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A comparative study of two urban planning models: The linear city model and the 15-minute city model

Shuodong Wang

Faculty of Mathematical Sciences, University College London, London, United Kingdom, WC1E 6BT

vincent.wang.21@ucl.ac.uk

Abstract. People have been exploring the perfect layout of a city since the birth of the first human settlement, it is not only a matter of aesthetics, but a complex and delicate subject. In modern cities, multiple city planning models have been proposed and experimented by city-planners, since an effective model can help the government to manage the flow of people, money and resources. In recent years, the concept of a 15-minute city has gained more and more popularity, while another hot topic is the linear city, both of them are supported by scholars, hoping that they may solve some of today's urban problems like inequality and pollution. This article considers the two models from four different aspects, namely environment, health, wealth and growth potential, comparative analysis is carried out to measure each model's ability, evaluation of the feasibility of each model in practice is also made. Finally, a suggestion regarding how to support the implementation of the two models is made, a direction for further supportive research is also provided.

Keywords: smart city, 15-minute city, linear city, city planning.

1. Introduction.

For thousands of years cities have been attracting people and resources, 50% of the world's population now live in cities, the success of cities is believed to be its compression of time and space [1]. Nowadays, to measure the success of a city or a type of cities, there is a large variety of aspects to consider.

The concept of a 15-minute city was first introduced by Clarence Perry in the late 1920s when he was working on the urban planning for New York city [2]. While the linear city concept was introduced even earlier, first time in 1882, by Arturo Soria y Mata [3], his idea of a linear city also focuses on increasing people's accessibility to daily necessities, but instead, the layout of the city is consisted of several parallel stripes with different functions, like living area, industrial area, entertainment area and so on.

Nowadays, how to enhance a city's economic and demographic performance through more scientific urban planning is the first priority of many policy makers from all over the world. Most studies done currently focuses on evaluating the strengths and weaknesses of a particular type of city model, or investigating into specific aspects of different models, such as the case study done by Batty et al in 2021, where the focus was about Neom, an ambitious linear city project launched by Saudi Arabia [4], while in this study we will compare two useful models: 15-city model and linear model in terms of environment, health, wealth and growth potential and evaluate their abilities.

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2. Environment

Both models appear to be relatively environmentally friendly, mainly because that they reduce the need for long-distance travelling, therefore decrease the amount of carbon emission overall. In the case of the 15-minute city, there's an additional benefit, urban intensification, in a study done in Cagliari, Italy, many of the disused public infrastructures in the city centre were refurbished to improve the inhabitants' access to daily necessities [5]. While for the linear city model, in a study related to the city planning of Neom, a 170-km long linear city project launched by Saudi Arabia in 2017, one may picture the layout as a string of 15-minute neighbourhoods, like shown in figure 1, each block is a square of a side length of 400 metres [4].

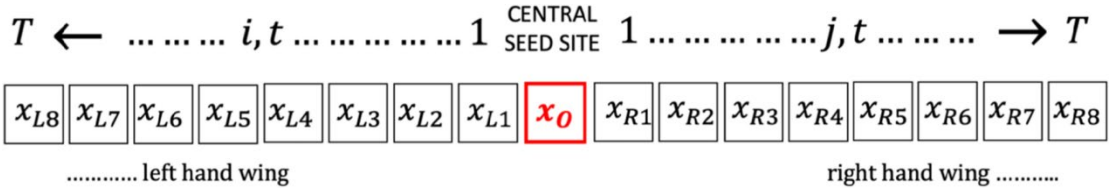

Figure 1. The planned layout of Neom [4].

Therefore, with the decrease of daily commute to work, school and shops, both models are very carbon neutral.

3. Health

The World Health Organisation defines a healthy city as "a framework to respond to health issues that have emerged due to urbanization." [6] A major urban health challenge is obesity, as highlighted in a large number of studies, the living condition actually plays a huge role in people's health, due to several reasons like lack of access to exercise facilities [7]. Both models can significantly improve people's physical health as there will be good access to hospitals, parks, and sports facilities, all within walking distances. In addition, there will be better access to not only food but healthy food as well. There will be better access to sports field and hospitals too. People will also be more driven to walk and cycle, as both models will have a high population density, according to the study done by Gilles Duranton and Matthew A. Turner, there is a plausible effect of densification policies to the decrease of aggregate driving [8].

Furthermore, the 15-minute city, as an urban form with multiple centres of activities, according to the findings in a study related to the spread of infectious disease in different urban structures are less vulnerable to a rapid spread of epidemics [9] . Which may be caused by several reasons including less daily mobility of the inhabitants. With good physical health, the 15-minute city model enables the dwellers to have a better psychological health as well, as they don't need to travel so far for daily necessities, and the enhancement of neighbourhood will make people feel more belonged.

The linear city model, as discussed earlier, also have decent accessibility, however its one-dimension structure inevitably makes its accessibility weaker than in a two-dimensional 15-minute city model, especially at the two ends of the linear city.

4. Wealth

The 15-minute city is not only an academic concept in urban planning, it's also a popular catch phrase in real-estate advertisements. People choose a certain property not only because of the property itself, but mainly consider the location of the property too, thus creating a wide range for the price of similar properties located in different places. In the most ideal form of a 15-minute city, resources like housing, education, health care and green space will be evenly spread out, but in reality policy makers will be having limited budget, and transform the city one area after another, which will inevitably causing some hierarchy in different regions of the city, resulting in an increasing possibility of larger inequality gap.

In the case of a linear city, inequality is linked with its strong centrality effect, in a study related to the city planning of Neom a model is generated to simulate the distribution of population in Neom [4]. Shown in the graph below (Figure 2)

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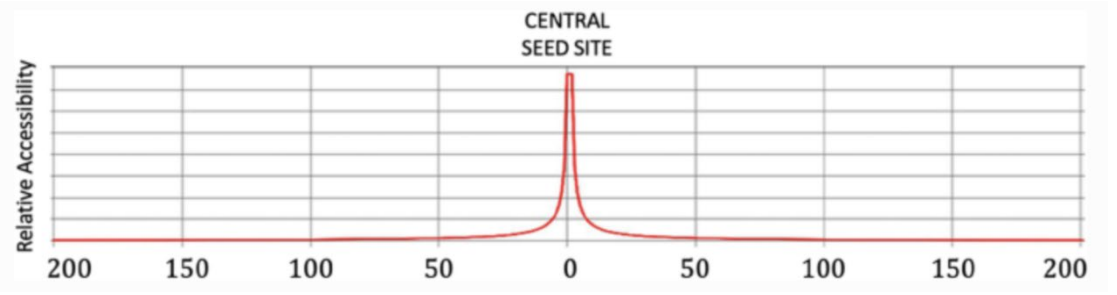

Figure 2. Visualized simulation of the relative accessibility of each of the 400 cells in Neom [4].

People are very likely to congregate in the midpoint of the line. The result of this is firstly a hierarchy in the housing prices in the city, leading to a divide of classes within the linear city, the place where the rich live in will likely draw more investment and more social resources will be located in the centre of the city, which will push the housing price in this area even higher, causing a vicious cycle. This cycle will mean a completely opposite life for the rich who live in the central area and the poor living in the two ends of the city, promoting inequality, which may turn to uncertainties in social order.

5. Growth Potential

The final aspect to compare is the growth potential of the two models.

Ever since the birth of the first city in the history of mankind, rivers have played a crucial role in the design and development of cities, nowadays many well-known old cities in the world is accompanied by a famous river that runs through the heart of it, for example the Thames for London, the Seine for Paris, the Hudson for New York and the Huangpu river for Shanghai. Indeed, the cities usually owe their existence to rivers [10], the city depends hugely on the river for clean water, faster transports and so on, primary human settlements near a river will almost always be along one side of the river, then as the settlement develops into cities, the inhabitants will have to cross the river at some point in order to satisfy their growing need of space.

Following this idea, the 15-minute city model seems to be the natural choice for river cities as these types of cities have already been separated into two halves by the river, which are suitable to develop multiple subcentres and form the 15-mintue units. Indeed, many old European river cities such as Amsterdam have already started to take such approach.

However, in order to create a completely new 15-minute city style neighbourhood, there's a large need of investment, like schools, hospitals, shopping centres and so on, to attract this amount of investment and people, by strictly following the 15-minute principle will cause a relatively slow growth and precise operational research is required to allocate these resources precisely, making the development of a pure 15-minute city model to be even more challenging.

On the other hand, the linear city also has a limited potential to grow as there are actually only two directions to go for. And by the analysis of the population distribution in Neom, a strictly linear city, the two ends are the places with the least population [4], however that's exactly where the growth is happening in a linear city. This means to develop the two ends, a large portion of raw materials and workers need to travel a long distance, making the development extremely costly, and the newly developed area is not even attractive, since citizens in a linear city will naturally concentrate in the centre. As a result, growth in a linear city is very limited.

6. Discussion

We have assessed the two models, the 15-minute city and the Linear city in four different aspects, namely Environment, Health, Wealth and Growth Potential. We have treated the four pillars separately in this study, however it is worth noticing that these pillars tend to intertwine with each other, for example Wealth and Health, it is usually the case that the wealthier the city is, the healthier the people are, as there will be more investment in exercise facilities, organic food suppliers, and so on. Hence, a comparison between the two models in term of the four pillars separately is necessary since it is the

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most straightforward approach, but we must consider the conclusion from the comparisons as a whole instead of separately.

7. Conclusion

Both models are good choices to improve some of today's urban problems like air pollution and obesity among citizens. However, the two models are likely to promote inequality and lack some growth potential, especially the linear city model, where growth are very limited and even undesirable.

Combing all points listed above, I propose that the most suitable uses for the two models maybe in some special parts of already large cities to promote living standards for their citizens. The concept of 15-minute city can be used as a guideline when the government is planning on urban regeneration programs. To be more specific, in a particular region of the city, the government can evaluate which parts of the region are not needed by the public, and what kind of infrastructures are needed by the people in this region. The linear city also has a good use in urban planning in places with unusual geographical conditions. For example, a linear layout maybe suitable for a city in a narrow valley or in a lean-shaped oasis next to a river, where the growth options have already been limited by the geographical condition.

Cities are complicated and as described by Jane Jacobs, we only get close to the structural secrets when we deal with the conditions that generate diversity [11], however perfect a model is, the most important part always remains in how to implement this in actual government policies. An ideal further research will be to provide a rigorous mathematical and operational analysis on the citizens daily movement to help policy makers allocate resources in order to maximize the strengths of different city models.

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