) that look at how cities work and how they might change in the future as they become smarter and more creative tourist destinations that use ecological services (ES) better. Three different participatory systemic foresight exercises are designed with detailed application to the Phuket province as a research case study. Along with 30 key participants in the field study, the study analyzed data that included both scientific and normative data to find change agents, build the city's functional system, and come up with the main themes that support plausible sustainable futures for cities today.

The results revealed the key forces of change in the macro-environment that might shape city development profiles. These forces of change underscore their potential impact on the urban realm and the likelihood of urban development occurring. By conceptualizing the city's functional system, the results demonstrate the urban side system and supply viewpoints that city planners need to consider as the city's main system develops, including societal demand subsystems, economic agents, the political system, and the environmental system. These subsystems also

provide necessities and infrastructure for ES functions and services, ensuring adequate and desirable living and working conditions.

Finally, we construct a process to deliver valuable knowledge co-creation pattern capacities for the city's co-development, and co-users would be employed as the city's sustainable tourist managerial approaches, which would apply in further learning schemes and in the transition to various cities' system characteristics and sustainable dimensions. Future research should incorporate causal loop structural system modeling to clarify the empirical data characteristics of city functional systems and cross-cutting theme trajectories, thereby creating effective sustainable city visions and choices for management development.

Keywords: City Functional System; City Science; Creative Tourism City; Real-world Urban Living Labs; Systemic Science

Introduction

Under the co-evolution of human-society activities, cities are characterized by uncertain and complex dynamically changing environments, social-ecological systems (SES), and within a given socioeconomic and physical setting (Berry, 1964; Churchman, 1968; McLoughlin, 1969). In the 20th century, sustainable and smart city (SSC) development, urban places can undergo revolutionary change by leveraging governance and planning (McCormick et al., 2013). In the middle of the 21st century, there is a growing popularity of the smart city (SC) transition management concept, which may offer a fertile environment conducive to advancing sustainability by strategically assessing and continuously enhancing the contribution to the goals of sustainable development (UN-DESA, 2014).

According to Berry (1964), Churchman (1968), and McLoughlin (1969), city sciences have been defined as a network of interrelated functional systems and elements with common ends where human activities are linked through communication and interact dynamically within a specific socioeconomic and physical setting. Systemic science (SS) defines the SC as a complex web of relationships between different urban functions and entities that work together to disseminate and mainstream sophisticated methods and innovative solutions (Bibri & Krogstie, 2017a). whereas systematic thinking and social systems are integrated, which promotes the co-creation of foresight knowledge for SC transition and social transformation (Carpenter, 2020; Costanza et al., 2014; Mauser et al., 2013).

Theoretically, research on sustainable urban transformation must explore local activity's interconnectedness with the global economy, society, and dynamics (Schneidewind, 2014). While a number of scholars have argued that the transition to the SC city has been centered around the integration of systemic science and city science, these two sciences require understanding specific cities' functional system contexts, actors' adaptations, and issues, making it challenging to generalize results (Wagner & Grunwald 2015). Cash et al. (2006) emphasize the importance of multilevel solutions in urban transformation. They suggest that governance and planning are crucial for achieving transformative change. Research on sustainable urban transformation must consider the interconnections of cities with global dynamics, the economy, and society.

Academic studies have aimed to understand SC transitions and their development processes in the turbulent and complex environment of contemporary cities (Appio et al., 2019; Letaifa, 2015; Harrison et al., 2010; Ibrahim et al., 2018). Most of them, however, fail to satisfy their initial objectives or without real recognition of understanding the nature and challenge of the transformations of SC under turbulence, the complexity of the environment, and intricate diversity (Jain et al., 2017; Rad et al., 2018). They also fail to recognize that these transformations should be treated as problems of organized complexity, as they may push sociotechnical systems towards a new state, highlighting the need for scaling up for a sustainable society (Patorniti et al., 2018).

Currently, a number of studies have not shed any light on revealing their influential intensity and the interrelationship among these factors. If these factors are included in any framework, then it is essential to explore their intensity of influence and relationship because they directly affect the output of the framework. Public discussion on future city plans and how they affect environmental and social justice must be allowed during this process (Neij et al., 2015). Clear guidelines on how to define targets for sustainable and prosperous cities—that is, how administratively feasible it is to meet those targets—are also lacking. Whereas, how to create a framework is another area of study and application, necessitating new kinds of governance and policy instruments (UN–Habitat 2016's SDG 11).

Novel forms of real–world experimentation in Urban Transition Labs (UTLs) attempt to merge the strengths of learning laboratory settings with real–world research advantages (Liedtke et al., 2015; Nevens et al., 2013; Olsson, 2016), with the promise of society knowledge generation in sustainable trajectories. Besides the growing debate on concepts, SC initiatives are needed to scale up for our sustainable society. Learning laboratories have become a leading approach in transformative research and sustainability governance, driven by political and scientific

agendas. Experiments in learning laboratories aim to create knowledge related to potential solutions for sustainability challenges (Wagner & Grunwald, 2015; Caniglia et al., 2017).

Based on the essential role of knowledge co-creation in Urban Living Labs (ULLs), this study presents a methodological framework combining city sciences and systemic science. It is designed and organized around a comprehensive systemic analytical investigation, recognizing an understanding of the nature and challenges of contemporary cities.

Through the field study, together with three systemic foresight learning workshop exercises, the study involved 30 participants (local administrators and key social stakeholders). Our analytical approaches were designed to combine scientific and normative data input to identify forces of change, construct the city's functional system, expose structural critical uncertainty, and draft the key cross-cutting themes underlying plausible trajectories of SC in transition to a smart and creative sustainable tourism city, leveraging social sustainability and ES quality, with detailed application to the Phuket Province as a research case study, as was treated over a two-year period (2018-2020)[1]. For our study this area is an interesting system since it is one of the most significant natural areas with protected areas on the west coast of Southern Thailand (Andaman Sea coast), and it shares many challenge features on the ecological components driven by critical changes in SES properties, an uncertainty of global turbulent, socioeconomic and environmental changes, and the city's smart city governing strategies.

Notably, our goals are to enhance city planners' understanding of contemporary city challenges and their ability to manage transitions under complex social and environmental conditions. Its aim is to bridge the knowledge gap in local governments and encourage effective governance choices for city planners and key stakeholders.

Research objectives

1. To identify forces of change that have a significant transition in city sustainable development profiles.

2. To conceptualize the city's functional system and synthesize a set of cross-cutting transition in transitioning to smart and creative tourism city.

[1]This study was carried out as a part of the research program "An Analysis of the City Functional System and Envisioning in Transition to the Smart and Creative Tourism City of Phuket Provincial Administrative Organization, Thailand" in 2023-2024. Ethical consideration was certified by MU-CIRB, Certificate of Approval (COA) No. MU-CIRB 2023/191.2812

Literature Review

Urban transformations are complex, dynamic environments with uncertain human–society activities (Schröter et al., 2019, 2017). Cities are interconnected and co–evolving across spatial and temporal scales, posing a unique challenge to research into social–ecological systems (SES). Cities engage in ecosystem services (ES), benefiting human livelihoods and society (Bordt & Saner, 2019; Carpenter, 2020; MEA, 2005). Understanding their properties like resilience, adaptability, transformation, connectivity, and diversity is crucial for designing adaptive systems to optimize function, create new niches, and adapt to evolving trends (Lucas, 2004).

Most city planners, especially in developing countries, appear either perplexed about the growing lead that sustainable city initiatives are taking within their professional realm (Adapa, 2018; Anand et al., 2017; Khan et al., 2017). Faced with these characteristics, city planners, municipal leaders, and other stakeholders are increasingly turning their attention toward the so–called smart city (SC). Smart cities are complex systems par excellence; from this perspective, the distinguishing features of the city's functional system should be taken into consideration with substantial effectiveness. The smart city (SC) initiative has been concerned with solving environmental protection, emerging and challenging problems of urbanization, spatial development, urban change, aging society, and improving energy efficiency.

In city sciences, SC is defined as a network of interconnected functional systems and elements with common purposes where human activities are linked through communication and interact dynamically within a given socioeconomic and physical context (Berry, 1964; Churchman, 1968; McLoughlin, 1969). To understand a city's functional system, three key attributes are needed: understanding the complexity of city development scale and its ability to self–transform through operational processes within city limits and surroundings (Allen, 1997; Meyers, 2009); analyzing urban diversity characteristics and the assets generated by local interests and diverse groups (Jacobs, 1961; Alexander, 1965; Innes and Booher, 1999); and understanding the uncertainty of the urban realm through foresight science for city planners to generate growth perspectives for long–term development in both static and dynamic environments (Abbott, 2005; Klosterman, 2013).

In systemic science (SS), the SC has been defined as a social fabric composed of a complex network of relationships between various synergistic clusters of urban functions and entities that are used to disseminate and mainstream innovative solutions and sophisticated methods (Bibri & Krogstie, 2017a). SS is a science that integrates systemic and social systems,

advocating foresight, knowledge, and co-creation for social change (Carpenter, 2020; Costanza et al., 2014; Mauser et al., 2013). It focuses on synchronizing a meta-system (Bossel, 1998) with the dynamics of nature, society, and the economy's interactions across spatial and temporal scales (Preiser et al., 2018; Singh et al., 2010) and implementing the fundamental changes that society needs to go through to achieve sustainability goals (Swart et al., 2004; Raskin et al., 2002; Parris & Kates, 2003) and transformation (Segers, 2020; Bai et al., 2016; Westley et al., 2011; Haberl et al., 2011; Folke, 2006; Berkhout et al., 2004; O'Brien, 2012; Friis et al., 2016). In SS, cities have some distinguishing characteristics that should be considered when compared to other functional systems. The social change process in the city is not sequential but rather concurrent. This change may have a significant impact on the city's functional system (Bibri, 2018; Bibri & Krogstie, 2017). They are, consequently, limits to a city's ability to accelerate or inertia in response to the rate of change (Batty, 2005).

Up to date, numerous studies have focused on visualizing aspects of sustainable smart cities, particularly the speed and nature of their governance processes and the legitimacy claims for city governance (Yigitcanlar et al., 2018; Herrschel, 2013). Various cases of becoming a SC have been examined to develop theoretical frameworks centered on SC governance and sustainable economic development (Al-Nasrawi, Adams, & El-Zaart, 2015). Some are based on empirical studies, including implementation experiences. Some studies focus on drivers and barriers to smart cities, while others propose new metrics for assessing performance, sustainability, and benchmarking. There is a cumulative burden on the ability of SC development to protect the environment (Kramers, Wangel, & Höjer, 2016). Additionally, several studies have looked into the current state of SC development and governance systems, focusing on creating new self-governing cities that are able to change and learn from experience and promote sustainable development and smart growth (Yigitcanlar et al., 2018; Herrschel, 2013). These research efforts have resulted in a number of methodological frameworks that seek to explain how smart city transitions happen (Kramers et al., 2014; Kramers, Wangel, & Ahlsen, 2016). However, the suggested frameworks lack a systemic view of smart city transitions and struggle to recognize urban transformations as complex problems, as they can drive urban sociotechnical systems towards a new state (Patorniti et al., 2018).

Real-world labs in urban contexts (urban living labs (ULLs)) follow a foresight learning practice in order to become literate about sustainable transformation in society (Block, 2003). Whereas, to deal with uncertainties and insecurities, city planners and social stakeholders demand

novel common frameworks and understandings of methodologies within real-world labs (Borner 2014). While stated laboratory settings operate within societal settings and necessarily adapt their proceedings to the given contexts, actors, and problems, In the context of smart cities (SC), the collaborative foresight laboratory setting with real-world research setting is defined as the systematic process of co-creating coherent city visions from stakeholders, envisioning long-term changes, and creating opportunities for sustainable development in economy, mobility, environment, people, living, and governance (Bjelland, 2010).

As the literature cited above suggests, based on the notion of an essential role of foresight learning laboratories in real-world urban living labs (ULLs), this study presents a methodological framework for integrating two system science (SS) disciplines that combine the city sciences and the systemic science of the foreseeable evolution of contemporary cities. Our goals are to improve city planners' comprehension of contemporary city challenges, and their capacity to oversee changes in intricate social and environmental contexts. Its aim is to close the knowledge gap in local government and support key stakeholders and city planners in making effective governance decisions.

Conceptual Framework

In this study, the conceptual framework was proposed as a core guideline for the research methodology and the method applied. It was designed to combine scientific and normative data input to identify forces of change, construct the city's functional system, expose structural critical uncertainty, and draft the key cross-cutting themes underlying plausible sustainable trajectories of contemporary cities (Figure 1).

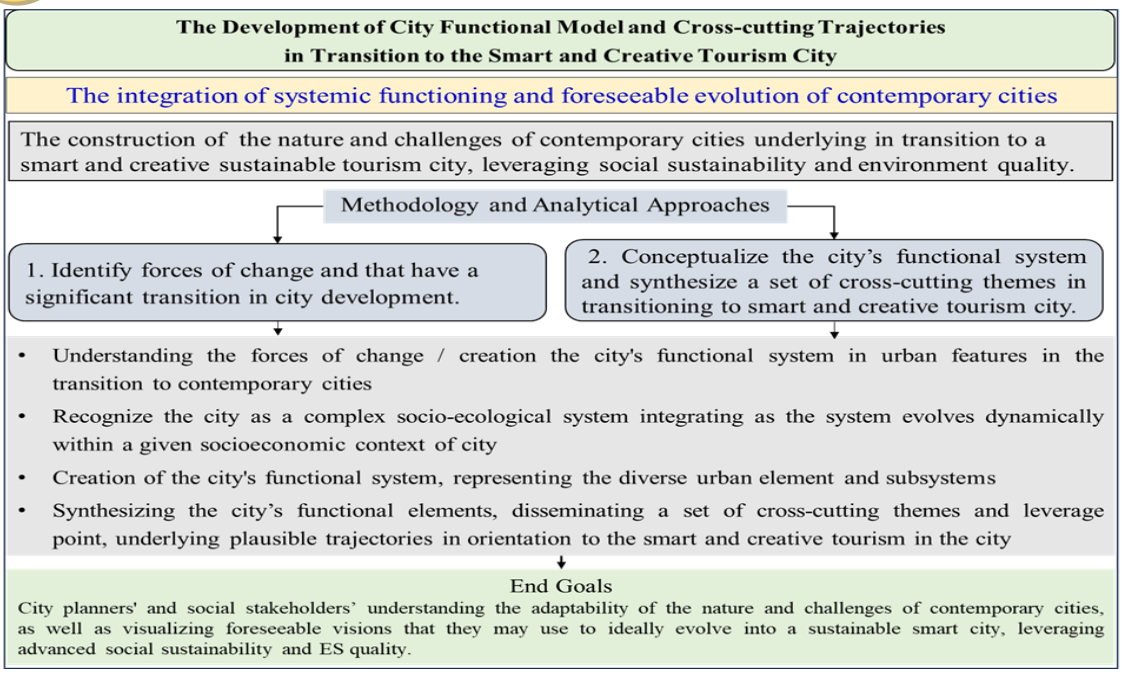

Figure 1. Conceptual Framework shows a flow chart of a methodological framework and data study approaches

Source: This Study

Research Methodology and Study Procedure

With regard to the study goals and objectives, the study methodology emerged by identifying urban attributes of significant changes contemporary cities face to a greater or lesser degree according to city development perspectives. In doing this, the city functional model developed was synthesized in a specific case study based on local city planners and key stakeholders' opportunities to orient to a SC. Together with the development and dissemination of the cross–cutting themes underlying plausible trajectories of SC in transition to a smart and creative sustainable tourism city (Fig. 1), as follows:

The first step (objective 1): Study approach was design to identify and assess major forces of change factors that might affect or later the future city development profiles. Here, the information produced from primary and secondary data and a group of semi–structured interviews was retrieved and discussed. Following, a horizon scanning change factors analysis (STEEPVL analysis) in the distant future (next 15–20 years) of the city operation context was undertaken and performed (Barišić, 2016; Caille et al., 2007). Change factors, at local, were identified and assessed based on their level of impact on the urban realm and certainty of occurrence (UNIDO, 2005).

The second step (objective 2)*:* The analytical approach emphasizes the creation of the city's functional system, to varying degrees, represents the significant changes that contemporary cities face in a higher or lesser degree according to city development experience. Together, the final evolution of the city's functional elements was synthesized and disseminated with cross-cutting themes underlying plausible trajectories in orientation to the smart and creative tourism in our case study.

Data methodology

The research resources and the complexity of the topic were based on a mix of the multiple collaborative foresight workshop exercises in local administrators and planners (PPAO) and social stakeholders' analysis and academic activities, where data methodology is designed and collected as follows:

The primary data and valuation methods are designed to gather the necessary information and gain a more in-depth understanding of local conditions under the effects of socio-ecological and environmental change in a remote area. In this step, the researcher reviews the literature and collects preliminary data in the area using questionnaires (city development profiles) and interviews. In the method of identifying perceptions and expectations of future developments within the city, the study process was based on a group of semi-structured interviews with all workshop participants. All the documents from any discussion are concerned with, e.g., the linkage of the city and the importance of natural resources, a sustainable and smart city, city function and service, and foresight planning. The questionnaire was designed (city development profiles) on topics that involved the city's key attribute system (city sustainability profiles) and its linkage to the importance of ES quality and leveraging effective sustainable and smart city governance. All this data is transcribed and analyzed through content analysis.

In the secondary data of this study, we comprehensively review and conclude how sustainable and smart cities are planned, envisioned, and implemented in remote areas. We collected a list of potential for the development of a city's sustainable strategy from relevant government agencies and research agencies involved in smart city initiatives based on prior empirical analysis of local administrators (PPAO). These data are collected through the relevant documents on basic information in terms of demographic data, physical and socio-economic conditions, past and current city planning, and future directional development policies and programs. We also gathered these data that had previously been conducted and analyzed by the

Phuket Provincial Administrative Organization (PPAO) and the Provincial Office of Natural Resources and Environment Phuket.

Study area

The study was conducted in Phuket province, with particular emphasis on Muang Phuket district and the Phuket Provincial Administrative Organization (PPAO) as a unit of study. Phuket province, the largest island in Thailand (Figure 2), is located on the upper southern part of Thailand and covers an area of 543.034 square kilometers (km2). Phuket province is one of Thailand's premier tourist destinations, famous for its scenic beauty, biodiversity, and unique history. In the last decade, through the Phuket Provincial Administrative Organization (PPAO) and local's key actors, this province has adopted sustainable city programs and local's sustainability planning prototypes, which are also linked to the multi–dimension of a sustainable city. In order to prepare for and make the transition to sustainable city solutions, some projects have been put into place to increase knowledge capacity and managerial approaches. These projects include upscaling living spaces to a higher standard and maintaining high–quality natural resources, particularly in the context of urban planning in transition towards a smart and creative tourism city. Due to the fact that there has been the development of all–in–one ecological, historical, artistic, and cultural tourism, Phuket province is now continually faced with challenges such as an increased number of wastes, decreased green areas, a destroyed ecosystem, etc. There are also global threats such as climate change and socio–economic development that could affect the city in the future. This remote area is ideally suited to be the unit of study for understanding the flexibility of the nature and challenges of contemporary cities and how city planners' and key stakeholders should ideally evolve and take advantage of advanced sustainability and smart cities.

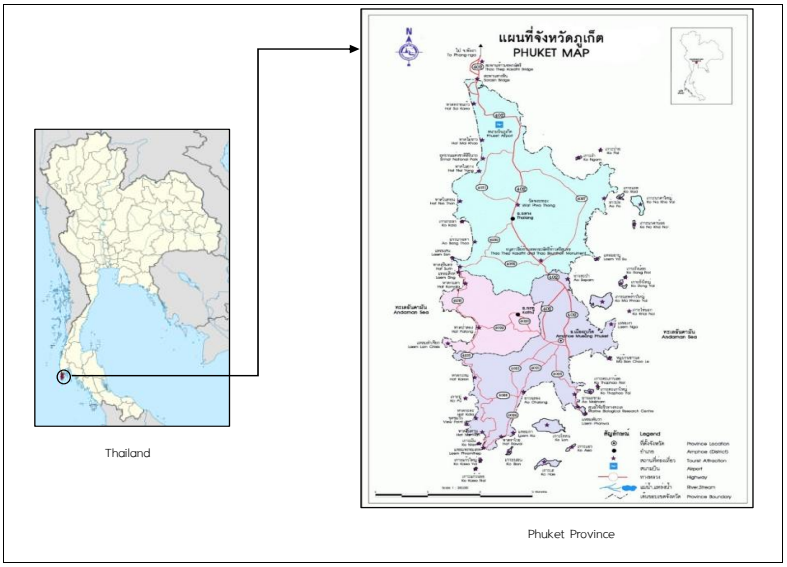

Figure 2 The case study of Phuket Province

Source: Phuket Provincial Statistics Report

Key participants and sample size

Throughout the study, this study is designed to invite 30 participants for group discussions and collaborative foresight workshop activities from local administrators (15 persons) and social key stakeholders (15 persons). They were chosen and invited based on prior knowledge of the landscape and as key actors who can influence the city's vision development and policy implementation, which included representatives from: i) Public organizations/institutions (8 persons), i.e., Provincial Office for Local Administration, Office of the Chief Administrator of PAO (Board Executive), Division of Public Works, Division of Planning and Budgeting, Division of Tourism, Environment and Pollution Control office 15 (Phuket), Provincial Office of Natural Resources and Environment Phuket, Tourism Authority of Thailand (Phuket office), Division of Education Division of Technical Services and Planning and Provincial Offices of Natural Resources and Environment Phuket, Provincial Health Assembly (Division of Public health and Environment and Social Welfare), Phuket Environmental foundation, and ii), Civil Institutions, Business Enterprise and Private organizations (7 persons), i.e., Urban experts and community networks, e.g., Community networks (Village Health Volunteers), Higher Education Institutions (Phuket Rajabhat University and Prince of Songkla University, Phuket Campus), Patong development foundation, Rotary Phuket, Natural Resources and. Environmental Protection Volunteer Network, and Young Entrepreneur Chamber of Commerce Group. It's worth noting that, each collaborative foresight workshops will be organized on the basis of a one-day activities at PPAO Townhall, Phuket Province.

Research Results

The results obtained from implementing the methodological framework and the study procedure are detailed as follows: First, basic information about Phuket province is provided, followed by the changing factors influencing city development profiles concerning the transition to sustainable city orientation. Second, the city's functional system, together with the initial vision, planning, programs, and projects of the remote area, are discussed. Third, the final evolution of the city's urban elements was validated, synthesized, and disseminated with cross–cutting themes underlying plausible trajectories in transitioning to the smart and creative tourism of the case study.

1. Basic Information of Phuket Provincial

Phuket Province is divided into 3 districts, consisting of Mueang Phuket District. Kathu District and Thalang District, 17 subdistricts, 96 villages, 61 communities, 19 local government administration areas, consisting of 1 Phuket Provincial Administrative Organization (PPAO), 1 City Municipality, 2 City Municipalities, 9 Subdistrict Municipalities, and 6 Subdistrict Administrative Organizations. Phuket Provincial Administrative Organization It is a local government organization with an area of responsibility covering the entire province. In this city, the tourist business has grown over the last decade, providing vital livelihoods and income to locals. The city's benefits include easy access to transportation, logistics, and modern commercial hubs that serve the various beaches and resorts located within its boundaries. This has led to an urbanization problem beyond its administrative boundaries. The statistical data shows that there is a trend towards an aging society in the future, since the elderly ratio is continuously increasing.

Since 2020, Phuket province has adopted the country's sustainable city programs as local government sustainability planning prototypes, *the so–called city blueprint of change*, focusing on localizing, i.e., Sustainable Development Goals (SDGs) and Low–carbon Cities (LCC). Phuket Provincial Administrative Organization (PPAO) is now working to promote sustainable development strategies by involving people, communities, government agencies, and the private sector in environmental management. Some projects have been implemented to scale up knowledge capability and managerial approaches, focusing on maintaining high–quality natural resources, living spaces, promoting sustainable local socioeconomic and cultural identities, and replicating sustainable solutions for other local governments and city–wide.

This includes enhancing infrastructure, quality of life, community organization, peace and order, investment promotion, commerce, tourism, natural resources, arts, culture, customs, administration, politics, governance, and corruption prevention and suppression.

2. The changing factors of the significant future sustainable city

In the workshop session, by using the results from the documents (city development profiles questionnaires) containing the basic information, we offered the participants the opportunity to determine the degree of impact and likelihood of occurrence of various forces of change in key urban change variables, as follows:

Over the last 20 years, globalization and economic development, climate change risk, urbanization, and socio–economic evolution have created numerous trends and challenges to the majority of cities in the country. The city is now continually faced with challenges such as increased number of wastes, a decline in green space, and ruined environmental quality, among others Some of those changes are already occurring, while others will occur soon, and still, others may be forces that have not yet occurred but are significant to the future or any uncertainties.

Following the plenary session, participants also discussed how to identify the key driving forces that might shape the future of Phuket province and how local planners (PPAO) and key social stakeholders need to consider transitioning to sustainable and contemporary cities over the next 15–20 years. At the conclusion of the workshop, participants had the chance to discuss and summarize the main variables, at local, city, regional, national, and global contexts, influencing urban evolution (trends and uncertainty). These change factors are categorized as a set of significant driving forces: social (S), technological (T), economic (E), environmental and ES quality (E), political (P), social values (V), and legal or governance (L). The following is a detailed summary of the information generated by the workshop's activities (Figure 3).

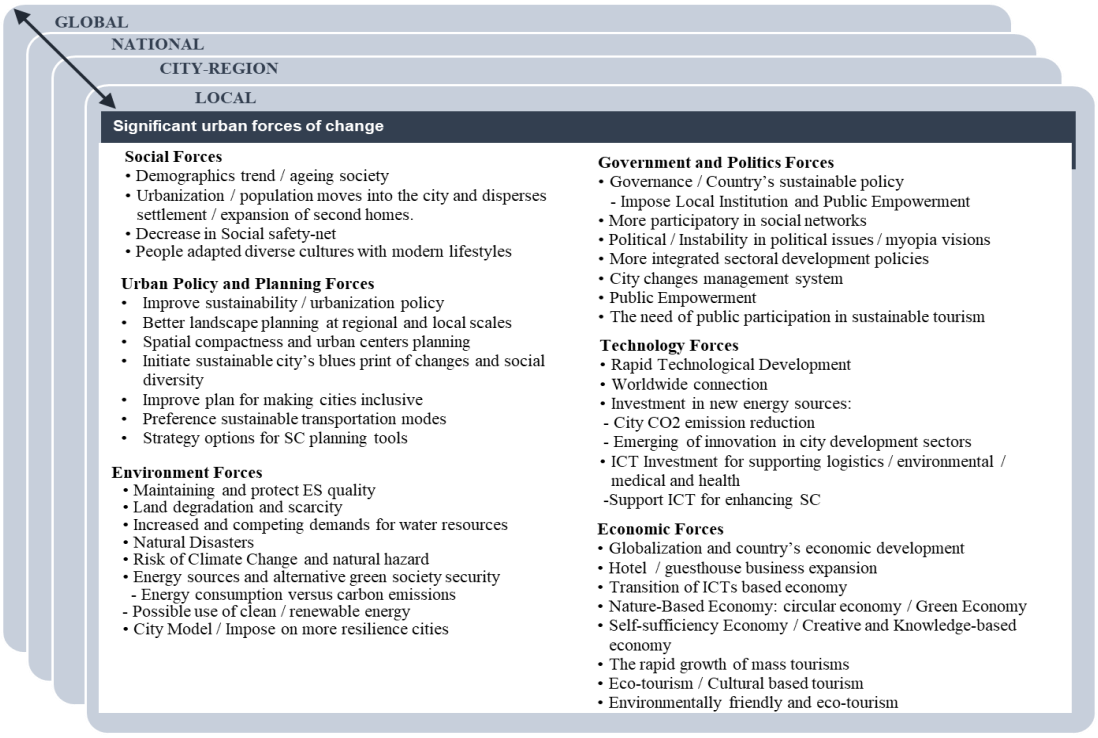

Figure 3 Urban Driving Forces

Source: This Study

Nowadays, in order to up-scale Phuket City to move toward a more sustainable and contemporary city, this would require a much more integrated urban planning paradigm. This paradigm, in which larger technical platforms are used to expand on the city's inter-sectoral functionality, However, significant expenditures and questionable long-term returns pose challenges to the expansion of sustainability projects and activities, especially in large municipalities like Phuket Province. Most sustainable city programs operate in technological silos, resulting in a lack of knowledge of urban complexity. To anticipate upcoming city developments, local administrators and social actors are now facing challenges in addressing social cohesion, CO2-neutral mobility, and renewable energies. Despite the trend towards smart and sustainable tourism cities, there is a misunderstanding about the term 'Smart City' and the challenges local governments face in dealing with uncertainty. Trends and forces of change seem to be a critical aspect and put pressure on local governments beyond their administrative capacity to become sustainable cities in the transition to smart cities.

3. Setting the city's functional system (objective 2)

In this step, the information produced from previous periods is retrieved and the interaction of common functions (complexity, diversity, and uncertainty) in orienting to the urban elements (supply and demand systems) of the city is discussed. Following that, the city functional system was developed, focusing on the diversity of urban components and subsystems that integrated three systemic perspectives, including the demand side system, the supply side system, and the support side system perspectives. Participants are then encouraged to clarify systems, subsystems, and functional components in Phuket City (Figure 4), as detailed as follows:

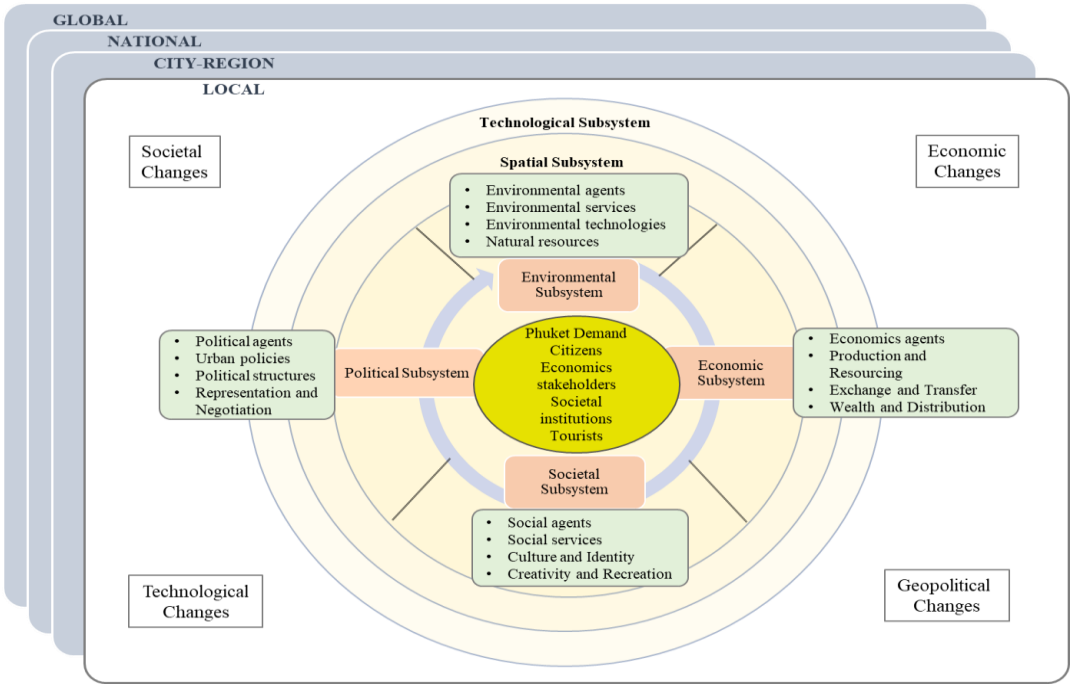

Figure 4 The city functional system of Phuket province.

Source: This study

In the face of complex socioeconomic and environmental dynamics, in Phuket province, the development of a sustainable city is seen as a comprehensive approach to maintaining environmental quality. Despite PPAO's and other municipalities' commitment to SC at the provincial level (*City Blueprint of Change*), it deserves critical scrutiny at the national level (e.g., Low–carbon Cities (LCC). SC initiatives are heterogeneous and disconnected from urban planning strategies, making them difficult to replicate and obtain in the local economy. Under these conditions and using our specific case study, despite the limited scope of sectoral applications in the city, it was developed to provide some conceptual clues as the local governments went

through reconciling sustainability, economic episodes, and cohesiveness goals under a progressive governance model.

It is worth noting here that, in Phuket province, the city's demand subsystems (the country's political system and local institutions, societal and community, economic agents, and environmental systems) are striving to interpret and satisfy the requirements of the different demand segments. Meanwhile, local tourism businesses are solely interested in how to support benefits and services that will meet tourists' needs, regardless of any potential long–term negative impacts on the environment or society. Most of the local communities were satisfied with the economic environment, but not with maintaining the environmental quality. With regard to the economic crisis, i.e., when the country experienced the novel coronavirus infected pandemic (COVID–19) situation in Thailand in the year 2020–2022, this force was still in full swing, producing a tough shock to most local municipalities in the country. At that point, it was clear that previous urban practices had aggravated the intensity and scope of the recession, generating a huge real estate bubble.

1) The Demand Side System Perspective: The urban demand system perspective considers the city's main system, which includes societal demand subsystems, economic agents, the political system, and the environmental system. These subsystems provide necessities for the city's functions and services, as well as infrastructure for living and working. Local businesses, particularly in tourism and services, primarily operate opportunistically with excellent public infrastructure, allowing them to execute risky transactions. However, most citizens in Phuket City show little interest in urban issues due to their contentment with their socioeconomic environment. Tourists expect a wide range of amenities and services without considering potential environmental or community impacts.

2) The Supply Side System Perspective: Considered as the city’s service system, this system identifies four city subsystems: societal, economic, environmental, and political, each designed to meet demanding segments' needs. Improvements include resource capital, ensuring efficient resource management, operating agents for societal value upscaling, service–provided systems for equal resource exchange, and technological use for co–creating values.

2.1) The Societal Subsystem: This subsystem describes a city's declining social fabric, loss of traditional cultural values, and tensions due to an aging society. Poor local traditional practices and heritage result in weak social network capital and the emergence of individual values and lifestyles in the city.

2.2) The Economic Subsystem: This subsystem measures economic satisfaction in relation to employment and local growth. The province of Phuket has had satisfactory employment growth and economic growth in recent years, with small and medium-sized businesses leading the tourism industry. However, low-tech management that focuses mainly on the national market, bureaucratic governance, and financial support for sustainable city planning have an impact on linkage to the national level. The central bureaucratic structure and the limited funding for sustainable city planning currently pose challenges for local planners.

2.3) The Environmental Subsystem: The city's economic dynamism led to aggressive local urbanization, massive transportation infrastructure development, and commercial facility development. The Phuket province subsystem was demoted to a secondary position, causing negative environmental effects in the city's urban context. Large-scale commercial and transportation infrastructure development and aggressive urbanization of the urban periphery resulted in numerous negative environmental effects in surrounding areas.

2.4) The Political Subsystem: The local governance system in the city is currently focused on short-term planning, leading to negative outcomes despite sustainable development and resource use. The local political system is isolated and favors economic stakeholders, with little concern for environmental issues and societal interests. This has resulted in collusion between economic stakeholders and local politicians in tourism-based businesses, facilitated by a lack of transparency in the local decision-making process. Local governments have limited access to the economic subsystem, and big real estate businesses have partnered with economic stakeholders and local politicians to further their interests.

3) Third perspective on Local physical versus the Spatial subsystem: *The Support Side System Perspective.* According to this system perspective, two supporting systems must meet specific requirements in order for the city's four supply-side subsystems (societal, economic, environmental, and political) to function properly, as follows:

3.1) The Spatial Subsystem: This city's common functional model has been transformed by integrating subsystems, particularly local tourism and transportation infrastructure. To date, due to overdevelopment in cities, it has increased ecological footprints and social and infrastructure pressures, posing challenges to urban design management. This has led to significant transformations in Phuket Province, with urbanization expanding into city peripheries, extensive transport infrastructure constructed for mobility, expensive commercial megastructures emerging in suburbs, and an excess of housing being built.

3.2) The Technological Subsystem: Although Phuket Province has achieved some success in improving its management systems, at a certain level, with well–articulated business clusters, cutting–edge services, and entrepreneurs, the local tourism industry is thriving. In the distant future, smart initiatives might have distinct characteristics in terms of their size, built environment, fiscal resources, and many other features, especially if they receive financial support from outside sources primarily in the form of technological silos with little interaction between their various systems of government. These variations have an impact on cities' ability to handle smart technologies and draw in ventures for smart cities.

4. Synthesize a set of cross–cutting themes in transitioning to smart and creative tourism.

In this step, the learning laboratory concept was first explained to the workshop participants. It is an environment where local planners and key stakeholders collaborate and learn together to understand and improve the problems of common interest. Following, we gave the participants the opportunity to discuss a set of cross–cutting themes that underpin plausible trajectories in which city planners and social stakeholders collaborate and learn together to understand and improve their ultimate goal, which is to achieve sustainable outcomes in smart and creative tourism cities. At the conclusion of the workshop, capacity building and the knowledge gap were identified by the participants as key leverage points for the successful application of the learning laboratory for sustainable development in the city, as follows:

In Phuket province, the city's demand subsystems (societal and communities, economic agents, the country's political system and local institutions, and the environmental system) are striving to interpret and satisfy requirements from the different demand segments. On the other hand, local tourism businesses are solely interested in how to support benefits and services that will meet tourists' needs, regardless of any potential long–term negative impacts on the environment or society. If the local planners and social agencies had to recover in the near future, despite amending past mistakes, they would have to assess the foreseeable impact of change factors in the coming years. Subsequently, the demand–side system and subsystems are not interconnected, with local businesses operating on short–term interests. Based on these circumstances, the city's local governments are challenged to capture the resource elements required for each demanded subsystem to deliver sufficient and appropriate products and/or services. The cross–cutting themes underlying plausible trajectories in the transition to a smart and creative tourist city should be considered as follows:

The city's demand subsystem, including societal, economic, political, and environmental sectors, is working together to meet different demand segments. Local governments must capture resource elements for each subsystem to deliver appropriate products and services. These elements include: i) resource capital for environmental enhancement; ii) operating agents for societal value upscaling; iii) service–provided systems for equal resource exchange; and iv) technological use to support and interconnect with each other systems and subsystem capital to co–create value in becoming a SC.

Together, the specific concerns and leverage points that may be required in the five guiding topics for the building's transition to the future desired vision as a creative tourism city are involved in the process of: i) the construction of a fair and coherent social safety net; ii) the development of a dynamic, robust, competitive, and resilient economic base; iii) the maintenance and protection of local environmental sustainability and ES security; iv) the establishment of a collaborative and transparent governance system; and v) the design of a compact and sustainable urban structure.

The details on the specific issues and leverage points that participants added at the end of this workshop session and may be necessary in the transition to a smart and creative tourism city are as follows: i) local planners and social actors would undoubtedly be inspired to develop unique approaches to city planning as a response to the complexity, diversity, and uncertainty emerging, as per the participants' assessments and expectations of prospective city developments; ii) the SC in Phuket province, which refers to the city's hard and soft ideas driven by sustainable development, should be a completely integrated urban system with more innovative solutions; and iii) in the future, creating a SC local government may involve societal, economic, and governance considerations. To increase service efficacy and quality, social and human capital are also necessary.

Discussions

From the significant outcomes of our study, first this section offers some discussions on the need and benefit, as well as key knowledge contributions of incorporating two system science disciplines, as the essential features of our study systemic analytical approaches. Following the completion of this study, we noticed a few critical issues that must be concluded as key lessons learned and recommendations to provide more in–depth details, the original of our study, and be more robust in future research in the field of research being studied, as follows:

First, this study integrates systemic sciences and city science, conducting a comprehensive systemic analysis to understand the nature and challenges of contemporary cities. Our systemic analytical approaches appear to be appropriate for the collaboration of city planners and among various stakeholders, including end–users, in working together to create mutual and shared benefits (Bibri & Krogstie, 2016). The study's analytical approaches and results enable local planners and participant stakeholders to understand and have the capability to detect problems and an opportunity to avoid threats resulting from growing complexity and environmental uncertainty to contemporary challenges of the SC before they appear (Regeer & Bunders, 2009).

Second, city planners and social key stakeholders recognize the forces of change that need to be considered in their city functional system operations (Nesti, 2018). These forces provide a comprehensive understanding of the diverse nature of city functional models and help them navigate the uncertain socioeconomic and environmental dynamics associated with becoming a smart city (Meijer & Bolívar, 2016). These driving forces will require city planners to scan and anticipate all geopolitical, societal, economic, technological, and environmental change factors that may affect the city's development. Participant stakeholders understood how much of a synergistic cluster of urban functions and entities was required to present SC initiatives, as well as how they should evolve in the future (Meijer & Bolívar, 2016).

Third, by initiating systematic guidance on the foreseeable evolution of the urban functional system, local planners and participants benefited from the exercise by gaining a better understanding of the relational complexities of cities. These results also exposed how city planners will have to be planned and managed holistically under the turbulent environment, and urge how all urban systems may design and implement in integration with the city's vision and in becoming a SC (Herrschel, 2013; Lee & Lee, 2014; Martin et al., 2018; Nesti, 2018). It also explains how the specific functional subsystems of a city interact with one another, how they should present a SC initiative, and how they should evolve over time. Our study highlights the city as a complex network of interconnected subsystems, challenging the predictability of contemporary SC models. Furthermore, the study's results provide a set of cross–cutting themes that underpin plausible trajectories that local planners and social stakeholders would need to take into account in order to transition to a smart and creative tourism, the leverage advanced social sustainability and environmental quality of our case study.

Knowledge from Research

By developing the different knowledge for different sciences, as in this research paper, it has striven to align diverse cities' functional models with stakeholders' world-views. This paper presents a conceptual framework and analytical approaches to address the knowledge gap in local governments and promote effective governance choices for city planners and key stakeholders. Our results reflected that local administrators must leverage the city's key attributes needed to conceptualize and characterize that need to provide a clearer understanding of the city's involvement in local natural resources, social prosperity, security and livelihoods. The study highlights the need for deep societal knowledge, co-learning for local planners and institutions, and social structural transformations in a smart city to develop long-lasting solutions for a smart and creative tourist city. It emphasizes the need for end-users to develop cross-cutting themes for preventive and adaptive action plans. The study highlights alarming signals regarding the future of smart cities and sustainability, suggesting a need for alternative, more desirable futures through transition (Haberl et al., 2011) and transformation. It emphasizes the need for societal changes to achieve smart city and sustainability goals, highlighting the need for further exploration and transformation (Westley et al., 2011; O'Brien, 2012).

Following, we synthesize the study's methodology applied and results obtained, reflect the knowledge gained, and conclude the outcomes on the underlying goals of the study as a portrait in mind mapping (Figure 4.1) as follows:

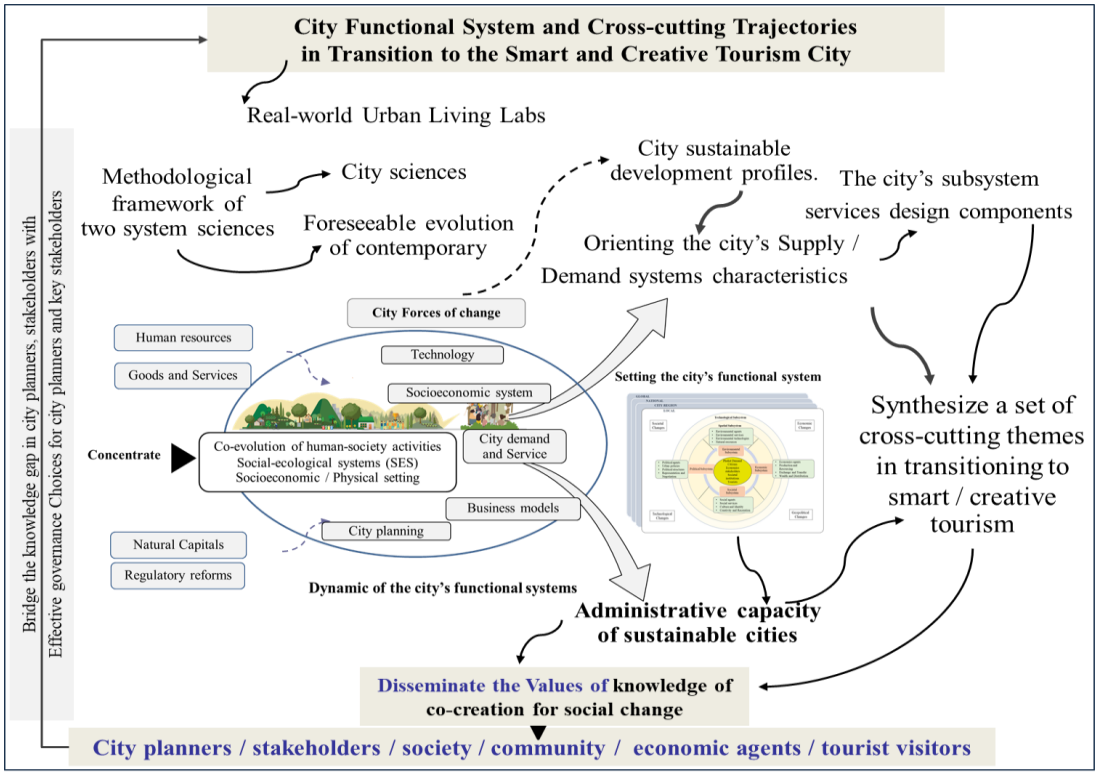

Figure 4.1 Mind mapping concluded the study's approaches and knowledge gained.

Conclusion

Given the significance of our research goals, it is necessary to debate some key conclusions of the analysis's results and its findings, as is explained in more depth as follows.

For the city's planners, forces of change from the study's results will mean scanning and anticipating all geopolitical, societal, economic, technological, and environmental factors affecting a city's development. Participant stakeholders can determine the synergistic cluster of urban functions needed for SC initiatives and how they should evolve in the distance future. Together, the foresight exercise provides information on how city functional subsystems interact, present SC initiatives, and evolve in the future. Planners must plan and manage holistically under dynamic environments, integrating all urban systems with the city's vision and transitioning to a SC.

Up until the study period, not all city functioning systems in the city were properly tied to the past. Every city functional system, both in theory and in practice, should be conceptualize on a feedback loop between urban subsystems rather than flowing in a linear sequence (Bibri & Krogstie, 2017a; Höjer & Wangel, 2015). External change factors like population shifts, economic cycles, technological developments, or environmental effects have an effect on the functional balance of the entire urban system. To ensure that forces of change linked with the city functional model are properly understood and to envision the functional system and manage it, city planners

and important related agencies must retrofit their foreseeable vision with the process of adopting a foresightful vision.

As mentioned in our cited literature and analytical approaches, smart city research might not be simple to conceptualize the city's common functional model. So instead, we should change the way we dialogue about knowledge and expertise of the local planners and social agencies, as a helpful part of the complete city sustainable system. Well-designed city plans, like the complexity from the economic turbulence and local business complexity, have been important for a long time to transition to a creative and sustainable tourism city. Likewise, city planning that looks at the big picture could be important in including

Finally, the anticipations of upcoming city developments, would definitely be motivated to create novel ways of city planning as a response to complexity, diversity, and uncertainty growing. A fully integrated urban system with more creative solutions should make up the SC in Phuket province, which refers to the city's hard and soft ideas driven by sustainable development. In the future, societal, economic, and governance concerns may be involved when establishing a SC of local government. Social and human capital are also required to improve service effectiveness, quality of life, economic competitiveness, environmental sustainability, and participatory governance (Giffinger et al., 2007; Caragliu & Del Bo, 2011; Chourabi et al., 2012; Angelidou, 2014).

Suggestions

1. Suggestions for the application of research results

In the future, our conceptual framework could adapt and enhance local transition arenas, network formation, and capacity building for city sustainability initiatives, especially if the primary outcome is an action-oriented community-led program for city sustainability, rather than a research agenda, given appropriate institutional and political context and support. Certainly, within the design and execution of the current study there was clearly a tension between the study's objectives of developing methodology and articulating a longer-term research agenda, and the need for short-term solutions to the city sustainability problems facing the local community. From the start, it was important to manage expectations and be clear about the limitations of the study to deliver practical change, whilst also seeking to exploit opportunities for adding value for both the local planners, the community and social unity.

In this paper, through the foundation of system science (SS) research to make the knowledge of co-creation for social change, we proposed a methodological framework that combined systemic functioning and foreseeable evolution of contemporary cities so that SC initiatives. Three participatory foresight exercises were created to be integrated into the research approaches. Using Phuket province as a case study, each foresight exercise was carried out to facilitate the development of sustainable and intelligent future visions for the development of a SC, and was incorporated by means of knowledge and experience in a wide range of participant stakeholders at all stages of its development. Notably, our approaches attempted to identify a set of underlying change forces that city planners and social agencies could use to determine how much of a synergistic cluster of city functional system was required, and how its entities were required to design and implement in integration with the city's vision and in becoming a SC, leveraging the ES quality. Our methodological framework provides a new gateway for scholars and practitioner to deepen their understanding of co-creation for social change. The analytical processes described in this study would be applied in other cities, since fine-tuning and consolidating a method already tested in diverse city planners and key related agencies. In the future, the results of our study should be incorporated into structural system modelling, which would contribute to further refinement in quantifying the social nature and of city's common functions with its key essential attributed, visualizing more robustness with the complexity and uncertainty, while also unfolding the future-oriented, and adaptable foresight contemporary cities for the sustainability transition.

2. Suggestions for future studies

First, according to our findings, more needs to be done to develop long-term foresight capability that ensures foresight work will promote state-of-the-art city and urban policies. City's planners need to incorporate other important national and urban policies, while more exploratory work should be done with different stakeholders' involvement in interpreting the functional system to guarantee that they can add value when discussing SC initiatives (Yigitcanlar et al., 2018; Allam & Dhunny, 2019). Besides, our study revealed the absence of urban planners or social scholars in defining the smart city and its consequences in practical level. So, the further study can work on defending a model or framework based on which the smart city concept and projects can be seen integrated in an integrated into the urban planning and sustainability model.

Second, the details on cross-cutting themes and the specific issues and leverage points that participants added at the end of this workshop session and may be necessary in the transition

to a sustainable SC are provided below. Local planners and social actors would undoubtedly be inspired to develop unique approaches to city planning as a response to the complexity, diversity, and uncertainty emerging, as per the participants' assessments and expectations of prospective city developments.

Third, the study approaches do not contemplate the possibility of plugging in quantitative models that would certainly enrich the whole approach. In the future, results from the combination of forces of change and a set of data from scenario logic analysis should be incorporated in the causal loop diagram and structural system modeling, that would lead to contributing to further refinement in cities' functional systems, especially. explaining the interaction.

Finally, a fully integrated urban system with more creative solutions should make up the contemporary sustainable city in Phuket city, which refers to the city's hard and soft ideas driven by sustainable development. In the future, societal, economic, and governance concerns may be involved when establishing a SC of local government. To increase service efficacy and quality, social and human capital are also necessary.

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