BIG DATA AND AI ARE THE ANSWER TO TRANSPORTATION'S RESILIENT SYSTEM

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ABSTRACT

As the externalities of the world become more and more obvious, the traditional transportation industry has many drawbacks due to the lack of flexibility. To rethink the transportation industry in order to plan and build a resilient system in response to global externalities. This essay collected and sorted out some phenomenon related to climate, carbon emissions, transportation facilities, health conditions. Using the functions of big data and artificial intelligence technology as well as the functions already used in the transportation industry, the solutions to the existing phenomena of big data and artificial intelligence technology are discussed respectively. Finally, the paper summarizes the possibility of applying big data and artificial intelligence technology in the transportation industry, and provides some ideas for dealing with global externalities.

1. INTRODUCTION

Entering the 2020s, the global climate problem is still prominent, and there is still much room for progress in environmental protection. Due to climate and environmental factors, every country in the world will cause huge economic losses in traffic every year. As far as China is concerned, the ports in the Yangtze River Delta have experienced at least 15 floods since the 20th century, with a single economic loss of 1 billion yuan (Editorial Department of China Journal of Highway and Transport, 2021). Moreover, in addition to the impact of climate and environmental factors, carbon dioxide emissions from the transportation industry, as one of the main causes of global warming in recent years, in turn affects the global climate issues closely related to it (Pi, 2022).

The planning, construction, management and maintenance of transportation facilities need to be invested in a large number of manpower, material and financial resources. Among the countries and regions of the world, for developed countries, there are more and more restoration projects for old facilities, and it is a major concern for them to ensure that the restored structures are safe. On the contrary, for developing countries, the improvement of transportation facilities is an indispensable part of social development and plays an important role in national development so that serious consequences may be caused if the transportation facilities are not properly constructed.

The transportation industry has also been critically affected by Covid-19 pandemic from 2020. As we enter the post-epidemic era, it is essential to find out the reasons for the impact on the transportation industry during the epidemic and to think about the solutions to such this medical issues.

Based on a summary of the above externalities faced by all countries in the world and combining with the current situation of the transportation discipline, the author will give a perspective to the problem of planning and building resilient system to cope with global externalities based on usage of big data and artificial intelligence technologies.

2. PHENOMENON

2.1 Climate

Transportation operations may be adversely affected by extreme weather and ultimately lead to three results: increased cost of infrastructure repair and maintenance, widespread traffic delays and congestion, and increased incidence of traffic accidents (Zhu, 2018). Rainfall intensity and rising sea levels, for example, have led to flooding in many low-lying parts of the world, posing a real threat to transportation infrastructure.

Effectively, flooding has long been a common occurrence in central Thailand (Cheng et al., 2020). For example, the 2011 floods occurred in 65 out of 77 provinces in Thailand flood zones. Similarly, in the UK, the Highways Agency estimates that 10% of the network is vulnerable to flood risk and the UK Environment Agency (EA) estimates that rainfall has increased by 30% over the initial design period. In addition to the risk of flooding, cold regions are experiencing more freeze-thaw cycles related to climate change, and frequent freeze-thaw cycles are to blame for the accelerated deterioration of road surface conditions.

2.2 Carbon Emission

Although countries around the world have made certain efforts, achieving carbon emission reduction is a long-term goal, and global climate governance still has a long way to be governed. In 2021, the Intergovernmental Panel on Climate Change (IPCC) released the sixth assessment report on climate change, which is clear that if the emissions of greenhouse gases, especially carbon dioxide, are not quickly and effectively controlled, not only the goal of global temperature control will be lost, but the whole human society will also face unprecedented severe challenges. Additionally, the latest figures from the International Energy Agency (IEA) show that transportation is already the biggest carbon emitter after energy industry.

2.3 Transportation Facilities

Closely related to local economic conditions, the construction of transportation facilities have an obvious gap between developing and developed countries. Actually, developed countries have already established a complete transportation system in the last century, while most developing countries still have a very low level of transportation construction. Besides, with the aging of materials and structural failure, many transportation facilities countries have entered the period of damage or even close to the service life in developed countries. Statistics show that majority number of bridges in the United States are now older than their service life, and the situation in European countries is not optimistic as well. At the same time, developing countries, backward science and technology, have no choice but to buy or rent construction equipment and hire professionals to build new bridges and roads from developed countries or transportation powerhouses like China.

2.4 Hygiene

The 2020 COVID-19 pandemic is one of the most serious global crises since the beginning of the 21st century. In order to prevent the spread of the epidemic, many countries and regions have to reduce traffic lines, and a sea of people avoid public traffic for their own safety. Huang and others from Shenzhen (2022), China, pointed out that as China's largest export city for 28 consecutive years, it is an important hub for the international market, but its transportation industry has also been seriously affected. Among them, Shenzhen Airport's domestic passenger volume in 2020 decreased by 21% year on year, and international passenger volume decreased by 88%. It is worth mentioning that the situation is not expected to return to previous levels until 2024, according to agency projections.

3. RESILIENT SYSTEM

To sum up, it is necessary to build a resilient system in the face of externalities such as those encountered by various countries and regions in the transportation industry. However, the problem of global externalities did not come out of the blue, and it has never been well resolved. So, what perspective could be conceived to alleviate the above-mentioned problems? The author gives the following thoughts.

With the development of science and technology, especially the development of big data and artificial intelligence, which can play an important role in many industries that the transportation industry is no exception. The key advantage of artificial intelligence technology is that it can extract complex potential laws that are difficult for humans to comprehend rapidly through the massive data collected in the past, and make reasonable judgments based on the judgment basis set in advance. In other words, it is not inconvenienced for individuals to see that these characteristics of big data and artificial intelligence are exactly what the transportation industry needs.

The fact is same that scholars from Tongji University (Yang Xiaoguang et al., 2022) have studied and introduced artificial intelligence technology for perceptual prediction, diagnostic decision, management and control, travel service and other aspects. This is a trend which can be seen that big data and artificial intelligence technology will certainly play a vital role in the face of global externalities.

3.1 Climate

While the fundamental solution to the occurrence of extreme weather is environmental governance, which is a long-term goal, some are undertaking multiple, small-scale initiatives to kick-start the process of climate change mitigation (Ostrom, 2012) and using AI to analyze past data can help people prepare for it in advance. For instance, using big data to predict that extreme rainfall may cause river water levels to rise, ships can be moved early, bridges can be inspected, and highways along the river can be protected.

3.2 Carbon Emission

To deal with the carbon emissions of the transportation industry, big data and artificial intelligence technology has its own unique advantages. The method of carbon emission detection is to first determine the measurement index: generally, carbon dioxide emissions per unit product; and then: Collect data: through monitoring and data collection of the production process, collect data such as energy consumption, fuel usage and waste

discharge; The third step, calculate the emissions: according to the collected data, calculate the carbon dioxide emissions per unit product through various methods.

Certainly, when these are given to big data for processing, it can not only classify the known data, but also combine various categories of data to find the connection between them, and then analyze the carbon emission data of road, waterway, railway, civil aviation, urban transportation and other sub-industries in depth, so the countermeasures of the current carbon emission situation to figuring out the next stage of response may be judged by experts as early as possible (Hu Xiyuan et al., 2022).

3.3 Transportation Facilities

As mentioned in the first part of this essay, developed countries invest more in the management and maintenance of the transportation industry, while developing countries invest more in the planning and construction, both of which can use big data and artificial intelligence technology as a tool. There is substantial data that reveal that a great deal of transportation facilities in developed countries have entered the end of their service lives, resulting in frequent accidents and serious economic losses.

However, big data and artificial intelligence can collate data on various transportation facilities and send alerts when structures are nearing the end of their service lives. In addition, if the method of repairing damaged structures and the effect after repair can be imported into big data, a series of complete processes such as risk prediction, disease comparative analysis, repair plan, monitoring and maintenance can be formed to greatly reduce economic losses. Different from the former, developing countries can make use of big data to learn from the successful experiences and failures of other countries, so as to develop their own technological level step by step and reduce their financial input.

3.4 Hygiene

The role of big data technology during the pandemic, such as collecting the travel paths of infected people and assigning risk levels, is well documented, but in the post-COVID-19 era, a human being is also exposed to various hygiene challenges. China has established a relatively mature transportation system after experiencing the COVID-19 pandemic, referring to the experience accumulated during the epidemic, and using big data to control the traffic flow are absolutely efficacious. For example, in the case of influenza A earlier in 2023, based on the traffic flow of infected people, the Chinese government was able to grasp the real-time situation and direct the traffic in areas near hospitals to prevent traffic paralysis.

4. CONCLUSIONS

With complicated factors, the world today is in a period of transition from the old pattern to the new. Various conflicts in the international community are deepening, presenting a complicated and confusing picture. However, every country and region in the world holds the same view on the using advanced science and technology to transportation industry deserves a rethink and it is worth trying to popularize big data and artificial intelligence technology in the transportation industry. In general, the function, big data and artificial intelligence technology outstanding data processing and future estimation capabilities, is perfect for planning and building flexible systems to meet global externalities.

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