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The major portion of his research focuses on transport policy analysis, transport and land use studies, sustainable urbanization, modeling and analysis of transportation systems, network equilibrium models and solution algorithm development, and large-scale traffic data sets analysis. He was awarded the DAAD Scholarship in 2010, the program for New Century Excellent Talents in University of China in 2011 (issued by the Ministry of Education of China), the EU Marie Curie International Incoming Fellowship in 2012, and the prestigious Excellent Young Scientist Programme in 2014 (funded by the National Natural Science Foundation of China (NSFC)).

He is the associate editor of the *International journal of urban sciences (IJUS)* (www.tandfonline.com/rjus), the international committee of the International Symposium on Travel Demand Management (http://2017tdm.ntu.edu.tw/index.php), and the member of the Editorial Advisory Board of the *Journal of Transportation Systems Engineering and Information Technology (TSEIT)* (http://www.tseit.org.cn/CN/column/column106.shtml) and the *International Journal of Transportation (IJT)* (http://www.sersc.org/journals/IJT/) .

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Sustainable Urbanization Driven by Big Data--

Big data analysis methods to stimulate the influence of urban mobility management policies in cities

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Importance of sustainable urbanization

- ✓ Metropolitan Regions, not Nation States, are the **competitive units** in a globalising economy/Cities are at the forefront of global socio-economic change.

- ✓ World Commission on Environment and Development (**WCED**)**:** sustainable development aims to “meet the needs of the present without compromising the ability of future generations to meet their own needs”.

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China‘s accelerating urban development

- ✓ Since 2000, China's urbanisation rate has increased by one per cent each year. On average, 20 million rural inhabitants per year move into Chinese cities, a number higher than the population of several EU member states.
- ✓ At the end of 2014, China's urban population reached 0.75 billion, which is 0.2 billion more than the whole population in the EU. This number is ever increasing.
- ✓ Urbanisation also involves changes in **city numbers and population size**. There are presently 654 cities in China, of which five have a population above 10 million; 14 with a population above five million; 70 with a population between one to five million; 136 between 500,000 to one million; and 434 with a population of less than 500,000.
- ✓ At the same time, there are 20,117 towns in China with an average population of more than 10,000 and 875 that have above 50,000.

The role of urban mobility management

- ✓ Urban mobility management plays an overriding role in transport sustainable development and sustainable urbanisation, and also, is of major importance for the quality of life of individuals as well as regional productivity.
  - It is estimated that **cities will be home to nearly 80 per cent of the world's population** by 2050, placing transport at the heart of future economic, social, environmental and health issues (Delli, 2015).
  - In the European Union (EU), transport is the only sector whose greenhouse gas emissions have continued to increase since 1990, and in the urban environment, it represents 25 percent of all CO2 emissions in Europe (Delli, 2016). **Decarbonising the transport sector** is both a challenge and an opportunity for European innovators (Delbeke, 2016).
  - In China, statistics have shown that more than three quarters of total air pollution come from vehicle carbon monoxide and hydrocarbon emissions in large cities including Beijing, Shanghai and Guangzhou (Xu et al., 2015).
- ✓ There can be no sustainable development without excellent urban mobility management

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Challenges

- ✓ There is no hesitation that urban mobility management is one of the keys to dealing with **these transport negative externalities and preserving our climate**; however, the question is how could we promote different urban mobility measures among travellers and keep the urbanisation sustainable?
  - Definitely, **travellers cannot solve the problem on their own**: With the urban sprawl affecting many European cities and the fast urbanisation in China which is placing increasing stress on already burdened transport infrastructure and the heavy management and operation, more and more urbanites spend a significant portion of their time and income on travel.
  - **We should be aware that urban mobility still relies overwhelmingly on the use of conventionally powered cars**. Any changes in people's travel behaviour is stimulated by a variety of factors, determined by positive results and benefits, and we can effectively trigger travel behavioural change by providing characterized urban mobility measure.
  - To achieve this target, it needs for **an improved understanding of travel characteristics and an innovational urban mobility management development**.
- ✓ The **emerging big data driven studies** provide a promising approach to dealing with both.

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Big data approaches

- ✓ Digitalisation and innovation are coming to transport: Opportunities for **businesses** to 'deliver the goods', but also new opportunities for **ordinary people** to find new ways of getting from one place to another (Benton, 2015).
- ✓ Digitalisation and innovation are definitely **changing the urban mobility management:** As we can see it in **automakers' focus** on next-generation vehicles, in the **arrival of services** that help urbanites get around without owning a car, in the **widening recognition** that the "information everywhere" world will utterly disrupt the transportation status quo (Fishman, 2012).
- ✓ Big data is a term used to recognise the increasing **variety, volume and velocity** of information sources that are available - not just in the transport sector, but also across all sectors in society.
- ✓ It reflects the fact that we are now able to **capture information** at *increasing level of scale, with exceptional speed* (thanks to new and powerful ICT capabilities), with *high frequency*, and from *a wide range of sources or multiple sources*.
- ✓ Examples range from (almost) **entire population digital data** (such as that from automatic highway monitoring sensor) to **'crowd-sourced' data** related to social attitudes and opinions in real time such as that from twitter and other social media (Transport Systems Hub, 2014).

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Big data approaches

- ✓ Simultaneously, the **power of computing and data handling** is now becoming so great that classic distinctions between micro and macro effects are breaking down. Computer modelling of an economy, a substance or a process is therefore becoming very different and far more sophisticated than it was even a decade ago (Batty, 2013; Transport Systems Catapult, 2015a&b).
- ✓ In these regards, it is possible **to identify the travel characteristics** very well, for example, the temporal and spatial distribution of travel demand at city-scale, which is driven by the interaction between a variety of travel decisions that individuals make and the existing transport network infrastructure along with its management.
- ✓ This type of modelling is a crucial part of **sustainable urban mobility management** driven by big data. Moreover, **impacts and effects** of a potential urban mobility management measure can be simulated and well understood with modelling driven by big data technologies. However, **modelling the interaction between travel behaviour and other characteristics of travel demand accurately and efficiently** poses several theoretical and practical challenges.

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Big data approaches

These facts and their interactions propose a series of research challenges:

- ✓ **Modelling approach and comparative studies** of this problem, which integrates theoretical approaches and practical applications, with a vision to presenting **a new big data development platform**, **innovational models of the sustainable urbanisation development**, **innovational policies investigation** adapted to local socio-economic and political specificities, and **comparative studies** on urban mobility management.
- ✓ This process should be supported by **a big data platform** integrating multiple sources together with **data processing methodologies** developed across different scientific fields in order to handle real world complexity.

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Research approaches

Research idea and objectives

Following this type of exploration, we will

- collect multiple sourced mobility data
- study the big data analysis techniques
- investigate and calibrate existing individual travel models and transport network models
- develop innovative mobility management measures.
- Carry out comparative studies with respect to the mobility management

Therefore, we will therefore seek effective ways to turning urban mobility related "big data" into "big insights" to support sustainable urban mobility management.

The proposed research has the following core objectives:

- ◆ O1: Mobility related big data analysis techniques and visualisation
- ◆ O2: Urban mobility management: from modelling to case
- ◆ O3: Comparative studies of sustainable urban mobility development

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Big data approaches

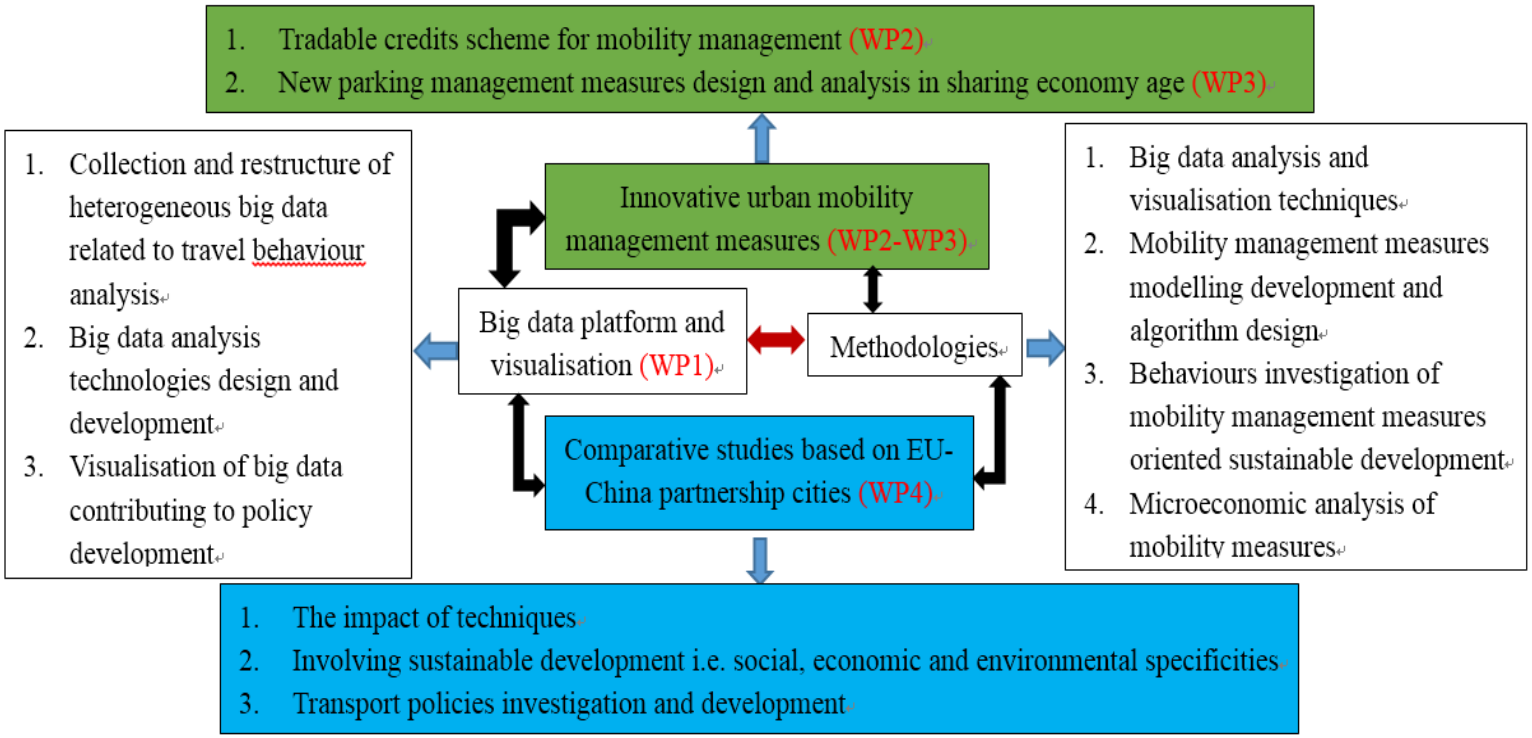

Figure 1. Research framework (Tentative!)

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THANKS