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Review

The Compactness of Non-Compacted Urban Developments: A Critical Review on Sustainable Approaches to Automobility and Urban Sprawl

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Abstract: This paper challenges the fact that the absolute freedom for residents to locate themselves wherever they want can lead to sustainable cities. Urban sprawl is the corollary to this freedom. Urban sprawl has become a controversial issue. Lines of thought among academics, practitioners, and local authorities have been diverse. Some academics advocate the compact city as an antidote to urban sprawl, some scholars doubt the ability of conventional notions of containments to create sustainability, and others are fascinated by urban technologies and believe in the feasibility of these technologies, whereas local authorities impose policies, one after the other, without effective results. The problematic point is the absence of a comprehensive approach to undermining the urban sprawl sustainably. On the other hand, the physical urban compactness alone cannot meet containment aims. The study therefore study poses a question: Is there a theory or policy that can accommodate all of these ideas? This study attempts to find a sustainable compromise through a critical review of the impact of auto-mobility on urban affairs and to solve the dialectical contradictions between the protagonists of compactness and their counterparts who advocate urban sprawl. The review ends with a comparison between urban initiatives and theories related to auto-mobilities, and highlights the approaches to sustainable urbanism. The conclusion is that all classic planning theories have neglected the sociocultural impact on the urban realm, and that the current initiatives and mutual debates consider the resident just as a physical object who cannot contribute effectively to sustainable urban syntax. The study concludes that urban sprawl can also be a compacted zone if authorities ensure the equity of loci-services. Then, the preference for housing locations will not be a challenge to urban residents' movements to settle closer to their work. In the end, the inhabitants will share in making an integrated and real urban containment.

Keywords: car dependency; automobility; modern theories of city planning; transportation policies; compact city; self-organizing city; ubiquitous city; zero-carbon city

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1. Introduction

Cities have become the dominant organizational system for accommodating people over the past three decades [1]. The world's population reached 7 billion people in 2011 [2], and more than 50 percent of these people now live in urban areas [3]; although, the livable urban areas of the world do not exceed three percent of the total land [4]. The UN expects that 60 percent of the globe's population will settle in cities by 2030 [1]. Notwithstanding

that the 20th century was known as the century of urbanization [5], urbanization has now become the most significant feature of the 21st century [6].

UN-Habitat and the World Bank have pointed out that around 80 percent of total global urban growth will take place in developing countries and, due to the rapid explosion of their populations, Asia and Africa will occupy the first rank of populated cities [7–9]. Because of rapid urban inflation, new descriptions of cities have emerged, such as "meta-city" or "hyper-city", which indicate cities of 20 million people, unlike "megacity", which encompasses only 10 million [10,11].

The rapid urban sprawl has led to numerous social and economic problems relevant to the environment. Therefore, long debates have been held over transitioning into sustainable cities; this has become an urgent matter since 1972 [12,13]. Many scholars have revived the old concept of the compact city; however, this trend has faced several criticisms despite its merits. The skeptics of the compact city state that urban containment is antithetical to sustainability in some aspects, such as livability. The conflict between urban sprawl and the compact city remains unresolved. Some countries such as the U.K., China, the U.A.E, and Korea have attempted to tackle the downsides of urban sprawl through technology [13]; they have established eco-carbon cities such as Masdar in the U.A.E. and ubiquitous cities, such as those in Korea. However, these kinds of cities are prohibitively expensive, were founded to serve the high-income classes, and increase social segregation. Low-income residents with low education cannot afford or deal with the services of such kinds of cities. Even if they have work in those cities, they will settle near cities. Then, the city loses its social coherence and one of the pillars of sustainability. Thus, this tendency is also equivocal. Local authorities all over the world have attempted to decrease urban sprawl and the congestion within cities by raising oil prices or imposing traffic taxes but these endeavors have not been effective enough to evolve into sustainability. Since the debates over versatility, the transition into a sustainable city seems fuzzy and needs more investigation.

This study aims to discover the reasons for urban sprawl through a survey of the urban planning theories, policies, and initiatives relevant to remedies for urban sprawl. The study is premised on two hypotheses; the first is that automobiles are the villains of the city, as they allow residents to live wherever they wish. The second premise is that planners created their theories regardless of the sociocultural dimension, or at least regarded this dimension as constant (as if humans were physical objects). This study poses a major question: How can we convert urban sprawl to create vibrant and sustainable compacted cities? The answer may resolve the clash between protagonists of the compact city and sprawling urbanism. Minor questions have also been raised: How has "automobility" been interwoven into the classic planning theories? What are the consequences of automobility on urbanism? Finding answers to these questions may prove important for understanding the main question.

This study is based on three approaches. The historical and inductive approaches that are traced offer proof of the hypothesis of the study. Thus, the role of the vehicle in the crystallization of city-planning theories, and how cars have had an impact on the planners' vision of the city of tomorrow, will be critically reviewed. Second, the inductive approach is used to identify the modern policies that deal with the phenomenon of car distribution, and to undermine the negative impacts of cars on the city, or adapt to them. The third is the comparative approach, which evaluates policies, theories, and initiatives by establishing the challenges that exist in each initiative or theory. Using this approach paves the way for presenting the compactness of non-compacted zones.

In the next part, the hypothesis is tested, by reviewing modern city-planning theories, ranging from the linear city published in 1882 by Soria Y. Mata, to the Broadacre City theory founded by Frank Lloyd Wright in 1932. In this section, we also shed light on some criticisms that planners' theories have elicited.

2. Automobility and Modeling Modern City-Planning Theories

2.1. Pedigree between City-Planning Theories and Automobility

Since the invention of the automobile in the 1880s, city planners have been motivated to publish numerous theories on modern city planning, which has strongly relied on the potential of cars to overcome urban sprawl [7,14,15]. In 1894, for example, Soria Y. Mata would not have been able to link two existing cities, without evolution in the means of transportation. He coined his idea of the linear city in 1882, and implemented it in Spain twelve years after publishing it [16]. In 1898, E. Howard founded the garden city theory, in a publication entitled "Tomorrow: A peaceful path to real reform" and reissued it in 1902, under the title "Garden city of tomorrow". The city was planned on a circular shape divided by radial boulevards [17], and was designed to be a utopia or ideal city, where the town met the countryside. Actually, Howard also would not have been able to build his theory, which advocates expanding horizontally, unless the potential of the car was taken into consideration [18–21]. The same applied to the Satellite cities theory that was put forth by Raymond Unwin in 1922, and the theory of the Broadacre City, a term coined by Frank Lloyd Wright ten years later [18,22,23]. The car had a vigorous impact on the horizontal city sprawl, as well as on its vertical growth. The radiant city, or "Ville Radieuse" embodied by Le Corbusier between 1922 and 1933, has wide thoroughfares and bridges (crossings) that were designed specifically because of the potential effect of cars [24–26], to the point where Le Corbusier noted in 1925 that "the corridor street must be killed" [27], indicating the wide streets and new urban systems that were imposed by the car. Theories oriented to neighborhood planning were also affected by cars, including Perry's Neighborhood formulated by Perry in 1910, which has a hierarchical street pattern to help cars move smoothly [28–32]. Meanwhile, the superblock theory theorized by Wright and Stien in 1929, relied on cul-de-sac streets to secure settlers from the risks of vehicles [33]. Using a historic gaze, we can recognize the role of the car in formulating and crystallizing modern planning theories. Therefore, the car provides a great opportunity for more urban sprawl and bigness—currently, and in the future. Table 1 shows the chronological of city planning theories affected by automobility.

Table 1. The chronological of city planning theories affected by automobility.

Initiative/Theory	Theorist	Planning Level	Date
The linear city	• Soria Y. Mata	• City	• in 1882
The garden city theory and garden city of tomorrow	• Ebenezer Howard	• City	• In 1898 and 1902
The neighborhood Unit theory	• Clarence Arthur Perry	• Neighborhood	• 1910
The Satellite cities theory	• Raymond Unwin	• City	• in 1922
The radiant city, or "Ville Radieuse"	• Le Corbusier	• City	• 1922–1933
The superblock theory	• Clarence Stein	• Neighborhood	• 1929
The theory of the Broadacre City	• Frank Lloyd Wright	• City	• 1932

2.2. Criticism of City-Planning Theories Based on Zoning

The rapid urban sprawl that was derived from the sequenced, modern city-planning theories aroused some critics to attack those theories that had bad consequences. In 1913, Arthur T. Edward was one of the earliest who criticized the solitude of vigorous urban sprawl; he proclaimed that man likes to live closer to services and other facilities, and wants

to live interactively with his neighbors instead of living as if in a fever hospital [27]. Jane Jacobs has also illustrated—in her book, "The death and life of great American cities"—that the trends adopted by Howard, Le Corbusier, and advocates of modern planning cities will produce unsafe, inhuman, uneconomic, and non-ecological cities [34]. Car ownership allowed the suburbs to double, causing social problems embedded in the segregation between the urban pattern of the mother city and the suburbs around it, the separation between social classes, and the increasing crime rate. Moreover, accident risks have increased, and the ratio of air pollution and noise has also been gradually rising owing to everyday travel. With the increase in the number of cars and car dependency, energy demand increases as well, and is considered a burden on the government's finances. Furthermore, the onus on the government has shifted toward the maintenance of the environment. Cities have become the habitat where all unsustainable actions arise and are exacerbated. However, they are also deemed to be the generators and hub for sustainable development [35], and they can afford to find a solution to the problems they encounter [36] if efforts are directed at the roots of the problem, rather than its manifestations.

3. Automobility as a Phenomenon

3.1. Private Car Dependency

The automotive industry may be the most invested among other industries according to different predictions by 2030. The car is an incredible phenomenon. It is the dream for both rich and poor. This dream is widespread and shared in all countries [37]. Among different kinds of vehicles available, the car is the most needed and, therefore, cars are dominant on the streets. In addition, they are considered a marker of personal identity, as well as an economic and social necessity [38]. Considering the traffic congestion in China [39], it was said that the Chinese would be happy with only rice, but this is not true; the minute people were given the opportunity to earn more money, the car became one of their priorities. In 1982, China produced 3428 cars. Now, China is deemed one of the greatest producers of cars in the world. In 2011, cars accounted for about 106 million vehicles, including around 78 million private cars [40]. Millions of Chinese obtained their first car during the last decade. Hence, China has become a country of new drivers. It only contains three percent of the vehicles cruising the world's streets, but the more bizarre fact is that Chinese vehicles are responsible for about 21 percent of road fatalities throughout the world [41]. In Africa, Luanda, among other cities, has chaotic traffic congestion; every week another 2000 new vehicles hit the streets [42,43]. People of Luanda endure traffic congestion of up to three to four hours to go to work.

Notwithstanding the car's disadvantages, for the majority, it seems like a temporary dwelling inhabited for a short time (while commuting), and humans naturally attempt to maintain their privacy. Hence, everyone tries to possess a car, once they are able to afford its initial price and the associated running costs. In addition, car ownership has become a gauge of social status in most communities [44]. Thus, any solution aimed at decreasing the number of cars, without paying attention to the social and cultural issues related to car possession, will not be a realistic one.

The capacity to move easily, which is offered by automobiles, has motivated people to possess them. Thus, the production of cars has been increasing annually, especially in the BRIC countries of Brazil, Russia, India, and China. The mass production of cars and their variety make them affordable for people all over the world. The average number of cars per 1000 inhabitants, and the high concentration of cars that exist in the USA, Canada, and Australia, whereas the lowest in Africa, as shown in Figure 1 [45]. In Saudi Arabia, low car prices and inexpensive oil have inspired low-income Saudis to acquire cars. Currently, dependency on cars is a significant phenomenon in Saudi cities [46].

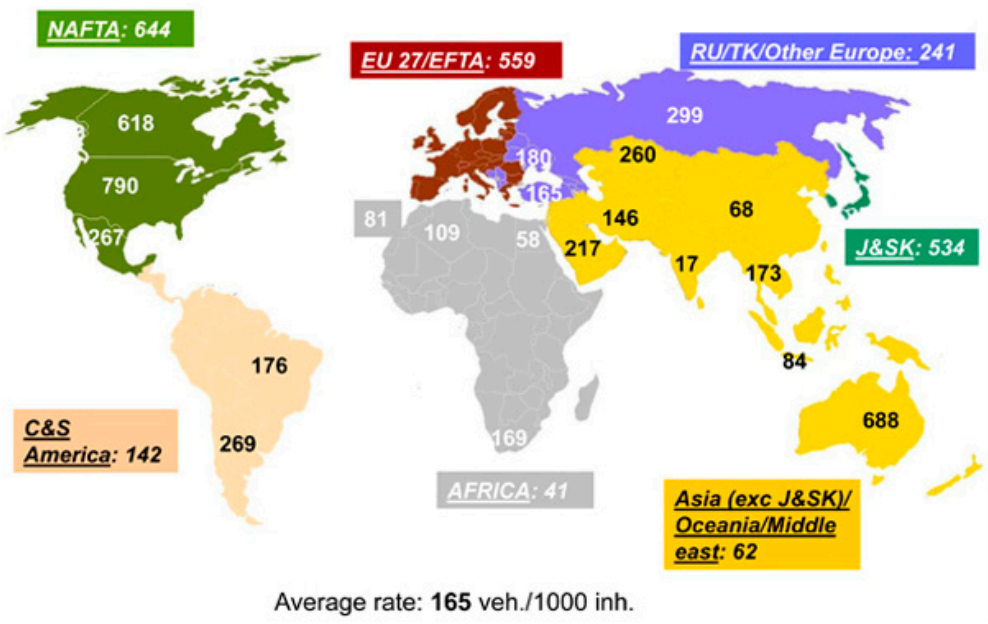

Figure 1. The average number of vehicles available per 1000 inhabitants throughout the world [45].

The rapid expansion of urban growth, increasing average human age, and increase in the affordability of automobiles has meant that automobiles are regarded as an essential tool for modern life, similar to the Internet; people cannot abandon them easily. In a survey of city dwellers, the extent to which people depend on their cars is shown in Figure 2 [47].

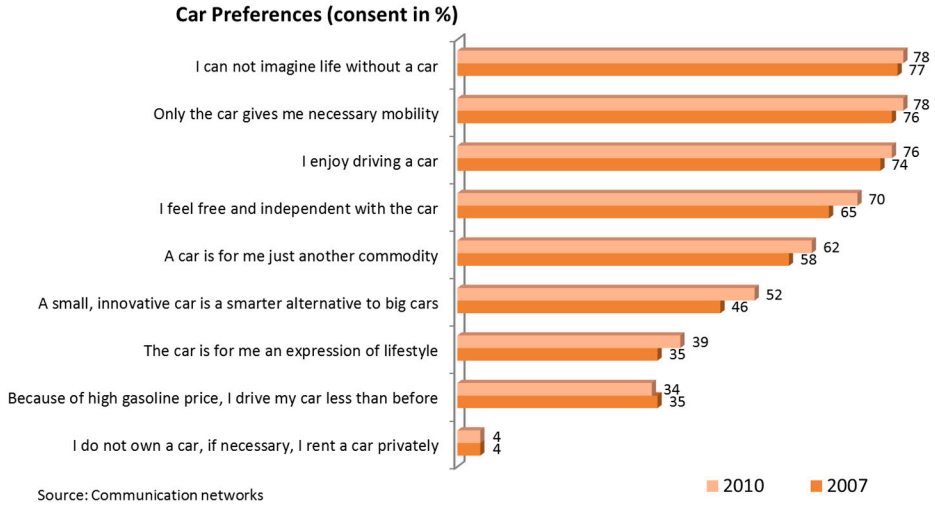

Figure 2. The average ratio of people who prefer cars, and their feelings toward them [47].

3.2. Economic and Environmental Problems of the Automobile

The economic growth of cities has opened the door to more ownership of motorized vehicles, such as the private cars that are distributed throughout Eastern European cities, the microbuses that have spread in Latin American and African cities, or even the 2–3 wheelers in Asia cities [48].

Cars in general, and the cheaper models such as Tata Nano and Bajaj produced by India in particular, have facilitated rapid urbanization and the inflation of cities, and caused land erosion. Urbanization consumes around 75 percent of global energy. Hence, cities emit about 80 percent of global greenhouse gas [4,49], in addition to various social and economic problems [50,51]. The transportation sector (road and air transportation) consumes the largest share of oil globally; it alone consumes about 47 percent of oil production, equivalent

to 34.5 million barrels per day according to 2001 statistics; road transportation consumes around 80 percent of total oil consumed by the transportation sector [52]. It is worth mentioning that the oil consumed by the transportation sector in total differs from country to country; the Organization for Economic Co-operation and Development (OECD) countries accounted for 55% as an average rate; whereas the non-OECD countries consume below 40 percent of oil purchased for transportation purposes. The difference in consumption between OECD and non-OCED countries took place because of the activity gap between them in terms of industrial and commercial transportation demands. The high oil demand needed to cater for transportation increases carbon dioxide levels, which are responsible for roughly 80 percent of global warming and climate change. Road transportation is responsible for about 20 percent of total carbon dioxide emissions [53,54]. In April 2007, automobiles emitted around 17 percent of total U.S. carbon dioxide emissions [55]. So, cars are a greater source of carbon dioxide [56], compared to other means of transportation, such as vans, trucks, buses, and motorcycles.

3.3. The Automobile and City Sprawl

Earle Draper is one of the pioneers of city planning in the U.S., who coined the term "urban sprawl" in 1937; the British planner F. G. Osborn followed him, by summarizing the relationship between urban sprawl and transportation in the 1940s [57]. The first national conference on city planning took place in Washington DC in 1909, where planners discussed the impact of automobiles on urban sprawl. The conference attendees pointed out that the transportation means did not merely facilitate movement, they reshaped urban patterns. Thus, they recommended that the city and the automobile must adapt to each other [58]. In the 1970s, the impact of automobiles on American life was clear, and a book entitled, "The architecture of four ecologies", was authored by Reyner Banham in 1971. A year later, a film entitled, "Reyner Banham loves Los Angeles", presented a picture of modern American life from inside a car [59]. Private cars were the most important component of the transportation system.

4. Tackling Automobility

As a result of car dominance, some initiatives have emerged to regain the street for its first function as a place serving people, rather than cars. "Reclaim the street" is one of the protesters' initiatives against the dominance of cars on the streets.

4.1. Sustainable Urban Approaches: The Compact City, Free-Carbon Eco-City, and the Ubiquitous City

4.1.1. Compact City

In the last quarter of the Twenty century (1973), G. Dantzig and T. Saaty rooted the term "compact city" in academia. The concept of a compact city has been published widely, especially since the beginning of the 1980s. The notion of the compact city was a correction path against urban sprawl resulting from repercussions of the world wars causing setbacks to environmental, economic, and socio-cultural values. The compact city has been oriented to raise urban density with mixed land use and simultaneously shorten automobile trips [12,60]. The open spaces providing from car-independency and minimizing parking spaces would contribute to creating vibrant spaces where residents' socio-cultural dimensions can be boosted. Frankly, the notion of a compact city is old; it is traced back to the medieval city, when the streets were for pedestrians rather than automobiles [61].

4.1.2. Free-Carbon City

Almost in conjunction with the date of propagation of the compact city, another approach to urban sustainability was launched in 1987 by Richard Register who published his book, "Eco-city Berkeley: Building cities for a healthy future" [62]. This notion stemmed from environmental motivations depending on the mitigation of carbon dioxide emissions,

and the uses of eco-friendly energy. A few models of this type of city have been designed throughout the world. Masdar City, located in Abu Dhabi, is considered one of the prominent innovative models of such a notion [63–66], where the inner transportation depends on electric personal rapid transit [67]. Underground tunnels have been developed to allow personal rapid transit to navigate through the city, avoiding traffic congestion and keeping traffic safe [68]. The benefits obtained by Masdar city are questionable compared to the USD 24 billion [44,69] cost of the construction of Masdar. This critical point will be discussed broadly in the Challenges section.

4.1.3. The Ubiquitous Eco-City

Undoubtedly, the rapid development of communication technologies has a remarkable effect on our lifestyle. Urban life is considered a melting pot where cutting-edge technologies of communication are interrelated in various urban activities. Thus, not far from the emerging notion of a Zero-Carbon city, Mark Weiser launched his notion about "ubiquitous" depending on Information and Communication Technologies ICT to connect people with goods and services wherever they are and whenever they need them. Weiser presented his computational project to the Xerox Palo Alto Research Center in the US in the 1990s [70] in order to improve the urban quality of life within the city or even on a regional scale.

By 1997, when the Asian financial crisis occurred, the vision of South Korea toward a sustainable urban life had provoked a new paradigm based on ubiquitous computing, whereby residents can access services and goods where they are and whenever they need them, through the ICT embedded in the urban infrastructure [71,72]. A decade later, South Korea launched the Korean U-eco-cities project. In 2008, the Hwaseong Dongtan was an exploratory project [73–75], and the number of such projects has reached more than 64 projects nowadays in South Korea. One of the attributes of these projects applied by the Korean Ministry of Environment is the utilization of green cards, which invite people to obtain credits for buying hybrid cars and eco-friendly equipment when they save energy consumption in their homes. This initiative was sponsored by some Korean companies such as Hyundai Motors and Samsung Electronics [71].

Another project was oriented toward an eco-friendly transportation system. In Yeosu city, the domestic authorities supplied residents with U-bikes, whereby the ICT-embedded bicycles are employed to support green transport within the city. Moreover, U-bikes could prevent bike theft cases because of the tracing-back smart system. Electric cars have also been adopted for transport in Jeju city so as to create a cleaner environment. After the COVID-19 pandemic, televideo-based conferences such as Zoom, Skype, and FaceTime can ensure affordable remote communications for groups and businessmen. Therefore, they save time and decrease carbon emissions and commuting costs. The U-eco-technologies can navigate the visitors to find their destinations easily and confidently. These technologies also offer a credible service for those who are responsible for elderly people suffering from Alzheimer's disease. These technologies have made some Korean cities, such as Seoul, Busan, and Incheon, into smart and ubiquitous cities and helped them to overcome the challenge of COVID-19.

The markets also have turned to be ubiquitous. A virtual store has been established by Homeplus (a Korean discount store retail chain) in Jamsil subway station in Seoul, which is deemed a creative idea, utilizing Ubiquitous and ICT technologies. The columns and walls of the Jamsil subway station are covered by virtual Homeplus products—digital advertising columns and walls—similar to what customers would see in real shops. This type of shop could significantly minimize the physical space of the traditional shop, and avoid shopping trips, unnecessary freight, and further car dependency.

4.2. Public and Governmental Policies Relevant to Traffic

4.2.1. Policies Interrelated to Traffic Congestion

Local interests have tried to address the negative outcomes that derive from automobiles. In 1925, McClintock assumed in his work, "Street Traffic Control", that the organization of car movement is essential for eliminating accidents and traffic congestion. Thereafter, some urban consultants attempted to make streets wider and more accessible, and less close-ended; they recommended the provision of traffic signs and focused on a hierarchical street system, in addition to separating paths for various types of vehicles to enhance movement flow [58]. The Vietnamese prefer to use motorcycles in commuting rather than cars, because of the motorcycle's ease of movement and its affordability in terms of oil provision and price, while the car consumes more urban area, both in cruising the street and in parking [76]. In 2000, the motorcycles on Hanoi's streets numbered 953,087 whereas cars numbered 130,746. It seems that reliance on motorcycles is a suitable alternative for cars in some Asian cities, such as Jakarta and Kuala Lumpur, as shown in Figure 3 [77].

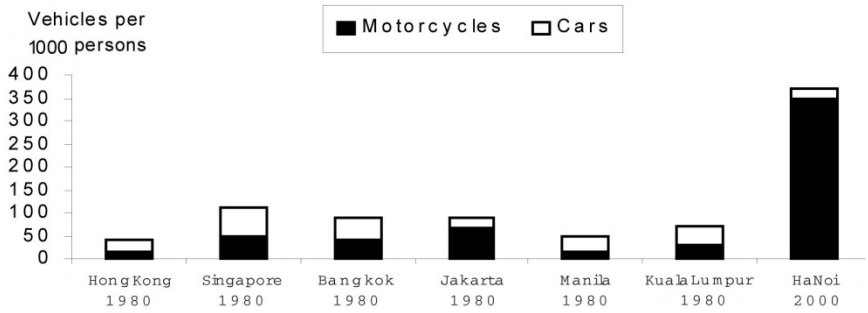

Figure 3. The ratio between automobiles and motorcycles in South East Asian capitals 1980 and Hanoi 2000 [77].

4.2.2. Policies Aimed at Improving the Environment

Air pollution increases the rate of fatalities among humans. In Serbia, for example, about 5000–7000 persons die annually, owing to air pollution and poor air quality [78]. These consequences motivated the Copenhagen authorities to reduce carbon dioxide by providing electric and hydrogen-run cars. This type of pilot scheme has also been carried out in Spain, where the use of electric vehicles, buses, and taxis to reduce air pollution has become a necessity [52]. The exacerbated air pollution resulted in the emergence of absolutely green vehicles, which produce zero pollutants while operating or cruising and use renewable energy resources, such as solar energy. Moreover, the use of vehicles with low greenhouse gas emissions, such as those that are operated by electricity derived from biodiesel or natural gas, produces a limited amount of pollutants. Thus, Al-Hinti et al. (2007) recommended using diesel cars to mitigate carbon dioxide emissions and save on energy consumption in order to achieve progress toward sustainability in Jordan [53]. Shared autonomous electric vehicles may replace about four automobiles less than the non-electric shared independent vehicle, which replaces seven cars. One of the challenges to electric cars is the availability of charging infrastructure [79]. Thus, it is probable that electric shared cars are still underused in Poland compared to other European countries [80].

The share mobility contributes to creating social equity and hence sustainable cities [81]. The Copenhagen government encouraged people to use car-share schemes, and made reserved parking spaces for licensed shared cars. Poland also is witnessing remarkable progress in the use of car-sharing [80]. A study conducted in Austin, Texas, concluded that a non-electric shared independent vehicle can replace about seven automobiles [79]. Similar to Stockholm, taxes on car congestion have been imposed to eliminate the problem [82–84]. In addition to raising fuel prices, this measure was an effective tool for decreasing private car dependency and promoting public transportation in oil-rich countries such as Iran [85]. In

the U.S. and U.K., planners have changed the regulations on minimum parking limits to the maximum parking limit, in order to shorten automobile trips, and thus support sustainable development and the vitality of the city center [46]. Since 2002, an initiative known as CIVITAS has emerged in Europe, which is co-financed by the European Commission (EC) and CIVITAS cities; it aims to create vital and sustainable cities, with an evaluation approach based on collecting and analyzing survey and interview data, in order to improve the transportation system [86].

5. Endeavors Assessment

Newman and Kenworthy [87] believed that planning policies can reorder the relationship between transportation and land use, to regenerate sustainable urban development. Table 1 shows a brief list of pros and cons derived from the reviewed urban initiatives and policies, which are relevant to transportation. The relationship between land use and transport systems seems complicated; we may attribute this complexity to either theorists or decision makers missing the relevant sociocultural factors. The mutual and prominent criticism against all the previous theories and policies is a neglect of the sociocultural dimension.

Compact cities, which were promoted to counter urban sprawl, are accused of lacking livability and the green areas that are necessary for social activities among residents, whereas the zero-carbon and ubiquitous cities were established to serve only the high-income stratum of society. In addition to being based on high-end technologies, they cannot offset the need for face-to-face communication or enhance the social linkages among urban residents.

In regards to traffic policies, the social factor was missed when the decision to decrease automobiles in the streets was made either by taxes or in other ways. In Mexico City, for example, the local authority prohibited the use of private cars one day per week, but people circumvented this regulation by using other kinds of motorized vehicles on this day [88]. Regardless of the accidents and carbon emissions, using motorcycles is common in Asian cities; although, it may be rejected in other societies, as shown in Table 2.

Table 2. The advantages and challenges against the reviewed theories and policies that relate to transportation and the sustainable city.

Initiative/Theory	Pros	Cons/Challenges
1. The compact city	• The compact city shortens motorized trips, and hence saves energy, and mitigates against carbon emissions. • Mixed land use is inherent to the compact city and makes it more livable and interactive. • The medium-to-high population densities that distinguish compact cities afford a feasible public transportation service. • Compact cities are safer than suburbs or gated communities.	• Regenerating the city in non-compact areas requires rehabilitation of infrastructure networks at prohibitive cost. • It does not interpret planners' invitations to decentralize, and does not give any consideration to its causes and effects [61]; the majority of people residing in compact areas look forward to living in lower-density zones, with a clean, pure and quiet environment [14]. This theory could not solve the contradiction between the sustainability of the compact city and its livability [89]. • The majority of compact cities suffer from lack of greenery [90] and privacy [91], in addition to the increase in noise, especially in over-compact cities.

Table 2. *Cont.*

Initiative/Theory	Pros	Cons/Challenges
2. The zero-carbon city	• It uses all tools available to achieve a carbon-free zone, depends on electric rapid transit, energy generated from PV, solar panels, and so on.	• The ability to achieve a waste-free city or zero-carbon city is still questionable. • Implementation of such cities is expensive [71], so developing countries cannot afford them. • These kinds of cities tend to serve a special class of the community (rich, highly educated citizens, etc.). In China, for example, eco-cities in which to live comfortably and safely are targeted at specific citizens, such as future developers, highly educated inhabitants, and high-tech corporations [92].
3. The ubiquitous eco-city	• The U-eco-city uses ICT embedded in the city infrastructure to offer services anytime and everywhere. • ICT embedded in bicycles can boost green transportation and health and fitness, and reduce bike thefts.	• The infrastructure of the U-eco-city is of prohibitive cost; moreover, all profits are actually reaped by the private sector, not by the government, nor by citizens [71]. • Some people believe that telecommunications may promote social linkages. Nevertheless, telecommunications cannot be a substitute for face-to-face interactions [93]. • The U-eco-city necessarily leads to undermining the employment rate, due to dependence on ICT technologies, instead of human workers.
4. The use of light motorization and widening the urban streets to keep up with the transportation capacity	• Light motorizations, such as the motorcycle, are small and can move smoothly through narrow spaces. • Motorcycles consume less energy. • Light and small-size vehicles occupy limited parking areas, in comparison to larger vehicles or private cars. • Motorcycles are more affordable than private cars.	• The incidence of fatal cases caused by motorcycles is much greater than by automobiles or private cars [94]. • Commuters who have a particular cultural heritage, or have social barriers, such as most of the Arab countries, may refuse to use these means of transportation. • Although these means consume less energy than private cars, they emit considerable pollutants [95]. • International experience shows that comprehensive construction programs advocating widening of streets, will not be able to fulfill the automobile's requirements for public urban space in the future [76].
5. Improvement of the public environment according to the fourth industrial revolution.	• Vehicles based on electricity or hydrogen can reduce air pollution, and hence provide a healthier environment. In the fourth revolution, the convergence of ridesharing and autonomous vehicles offers great opportunities to improve safety reduce congestion and enhance transportation freedom for everyone, including the elderly and disabled.	• Without a doubt, innovative cars or innovative fuel technologies can reduce emissions. Nevertheless, steady ownership of cars disperses all profits [96]. • Imposing taxes is a tool of punishment, and not a reformation procedure [84]. • These policies cannot be generalized; they may succeed in one place, and fail in another [97]. • The sharing economy that is changing the way customers interact with cars, will contribute to creating sustainability.

In regards to tackling urban sprawl, land use, and transportation, the compact city seems more sustainable than other attempts and initiatives; however, it faces the paradox between livability and sustainability, as Neuman argued in his paper, "The Compact City Fallacy, 2005" Therefore, we pose a question for solving this contradiction: Can we compact the non-compacted development? This will be debated in Section 7.

6. Discussion: Compactness of Non-Compacted Developments

There is no doubt that a sustainable urban environment cannot be created, without successful links between transportation and land use. "A Communications Theory of Urban Growth" by Meier in 1961 focused on the role of communication inventions, notably private cars, in urban sprawl, and the spread of suburbs. Meier advocated undermining dependence on cars [98].

Wouter Schik confirmed that good public transport access is an important issue when stakeholders select their workplaces. Schik provides an example to explain his idea: If one takes a sustainable office complex outside the city, and even if this office is energy-neutral and eco-friendly, it cannot improve sustainability within the existing city, and it also causes more vehicle trips. Thus, the negative ecological and economic results will exceed the positive features inherent in the building itself. In this context, Michaël Meijer also agreed with Schik that effective development should take place within the city, not outside of it; he added that if offices were built near homes, shops, and other facilities, then likable, healthy, and livable places where the inhabitants depended on cycling and walking, rather than cars, would be created [99]. Therefore, good allocation of land use improves the efficiency of the city [100]. Hence, the resident must be an important component in shaping the city, not just a user who has ultimate freedom in selecting his or her location.

The major mistake made until now, by both planning theorists and their predecessors is to have considered the user as a physical object, a constant element who cannot change socially, economically, or even emotionally. In zoning planning theories or even nodal developments, the planners, for example, suggest that one primary school in the center of the neighborhood is an educational service; the planners consider that all residents living in the neighborhood have the same desires, cultures, social structures, and aspirations. However, this premise is unrealistic; human structures are continuously changing, and the difference in tastes and desires is inherent in the human soul even between members of the same family; thus, some residents need national schools, some others need private schools or languages schools, and so on. Hence, the zoning imposed by planners in the blueprints will be demolished by residents in the built environment. This is our main problem—the planners have neglected the changing human factor!

The skeptics of the compact city considered it a physical form with tall buildings and high population densities. We agree that the physical meaning of the compact city may be worse than urban sprawl where the physically compacted form cannot prohibit the chaotic movement of residents from one place to another; however, the intellectual meaning of containment or compactness is a synonym for sustainability, which depends on the residents, instead the of high-density physical form, to weave together the compacted, urban-built environment. The local authorities should induce people to live near their workplaces through prioritizing the improvement of housing options and educational services. Figure 4 clearly shows the compactness of non-compacted developments by ensuring proximity between workplaces and homes regardless of the physical form of the traditional compact pattern.

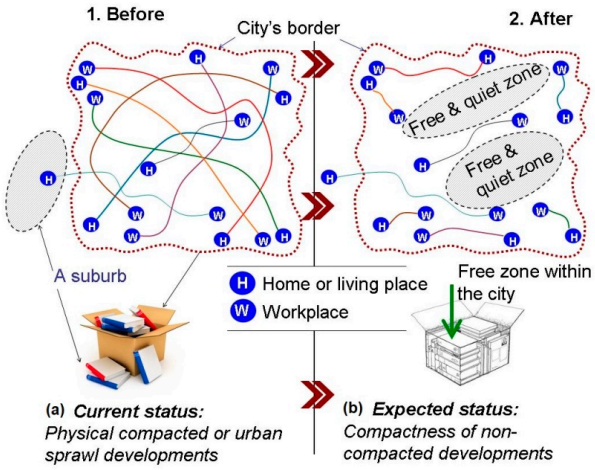

Figure 4. Compactness of non-compacted developments differs from the physical compact city and the urban sprawl. Herein, the city organizes itself through continued movements of residents to live near to their workplaces (the authors). When settlers attempt to move from their current homes to places closer to their work, there are three potential scenarios according to the family's breadwinners. The first, for the family that has a single breadwinner, is that the optimum position for a new family home will be within a 600 m radius around the breadwinner's workplace as shown in Figure 5 (first scenario). In the second scenario, for families that have two breadwinners, the ideal location of the new home will be determined by the intermediate distance along the line linking the two existing workplaces as shown in Figure 5 (second scenario). In the third scenario, families encompass more than two breadwinners. Here the optimum place for the new home should be a location in the geometrical middle among the vertices of the triangle or the polygon as shown in Figure 5 (third scenario).

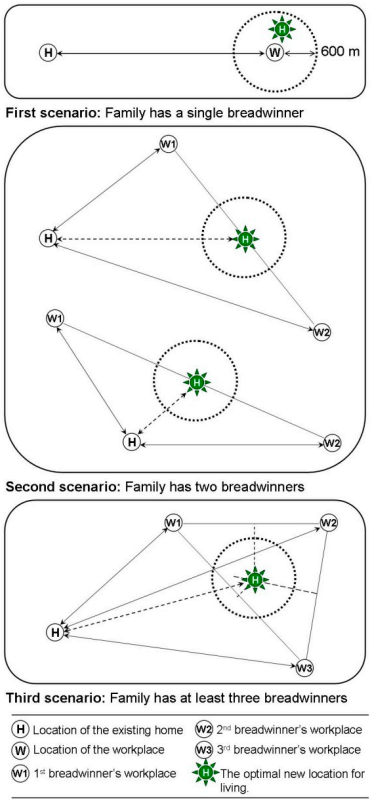

Figure 5. The optimal location of the expected living places according to different scenarios. The new location aims to reorganize the city and decrease the intersections between vehicles and people (the authors).

7. Conclusions

The study is an attempt to find out the relation between automobility and the urban problems resulting from car dependency such as traffic congestion, carbon emission, etc., in our cities. To find a sustainable urban solution, the study aims to review the various policies related to automobility and the different theories and strategies relevant to urban sustainable developments such as urban compactness, zero-carbon urban development, and the ubiquitous urbanization. In addition, the study tries to compromise the thorny issues among those policies.

The policies related to the means of transportation such as light vehicles: motorcycles, cycles, and tricycles regardless of their operating systems, are place-based policies. The success of these policies depends on some factors such as the environmental conditions and socio-cultural exigencies. The light transport vehicles are not suitable for people in the Gulf, for instance, or even in the very cold regions such as Russia and Scandinavian countries. Therefore, the car is the predominant transport machine that controls our hypothesis regardless of the operating system (oil car; electric car; Hybrid car; share riding, or even autonomous car).

Car dependency has emerged because of the long distance between the frequent two places that residents usually commute. Commuting between work places and living places is the major determinant of the automobile dependency issue. Apart from working remotely, the ubiquitous strategies cannot transit our cities to sustainability. The zero-carbon strategies also can contribute partly to solving the problem. However, the correct understanding of compactness depending on people may solve the problem completely. Thus, the study attempted to answer the question: What is real urban compactness?

Newman and Kenworthy [89,101] proclaimed that giving total freedom of choice to individuals to locate themselves, together with providing them access to the urban fringes, while maintaining clean air, a safe environment, and livable public spaces, is the greatest challenge for our cities. Thus, the freedom that some residents have to locate themselves wherever they need should be adjusted because the city is for all, and all residents should synergistically create a sustainable city because planners alone cannot create it through their blueprints. The compactness of non-compacted developments allows the city to reorganize itself through continuously persuading people to live near to their work; hence, the city can repeatedly rearrange its spaces and create compactness. This notion cannot succeed without improving the residential facilities and educational services for greater diversity and flexibility. The compactness of non-compacted zones may be the key to the paradox between the conventional compact city and urban sprawl; therefore, it can be implemented in any city regardless of the city's form.

The services equity is considered a study limitation. It is a threshold of success that allows residents to be effective contributors to create a sustainable urban containment. When the authorities consider the equal distribution of urban services and infrastructure throughout the city, the spatial tradeoffs will be easier, allowing employees to settle around their work places where the services are almost the same in the city. Numerous benefits could result from residents working near their homes:

- Dependence on private cars would automatically fall;
- Time lost during daily motorized travel (due to congestion) would diminish;
- The social relationships between residents would improve because they would be working and living in the same area;
- Public transport would be more comfortable since fewer regular employees would be using it during peak hours;
- Reducing the use of non-renewable oil, and hence lowering GHG and helping solve the problem of climate change;
- Residents would be encouraged to walk between their jobs and homes, enhancing their physical fitness.
- In addition, there is the potential to increase the green space to a built area ratio and create compact communities due to a decrease the parking areas.

All these incentives should inspire us to study passive tools, based on the premise that residents should not be completely free to live wherever they want. Upon the state's request or regulations, the companies or institutions where workers and employees are working may provide them incentives if they commuted to live closer to their work place. On the other hand, those who prefer to live far from their work location may be required to pay taxes according to their destination. The taxes will be commensurate with distance, where the farther living location is exposed to pay more. The amount of taxes may cover the road and environment maintenance expenses. However, urban services equity must be achieved beforehand. This policy may be a practical recommendation for the authorities towards their endeavors to provide sustainable urban developments.

The study opens a door to developing the notion of real urban containment in the real world through a case study. This study invites researchers to consider the urban resident as a generator in the urban compactness process rather than being an object after taking into account the equity of urban services.

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