

The effect of sustainable and smart planning framework on urban logistics and mobility

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Abstract. Urban planning and design have witnessed an exceptional transformation following the rapid development of information and communication technologies (ICTs). This new era paved the way for the rise of new technical concepts and methods in urban planning where human-computer interaction is at the centre of interest. However, despite this fast evolution, there remains a significant research gap that needs to be addressed. It is essential for urban planners and designers to keep pace with technological advancements while simultaneously securing environment-friendly outcomes and fostering environmental sustainability. In this context, our work focuses on the challenges encountered by urban designers as they seek to transition toward smart, sustainable industrialized cities. Of a special concern is the inclusion of mobility, logistics features and digitalization of city supply chain management, where we consider the management of physical, information and financial flows in modern urban areas.

1 Introduction

Urban planning plays an important role in managing various aspects of an industrial company, impacting the physical handling and delivery of products, as well as financial and informational management between source and consumption points [1]. It incorporates multiple disciplines such as architecture, engineering, sociology, finance, and economics [2]. The objective of urban planning is to prepare cities for future challenges, enhance architectural and managerial features, and address societal requirements [3][4].

In the present time, cities encounter a range of difficulties, notably due to the rapid urbanization process, which gives rise to various design challenges including environmental impacts, population growth, and the need for sustainable solutions [5]. Therefore, redefining urban planning is essential to support sustainability objectives, smart management, and address urbanization pressures.

The rising urbanization generate several management issues such as traffic congestion and mobility challenges, particularly with the rise of e-commerce and direct delivery modes [6]. Urban logistics, supply chain management, and urban sustainability concerns are crucial in managing the urbanization pressures effectively.

While several attempts in the development of sustainable and intelligent urban designs [6][7], there still exist a research gap regarding the incorporation of industrial, economic, and supply chain considerations into urban planning. Striking a balance between urban

planning and the ever-changing mobility needs is essential to achieve a holistic approach to city management.

Therefore, this paper focuses on studying the impact of sustainable and smart urban planning on city logistics. The objective is to review environmentally oriented urban planning frameworks and sustainable urban mobility plans to assess the effectiveness and potential improvements.

The study contributes to the field of urban design and mobility by examining and analyzing the steps involved in implementing urban planning frameworks. While prior studies have mainly concentrated on developing and applying these frameworks within the context of sustainability, this research addresses a knowledge gap by investigating the mobility and logistics aspects of urban planning, particularly in the face of challenges posed by industrialized cities. Through an evaluation of mobility plans in African cities, this study identifies barriers to adoption and implantation and assesses methods for managing mobility, thereby uncovering ways to incorporate logistics elements into urban mobility and sustainability plans.

The remainder of this paper is organized as follows: the second section is a comprehensive analysis of the Urban Planning Sustainable Framework (UPSF), the third section is a review of Urban Mobility Plans and their effects on the urban design and adjustment with an emphasis on three major value streams (product, information and financial). The fourth and the last section presents potential future work and closing remarks.

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2 Urban Planning Sustainable Framework

Sustainable urban development is based on creating an equilibrium between several design objectives such as affordable housing, clean water grid, biodiversity, clean air, transportation network and community services [8]. It also emphasizes the efficient management of finances and information flow at a reasonable cost. Therefore, it is essential to develop a road map to introduce a comprehensive design of urban space hence the focus of our study on the urban planning sustainable framework (UPSF).

According to Puchol-Salort et al [2], UPSF can be defined by two key points. Firstly, it involves improving the design and evaluation process of urban development by integrating both the built and natural system components, using the concept of Urban Ecosystem Services (UES). Secondly, it emphasizes system enhancement through decision making and incorporating perspectives from multiple stakeholders during the planning and co-development process. Figure 1 illustrates the main steps and the decision process of the UPSF.

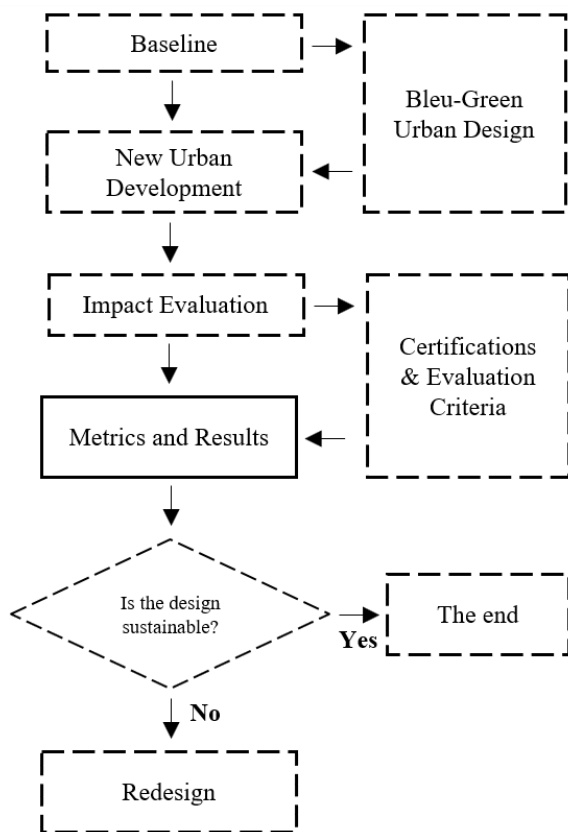


Fig. 1. Urban Planning Sustainability Framework (UPSF) [6] (modified version).

The UPSF follows an interactive approach, representing the various phases of urban development from governance and decision-making to application, evaluation, and control.

It consists of five steps and three framework components:

- Planning System Process
- Design Solutions
- Integrated Evaluation Toolkit.

Sustainable urban planning can be represented by two forms of discussions: urban forms and sustainable constructions. The two concepts complement each other; however, it is important to differentiate between them in order to understand the adoption and application requirements and prerequisites. The former refers to the dimensions and characteristics of buildings, including the incorporation of green spaces. The latter focuses on the use of local materials and natural resources during the construction process. Both concepts contribute to the adoption and implementation of Bleu-Green infrastructure (BGI). Additionally, the application process varies depending on the roles of decision-makers, stakeholders, and developers (Whether from the private or public sector).

Furthermore, the standards and requirements, such as certifications and evaluation criteria, differ based on the specific application environment, for example, what may be considered as sustainable design in New York may not be applicable in Dubai or Sydney.

The plan and design of an urban space should take into consideration the requirements of mobility and logistics movements, it is nowadays an essential element contributing to the achievement of the sustainability and resilience objectives of city management. Therefore, we tackle in the next section the concept of mobility integration on the process of urban design and planning and analyze the concept of sustainable urban mobility plans (SUMP).

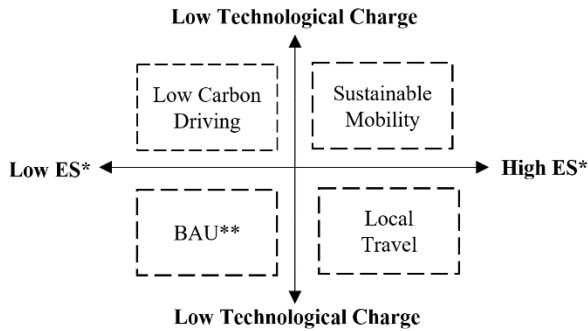
3 Sustainable Urban Mobility Plans

Various studies have shed light on the transport sector and its contribution to climate change [9]. Giannakis et al focused-on land transportation and proposed an assessment in the city of Cyprus to address carbon dioxide emissions [10]. Panahi et al discussed the transportation problem and reviewed green liquid fuels as a potential solution [11]. Khreis et al emphasized the role of transport policy measures in reducing greenhouse gas emissions and achieving economic benefits, including compact land use planning, passenger modal shift, transit efficiency, electrification, and freight logistics [12].

The effect of climate change on city management effects as well the transportation sector. According to Markolf, the transport sector is under pressure to adapt to the effects of climate change, which can disrupt the transportation system through direct and indirect pathways [13]. To mitigate this disturbance in urban areas, smart and sustainable mobility-centred urban design is gaining traction as a potential solution.

It not only addresses environmental challenges but also supports economic growth through improved urban logistics [14]. Hickman et al discussed the importance of integrating urban planning with transport investments, including the transition to sustainable mobility that can be achieved through various scenarios [14].

Two main narratives are presented the figure 2, the technological charge that evolve the smart inclusion of city management through Information and Communication Technologies and Environmental Stewardship that evolve the consideration of the urban design features contribution in pollution rates and climate change. The two narratives are interconnected, while the level of adoption and application affects the achievements of the design objectives.



*ES: Environmental Stewardship
 **BAU: Business As Usual (the land use and emissions profile for a forest carbon project area prior to intervention, which serves as a benchmark to measure the impact of agriculture, forestry, and land use actions. Also referred to as “baseline.”)

Fig. 2. Narratives in Transport [14] (modified version).

Sustainable mobility involves investing in public transport, walking, cycling, low emission vehicles, and effective urban and regional planning. It leverages technological solutions to improve citizens ‘quality of life. Bawany and Shamsi emphasize the need for an integrated system that connects various subsystems such as health, education, transportation, and power grid to transform the urban space into an interconnected information system [26]. However, this design approach presents optimization challenges, including IT infrastructure, security, privacy, big data management, cost, heterogeneity, interoperability, efficiency, availability, scalability, and social adaptation. Moreover, the issue of financial inclusion and citizen awareness and literacy pose a substantial challenge in the application, evaluation and control stages.

The concept of Sustainable Urban Mobility Plans (SUMP) addresses the architectural diversity of urban spaces, particularly in old cities with conflicting characteristics. It focuses on improving mobility management in urban planning by considering the city’s physical constraints. SUMP aims to address the increasing demand for passenger and freight transport in urban areas driven by population growth and evolving logistics and supply chain requirements. The framework aims to tackle problems such as congestion, limited parking availability, and environmental pollution resulting from customer demand.

The SUMP framework is described as a “new way of planning urban mobility” and aims to meet the mobility needs of people and businesses for a better quality of life. It emphasizes integration, participation, and evaluation principles. The framework as described in the table below is based on eight main principles:

Table 1. SUMP Principles [32]

Number	Principle
1	Plan for sustainable mobility in the entire “Functional city”
2	Define long-term vision and a clear implementation plan
3	Cooperate across institutional boundaries
4	Develop all transport modes in an integrated manner
5	Involve citizens and stakeholders
6	Arrange for monitoring and evaluation
7	Assess current and future performance
8	Assure quality

Several authors have addressed the SUMP framework from the perspective of improvement and evaluation. May et al developed a set of recommendations to support cities in developing their customized Sustainable Urban Mobility Plans [15]. Their work resulted in nine recommendations and twenty criteria that include policy making, coordination and cooperation, decentralized & centralized responsibility, and public participation, etc. [15]. Torrissi et al presented a critical analysis of SUMP guidelines and the Italian version for sustainable mobility plans so-called “Piani Urbani della Mobilita Sostenibile” (PUMPS) [16]. Diez et al questioned the effectiveness of the SUMP framework in their paper; they argued that the evaluation of such policy framework should be conducted after a certain time elapsed due to its long-term vision. They used a methodology usually implemented in the field of lighting and energy to measure the cost analysis for each ton of CO2 saved withing transport in the city of Burgos in Spain (Burgos implemented SUMP since 2015 and it was one of first cities to adopt this new vision proposed by the European Council) [17].

The SUMP framework was adopted and implemented in several European cities such as Venice Lagoon [19] and Burgos in Spain [17]. However, the transition to African cities stays very limited due to different characteristics and challenges compared to their European counterparts.

The enhancement of logistics and transportation networks is a significant priority for African cities as they strive to support industrialization efforts. To enhance this concern, the African Mobility Framework, known as “Mobilize Your City” initiative, is a designed as an expansion of the Sustainable Urban Mobility Plan (SUMP) from an African standpoint, which was introduction during the Conference of the Parties COP21. The goal is to enhance urban mobility planning and transition cities towards an inclusive vision based on four key principles.

- (1) Livable
- (2) Improved citizen quality of life
- (3) Improve economic attractiveness
- (4) Reduce greenhouse gas emissions.

Among the first cities adopting the initiative in Africa are the city of “Yaoundé” and “Douala” in Cameroon. They focused on the passengers’ mobility and the improvement of the transportation network while

respecting water canals and optimizing the irregularities of the existing transportation systems [20][21][22]. In Morocco, Mobilise-Your-City was applied in different cities such as Casablanca, Rabat, Oujda, Khouribga and Kenitra. These cities have different demographic statistics and different architectural and mobility needs [23][24][25]. There use of Information and Communication Technologies has been included in the design of the African sustainable cities and to support the mobility management as well. The following table gather examples of initiatives and applications found in the literature review:

Table 2. Smart city initiatives in African Cities

City	Initiative
Kigali, Rwanda	Sensors were installed around the city to measure air quality, monitor the power grid's safety, and detect water leaks.
Konza, Kenya	Smart city that is built from scratch with a National Data Center.
Casablanca, Morocco	A smart city cluster is working to make the city of Casablanca more attractive, efficient, and competitive for companies, citizens, and visitors. The initiative is based on technological solutions inviting private, public and citizen partnerships. https://www.e-madina.org/

The sustainable urban mobility framework does support the inclusion of smart and eco-friendly mobility solutions in the urban area; however, the adoption and application examples of the SUMP are limited to a set of cities and doesn't provide a comprehensive evaluation of its effectiveness and efficiency. Moreover, the inclusion of ICTs remains limited to certain aspects of city management features such as electricity and water grids. The difference in the advancement of urban planning between regions within the city itself does create an interruption of physical, informational, and financial flows and between a set of cities. Therefore, revisiting the concept of city mobility under the perspective of architectural differences is essential to achieve notable outcomes in African cities. The financial limitations in the application of innovative solutions and the restricted financial abilities of citizens should be considered in the design of mobility networks and the inclusion of environmental constraints in the urban design.

4 Discussion and Conclusion

Urban planning and design have been the focus of extensive discussions on key topics such as mobility, sustainability and resilience. These issues are closely interconnected with urban architecture, logistics, supply chain management, industrial activities, and the overall economic growth of cities. Therefore, it is essential to

consider a wide research angle when addressing urban planning through the inclusion of industrial oriented criteria and mobility needs in the sustainability optimization models. In doing so, we proposed in this study to focus on the analysis of urban planning frameworks and their effects on mobility and logistics efficiency. The urban planning and infrastructure system was discussed to illustrate the different elements and components of the urban space. We chose to discuss two different frameworks aiming to increase the sustainability and mobility of the city; the first is the Urban Planning Sustainable Framework where the process is based on the analysis between grey infrastructure in one hand and green blue infrastructure on the other.

The UPSF can also be used as an evaluation method to measure a set of Sustainability KPIs. The second framework is the Sustainable Urban Mobility Plans, where the focus is oriented toward the management of urban planning and design to serve a smooth mobility inside the urban space. The use of advanced technological tools and eco-friendly logistics materials is among the pillars of the framework.

The USPF can serve as an assessment approach to gauge a range of sustainability Key Performance Indicators (KPIs). The second framework is the Sustainability Urban Mobility Plans, where the focus is oriented toward the management of urban planning and design to facilitate seamless mobility within urban areas. This framework prioritizes the utilization of advanced technological tools and environmentally friendly logistics materials as key pillars. The objective is to transform the city planning to respond to the needs of the community as well as the challenges of the commercial markets.

The two discussed frameworks have been applied in several cities such as London (UK), Burgos (Spain), and Yaoundé (Cameroun). However, the difference in geographical aspects and architectural designs of cities generates different results. Moreover, the policymaker and stakeholders' level of commitment to urban planning improvements does participate in the level of efficiency of the framework's application. In addition, technological adoption and implementation are one of the major constraints in the transition efforts towards smart and digital sustainable urban planning. The use of smart technologies does require mitigating the differences in technology literacy among citizens.

The two discussed framework have been implemented in various cities, including London (UK), Burgos (Spain), and Yaoundé (Cameroun). However, due to variations in geographical factors and architectural designs among cities, the outcomes of their application differ. Furthermore, the level of commitment demonstrated by policymakers and stakeholders toward urban planning improvements directly influences the effectiveness of these frameworks. Additionally, the adoption and implementation of technology presents significant challenges in the transition towards digitally sustainable and smart urban planning. Addressing the disparity in technology literacy among citizens is crucial

when incorporating smart technologies into urban planning processes.

Besides addressing the mobility, sustainability, and resilience needs of urban environments, cities are recognized as the birthplace of communities and are characterized by their unique cultural and historical features. These aspects play a crucial role in urban planning and contribute as design attributes in the development of frameworks. Among the key roles of city cultural and historical aspects:

- Identity and the essence of place: Cultural and historical elements contribute to a sense of identity and place-making within cities. They reflect the unique heritage, traditions, and values of a community. Incorporating these aspects in the urban planning framework fosters a strong connection and attachment among citizens.
- Urban Character and Aesthetics: The visual and aesthetic quality of the city should be inspired by the cultural and historical features. It can shape the urban space and character and provide an influential atmosphere.
- Social Cohesion and Inclusivity: Cultural and historical aspects have the potential to strengthen social cohesion and inclusivity within communities. They serve as a common ground for diverse groups of people, fostering a shared sense of belonging. Urban planning frameworks can leverage these aspects to create spaces promoting social interaction and community engagement.

This work focused on studying the effect of sustainability-oriented planning on urban mobility and logistics. It represents groundwork research to dive into the details of urban design and planning, especially when dealing with multi-architecture cities. The diverse characteristics such as type of buildings, routes dimensions and network, limited space availability for logistics-related activities do represent additional attributes to consider in the development of customized urban plan.

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