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Architectural and Urban Implications of New Transportation Technology

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The transition of transportation systems in the city leads to changes in urban space and urban organization. In most pre-medieval towns, where most people walked, only a small part of the population, such as high nobles or soldiers, used horses as a means of transportation. The boundaries and the spatial structure of towns were based on the limits of a person's walking ability. Land use patterns were determined based on physical properties and the mobility of the means of transportation.

As the next generation of traffic technology developed, the traffic system in the city changed drastically. It will have a significant impact on the development and change of architecture and urban space, and it can be applied in various aspects such as planning, design, and operation in relation to the spatial changes caused by the next generation of transportation technology. The temporal range covered in this study is set to be 5 to 10 years (near term) in the future.

1. Expansion and convergence of urban space for self-driving cars

In order to ensure the safety and stability of autonomous vehicles, a separate lane for autonomous vehicles is expected to be provided for a considerable period of time, during which people need to use the urban space together with the vehicles they drive. The installation of these lanes will divide the area

of human driving from that of autonomous driving, but the human segment will gradually disappear as autonomous driving cars become more prevalent.

2. Reasonable alternative use of parking spaces

As the urban space for cars are shrinking and roads can be used more efficiently through autonomous vehicles, areas of traditional automobiles, such as highways and public roads, as well as garages and parking lots, will turn into human spaces. Many of these parking spaces are expected to become unnecessary due to the spread of autonomous vehicles, and these spaces are likely to be used for commercial, or public use.

This change, of course, brings about the architectural design shift of existing buildings and the amendments of laws and ordinances related to parking lots. Therefore, this could be a chance to improve the current urban problems on functions and aesthetics in town. The effect of replacing parking lots is expected to vary, depending on city conditions, but most parking lots, especially in urban areas, are expected to disappear altogether, unless there are special reasons. In addition, it is expected that the amount of street parking can be further reduced as demand-oriented traffic services spread.

3. Changing spatial demands

With the increase of vehicle sharing systems, the demand for collective public parking lots will be maintained until autonomous vehicles are generalized. Even in an apartment building, it is easy to utilize shared cars because a private company can exclusively use part of the public parking lot if the company provides vehicles such as Car2go, Socar, and Green Car. In this regard, it is necessary to agree on the management of parking lots, regarding vehicle sharing systems, during apartment representative meetings. These problems are larger in existing single-family homes. This is due to the fact that it is difficult to create a parking spaces for private vehicles because space is so limited.

4. Driving / storage space for Personal Mobility Vehicles

If shared bikes become common, the spatial demand for them on roads may increase. Alternatively, if personal mobility, developed in various formats, is used as a shared means of transportation for the first and last part of a trip, a storage place for these modes of transportation needs to be provided at the public level.

The analysis of next-generation transportation technology in this study was carried out to clarify how autonomous vehicles, Personal Mobility Vehicles, and demand-responsive

transportation will affect urban space. Regarding the proliferation of autonomous vehicles in Korea, sales of autonomous vehicles will begin in 2025 with market saturation expected by 2050.

In the case of the Personal Mobility Vehicle, numbers are expected to expand from 240,000 to 1 million by 2030. On average, it will reach 62,000, but it will be greatly influenced by institutions and institutional aspects. In particular, it is expected that the Personal Mobility Vehicle will replace the vehicle share system for short distances, within 5 km. It is expected that the use percentage of PMVs to total modes of transportation will be 76% for 2.5 km or less and 89% for 2.5 – 5 km.

It is difficult to predict the timing of the diffusion of demand-type transportation, because the technological base is already at the level of commercialization, but it will greatly depend on legal and institutional maintenance. Indeed, it appears that social constraints are more likely than technological constraints, such as Uber, which has been widely used in the West as well as in Southeast Asia.

According to survey results from 1,500 people regarding next generation transportation technology, 93.7% knew about autonomous vehicles, and 76.2% thought that autonomous vehicles will be commercialized within the next 10 years. 44.6% of respondents said they were willing to use autonomous vehicles, and only 7.7% said they would not use them. 48.7% of the reasons for rejection of autonomous vehicles was that people believe accidents are more likely to occur, followed by lack of confidence in technology levels. In terms of cost, 30.9% said that they would use a car at the current price level, and 59.4% said they would pay a considerable sum to 1.5 times below the level.

In the case of the Personal Mobility Vehicle, 20.4% of respondents had experience of using them, 82.7% had used them for leisure purposes, 50.7% for walking distance, 30.7% for low cost. The average moving time of personal moving means is 38.9 minutes and the average moving distance is 11.2km, which means that it moves farther than expected.

The number of experienced respondents was 38.8% for the responding type of transportation. These users used it 1 or 2 times a month, mainly for cultural life (31.8%) and commuting (18.9%). The average use time was 43.8 minutes and the moving distance was 20.9km on average. In the case of replacing public transportation by means of accommodating transportation, 89.7% of respondents indicated that they would be willing to pay more. The intention to pay was within the bus fare level (37.5%) and within the taxi fare level (42.1%).

In this study, we analyze the change of parking demand caused by the introduction of an autonomous driving car. In this paper, we consider the possibility of future changes to parking

areas by constructing a logarithmic parking demand model. As a result, when the market share of autonomous vehicles reaches 5%, 1,000 - 9,472 parking lots are estimated to decrease in each Dong in Seoul.

In order to estimate the spatial demand for Personal Mobility Vehicles, it was assumed that the demand for expansion of one area around the station area of Seoul occurred and the project volume was estimated at 468.6km, and the total construction cost was estimated to be about 238.7 billion won. These estimates were made on the assumption that access to the final destination around a station area would be reached by using a Personal Mobility Vehicle.

The results of numerical analysis can be said to be preliminary numbers that define policy objects, but a large amount of trial-and-error is expected if institutional arrangements for managing and utilizing urban space, especially public space, are not implemented.

Regarding autonomous vehicles in terms of architecture and urban space, institutional arrangements for the installation and operation of lanes for autonomously-driven cars should be prepared, and the number of installed parking lots and physical design standards should be changed soon. Regulations for parking lots should also be re-considered. In addition, there is a need to improve the design criteria of existing roadsides and intersections, considering autonomous vehicles.

It is expected that improvement of street design will be closely related to the Personal Mobility Vehicle system, in addition to autonomous vehicles. In particular, the Personal Mobility Vehicle system is expected to be similar to the public bicycle sharing system. Therefore, the driving space and the storage space for Personal Mobility Vehicles must be systematically prepared.

Demand-responsive Transportation Services may have a relatively small number of visible changes, but underlying shifts are likely to change the character of bus stops into a pick-up point. In addition, since the center of transit-oriented stops seems to be relatively smaller than the existing stops, it is expected that the meaning of pedestrians' density and location centrality will decrease. These changes mean that the spatial structure of existing urban areas may fundamentally change, in addition to the changes in the location, spacing, and facilities.

The rapid development of traffic technology is expected to change the use conditions of architecture and urban space. Among them, there is a need to consider the characteristics of space and the architectural environment, in advance. This study shows a general viewpoint of how these changes of the transportation system can affect urban land uses, street spaces and the built environments, and how spatial standards should be improved and regulated according to this transportation change.

Although it is inevitable for a certain space change to occur due to the development of traffic

technology, no one can offer a clear picture as to how next generation transportation technology will adjust, converge, and integrate into the current urban system. Therefore, it is urgent to clarify the direction and concept of the future transportation system that can be practically applied in Korea, based on the present technology and development direction.

Keywords : Autonomous Vehicle, Personal Mobility Vehicle, Demand-responsive Transportation Service, Spatial Change

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