In-country Training Workshop on Smart Cities for Building Inclusive, Resilient, and Sustainable Cities and Communities

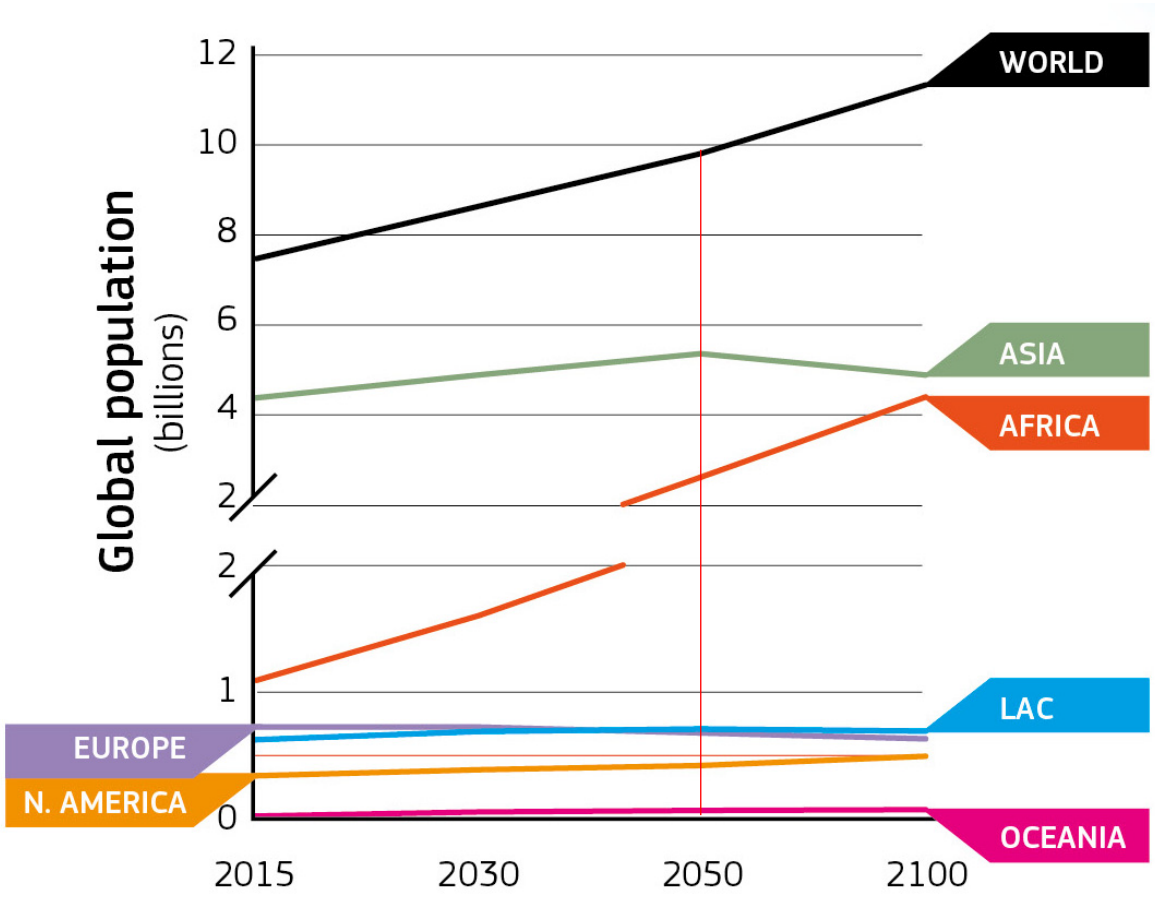
10 November 2022, Bali, Indonesia

Transforming our cities and communities through smart mobility solutions

Ganesh Raj Joshi (Ph.D.)

United Nations Centre for Regional Development

Population and Economic Growth

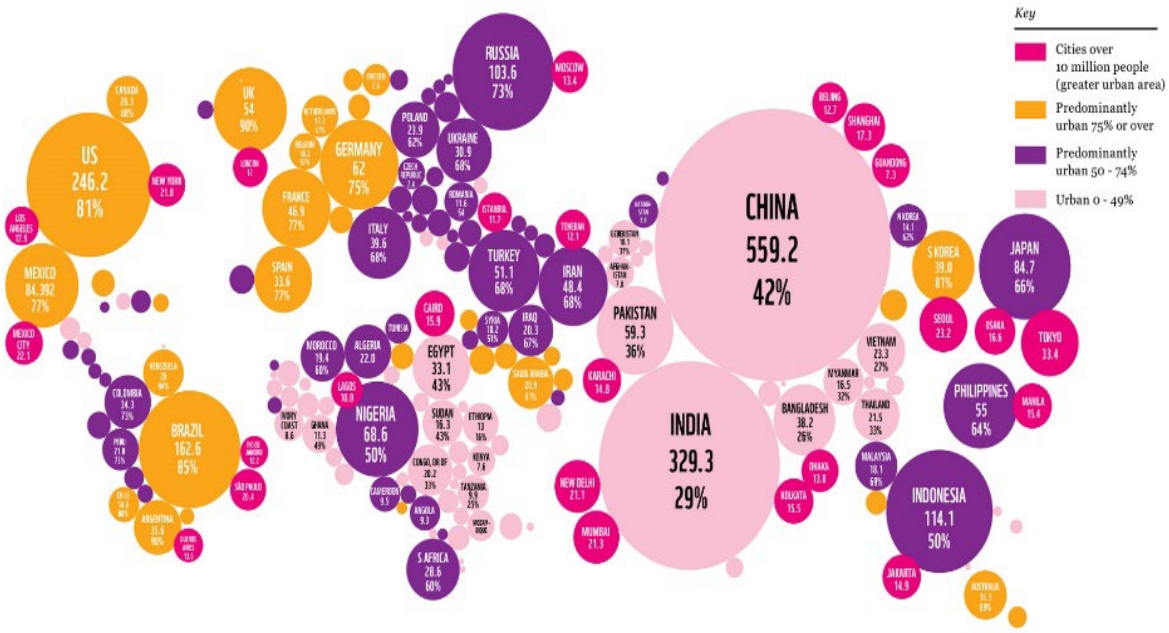


- According to the UN, the global population will reach **8.5 billion by 2030** and **9.7 billion by 2050**.
- **Approx. 68% of the world population is** projected to live in urban areas by 2050.
- World Economic Forum predicted that by 2030 **Asia will have 50% of the global population with 60 % of global economic growth.**

Urbanization and Motorization

Asia is the most urbanizing region in the world, with an average annual urbanization rate of 3 %.

95 % of urban expansion in the next decades will take place in the developing world.



Source: https://www.businessinsider.com/small-cities-population-growth-by-2050-2012-5

More than two-thirds of the world's megacities will be located in Asia by 2025.

Urban Development in Asia and the Pacific

An Asian urban dweller spends in traffic congestion is about 35 hr./year

(Source: The Future of Urban Mobility Report)

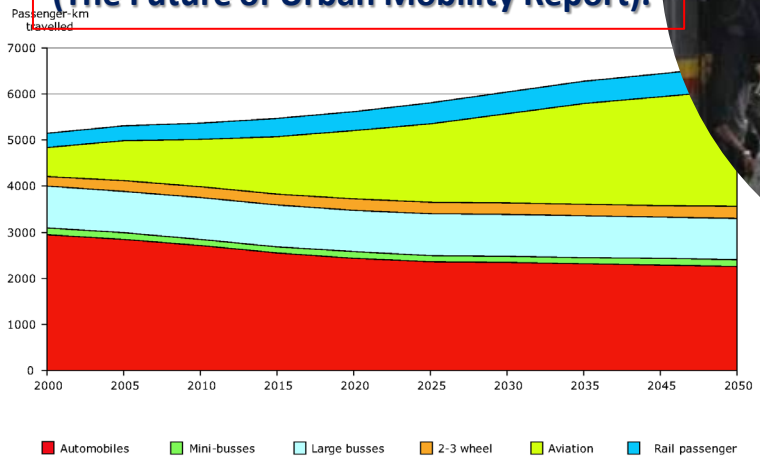

https://en.wikipedia.org/wiki/Ranganathan_Street

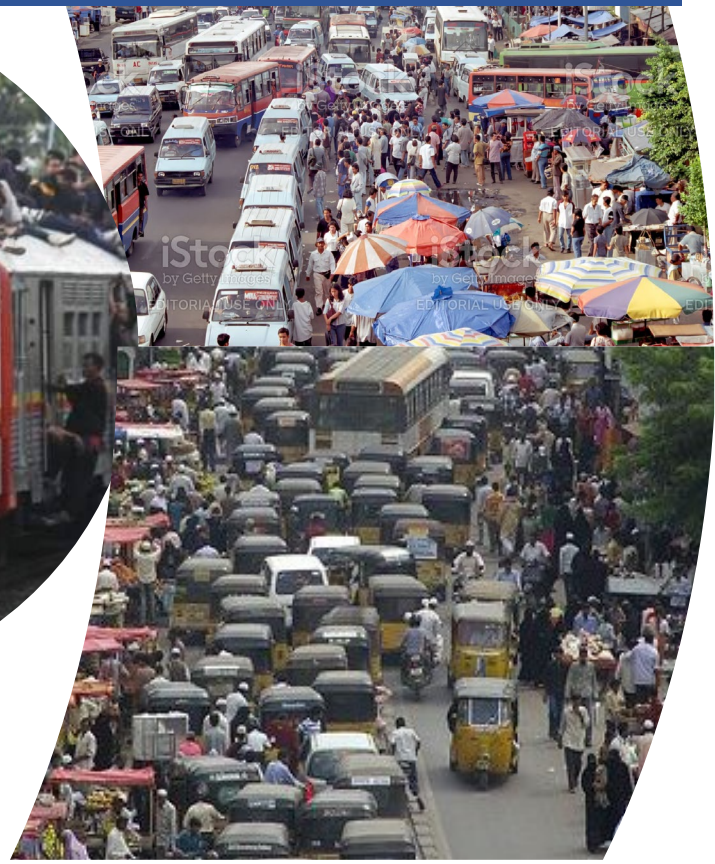

A traffic jam on Nguyen Trai Road, Ha Noi
Photo *kenh14.vn*

By 2050 world transport demand will increase by 2.6 times (ITF, 2021)

Congestion costs Asian countries 2-5 % of their GDP per year due to time delays, the waste of fuel, and higher transport costs. (The Future of Urban Mobility Report).

By 2050, the average time an urban dweller spends in traffic congestion will be 106 hours (three times more than today) which is equivalent to almost 400-days in a lifetime.
(The Future of Urban Mobility Report).





Private car ownership is projected to increase by up to 500% outside the OECD by 2050 (New Climate Economy Report, 2018).

Traffic congestion in Indonesia

Study conducted by INRIX in 2019 (pre covid era) reveals that **Jakarta ranked the world's top 65 cities most impacted by traffic congestion,** where Jakarta-driver lost almost **78 hours/year (260 days in a lifetime)** in congestion. Source: https://www.tomtom.com/traffic-index/ranking/

Photo source:

Air Pollution

An estimated **92 % of the world's population is currently exposed to air pollution** greater than the WHO air quality guidelines

WHO data shows air pollution kills 7 million people a year (WHO, 2021). However, a recent study reveals that air pollution kills **more than 10 million people each year (Vohra et al., 2021).**

Pictures Source: https://www.google.com/

Exposure to air pollution costs almost **US$ 5.11 trillion in welfare losses globally** (WHO, 2018).

Air pollution from the transport sector

- Transport CO2 emissions will grow 20% by 2050.
- It is predicted that by 2030 **Asia will account for one-third of global transport CO2 emissions** (SLOCAT, 2020)
- Even if today's commitments to decarbonize transport are fully implemented **CO2 emissions from transport will increase by 16%** by 2050 (ITF, 2021).

Road accidents and fatalities

- **Approximately1.3 million people killed annually** due to road traffic crashes (WHO, 2021).
- More than **60% of the global road fatalities** occurred in the Asia-Pacific region (UNESCAP, 2020).
- It cost countries **3% -5% of their gross domestic product** (GDP).

Road traffic injuries are the leading cause of death for children & young adults aged 5-29 years.

Impact of the unsustainable urban Development

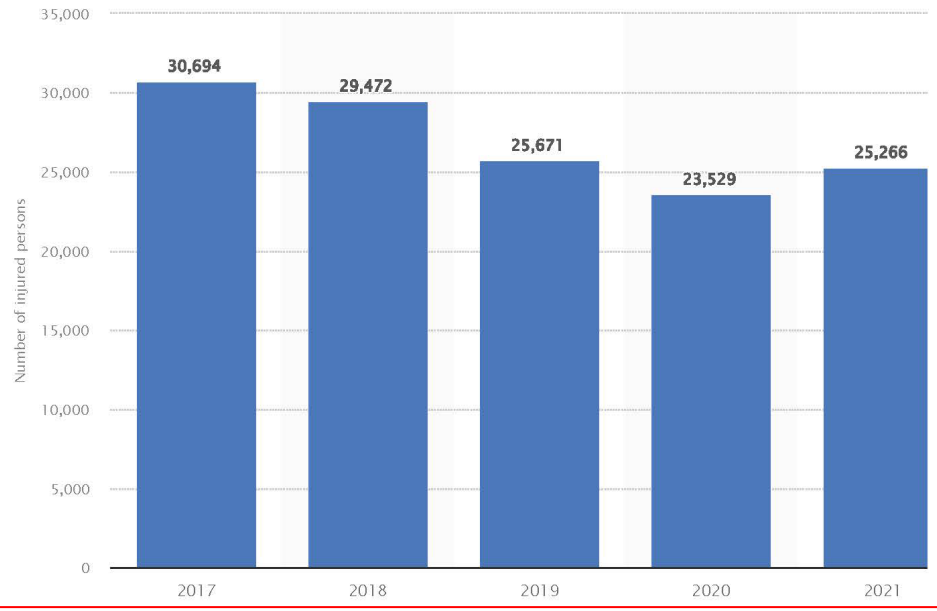
Road accidents & fatalities in Indonesia

Number of fatalities in road traffic accidents Indonesia 2017-2021

Published by Statista Research Department, Oct 18, 2022

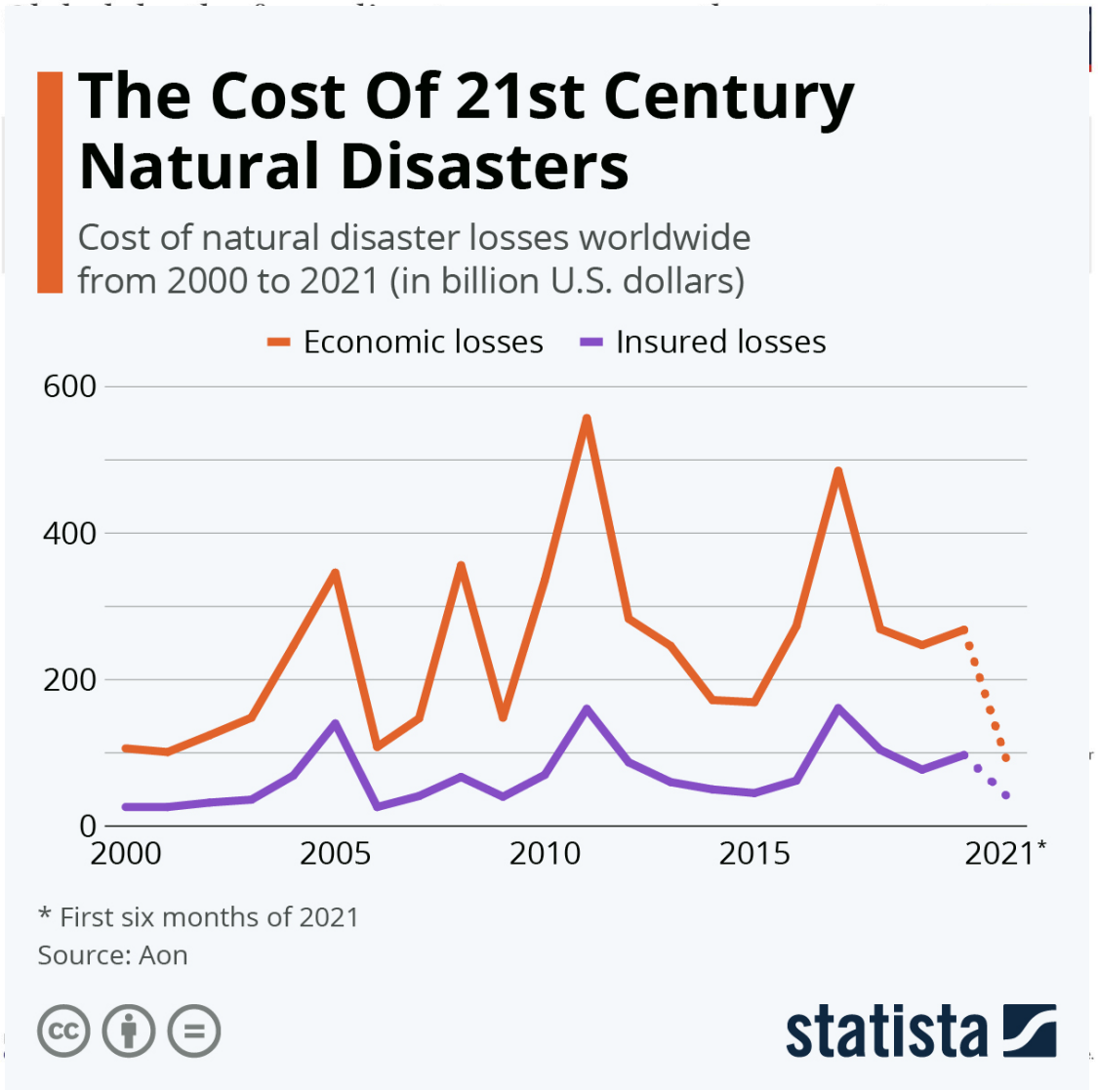
In 2021, the number of fatalities in road traffic accidents in Indonesia was approximately 25.27 thousand persons, indicating an increase compared to the previous year. During the time under consideration, the highest number of fatalities was reached in 2017, with over 30 thousand persons dying in traffic accidents.

Number of fatalities in road traffic accidents in Indonesia from 2017 to 2021



Natural Disasters

Between 1998 and 2017, more than 526 000 people died worldwide, and lost of US$ 3.47 trillion.



People in Asia are 4-times more likely to be affected by natural disasters than in Africa, and 25 -times more likely than in Europe or North America. Picture: *Bangkok's 2011 flood*
Source: www.asianews.it

Climate Change and Global Warming

- As most of the mega cities in Asia and Pacific are located along the coastline, they are at high risk of global warming and sea levels rise. **Over 800 million people living in 570 coastal cities that affected** to sea-level rise and coastal flooding (C40, 2019).

- In business as-usual scenario, the global economic losses from coastal flooding may exceed **US $1 trillion annually by 2050** unless the major coastal cities prepare for it.

A rescue team evacuates residents from their flooded house at in Jakarta, Indonesia, on Jan. 1, 2020.

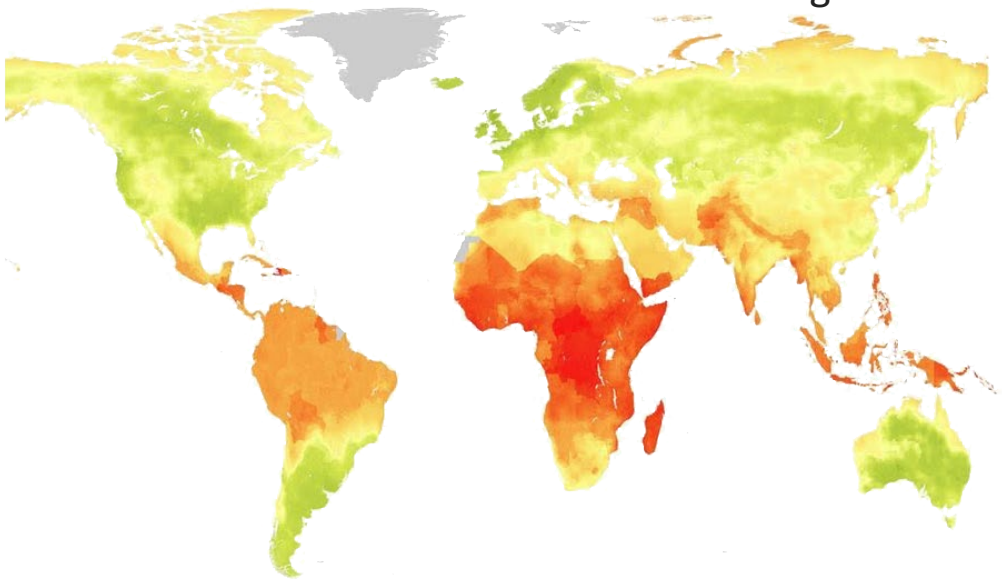
(source: https://time.com/5761097/jakarta-indonesia-floods/)

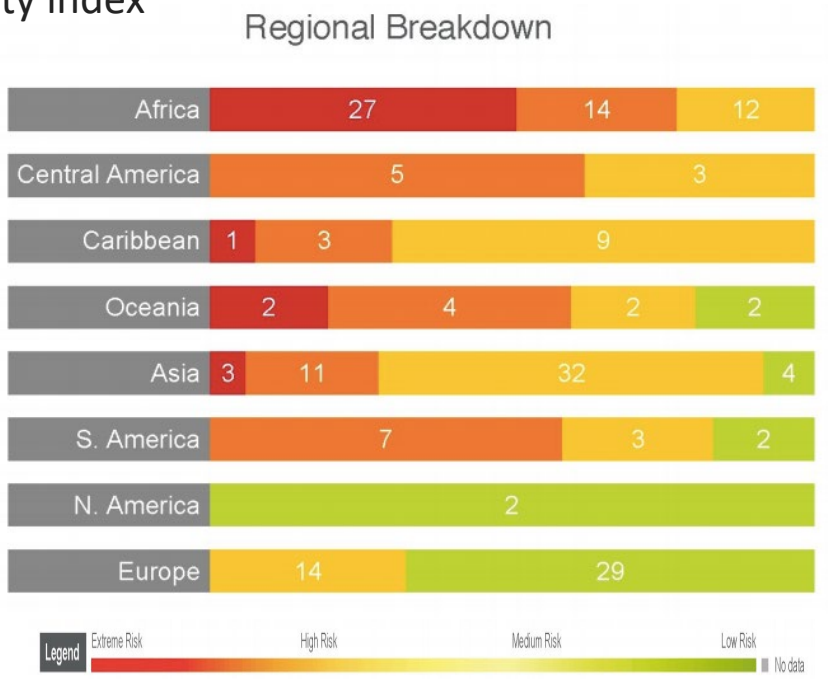
Photo : Urban flooding in Zhengzhou, China's Henan Province, on 23 July 2021; Photo source: https://asia.nikkei.com/

Climate change around the world

Transport being responsible for a quarter of global GHG emissions and 23% of global CO2 emissions.

climate change vulnerability index

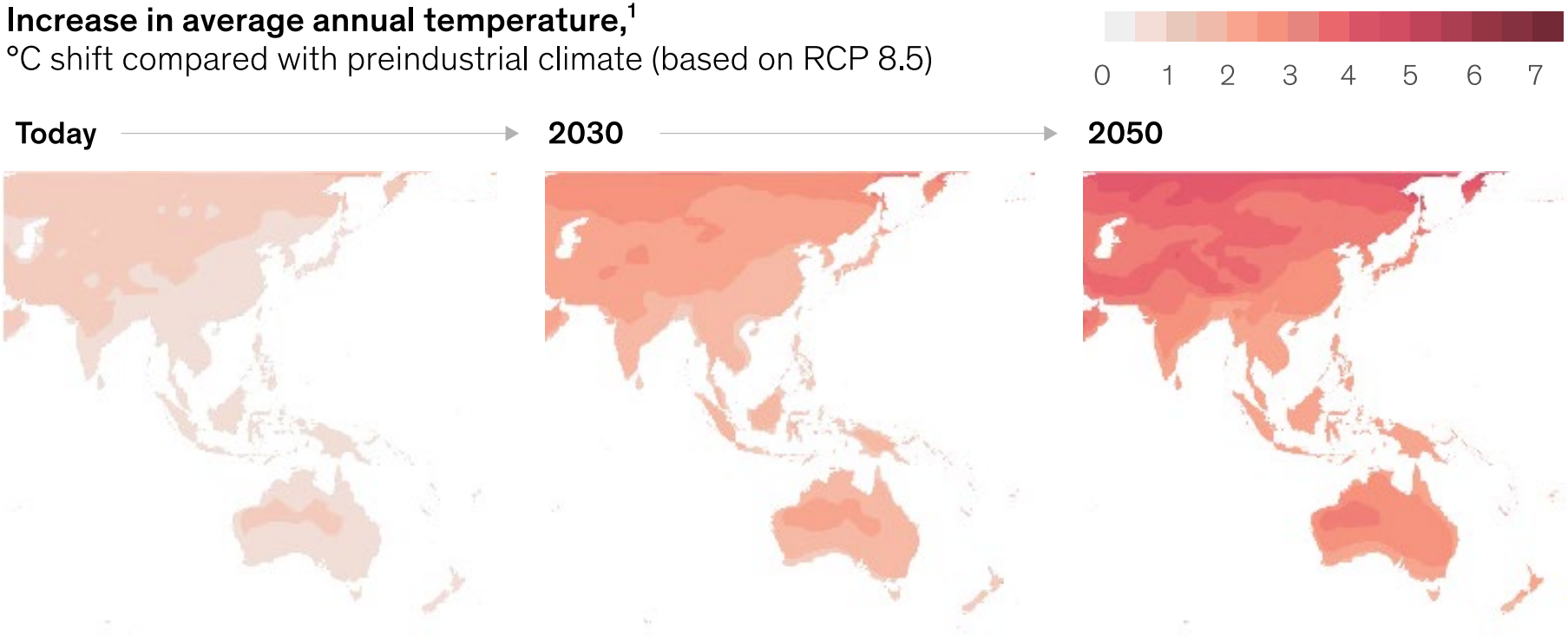




soruce: versik maplecroft 2016

Average temperatures are projected to increase in many parts of Asia.

Increase in average annual temperature,[1]
°C shift compared with preindustrial climate (based on RCP 8.5)



Note: See Technical appendix, *Climate risk and response: Physical hazards and socioeconomic impacts,* McKinsey Global Institute, January 2020, for why we chose RCP 8.5. Projections based on RCP 8.5 CMIP 5 multimodel ensemble. Heat-data bias corrected. Following standard practice, we typically define current and future (2030, 2050) states as average climatic behavior over multidecade periods. Climate state today is defined as average conditions between 1998 and 2017, in 2030 as average between 2021 and 2040, and in 2050 as average between 2041 and 2060.
[1]Taken from KNMI Climate Explorer, 2019, using mean of full CMIP5 ensemble of models. Preindustrial levels defined as period between 1880–1910.
Source: KNMI Climate Explorer, 2019; Woodwell Climate Research Center; McKinsey/United Nations (disputed boundaries); McKinsey Global Institute analysis

McKinsey & Company

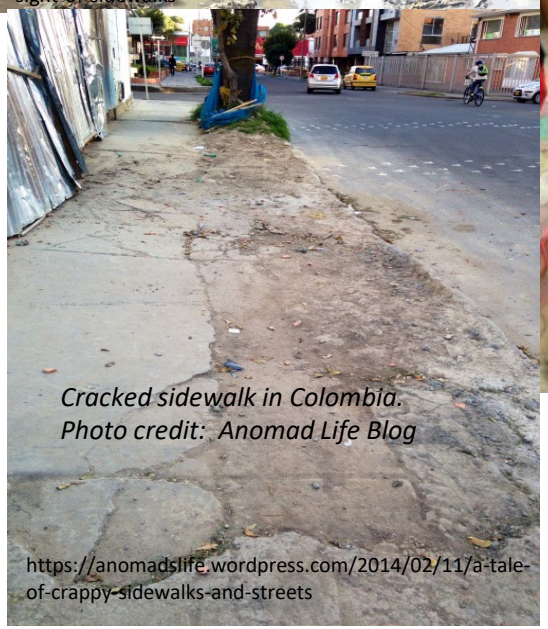
Source: https://www.mckinsey.com/capabilities/sustainability/our-insights/climate-risk-and-response-in-asia

Other Issues Associated with the Public Transport System

- ✓ Safety and security
- ✓ Availability and affordability
- ✓ Connectivity and frequency
- ✓ Reliability and flexibility
- ✓ Integration and inclusiveness
- ✓ Efficient and economical

Issues with walking space & pedestrian facilities

https://bdnews24.com/media-en/2019/07/03/no-sight-of-sidewalks



Cracked sidewalk in Colombia.
Photo credit: Anomad Life Blog

https://anomadslife.wordpress.com/2014/02/11/a-tale-of-crappy-sidewalks-and-streets

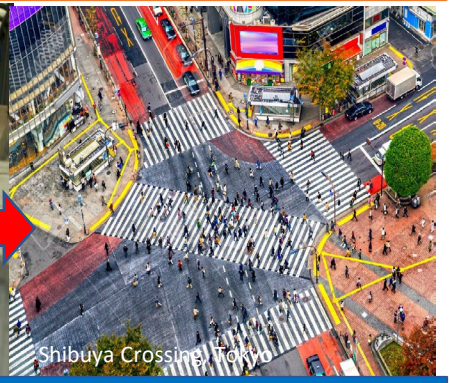
Excavated soil on top of a pedestrian sidewalk.
Photo credit: Pallavi

Source: https://www.tripadvisor.com/

Which city do you prefer?

Haphazard urban development with less mobility

Sustainable urban development with better mobility



A Significant transformation is required on ***how city designed, how they function, how they are managed and how we live in these cities that all determine our future survival.***

Smart Mobility

- **'Mobility'** refers to the ability of a person to move from one part of the city to another.

- **'Smart Mobility'** is the use of technology to enhance the mobility in cities through a focus on interconnected transport systems and better mobility options. Such technologies can reduce travel costs, air pollution and GHG emissions.

Smart Mobility City

- Smart technologies can enhance multiple outcomes:
  - to inform the effective and efficient expansion and operation of shared transit services (such as train lines, metro lines, light rail and tram lines, bus services etc);
  - to enable seamless mode changes as part of a journey to streamline ticketing between modes;
  - to allow for predictive maintenance to reduce associated costs; and
  - to enable the transport system to deliver enhanced mobility across a city.

Smart Mobility Principles

The overarching goal of smart mobility is to provide safe, clean, affordable, efficient, and effective mobility for all with the help of smart technologies and solutions.

1. Safety and Security
2. Improved accessibility and connectivity
3. Encourage non-motorized transport
4. Promoting clean, green, and low-carbon transport solutions
5. Social equity and Inclusiveness
6. Planning dense and human-scale cities
7. Optimizing existing transport infrastructure

8. Discouraging private vehicles
9. Harnessing technology
10. Encourage public-private partnership
11. Data collection, sharing and analytics
12. Promote community engagement and participation
13. Providing a healthy environment for all
14. Protect urban biodiversity and ecology
15. Encourage innovation, research,and development
16. Promote economic growth

Principles of Mobility Planning

By connecting people, commodities, and data, smart mobility policies keep the city inclusive, liveable, and attractive.

The following Principles of Mobility Planning have been developed for smart mobility solutions:

1. **Integrated Planning**
2. **Multimodal Integration**
3. **Mixed-use Development**
4. **Transit-Oriented Development.**
5. **Transportation Demand Management (TDM)**
6. **Transit Activated Development (TAC)**
7. **Barrier-Free and People-Friendly and Universal**
8. **Design Urban Design**
9. **Accessible, Usable, and better connectivity**
10. **Low-Carbon and Green Growth Development**
11. **Smart Technology and Innovation**

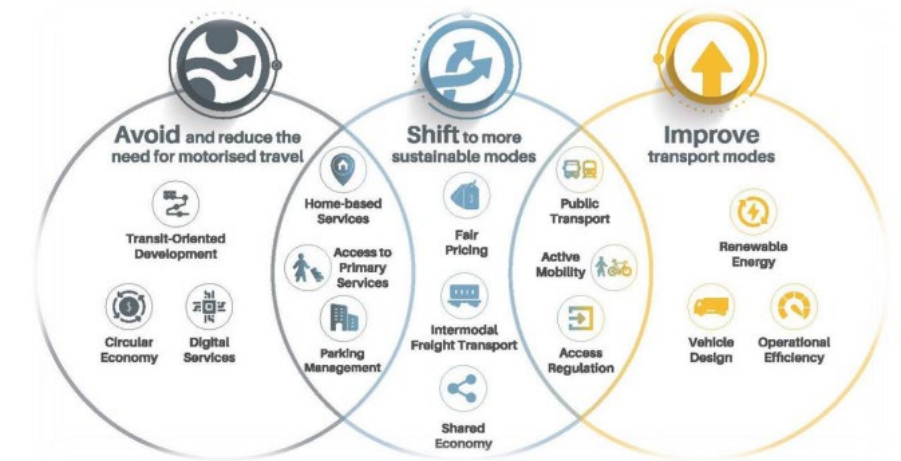
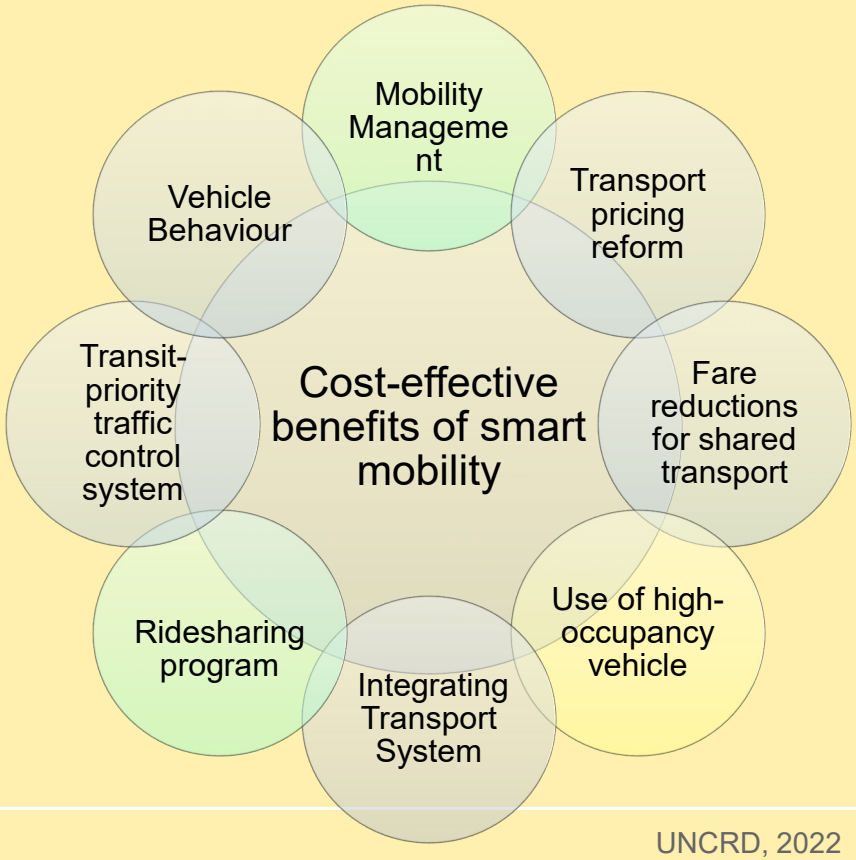


Figure 2.2: Transportation demand management strategies-avoid, shift, and improve. (*Source*: Slocat)

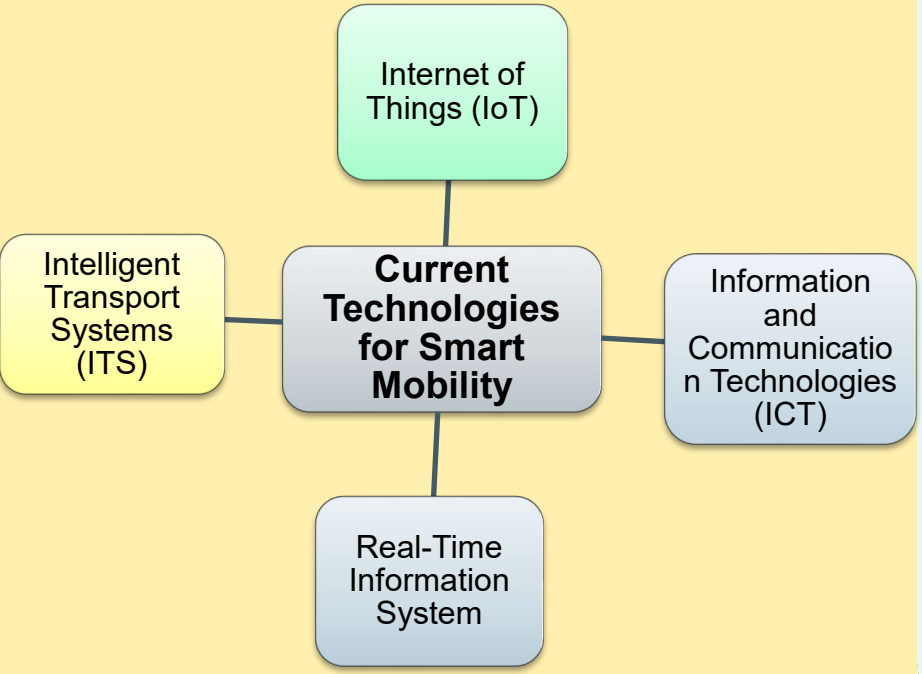
Benefits of Smart Mobility

- ✓ **Reduce traffic congestion, air and noise pollution**
- ✓ **Decrease traffic accidents, injuries, and fatalities**
- ✓ **Enhance greater mobility, connectivity, and access**
- ✓ **Reduce GHG emissions**
- ✓ **Reduce household spending on transportation**
- ✓ **Reduce urban sprawl**
- ✓ **Improve the natural environment and green growth**
- ✓ **Active and healthier lifestyle with more walking and cycling**
- ✓ **Improve the resilience of cities by access to high-quality public transport**
- ✓ **Businesses grow in the local community**
- ✓ **Enhance energy security by reducing oil dependency**
- ✓ **Increase property values**
- ✓ **Improve the quality of life with a better living and working environment**

Cost-effective Benefits of Smart Mobility



Current Technologies for Smart Mobility



Emerging Technologies for Smart Mobility

Bike-sharing and Car-sharing: This method enables an occasional use of a vehicle in particular route or the area.

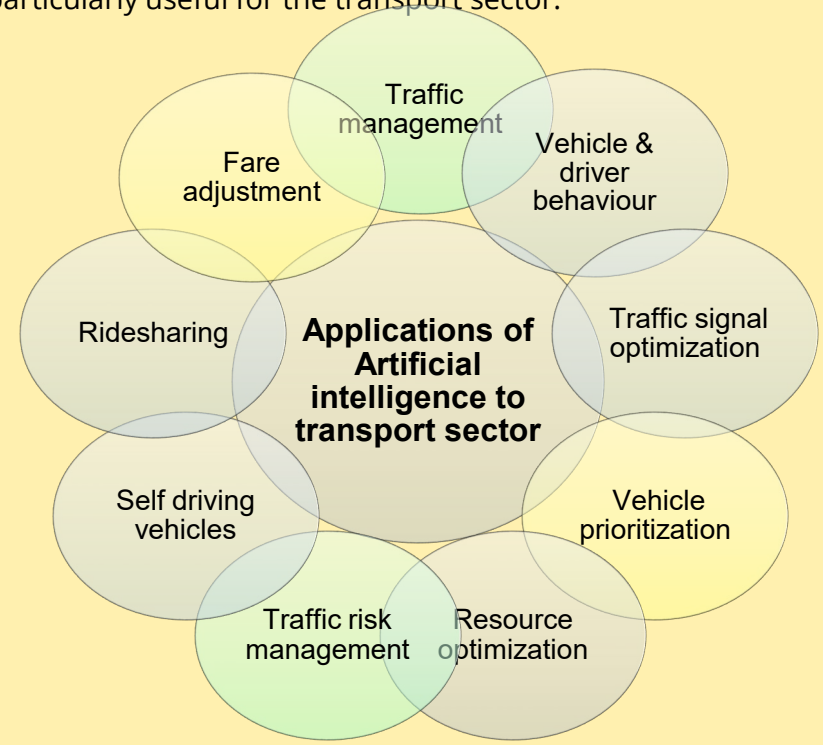
Mobility on Demand (MoD): MoD can significantly contribute towards modal shift to public transport and addresses spatial inefficiencies of private mode of transport.

Mobility-as-a-Service (MaaS): It allows multimodal mobility options by providing user-centric travel information and services including navigation, location, booking and payment methods.

Advanced Technologies for Smart Mobility

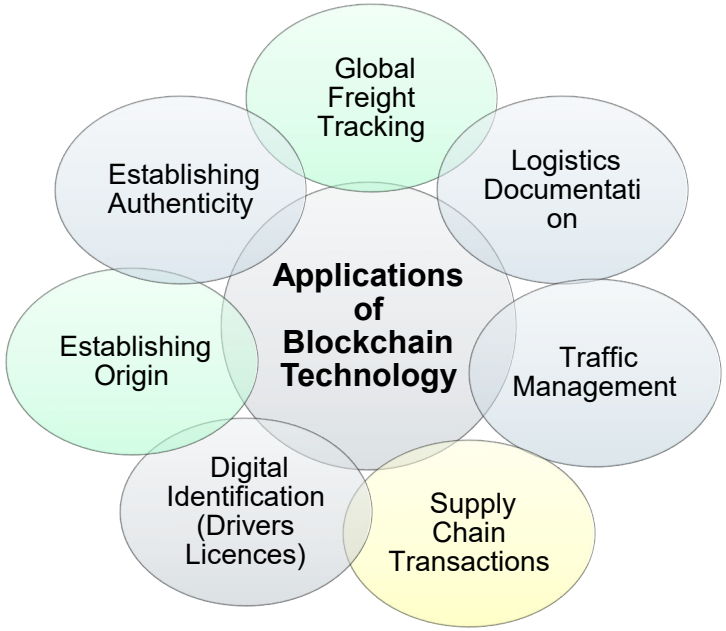
Artificial Intelligence

Artificial Intelligence can be a powerful tool for learning how to manage and predict flows of objects, making it particularly useful for the transport sector.



Blockchain Technology

"Blockchain enables network participants to exchange data with a high degree of reliability and transparency. Blockchain is essential to create more secure, transparent, efficient, and resilient cities.



Smart Mobility : Best cases

JAPANESE CASE

Shinjuku Tokyo, Japan

World's busiest railway station and largest bus terminal where more than 35 railway platforms and 1600 buses operate every day connecting 300 cities in 39 prefectures across Japan

Photo source: dreamstime.com

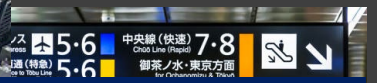
Shinjuku Station, Tokyo

Shinjuku Station opened in 1885 which have a total of 53 platforms, over 200 exits and many department stores and shopping malls which are well connected to the station.

Taxi Station


Main road

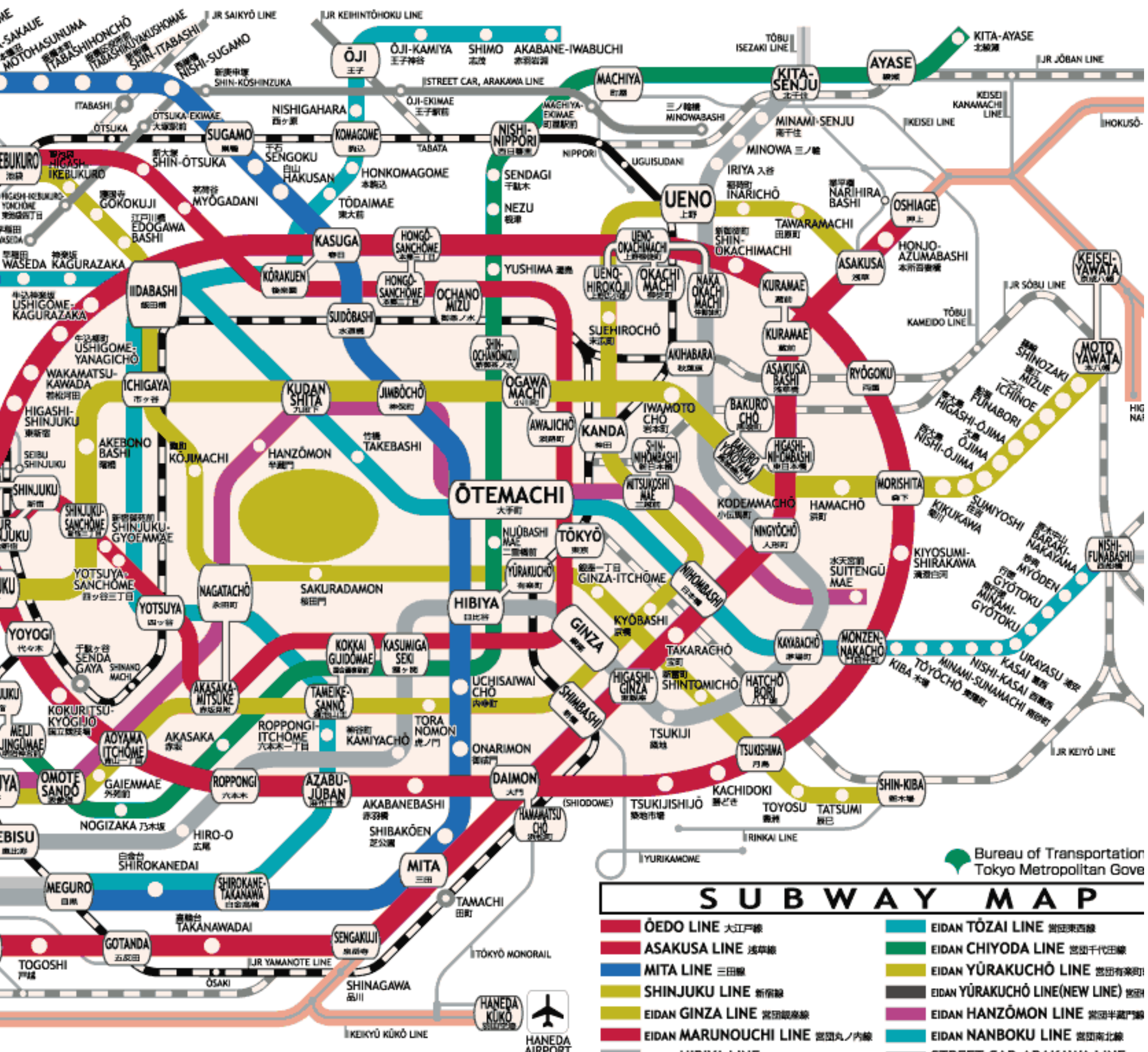
Metro station

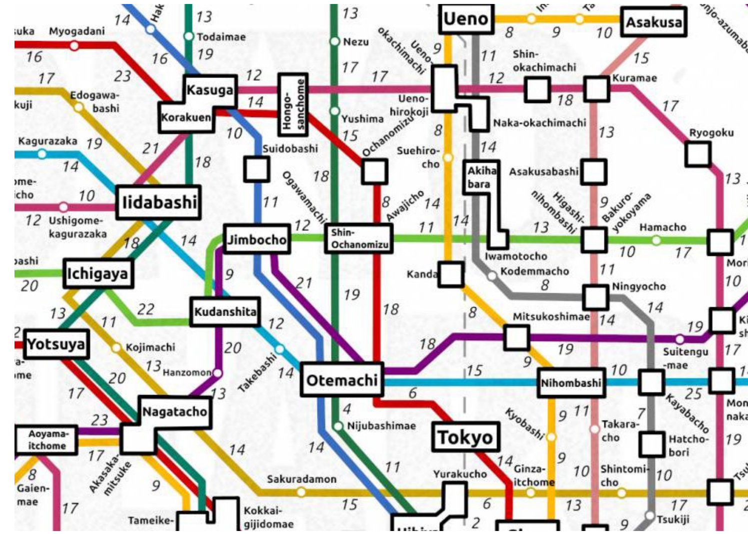


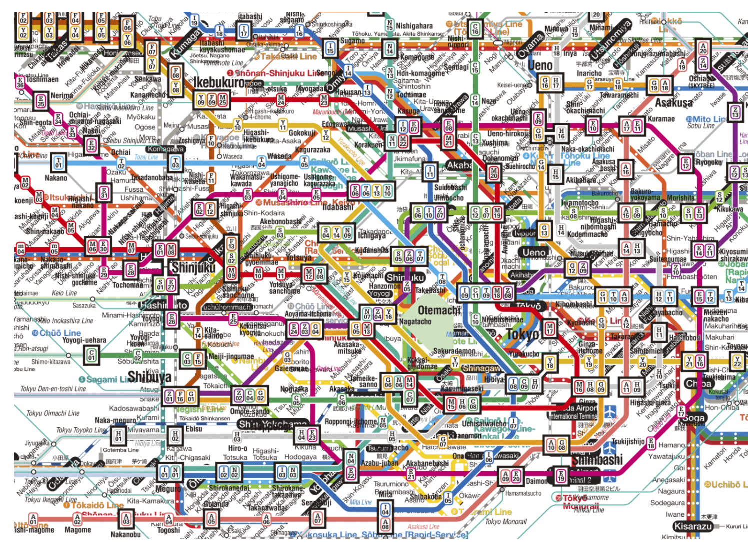
According to Guinness World Records, Shinjuku station used by about 3.59 million people per day (in 2018) which making it the world's busiest station.

Bus Station


Rail station


SUBWAY MAP
Bureau of Transportation Tokyo Metropolitan Gove
ŌEDO LINE 大江戸線
ASAKUSA LINE 浅草線
MITA LINE 三田線
SHINJUKU LINE 新宿線
EIDAN GINZA LINE
EIDAN MARUNOUCHI LINE
EIDAN HIBIYA LINE
EIDAN TŌZAI LINE
EIDAN CHIYODA LINE
EIDAN YŪRAKUCHŌ LINE
EIDAN YŪRAKUCHŌ LINE(NEW LINE)
EIDAN HANZŌMON LINE
EIDAN NANBOKU LINE
STREET CAR, ARAKAWA LINE
ŌTEMACHI
UENO
TŌKYŌ
IIDABASHI
KASUGA
HIBIYA
GINZA
AKIHABARA
ASAKUSA
SUGAMO
KOMAGOME
ŌJI
KITA-SENJU
AYASE
MACHIYA
NISHI-NIPPORI
SHINJUKU
YOYOGI
YOTSUYA
ICHIGAYA
KUDANSHITA
JIMBŌCHŌ
NAGATACHŌ
AKASAKA-MITSUKE
AOYAMA-ITCHŌME
OMOTE-SANDŌ
ROPPONGI
AZABU-JŪBAN
DAIMON
MITA
MEGURO
SHIROKANE-TAKANAWA
GOTANDA
SENGAKUJI
SHINAGAWA
TAMACHI
HAMAMATSUCHŌ
SHIMBASHI
TSUKIJI
TSUKISHIMA
SHIN-KIBA
MONZEN-NAKACHŌ
KAYABACHŌ
MORISHITA
RYŌGOKU
KURAMAE
OSHIAGE
KEISEI-YAWATA
MOTO-YAWATA
NISHI-FUNABASHI
HANEDA AIRPORT
JR YAMANOTE LINE
JR KEIYŌ LINE
JR SŌBU LINE
TŌKYŌ MONORAIL
YURIKAMOME
RINKAI LINE


Ueno
Asakusa
Kasuga
Korakuen
Iidabashi
Jimbocho
Ichigaya
Kudanshita
Yotsuya
Otemachi
Nagatacho
Tokyo
Nihombashi
Akihabara
Suidobashi
Shin-Ochanomizu
Kanda
Mitsukoshimae
Kuramae
Ryogoku
Hamacho
Ningyocho
Kodemmacho
Iwamotocho
Naka-okachimachi
Shin-okachimachi
Asakusabashi
Takebashi
Nijubashimae
Sakuradamon
Kokkai-gijidomae
Yurakucho
Ginza-itchome
Takara-cho
Hatcho-bori
Kayabacho
Suitengu-mae
Shintomi-cho
Kojimachi
Hanzomon
Ushigome-kagurazaka
Kagurazaka
Edogawa-bashi
Myogadani
Todaimae
Nezu
Yushima
Tsukiji
Tameike-


Ikebukuro
Shinjuku
Shibuya
Ueno
Asakusa
Otemachi
Tokyo
Shinagawa
Shimbashi
Ebisu
Chiba
Soga
Kisarazu

Integrated urban and transport planning

Integrated urban and transport planning and better road design can significantly enhance the quality of the urban mobility and ***transport system*** by improving ***safety, comfort, and accessible and reliable for all sector of society.***

Photo sources: www.google.com

Smart Public Transport System can Transform Cities and Communities

Use of state-of-the-art advance smart technologies and solutions such as IoT, ITS, GPS, sensors, smart cards, mobile apps; and other advance technologies like automatic vehicle location (AVL), automated stop announcements (ASA), computer-aided dispatch (CAD), live cameras, transit apps can bring number of benefits.

Picture source :https://www.analyticssteps.com/blogs/how-does-internet-things-sketch-smart-city-under-iot-ecosystem-2020

Smart and Sustainable City Planning, Nagoya, Japan

- **UNESCO appointed Nagoya as a 'City of design' in 2008.**
- **A hub for automobile businesses.**
- **Home to world-class industrial technologies (automotive, aircraft, robotics, and machine tool).**
- **Has a strong economic, social, and environmental concentration.**
- **Center of a wide multi-modal transport system with automated Maglev trains, guided bus systems, mass rapid transit, expressways, waterways, and high-speed railways - the Shinkansen.**

Figure 6.1: The City of Nagoya, Japan (*Source*: Travel Lens)

Smarter, compact, connected, and coordinated cities are worth up to US$17 trillion in economic savings by 2050.


Thank You!