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# How can Transit Mapping contribute to achieving Adequate Urban Mobility?

**FRIEDRICH  
EBERT  
STIFTUNG**



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Takween Integrated  
Community Development

The case of the  
Greater Cairo Region  
(GCR)

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*This paper was prepared by Transport for Cairo (TfC) and Takween Integrated Community Development (TICD).*

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## -About us-

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Transport for Cairo (TfC) was founded in 2015 by a young team cross-disciplinary team of urban planners, social scientists and computer engineers.

TfC believes that mobility is a universal right, where mobility is the accessibility of people, goods and services to go where they need or want to safely, efficiently and affordably. Our Intent is to improve mobility & accessibility in Cairo by mapping all formal and informal transportation and leveraging Public Private Innovation to advance sustainable future mobility systems and the industries and enterprises that will supply them.

We work to enhance the quality of research and level of understanding of transit service provision in GCR by developing and disseminating contextualized research methodologies and non-conventional data collection and management techniques.



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**Takween** Integrated  
Community Development

Takween Integrated Community Development is an urban development company established in 2009 in Egypt by a dynamic team with more than 20 years of experience. Takween specializes in the development of integrated, sustainable and innovative packages in urban development services to support efforts of tackling urban challenges.

We focus our work under three thematic areas of interventions, offering multi-disciplinary services: i) Built Environment Development (participatory urban design and planning, public open space, mobility and infrastructure upgrading); ii) Social Development and Community Mobilization; and iii) Economic Development (vocational training, creating job opportunities through urban revitalization and upgrading and feasibility studies.)

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## - Executive Summary -

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Big cities are engines of development, economic growth and innovation. Cairo produces more than half of its GDP using just 0.5% of its land. Traffic congestion and inadequate public transport infrastructure and services choke off big cities and threaten their ability to deliver prosperity.

The issue of mobility has become a pressing development concern, especially in Africa due to its predicted demographic and economic growth. Improving accessibility to opportunities and services requires powerful policy and transport infrastructure development. Public transport will influence our mobility patterns, urban shape, social equity and economic performance for the coming decades. For the developing cities of Africa, paratransit has emerged as the provider of the majority of mobility services, linking communities.

Using these principles, this policy paper hopes to reframe the policy debate on mobility and public transport in cities with paratransit. It contributes the concept of the **Right to Adequate Mobility**, in line with global development decisions such as the Sustainable Development Goals adopted by the United Nations and the New Urban Agenda. To measure transport system adequacy, the paper develops specific indices within six parameters: availability, affordability, accessibility, acceptability, safety and sustainability designed to holistically look at transport services.

Improving accessibility should begin with mapping cities' formal public transport and paratransit networks. This paper analyzes the existing experience of collecting **spatial and temporal data** on comprehensive urban mobility systems, discusses the possibility of collecting **data on system adequacy** and draws practical implications for transport policies in today's developing cities. Two case studies from the United Kingdom and South Africa provide a vantage point to understand the present state of Cairo.

For Cairo, this paper describes the current urban mobility systems and develops a **catalog of transport modes**. It examines existing data to create the **transport data availability matrix** for the city, positing mapping as a near-term opportunity to achieve the Right to Adequate Mobility.

-1.Introduction-

Around the world new ways of providing mobility are changing how people move: autonomous vehicles, public shared e-bikes, ride-sharing & ride-hailing services are increasingly complementing expanding public transportation networks to offer seamless multi-modal transport. A new alternative to car ownership is emerging: seamless mobility-as-a-service. Meanwhile, in the developing world car ownership is skyrocketing, investments in public transport are lagging and paratransit is filling the mobility gap.

In the case of Cairo everyday hundreds of thousands of motorists line up to access the 26th July Corridor Road, known as the 'Mehwar', a 35km long elevated highway between 26th of July street in the heart of downtown Cairo and the urban communities of Sheikh Zayed City & 6th of October City. The road crosses downtown Cairo, popular districts, peripheral informal settlements, open green countryside and finally the desert where the cities are situated.

Since there is no link with the Cairo Metro network, personal vehicles compete with public transport for limited road-space: motorists in private cars as well as commuters riding formal government-operated buses, licensed paratransit or other vehicles all suffer from the same congestion. ***A 4-month analysis of travel time between Tahrir Square & the entrance of Sheikh Zaid City reveals the average travel time to exceed the normal travel time of 26 minutes by 57.7%.*** One out of four trips on the 'Mehwar' take more than double the normal driving time. This traffic congestion is costly: air pollution and greenhouse (GHG) gas emissions pollute the environment, time losses and excess fuel use slow the economy, while commuting prices and locational access exacerbate social divisions making the present state is not sustainable on the long run.

These transport related challenges cannot be addressed in isolation from other highly interconnected developmental challenges. The UN Sustainable Development Goals (SDGs) recognize that each of its goals and targets relies on one another to achieve the equilibrium of economic, social, and environmental sustainability envisioned by the United Nations. Transport has been centrally integrated within the SDGs and the New Urban Agenda (NUA). They stress the importance of sustainable urban mobility systems as SDG target 11.2 stipulates that countries and cities should aim to "provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons" by 2030. These definitions stress that mobility systems are not only about physical movement from Point A to B but rather about enabling access to vital opportunities such as education, employment, health services or trade. The Policy Committee of the Council of European Municipalities

and Regions (2007) even classifies the right to urban mobility as a human right as it is essential for the realisation of other basic human rights.

From the current global discussions on the matter, this paper has developed the concept of the Right to Adequate Urban Mobility. The adequacy of urban mobility systems are reflected in the following six parameters: availability, affordability, accessibility, acceptability, safety and sustainability. Each parameter includes a set of indicators to allow for the measurement of the parameter. The Right to Adequate Urban Mobility is achieved when urban mobility systems fulfill these parameters. To achieve adequate urban mobility systems, decision-makers have a number of interventions at their disposal. One potential policy intervention is investing in mapping urban mobility systems to capitalise on the power of data to inform better policies and to enable data-driven mobility solutions.

This paper proposes mapping urban mobility systems as a powerful policy intervention to get out of the traffic congestion trap, improve personal mobility and achieve real development. It develops the concept of the Right to Adequate Urban Mobility as a benchmark to aim for, and suggests first steps towards achieving it.

Leveraging the power of data has an enormous potential in the Egyptian context which is expected to witness a growing motorization rate of 4 per cent per year between 2001 and 2022 with 25 million daily passenger trips (Al-Araby, 2013). Optimizing the performance of urban mobility systems in Cairo and ensuring their adequacy becomes particularly challenging against the backdrop of institutional fragmentation, tight budgets and large numbers of formal and paratransit collective operators. While the 2014 Egyptian constitution does not recognize the right to Adequate Urban Mobility; it does recognize the right to adequate housing (which includes access to services which include mobility options) in article 78 as well as the right to freedom of movement in article 42 and the right to equal opportunities for all citizens without discrimination in Article 9. Following the logic above, the Right to Adequate Urban Mobility is paramount to realising the right to equal opportunities in the GCR.

The paper will start by conceptualising the Right to Adequate Mobility, and explaining the different parameters and indicators that can be used to assess the adequacy of urban mobility systems. It will then explore the potential of data as a tool for improved urban mobility systems and will present the case studies of Transport for London's mapping efforts of the London transport system and Where is My Transport in South Africa.

Further, to contextualise the potential of mapping to promote adequate urban mobility systems, the mobility landscape in the Greater Cairo Region (GCR) will be explored with a focus on public modes of transport. Public

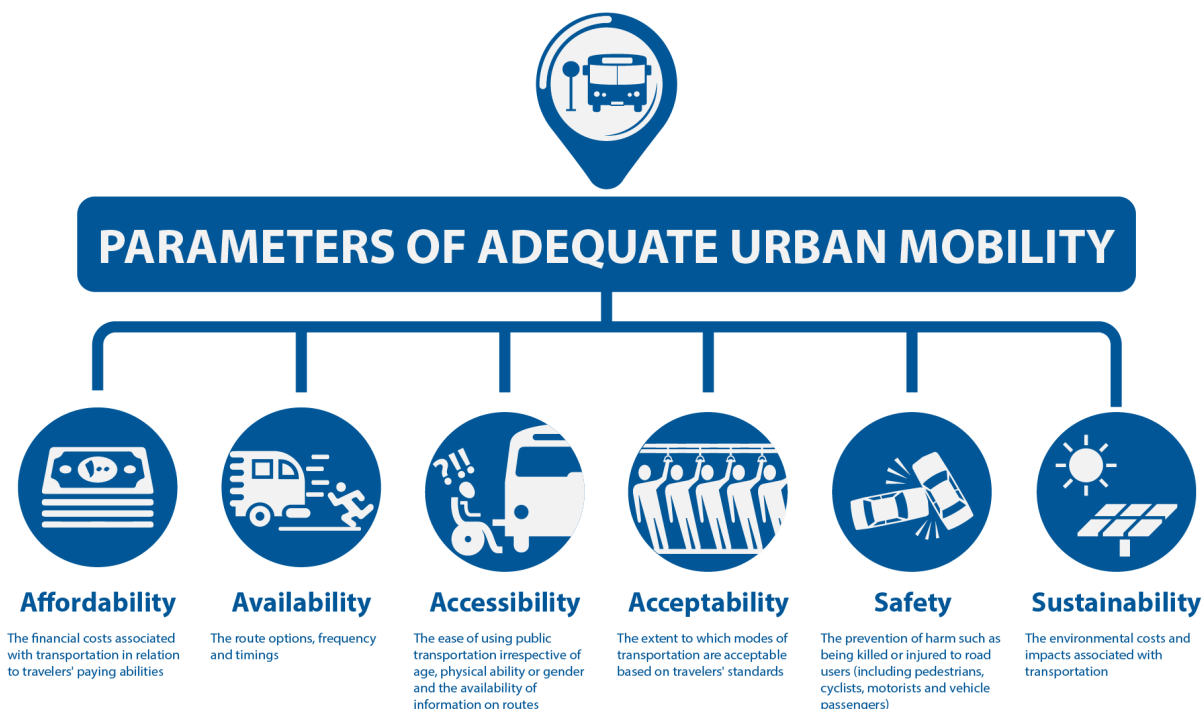
transportation in the GCR is comprised of a mix of operators working with varying forms of ownerships and governed by different regulations. A prerequisite to leverage the power of mapping to achieve adequate urban mobility in Cairo is to understand what exists and what is missing. As such, we developed the **Transport Mode Catalog** which describes and classifies the main transport modes found in the GCR along some main criteria such as ownership, operating model, regulation and others. Additionally, we drafted the **Transit Data Availability matrix' for the Greater Cairo Transport System (GCTS)** to provide an overview of the currently available data in relation to the indicators of adequate urban mobility systems for the different modes. The matrix will function as a gap analysis indicating areas of opportunities to guide the mapping efforts of research entities and public institutions on their quest to achieve the Right to Adequate Urban Mobility.

## Defining Adequate Urban Mobility Systems

Urban mobility systems consist of a number of components such as the physical and digital infrastructures, the network connecting the different parts of the city, the flow of people and freight in the network and lastly the modes of transport, the mobile elements of mobility systems. Traditionally, transport planning assumed that the objective of transport was to maximize the distance travelled in a set time given a certain budget. The performance of transport systems, therefore, was based on travel speed, distances covered and operating cost of motor vehicles (Litman, 2013). This has led to the transport bias of urban mobility which equates vehicular mobility with transport. This bias is manifested in two trends. Firstly, a higher level of motorisation prevails, where in 2010 there were over 1 billion motor vehicles globally, with developed countries having ten times as many motor vehicles per capita as developing ones (UN-Habitat, 2013). Secondly, increased investments are directed at infrastructure, particularly the construction of roadway systems (Litman, 2013). Public space and road space in cities is limited. Infrastructure must satisfy the needs of competing users- pedestrians, cyclists, public buses, private motorists driving as well as in need of parking and the movement of goods and service vehicles (Travelspirit, 2017). The transport bias prioritizes private motorists over all other modes. It has not led to better access to places, services and activities. On the contrary moving from one place to the next has increasingly become less convenient, more time-consuming and more expensive. Additionally, it has been accompanied by negative externalities such as increased energy use, carbon emissions, congestion and urban sprawl (UN-Habitat, 2013). The hardest hit are cities that tried the most to create unrestricted road capacity, such as Los Angeles and Dubai.

These urban mobility challenges faced by many cities around the world gave rise to a paradigm shift in transport planning. Rather than viewing mobility as a goal in itself, the new paradigm recognizes universal access to safe, clean and affordable transport as a tool to achieve the ultimate purpose of creating “access to opportunities, services, goods and amenities” (Un-Habitat and UNEP, 2015). The importance of urban mobility systems for the achievement of development goals is iterated in the United Nations’ SDGs in target 11.2. The importance of urban mobility is further highlighted in the NUA, a framework document that sets the guidelines according to which, countries, cities, international development agencies and civil society ought to tackle urbanisation. NUA (2016) encourages cities to “promote age- and gender-responsive planning and investment for sustainable, safe and accessible urban mobility, and resource-efficient transport systems for passengers and freight, effectively linking people, places, goods, services and economic opportunities”. Stressing the importance of meeting the needs of vulnerable groups, in the NUA states commit themselves to ensure that the needs and rights of women, children and youth, older persons and persons with disabilities, migrants, indigenous peoples and local communities, as appropriate, and to those of others in vulnerable situations are met to allow for their participation in social and economic activities. The document encourages the prioritization of public transport, walking and cycling over private motorized transportation. It asks cities to address the chronic conflict of road-space allocation by replacing arbitrary policy decisions of increasing capacity to combat congestion with planning informed by robust data and informed decisions. For instance, it calls for the promotion of “transit-oriented development” which integrates housing, employment and retail into mixed walkable neighbourhoods. Further, it stresses the importance of integrating and coordinating transport and land-use planning which has the potential to increase connectivity while reducing travel needs.

From the definitions for sustainable urban mobility put forward by the United Nations, we have developed a number of interconnected parameters (described below) and a corresponding set of indicators to measure the adequacy of urban mobility systems (Annex 1). Measuring these indicators for every mode of transport will allow decision makers to assess the current state of urban mobility systems and to take the necessary steps to improve it. Moving closer to these indicators will allow states to abide by the commitments they made in the SDGs and NUA and will bring them a step closer to realising the right to adequate urban mobility. Transit Data Availability matrix for GCR (Annex 2) explores the availability of data for the identified indicators for each mode of transport in the GCR .



Source: Modified from "Urban Mobility: More than Just Building Roads", Tadamun 2016.

## Availability

The most basic parameter is the availability of transport options in terms of routes, timings and departure frequencies to cater to the needs of the residents. Availability can be measured by the departure frequency and consistency in relation to the distance people would need to walk to reach a transport mode. Poelman and Dijkstra (2015) suggest that areas with high availability/access are those where people can walk for less than 5 minutes to a tram or bus stop and with more than ten departures an hour and to a train or metro station with more than ten departures an hour. The Sustainable Development Strategy: Egyptian Vision 2030<sup>1</sup> aims to measure the availability of transport options by the percentage of people who can walk a 500m radius to reach a mode of collective transport (publicly or privately owned) with three or more departures per hour (Government of Egypt, 2016). Other indicators to assess the availability of transport modes are the system's responsiveness to demand and ad-hoc events as well as the operating hours and passenger volumes.

## Affordability

An important equity consideration for transport planning is that of affordability. In order to ensure equal access to basic goods, services and activities and expand opportunities particularly for those in vulnerable situations, it is important to ensure that the financial cost incurred by an individual to travel is affordable. Currently, in some cities in the Global South such as Nairobi, Kenya and Dar Es-Salaam, Tanzania the cost of travel consumes up to 30 per cent of daily income forcing households to make sacrifices to be able to afford travel costs (UN-Habitat, 2013). However, these direct costs are not the only costs incurred. Often people have to take a number of modes and spend a significant amount of time in traffic, which could have been spent on other activities. Thus, to be able to measure the affordability of mobility system it is important to measure the direct costs of transport fares as a percentage of income, in addition to measuring the opportunity cost of time spent commuting.

<sup>1</sup> The Sustainable Development Strategy is Egypt's strategy for sustainable development which was launched in 2015 and outlines the principle which will guide Egypt in pursuing its development goals across the economic, social and environmental dimensions.

## Accessibility

While modes of transport may be available and affordable, they are not always accessible to vulnerable and disadvantaged groups such as, women, children, older persons and persons with disabilities. The third parameter, accessibility, is concerned with the suitability of the modes of transport, as well as the stations, to the needs of the different groups of passengers. A key driver of increased accessibility is better infrastructure. In a number of countries public transit vehicles have to meet a number of regulations to allow access for disabled passengers. For example in the UK the Public Service Vehicle Accessibility Regulations 2000 (PVSAR) stipulates that buses carrying more than 22 passengers need to be fitted with a boarding device for wheelchair users to be able to get on and off the bus. The bus itself should have a space for a wheelchair, a minimum number of priority seats for the disabled, handrails to assist people as well as colour contrasting of handrails and steps to help partially sighted people (Citizens Advice, 2015). These modifications cater to the needs of other passenger groups as well, such as parents with babies and the elderly. Another important driver for better accessibility is higher availability of information. This refers to information on routes, timings and departure frequencies before a passenger undertakes a trip as well as information during the trip on route, location, direction and destination. It's important that the information is audio-visual and multi-lingual to be suitable to people with disabilities as well as foreigners.

## Acceptability

The fourth parameter, acceptability, relates to the standards of the traveller and their expectations of the mode of transport. These can be reflected in a number of indicators: comfort can encompass qualities such as quality of seating, level of noise, responsiveness to climate conditions, for example, air conditioning in the summer months etc. Other indicators include the degree of cleanliness and maintenance of the mode of transport, the trip duration, required changes to reach the destination and the availability and quality of amenities at stations.

## Safety

Security and safety concerns often deter children, women and the elderly from the use of public transport (UN-Habitat, 2013). Safety concerns are not limited to the safety of passengers on the mode of transport but also extend to the levels of safety experienced in the sta-

tion and to reach the station. On the mode of transport safety concerns can be divided into two categories. Firstly, concerns arising from undesirable behaviour of fellow passengers such as sexual harassment or theft. Interventions to curb these have included designating areas for women only on public modes of transport in cities like Cairo, Alexandria, Mexico City or Teheran (ibid). Indicators to measure safety on modes of transport include the rate of theft incidents, gender or ethnic based violence incidents and the presence of security services and surveillance in stations and on vehicles of transport. The second category of safety concerns arises from high rates of accidents due to erratic driving behaviour, lack of maintenance and poor road conditions amongst other reasons. The WHO reported 1.25million deaths globally in 2013 due to road accidents, while the number for Egypt was estimated to be 10,466 in 2013. The NUA has stressed the importance of enhancing road safety and integrating safety elements into sustainable mobility policy-making, planning and design. Indicators to measure these targets include death and accident rates in transport related accidents, the availability of emergency precautions on modes and stations, the availability of safety measures such as rail protection doors or seat belts and the existence and enforcement of regulations on driving behaviour.

## Sustainability

Lastly, it is important to consider the sustainability of urban mobility systems on the social, economic, environmental and governance levels. The governance and institutional frameworks are perhaps the central pillar in designing sustainable transport policies to guide the resource allocation and implementation of programs to achieve a balance between the social, economic and environmental aspects of urban mobility systems. For the institutional frameworks to be sustainable there is need for institutions that are capable, responsive and accountable.

Environmentally, the sector is responsible for 22 per cent of global energy use, with 95 per cent of motorised transport using oil-based products as energy such as diesel and petrol (UN-Habitat, 2013). The reliance on oil-based energy translates into greenhouse gas emissions, which have increased by 85 per cent from 1973 to 2007, heavily contributing to climate change (ibid). In Egypt, the Ministry of State for Environmental Affairs estimated that in 2009 vehicle emissions produced 26 percent of total pollution load with 40 percent of that attributed to the GCR (Abou-Ali and Thomas, n.d.). Furthermore, increased motorisation with its related air and noise pollution pose significant threats to human health such as

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respiratory difficulties, cancer, increased morbidity as well as anxiety, depression and insomnia. Indicators to measure the environmental sustainability of urban mobility systems include energy consumption levels, transport related emissions as well as share of renewable energy used in the transport sector.

The social sustainability of urban mobility systems refers to the extent by which the benefits and costs of transport and their spatial organisation are equally distributed in society (Grieco, 2015). Naturally, important equity considerations are accessibility and affordability, which constitute parameters of their own. Instead, the social sustainability sub-parameter will look at the rights granted for workers in the urban mobility sector. As such indicators considered to measure the adequacy of urban mobility system should reflect the availability and quality of social safety networks for workers in the mobility sectors and their families, the existence of independent labour unions representing their interests and the benefits systems for workers and their families.

Lastly, an important pillar which is central to aligning the social, economic and environmental goals are the financial arrangements in place in the urban mobility sector. Improving urban mobility systems requires strategic decisions regarding the projects to finance and the way to do so. As such economic indicators should reflect the costs and benefits of motor vehicle use. Two suggested performance measures relate to finance equity meaning that transport is financed in an equitable manner and secondly the resilience of the mobility sector to economic fluctuations (Litman, 2007).

-2.Mapping as a Strategy Intervention-

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## 2.1. Data as a Driver for Adequate Urban Mobility

Section 1 explored the impactful role adequate urban transport systems play in development efforts by creating equal opportunities for access. In this section, we explore the ways in which the power of data can be harnessed to realize the Right to Adequate Urban Mobility. As demand for mobility services continues to grow, researchers and practitioners are recognising the potential of information technology and data to improve the allocation of scarce resources for sustainable development. We discuss three domains that are transformed by new data technologies:

***1. How does data aid decision-makers in the process of evaluating and enacting policies and regulations?***

***2. How is data used to improve service provision for citizens?***

***3. How can data be used to forecast future activity for the sake of planning and policy making?***

The present day reality for each of these domains differ between the developed and the developing world contexts and therefore we will start by exploring these realities in both contexts. We will then explore how mapping is emerging as a powerful tool for developing countries to realize the Right to Adequate Urban Mobility.

### 2.1.1. Gold Dust: The Data Ecosystem in the developed world

‘Gold Dust: The Impact of Digitalisation’. This catchy title of a session at the UITP Global summit, the world’s largest public transportation conference in Montreal, sums up the industries’ expected impacts of new data technologies. In recent years technology based services have emerged to address inefficiencies in mobility service provisions and have catered to personal mobility demands. An enabler of these technologies is the advancement of information-sensing and wireless technologies which has increased access to recorded and real-time data through the digitization of records, expansion of sensor networks, and the computerization of society. A flood of new data sources emerged: public organizations opened up government datasets, private entities emerged combining information from multiple technologies and crowdsourcing emerged as a new technology leveraging the large numbers of contributing users.

The data created often has lower levels of spatial and temporal aggregation than was previously available: journey times, usage patterns, service availability and other transport system characteristics are available at higher granularities than ever (Vandervalk, 2012 and Glaeser et al, 2016). With greatly enhanced computing power and storage capacity, it is possible now more than ever to collect, store and analyze large data sets – so-called “Big Data” – to get a wider and timely understanding of the mobility sector. ‘Call detail record’ data – signaling information from cell phones – determine which roads entire populations are using every moment. Smart ticketing services, such as the Oyster smart ticketing in London, are now used widely to define different travel patterns and other variables. Crowd-sourced options, such as Waze, a self-described community-driven GPS navigation app collect accidents, traffic jams, speed and police traps and more from its users. These Big Data sources provide millions of traces of trips starting and destination points. This data is anonymized - and must remain anonymous to avoid personal privacy threats – meaning that certain layers important for analysis are not easily collected.

Big data sources are not replacing traditional datasets such as transit maps and travel surveys, they are complementing it. Traditional travel surveys which target statistically viable samples of travelers are about taking snapshots of individual trips with more details on socio-economic level, trip purpose and user experience. Even with its limited quantitative power, travel surveys provide some data layers that Big Data is not capable of.

Big Data provides rich material for analysis from which information - “data organised to provide context and meaning” - can be derived (Vandervalk, 2012). Combining this information with up to date and statistically viable travel surveys and with experience and interpretation creates knowledge and a comprehensive understanding of the mobility sector. This can be used to create value for city governments, planners, operators and travelers alike, as they serve to guide urban planning, transport system design and service management (Buscher et. al., 2014).

Cities enact and evaluate policies and regulations, they operate public services, and they forecast future activities for planning and policy-making. These activities highly rely on and can benefit from better, more readily available data (Glaeser et al, 2016). The information derived from the data can inform decisions regarding operations, planning, funding and policy formulation (Vandervalk, 2012).

Increasingly, the value of data for these activities has been recognised by government authorities. In 2016, the US Secretary of Transportation asked transport agencies to share their General Transit Feed Specification (GTFS) data with the US Department of Transportation. The data was used to create a nationwide catalog of fixed-guideway and fixed-route transit service to support research, analysis and planning by providing an overview of existing service to be assessed and improved on by policy-makers and advocates (US Bureau of Transportation Statistics, n.d.). Similarly, Mexico City's public transport authority, SETRAVI, collaborated with the World Bank's Latin America and Caribbean Transport Unit on the development of a digital platform to collect and manage urban transport data. The creation of this platform provided planners with comparable data on minibuses which allowed them to visually represent routes and to accordingly identify gaps and/or oversupply in their provision, ways to improve the service and integrate it with more structured transport services as well as plan for the long-term (World Bank, 2013).

Real time aggregate data can enable command-and-control centres to rapidly respond to increases in demand or traffic peaks. These strategies can further lead to optimisation of fleet and costs depending on traffic conditions and demand needs. Furthermore, high fidelity and high granularity data can help decision-makers in making timely and quick decisions based on frequent modelling of planned interventions before they are implemented.

In addition to decision-makers, data can create benefits for customers. Increased data availability in recent years have sparked a surge in services targeting commuters to enhance their user experience. These services - developed by public transport operators or third party service developers - include autonomous vehicles (all Tesla vehicles sold in 2017 and beyond are fully autonomous ready), public shared bikes (e.g. the Velib system in Paris; additionally, 17 towns and cities in the UK have bike-sharing schemes), ride-sharing (e.g. blablacar in Europe), ride-hailing services (e.g. Uber), journey planners (e.g. Google Transit or Citymapper) and more. Users can access new services and access real-time information about their journeys, find out about disruptions and ultimately better plan their journey.

Additionally, better access to data allows governments, practitioners, academia and other stakeholders to measure the advances made with respect to the targets stipulated in the SDGs and the NUA. Identifying indicators and measuring progress against them is important because indicators measured are more likely to be achieved.

### 2.1.2. The Potential of Mapping as a Driver for Adequate Urban Mobility in the developing world

Digitalisation has had a profound impact on the developing world as well: low-income countries without fixed-sensor networks such as loop- or radar-based detection for traffic can now perform a leap-frog and query the Google Maps Distance Matrix API for estimated trip-durations instead. Crowdsourcing applications such as Bey2ollak have been for years collecting data from motorists around road conditions and traffic accidents. Ride-sharing services have profoundly altered urban mobility systems: Cairo is the fastest growing city in Europe, the Middle East and Africa for Uber despite stiff competition from Careem, the regional market leader.

Still, two profound challenges remain: first, most new data-sources and data-based services target private motorists and strengthen the transport bias explained in section 1. Second, they leave out and ignore the large paratransit sector which perform the majority of mobility services, deepening a digital divide.

To tackle these challenges mapping urban mobility systems has emerged as a powerful new policy instrument to capitalize on the power of data to inform better policies and to enable data-driven mobility solutions. In 2012-2013 Digital Matatus mapped the paratransit services in Nairobi, the so-called Matatus and released the data in the industry standard GTFS standard. They also highlighted specific changes needed to the GTFS standard to accommodate the nature of paratransit.

### A definition of public transit mapping

The most common and best understood level of mapping urban mobility systems refers to collecting spatial data on routes, stops and building a record of stop names, stop infrastructure, interchanges and route pricing (Williams et al., 2015). A more advanced level of mapping covers temporal data to include data collection on service frequencies, service operating times, and creation of estimated timetables incorporating expected trip durations according to road traffic conditions by relying to Big Data API's.

Such mapping exercises take integration of different modes of transport at their core. They seek to create a complete overview of existing systems, and highlight the previously opaque intersection of different systems into one unified urban mobility system. They will be how we are eventually able to answer questions from an individual perspective such as:

*What modes of transport can a passenger use to go from place A to place B at a certain time? How do they compare in cost and duration of the trip?*

***Does a certain combination of modes provide a superior solution?***

Having a complete overview meanwhile allows for answering questions from an aggregate perspective in ways not previously possible, such as:

***Does paratransit compete with or complement formal public transport service provision?***

***Do private cars offer superior or inferior mobility compared with public transport?***

***Which geographic areas within the larger metropolitan city region offer the best/worst locational access?***

The third level of mapping includes the collection of data and integration of third party data sources on additional parameters and indicators related to adequacy of urban mobility system and eventual user perception of different modes of transport within the larger urban mobility systems. This level goes beyond the spatial and temporal dimensions of the system to cover system adequacy. The aim is to answer questions on a wider variety of issues. An example relating gender with modal choice (Economic Commission for Europe, 2008) would be:

***To what extent does concern for personal safety guide a woman's decisions regarding transportation options?***

***Another example concerning comfort would answer the following question:***

***What modes of transport offer air conditioning?***

In developing-world countries a majority of mobility services is performed by paratransit operators. It is not sufficient to have high fidelity and high granularity supply data on the formal sector only. Obtaining data on the paratransit sector is challenging due to the large number of non-institutionalised operators, which operate on demand. However, harnessing the full potential of data for better mobility services will arguably only be achieved when more data is collected for the paratransit sector. For decision-makers, this will translate into more accurate plans as they will have a better understanding of the full system. Private sector operators seeking to enter the market will gain a broader understanding of demand and supply and the gaps to be filled, encourage them

to expand investments in the urban mobility sector and improve service provision for sectors. Consumers would benefit from access to hitherto unavailable trip-planning and journey-planning abilities, saving time, money and improving the commute experience directly.

## 2.2. Case Studies

As city populations around the world are growing larger - a growth that is accompanied by an increasing demand on transportation - many cities are recognizing data and technology as tools for the development of the transportation sector in order to match this increasing demand. In this section, we take a look at two case studies where data and technology were used for the improvement of the mobility sector to inform users, provide decision makers with relevant knowledge for a better governance and enhance participation of both ICT and transportation private sectors alike.

### 1. Transport for London (TfL)

#### Background and strategy:

Transport for London (TfL) is the local government body responsible for implementing transport strategy and managing transport services across the UK capital. It oversees almost all aspects of transport. TfL is responsible for all modes of public transportation in London, and manages the whole network of main roads, traffic, and city's cycle hire scheme (TfL Portal, 2017). TfL has been doing great efforts in mapping and collecting data on the urban mobility landscape in London as described in Box 1.

TfL was a cautious entrant into the open data, since the business case for open data was hard to model. But now, five years after beginning to release its key datasets, many in real time, the apps built on the back of its data number in the hundreds, and reach millions of London transport user. Open Data Thinking is now embedded in the organization and considered one of its assets (Hogge 2016).

|                                      |                                                                                                                                                                                                 |
|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Location</b>                      | London, UK                                                                                                                                                                                      |
| <b>Mapping Agency</b>                | <b>Transport for London (TfL)</b><br>Local Government                                                                                                                                           |
| <b>Purpose Of Mapping</b>            | <ul style="list-style-type: none"> <li>• Transportation Planning Purposes</li> <li>• Passenger Information System</li> </ul>                                                                    |
| <b>Modes Covered</b>                 | Tube- Rail Dockland Light Rail (DLR) – Tram – Bus- River Bus- Cycling Net work                                                                                                                  |
| <b>Percentage Of Coverage</b>        | 100%                                                                                                                                                                                            |
| <b>Outputs</b>                       | <ul style="list-style-type: none"> <li>• GTFS</li> <li>• Web-Based Trip Planner &amp; Passenger Information</li> <li>• Digital Maps</li> <li>• Audio Maps</li> <li>• TfL Unified API</li> </ul> |
| <b>Data Release License</b>          | Open Government Licenses (OGL) <sup>2</sup>                                                                                                                                                     |
| <b>Availability Of Baseline Data</b> | TfL Base Map Master <sup>3</sup>                                                                                                                                                                |

### Box 1: Snapshot of TfL's mapping practices

As the main operator of all public transport network in London, TfL's data collection does not include any route mapping as they are responsible for route planning. TfL's data collection methodology heavily relies on data collection devices, whether fixed or mobile, installed in their fleets, stations and main roads. iBus on-bus equipment sends real time geolocation of the bus every 30 seconds, while stop times are recorded in every station upon arrival. Automatic passenger count (APC) and smart ticketing services like Oyster Cards are used to collect ridership data. This high level of coverage by hardware devices allows the collection of tons of real-time data. Additionally, soft technologies play a vital role in estimating what is not collected by hardware devices, for example, ODX big data tool is used to estimate destinations of trips that don't require a check-out (bus trips for example) by inferring destination stop from the beginning of next trip. Following is a detailed list of the data collection methodologies used for the different data types:

- Live Geodata is collected by iBus On-bus equipment

that records bus location and sends it every 30 seconds.

- Stop times (arrival time) is recorded when bus passes or stops in a station.
- Stop times prediction is calculated based on live location sent from the bus every 30 seconds & history data from previous similar trips on route segments.
- Ridership data is collected by Automatic Passenger Count (APC) and smart ticketing services
- Destination of incomplete trips is estimated by ODX tool that infers destination from the beginning of next trip to create Stop-Destination matrices.
- Traffic data is collected by Automatic Number Plate Recognition (ANPR) cameras, which feed information to the London Congestion Analysis Project (LCAP) analysis system. This system provides continuous journey time information for key routes in London.
- Accessibility data for vehicles and stations are collected per vehicle/station. Dataset determines acces-

<sup>2</sup> OGL is a governmental license in the UK designed as a tool to enable information providers in the public sector to license the use and re-use of their Information under a common open license.

<sup>3</sup> TfL basemap master is a map of London's main roads network, areas, edges, railways and tram lines.

sibility system (low floor buses, stops equipped with elevator/ramp/escalator)

TfL's journey to open their data began back in 2007 by releasing a set of web embeddable widgets, allowing users to integrate live travel updates data in web contents aggregators as well as costumed websites. In 2009, with the increasing demand from developers, TfL launched the first version of area dedicated to developers on TfL's website. In 2011, the London Underground train journey planner API was launched, followed by the launch of bus journey planner API in 2012 (Hogge 2016).

Now, TfL releases a mix of real-time feeds (such as the London Underground's departure boards, live traffic disruption, live bus arrivals), fixed datasets (timetables, station location, station facilities), and transparency oriented datasets (detailed operational performance, annual passenger counts).

TfL reveals how frequent every data feed is updated, ranging from every 30 seconds as in the London Underground's departure boards, to annually as in London passenger counts data. Maintaining this level of data fidelity in TfL's live feed datasets allows users to better plan their trips based on data of high temporal details they receive.

Data is produced in a variety of formats to match different users' needs and to allow data integration in a wide variety of applications. Some of data release channels and formats are listed below:

- TfL unified API is a front-end tool designed to simplify access to large and complex datasets of different transportation modes for developers.
- Web-based trip planner
- Printed and digital maps of geographic and accessibility data for stations and vehicles
- On-bus display of next stops and predicted arrival times
- Countdown system showing predicted arrival times at roadside signs
- Audio Guides to make data more accessible for people with disabilities.
- Recent and upcoming planned service changes such as diversion of routes, introduction of new vehicles and service are released periodically in a document detailing service changes.

TfL's move to open its data has been shown to deliver 15mn-58mn Sterling Pounds in annual monetized time savings to London's transport users, all for relatively low investment if compared with investments in transportation infrastructure. This is comparable to savings used to justify building the first phase of the High Speed 2 rail

project linking London and Birmingham, a major transport infrastructure project (Hogge 2016).

The existence of a core of individuals within TfL committed to Open Data championed the release of the Open Data portal: Vernon Everitt from a customer user perspective, Phil Young from a technology perspective and Emer Coleman from a policy perspective, who led TfL from a tentative entrant to open 10 years ago to an organization that considers data an asset like other physical assets.

## 2. WhereIsMyTransport

Public transport in South Africa is dominated by the hugely important paratransit sector, which emerged in the later years of apartheid. During the apartheid, millions of black South Africans were put in distant townships that were located long distances away from job opportunities, places of leisure and public services. A largely illegal minibus-taxi sector started to emerge to cover demand for mobility. After apartheid, the sector was re-regulated to cope with South African sprawling cities and the major urban developments taking place at the fringes of urban areas (Walters, 2013).

The current state of public transport in South Africa is difficult to quantify due to the lack of systematic data collection; the latest national travel surveys are from 2003 and are thus only indicative. They portray the percentage of car-owning households in the population to be 26.1%; three-quarters of the population are thus captive riders with no access to a car and fully reliant on public transportation. Citizens have access to multiple forms of public transportation: railways connect most townships with city-centers; and Bus-Rapid-Transit systems, which have been implemented incrementally over the past 10 years in Johannesburg and Cape Town provide some coverage of metropolitan areas. These are complemented by subsidized commuter bus networks. Still, paratransit dominates public transportation with an estimated 65% of all trips taking place on paratransit modes (Arrive Alive, 2011b) (DoT, NHTS, 2003). It is largely fragmented across dozens of disparate taxi associations, and largely operates without coordination with the aforementioned more formal services.

The user experience for city residents is thus similar to most cities in Africa: routes are only communicated by word of mouth and are a daily hassle to figure out. No route specifications are indicated and only a general area is announced as a destination. To address this concern,

WhereIsMyTransport started 8 years ago with the idea of mapping Cape Town. Since then, they have built an open data platform that allows integrating formal and informal transit data. Its system works with the formal railway and BRT services operating within Cape Town

and Johannesburg, amongst other cities. To map the informal system of Cape Town, WhereIsMyTransport hired 13 data collectors who rode buses for eight hours a day. Using a mobile application developed in-house, they collected speed, location, stop, geographic markers and fare data for the whole minibus-taxi network. WhereIsMyTransport's unique data is a result of years of work with formal transport operators, augmented with openly available network data, and unique data collected by WhereIsMyTransport's team from informally run networks.

In August 2016 WhereIsMyTransport received an investment of £1.165 million from Goodwell Ventures and the Omidyar Network; and in June 2017 secured a further £1.2 million investment from the Global Innovation Fund, Goodwell Investments and Bombardier. The investors, mostly from the social-impact investments space, lauded the WhereIsMyTransport's model as addressing a key barrier to inclusive growth by the targeting the large addressable market of mass transportation in African cities. Access to reliable data enables individuals and organisations to analyse, integrate or make decisions which rely on understanding public transport in African cities. City planning and infrastructure analysis can be improved, geographical coverage of public transport information increased, and informed decisions relating to knowledge about a city's centres of activity are made possible.

-3.Greater Cairo Transport System (GCTS)-

In the beginning of the 20th century the first tram line was introduced in Cairo to connect Downtown - where most of businesses and crafts were concentrated - with Heliopolis, the then newly constructed residential neighbourhood. Afterwards, the authorities expanded the tram network in the capital to ease and facilitate the quotidian commuting around the city. At that time, it seemed that the authorities comprehended the significance of public transportation as a driver for economic prosperity and development. In 2016, the last tram line, in Cairo, went out of service and was replaced with asphalt instead. This bias towards private cars is also manifested in the construction of new satellite cities. Since 1979, the Government of Egypt (GoE) aimed at depopulating the Nile valley and redistributing the expanding population all over the desert lands by constructing new urban communities. The development of these new cities was and still is dependent on connecting them with the existing urbanism by only a road network. This in fact is one of the reasons that these new cities have not attracted their targeted population. Moreover, along the new developed road network, many informal settlements have emerged. Informality did not only develop in the housing sector but also in the transportation sector where the shortage in supply of formal public modes of transportation was filled by the emergence of paratransit transport modes.

Moving towards adequate urban mobility in the GCR is a huge challenge which necessitates readdressing many issues such as mixed land use planning, street planning and designing for people rather than for cars. This section shall focus only on the collective transportation system in the GCR, and shall address some of the challenges that confront it, with the aim to demonstrate the significance of mapping in addressing these challenges.<sup>4</sup> Mapping, which was addressed in the previous sections, as a specific form of data gathering is a significant tool for measuring and developing adequate urban mobility.

### 3.1. Greater Cairo Region within Egyptian Context

Egypt is divided into 27 governorates, and the GCR is made up of the Cairo Governorate, the urban areas in the Giza Governorate, and Shubra al-Khyma and al-Obur city in al-Qalyubiyya governorate (GOPP, 2012). The Egyptian population is currently estimated at 93 million inhabitants, out of which 20.9 million live in the GCR (Central Agency for Public Mobilization and Statistics, 2017); the population is increasing by a rate of 2.5% annually. Around 43% of the Egyptian population lives in urban areas, and the number is projected to increase - due to the urbanization process Egypt witnesses - with an estimated annual rate of 1.68% between 2010-2015 (CIA, 2016). This rate of urbanization creates an urgent demand on housing, mobility, infrastructure, and other services. This demand is highly concentrated in GCR where approximately 46% of Egypt's urban population lives (GOPP, 2012). The significance of GCR - that makes many citizens call it Egypt - is largely due to its centrality and connectivity with the other regions in Egypt, which puts high pressure on the infrastructure and road network.



GC borders proposed by JICA (2008) study and the GOPP Urban Development Strategy for Greater Cairo (GOPP, UN-Habitat, UNDP 2012) (©TCID)

<sup>4</sup> Greater Cairo comprises Cairo Governorate, the urban areas in Giza Governorate, and Shubra elKhyma and al-Obur city in al-Qalyubiyya governorate (GOPP, 2012), whereas Greater Cairo Region, according to the Egyptian administrative system, includes the complete three governorate of Cairo, Giza, and al-Qalyubiyya.

### 3.2. Greater Cairo Collective Transportation System (GCR/CTS)

There is much of a difference between the GCR/CTS and the rest of Egypt in terms of modes, infrastructure and services. The metro operates only within the GCR. There are 4,529 publicly-owned public bus vehicles out of which 2,794 are operational along 439 routes in the GCR. This compares with just 1,010 vehicles out of which 774 are operational along 165 routes in all other Egyptian cities combined (CAPMAS, 2015). In 2013/14, these vehicles transported over 1 billion passengers in GCR, which dwarfs the approximately 250 million passengers transported in all other cities combined (ibid.).<sup>5</sup> Moreover, half of motorized vehicles in Egypt operate in Cairo with an estimated growing motorization rate of 4% per year between 2001 and 2022 (El-Araby, 2013). In addition, among the 25 million daily passenger trips that are made in the GCR, almost 18 million of those trips are motorized, and around 12 million trips are done by collective transportation (ibid.).<sup>6</sup> Based on CAPMAS bulletin of licensed vehicles, Cairo's car ownership rate is double the average in Egypt with around 110 vehicle/1000 person where the average was estimated to be around 53 vehicle/1000 person (CAPMAS, 2014).<sup>7</sup> Therefore, trip distribution outside Cairo is more likely to tend towards collective and non-motorized transportation. Despite this, only 18% of the public transportation budget was allocated to collective transportation projects in Egypt out of which 91% was channeled to Cairo alone (Shawkat & Khalil, 2016).

As a result, private spending on transportation in all its forms (Individual & Collective Transportation) is the fourth largest expenditure item for the average family, behind expenditure on food & drinks, housing and healthcare. According to the Egyptian Spending Survey of 2015 (Economic Research Forum, 2015), 7.4% of income of urban dwellers is spent on transportation. Across the nation, total aggregate consumer spending on the transportation market is \$17.1 Billion, excluding corporate and government expenditures.

#### Collective Transport Modes Catalog (CTC)<sup>8</sup>

Collective transportation in GCR is distinct from the rest of Egypt, due to the fact that it has various and multiple modes of transportation including a metro system that comprises three lines. The first two lines link the GCR along the north-south axis, and carried an average of 1.2 billion in 2012/13. The third line - which is under construction - runs along the east-west axis (ECMMO, 2014). Finally, there is the paratransit collective transit which according to our fieldwork comprises minibuses, Suzuki minivans and pickups<sup>9</sup>. Minibuses are the paratransit dominant mode of transport all over Egypt as they complement the bus and metro systems in GCR; and they operate as the main collective mode of transport in other cities and small towns. Suzuki minivans also operate in GCR and Egypt at large. Pickups, mainly, operate in peri-urban areas, small town and villages.

The multiplicity of actors and operators with the lack of comprehensive, concrete data on each mode prevents an effective policy making process which necessitates a detailed understanding of conditions of transportation, operational structure and legal framework for every mode of collective transportation. This understanding was developed comprehensively by mapping the different formal and paratransit mode in a **Collective Transport Modes Catalog (CTC)** with an aim to address the knowledge gap about collective transport modes in the GCR. The significance of CTC is to guide mapping, planning and policy making activities for the transportation sector. Explaining each mode of collective transportation is of paramount importance in the data collection process. Having a clear understanding of how different modes operate, are regulated and are financed is essential to design relevant data collection methodologies that go beyond basic geographic data for each mode. Box 2. below shows aspects used in each mode's definition process.

<sup>5</sup> Following the format of the CAPMAS report, all statistics mentioning other cities do not include Alexandria, as it is referred to in separate numbers.

<sup>6</sup> Collective transportation includes public and paratransit modes of transportation.

<sup>7</sup> Cairo has the largest share of licensed vehicles in Egypt with 2.2 million vehicles by 27.9%, in 2014 followed by Giza with 921 thousand vehicle by 11.7%.

<sup>8</sup> The full catalog can be found in Annex 3.

<sup>9</sup> A paratransit system is a flexible and privately owned collective demand-response system composed of minibuses, vans or shared taxis. Their key advantage is the possibility of a door-to-door service, less loading and unloading time, on-demand stops and more maneuverability in traffic. In the cities of many developing countries, this system is informal, dominant and often services central areas because of the inadequacies or high costs of the formal transit system.

|                                |                                                                                                                                                   |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Ownership Status</b>        | Defines the ownership status of the mode's vehicles<br><b>Public - Private (individual/institutional) - Precarious</b>                            |
| <b>Regulatory Framework</b>    | Defines how service is regulated on ground<br><b>Governmental – Institutional - No Regulatory Framework</b>                                       |
| <b>License</b>                 | Defines the license of the mode's vehicles<br><b>Passenger Transport License – Another License – No License</b>                                   |
| <b>Routing</b>                 | <b>Fixed Routes – Alternating Routes</b>                                                                                                          |
| <b>Operation Model</b>         | Defines relation between government and operators<br><b>Direct Public Service – Public Service Concession – Other Mobility Service Concession</b> |
| <b>Geographic Availability</b> | Defines the geographic range in which the service is available                                                                                    |
| <b>Geographic Coverage</b>     | Shows whether there's clear geographic data for service range                                                                                     |
| <b>Financing</b>               | Defines how the service is funded<br><b>Public Budget – Private Investment – Loans &amp; Grants</b>                                               |
| <b>Monopoly</b>                | Defines whether the service model is monopolized by certain parties                                                                               |

#### Box 2: Criteria for the mapping and categorizing of modes of transport in the GCR

With regard to road collective transportation, there are three service providers in GCR: Cairo Transport Authority (CTA) through their own fleets of buses and minibuses, private sector companies and co-operatives with concessions from CTA to operate privately owned buses and minibuses, and individual operators through privately owned minibuses and Suzuki mini-vans. The first two models work under the regulatory framework of CTA, and they operate within fixed routes. The third model, the paratransit system, is different and more complex. Minibuses are licensed as public transport service from Cairo Governorate (under the jurisdictional umbrella of the CTA), Giza Governorate and Qalyobeya Governorate. Minibuses are licensed to operate between defined terminals through al-Karta, which is the document that defines routes and fares. In reality, a considerable number of minibuses run without a route label, which makes it difficult to determine the actual number of operating minibuses without extensive mapping activity. In 2006, the World Bank estimated the number of operating minibuses by 80,000, only 20,000 of them were licensed (World Bank 2006). In addition, minibus drivers tend to change their routes based on congestion

after negotiation with the passengers. The service is demand-driven with no fixed stops, so drivers may stop to load or drop-off passengers at any point along the route. Suzuki mini-vans operate as a paratransit mode yet with private licenses.

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### 3.3. Transit Data Availability matrix for GCR

Building on the work done in CTC, the adequacy matrix is a tool that we developed to draw the relation between the six parameters of adequate urban mobility and the CTC in terms of the availability of data and measuring methodology for each indicator and mode. The matrix provides a visual overview of the availability of data on the developed indicators by mode and highlights gaps in knowledge and thus, opportunities for mapping, to be filled out by researchers and government entities. A number of insights can be derived from the matrix.

*1. The matrix reveals that more readily available data exist for CTA buses and minibuses, private buses and the metro, whereas information on microbuses and Suzuki minivans tend to be scarcer. This is particularly evident in the case of the sustainability indicators. The changes in availability of information can be traced back to the legal status of the mode and the regulatory framework it operates under. While microbuses and Suzuki minivans may be licensed, they often operate individually, not under the purview of the state or an organising body. As such they may not be obliged to report on their operations as other publicly run services.*

*2. Safety and sustainability indicators can mostly be obtained from second parties. It is therefore, important for researchers to develop partnerships with these entities. CAPMAS possesses of large amounts of useful data, however, they may need adjustments to fit the international standards of collecting and storing data. Therefore, reaching out to CAPMAS as a partner and potentially developing collection methodologies with them is an important step.*

*3. While some indicators are straightforward and can be represented by a number, others require qualitative data and a level of analysis. Indicators on the sustainability of financial models, the level of welfare for human resources or the availability of public funding for the modes can be developed to become research questions on their own which combine field research and mapping activities with conceptual frameworks to help inform policy and planning.*

*4. Indicators, which rely on reporting from the users, may be of questionable quality. For example, police reports on incidents of sexual harassment on modes of transport are likely to be much low-*

*er than the actual incidents of sexual harassment due to the reluctance of some victims to report their incidents. As such qualitative research pieces will be a good option to truthfully portray such indicators.*

## - 4. Conclusion -

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Building on the global discussion on the importance of urban mobility systems- especially in light of the increasing urbanisation- the paper has developed the Right to Adequate Urban Mobility. This concept reaffirms that every individual regardless of age, gender or physical abilities has a right to mobility and presents six parameters (affordability, availability, accessibility, acceptability, safety and sustainability) to measure and classify the adequacy of existing urban mobility systems. One intervention to promote the Right to Adequate Urban Mobility is to harness the power of data. The advances in information-sensing and wireless technologies has opened up a flood of new data sources. The resulting data is important, as it can be used to measure the adequacy of existing services and infrastructure, which is a significant step towards identifying shortcomings in needs for improvement and thus, towards achieving the Right to Adequate Urban Mobility. Importantly, however, the real-time provision of high-granular data, additionally, allows for the emergence of smart mobility technologies which benefit policy-makers, private businesses and commuters alike. This implies that data in and of itself can be considered a development intervention and therefore, it is valuable to invest in the necessary digital infrastructures to enable the operational, information and communication technologies which can contribute to the management and operation of urban mobility systems.

Taking the GCR as an example, the transportation landscape is suffering from a data gap- caused by the multitude of actors in the Egyptian transportation landscape and the scarcity of publicly available data- and thus, it is missing out on an important opportunity to improve the performance of the sector. In an effort to create an overview of the current data landscape in the GCR, the Adequacy matrix for GCR was developed. The matrix revealed that data across the different indicators is more readily available for formal modes of transport and is more difficult to collect for paratransit operators. Given that in the GCR paratransit operators play a major role, harnessing the power of data to the fullest, will only be possible when data from paratransit operators are included. The matrix highlights a number of opportunities for researchers and government institutions to develop data collection strategies and partnerships with already existing entities carrying out data collection activities in order to produce accurate data in usable formats to be used for the promotion of the Right to Adequate Urban Mobility.

- 5 . Annexes -

## 5.1. Annex 1: Table of Indicators



### Affordability

| Indicator                                                                                |
|------------------------------------------------------------------------------------------|
| 1.1. Trip Fare                                                                           |
| 1.2. Transportation expenses as a share of total income<br>(for different income groups) |
| 1.3. Time lost in transport due to congestion<br>(as an indirect financial cost)         |



## Availability

### Indicator

#### 2.1. System responsiveness to ad-hoc events

##### Explanation

*The system's ability to respond to increased demand due to special circumstances through demand based special service for example seasonal or midnight service*

#### 2.2. Operating time

##### Explanation

*The time period of the day in which a mode of transport operates*

#### 2.3. Ability to operate in difficult weather condition

##### Explanation

*Whether or not a mode of transport is capable of operating in bad weather conditions*

#### 2.4. Network length per capita

##### Explanation

*An individual share of the transport network*

#### 2.5. Proportion of population with access to station or mode of transport within walking distance



## Accessibility

### Indicator

#### 3.1. Stations and modes of transport are barrier-free

##### Explanation

*The degree to which modes of transport and station can accommodate the needs of vulnerable groups such as the elderly, women and children*

#### 3.2. Modes of transport are gender sensitive

##### Explanation

*Gender-sensitivity is defined as the availability of women's only sections of the modes of transport.*

#### 3.3. The availability of passenger information systems

##### Explanation

*The availability of publicly accessible, multilingual, audi-visual travel information prior to the trip (in stations and various media outlets) and during the trip (on the mode) to help with effective trip planning and cater to the needs of people with disabilities and non-native speakers.*

#### 3.4. Coverage in low-income areas (trip coverage)

##### Explanation

*The amount of trips conducted by a mode in low-income areas relative to demand relative to demand.*

#### 3.5. Coverage in low-income areas (Spatial distribution)

##### Explanation

*The degree to which a mode is available in low income areas.*

#### 3.6. Average travel distance in an hour



## Acceptability

### Indicator

#### 4.1. Crowding

##### Explanation

- 1) Public Transport: volume of travelers in crowded conditions in %  
2) Vehicles: represents journey time reliability as reflected in the % of trips that experience above average trip durations*

#### 4.2. Comfort

##### Explanation

*An assessment the degree of comfort offered to the passengers by a mode of transport which takes into account the quality of seating, responsiveness to climate conditions and the level of noise and cleanliness on a mode.*

#### 4.3. Maintenance of the modes of transport

#### 4.4. Availability and quality of amenities in and around stations

##### Explanation

*An assessment of the availability and quality of amenities in stations including public bathrooms, kiosks, ATM services etc.*



## Safety

### Indicator

#### 5.1. Emergency preparedness

##### Explanation

*Availability of Emergency Management Systems based on data and pre-planning for emergencies*

#### 5.2. Surveillance

##### Explanation

*The safety granted to passengers through the availability of regular police patrols and CCTV cameras on the mode and in the station*

#### 5.3. Safety and walkability of station's catchment area

##### Explanation

*The degree to which accessing the station might put passengers at risk, for example if they need to cross a highway or dangerous areas to reach it*

#### 5.4. Safety of driving behavior

##### Explanation

*The measures put in place to minimise the possibilities of harm to passengers from risky driving behavior, for example the enforcement of speed controls, regular substance abuse testes, GPS tracking of the vehicle and thorough background checks on drivers*

#### 5.5. Equipment of modes with safety measures

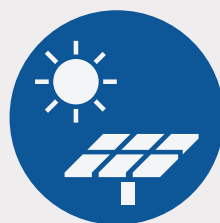
##### Explanation

*The infrastructure equipment in place to minimise the possibilities of harm to passengers on the mode or the station, for example the availability of seat belts or rail protection doors*

#### 5.6. Deaths and injuries in transportation related accidents

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| Indicator                                        |
|--------------------------------------------------|
| 5.7. Number of theft incidents                   |
| 5.8. Number of gender-based harassment incidents |
| 5.9. Number of ethnic-based harassment incidents |



## Sustainability

### Environmental

#### Indicator

|                                                                   |
|-------------------------------------------------------------------|
| 6.1.1. Energy Consumption per capita by mode and/or fuel          |
| 6.1.2. Transport Emissions of GHG per capita                      |
| 6.1.3. Transport Emissions of air pollutants (Non-GHG) per Capita |
| 6.1.4. Energy Efficiency                                          |
| Explanation                                                       |
| <i>Modes' consumption of fuel units per kilometer travelled</i>   |
| 6.1.5. Share of renewable energy in the transport sector          |
| 6.1.6. Share of clean energy in the transport sector              |
| 6.1.7. Noise pollution level                                      |

### Financial / Economic

#### Indicator

|                                                                                            |
|--------------------------------------------------------------------------------------------|
| 6.2.1. Sustainability of financial models                                                  |
| Explanation                                                                                |
| <i>An assessment of the sustainability of the financial model used to fund investments</i> |
| 6.2.2. Mode cost per capita                                                                |
| Explanation                                                                                |
| <i>The capital and operational costs of a mode per capita</i>                              |

## Social

### Indicator

#### 6.3.1. Social welfare system for human resources

##### Explanation

*The availability of social safety nets for operators and drivers such as fixed basic income, health & life insurance, work hazards insurance, independent labor syndicates, system of benefits for workers and their families*

## Governance

### Indicator

#### 6.4.1. Availability of capacity building programs for human resources

#### 6.4.2. Availability of public funding

##### Explanation

*The budget allocated to the sectors from public funds*

#### 6.4.3. Responsiveness to users' needs

##### Explanation

*The degree to which planning responds to the users' needs*

#### 6.4.4. Availability and effectiveness of channels for users' feedback

##### Explanation

*The degree to which user feedback is integrated in planning processes in terms of, for example route planning and customer experience*

#### 6.4.5. Level and effectiveness of regulatory framework

##### Explanation

*The degree to which a mode of transport follows state regulations*

#### 6.4.6. Transparency

##### Explanation

*The availability of publicly accessible technical reports, plans and budgets*

## 5.2. Annex 2: Transport Mode Catalog

The first step of any mapping process is to have a clear understanding of the context.

In GCR, there are several providers of public transportation services:

*1- CTA through their own fleets of buses and minibuses,*

*2- Private sector companies and co-operatives with concessions from CTA to operate*

*privately owned buses and minibuses.*

*3- Metro Company through underground electric trains*

*4- Individual operators through privately owned minibuses and Suzuki mini-vans*

Every mode of transport has specific characteristics in terms of conditions of transportation vehicle, operational structure and legal framework.

The role of **Transport Modes Catalog** is to address the knowledge gap about transport modes in the GCR, as a first step towards creating comprehensive definitions for different modes of transportation to guide mapping, planning and policy making activities.

Defining a transport mode is of paramount importance in data collection process. Having a clear understanding of how a mode operates, regulated and financed, is essential to create a relevant data collection methodology that go beyond basic geographic data. The table below shows aspects used in modes definition process.

|                                |                                                                                                                                              |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Ownership Status</b>        | <b>Public - private (Individual/institutional) - precarious</b>                                                                              |
| <b>Regulatory Framework</b>    | Defines how service is regulated on ground<br><b>Governmental – Institutional - No Regulatory Framework</b>                                  |
| <b>License</b>                 | Defines the license of mode's vehicles<br><b>Passenger Transport License – Another License – No License</b>                                  |
| <b>Routing</b>                 | <b>Fixed Routes – Alternating Routes</b>                                                                                                     |
| <b>Operation Model</b>         | Defines relation between government and operators<br><b>Direct Public Service – Commercial Service Concession – Other Commercial Service</b> |
| <b>Geographic Availability</b> | Defines the geographic range in which the service is available                                                                               |
| <b>Geographic Coverage</b>     | Geographic Coverage Shows whether there's clear geographic data available                                                                    |
| <b>Financing</b>               | Defines how the service is funded<br><b>Public Budget – Private Investment – Loans &amp; Grants</b>                                          |
| <b>Monopoly</b>                | Defines whether the service model is monopolized by certain parties                                                                          |

## CTA BUS

|                         |                                                                                                        |
|-------------------------|--------------------------------------------------------------------------------------------------------|
| Ownership Status        | Public (CTA)                                                                                           |
| Regulatory Framework    | Governmental (CTA)                                                                                     |
| License                 | Passenger Transport License                                                                            |
| Routing                 | Fixed Routes                                                                                           |
| Operation Model         | Direct Public Service                                                                                  |
| Geographic Availability | Greater Cairo Region                                                                                   |
| Geographic Coverage     | Geo-Data not available                                                                                 |
| Financing               | Public Investments                                                                                     |
| Monopoly                | Yes                                                                                                    |
| Routes Number           | <b>430</b><br>(GCR, 2013-2014, CAPMAS)                                                                 |
| Fleet Size              | Normal: <b>3191</b><br>Air Conditioned: <b>412</b><br><b>62% Operating</b><br>(GCR, 2013-2014, CAPMAS) |
| Annual Passenger Number | <b>359,311,000</b><br>(GCR, 2013-2014, CAPMAS)                                                         |



### Fleet size and route numbers:

*Cairo Transport Authority (CTA), founded in 1966, provides subsidized public transport service in the GCR through its fleet of 49-passengers buses.*

## Financing:

The CTA is financed by fare revenues in addition to subsidies from the national budget to keep fares stable (DRTPC Study Experts 2009). Another financial source is the revenue collected from private companies through concessions from CTA to operate private mass transport buses and minibuses in Cairo Governorate.

## CTA MINIBUS



*Cairo Transport Authority (CTA), founded in 1966, provides subsidized public transport service in the GCR through a fleet of 29-passengers mini-buses.*

|                         |                                 |
|-------------------------|---------------------------------|
| Ownership Status        | Public (CTA)                    |
| Regulatory Framework    | Governmental (CTA)              |
| License                 | Passenger Transport License     |
| Routing                 | Fixed Routes                    |
| Operation Model         | Direct Public Service           |
| Geographic Availability | Greater Cairo Region            |
| Geographic Coverage     | Geo-Data not available          |
| Financing               | Public Investments              |
| Monopoly                | Yes                             |
| Routes Number           | NA                              |
| Fleet Size              | 782<br>(GCR, 2013-2014, CAPMAS) |
| Annual Passenger Number | NA                              |

## PRIVATE SECTOR BUS

|                         |                                                     |
|-------------------------|-----------------------------------------------------|
| Ownership Status        | Private (Institution)                               |
| Regulatory Framework    | Governmental (CTA)                                  |
| License                 | Passenger Transport License                         |
| Routing                 | Fixed Routes                                        |
| Operation Model         | Public Service Concession<br>(Mass Transit Project) |
| Geographic Availability | Greater Cairo Region                                |
| Geographic Coverage     | Geo-Data not available                              |
| Financing               | Private Investment                                  |
| Monopoly                | NA                                                  |
| Routes Number           | NA                                                  |
| Fleet Size              | NA                                                  |
| Annual Passenger Number | NA                                                  |



Private companies which have a concession with CTA under Mass Transit Project (MTP) operate 49-passengers buses on fixed routes.

Routes & fares are determined in the contract between the company and CTA.

## PRIVATE SECTOR MINIBUS



Private sector companies have concessions with CTA under the umbrella of Mass Transit Project (MTP) to operate 29-passengers buses on fixed routes.

Routes & fares are determined in the contract between the company and CTA.

|                         |                                                     |
|-------------------------|-----------------------------------------------------|
| Ownership Status        | Private (Institution)                               |
| Regulatory Framework    | Governmental (CTA)                                  |
| License                 | Passenger Transport License                         |
| Routing                 | Fixed Routes                                        |
| Operation Model         | Public Service Concession<br>(Mass Transit Project) |
| Geographic Availability | Greater Cairo Region                                |
| Geographic Coverage     | Geo-Data not available                              |
| Financing               | Private Investment                                  |
| Monopoly                | No                                                  |
| Routes Number           | NA                                                  |
| Fleet Size              | NA                                                  |
| Annual Passenger Number | NA                                                  |

## COOPERATIVE MINIBUS

|                         |                                                     |
|-------------------------|-----------------------------------------------------|
| Ownership Status        | Private                                             |
| Regulatory Framework    | Institutional (Cooperatives)                        |
| License                 | Passenger Transport License                         |
| Routing                 | Fixed Routes                                        |
| Operation Model         | Public Service Concession<br>(Mass Transit Project) |
| Geographic Availability | Greater Cairo Region                                |
| Geographic Coverage     | Geo-Data not available                              |
| Financing               | Data not available                                  |
| Monopoly                | No                                                  |
| Routes Number           | Data not available                                  |
| Fleet Size              | Data not available                                  |
| Annual Passenger Number | Data not available                                  |



## MICROBUS



|                         |                                                                            |
|-------------------------|----------------------------------------------------------------------------|
| Ownership Status        | Private (Institution)                                                      |
| Regulatory Framework    | Individual                                                                 |
| License                 | 1. Route License (Karta)                                                   |
| Routing                 | Alternating Routes<br>Fixed Terminals                                      |
| Operation Model         | Commercial Service Agreement with the local government on routes and fares |
| Geographic Availability | Greater Cairo Region                                                       |
| Geographic Coverage     | Geo-Data not available                                                     |
| Financing               | Private Investment<br>(DRTPC Study Experts 2009)                           |
| Monopoly                | Data not available                                                         |
| Routes Number           | <b>312</b><br>(GCR Microbus Routes, SETS North Africa)                     |
| Fleet Size              | <b>13921</b><br>(GCR Microbus Routes, SETS North Africa)                   |
| Annual Passenger Number | Data not available                                                         |

### Licensing and regulatory framework:

14-passengers microbus service have route licenses from Cairo Governorate (under the jurisdictional umbrella of the CTA), Giza Governorate and Qalyobeya Governorate. Each Governorate is responsible for licensing minibuses that operate on its territory. Minibuses are licensed to operate between defined microbus terminals through El-Karta, which is the document that defines routes and fares.

Traffic police is also involved in the vehicle licensing process through its respective departments (DRTPC Study Experts ,2009)

### Fleet size and route numbers:

A total of 13,921 licensed minibuses operate on 312 routes in the GCR; 7253 vehicles operate on 211 routes In Cairo Governorate, 6328 vehicles operate on 87 routes in Giza Governorate and 1265 vehicles operate on just 14 routes in Qalyobeya Governorate (SETS North Africa).

According to Giza Governorate's Portal; 6,519 licensed minibuses operates on 89 routes, with an estimation of three million passengers using the service daily.

Throughout fieldwork conducted by TfC over the course of the past year, a considerable number of minibuses was spotted running without a route label, which makes it difficult to determine the actual number of operating minibuses without extensive mapping activity. In 2006, the World Bank estimated the number of operating minibuses by 80,000, only 20,000 of them were licensed (World Bank 2006).

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## Routing:

Licensed Microbuses operate between defined terminals as indicated in El-Karta. However, drivers tend to change their routes based on congestion after negotiation with the passengers. The service is demand-driven with no fixed stops, so drivers may stop to load or drop-off passengers at any point along the route.

Microbus service is highly demand driven. Unlicensed microbus routes emerge during specific seasons. For example, the route from El-Sayeda Zeinab Metro Station to Cairo University is available during the academic year but disappears during summer vacations. Microbuses on this route are originally licensed to work on a route from El-Sayed Zeinab to Giza that passes by Cairo University, but some drivers tend to end their trips by Cairo University during the academic year, in order to achieve shorter but more frequent trips (TfC Fieldwork Notes)

## SUZUKI MINI-VAN (TOMNAYA)

Licensing and Regulatory Framework:

*Individual owners/drivers operate 7-passengers Suzuki Mini-Vans, locally known as Tomnaya. According to fieldwork data by TfC, vehicles are commonly licensed as private vehicles, with no clear regulatory framework for the service despite its major role on some routes as the only mass transportation mode available.*

*Tomnaya service has no clear regulatory framework as it's often regulated by drivers themselves.*

|                         |                                   |
|-------------------------|-----------------------------------|
| Ownership Status        | Private (Individual)              |
| Regulatory Framework    | Precarious                        |
| License                 | Another License (Private Vehicle) |
| Routing                 | Alternating Routes                |
| Operation Model         | Data not available                |
| Geographic Availability | Greater Cairo Region              |
| Geographic Coverage     | Geo-Data not available            |
| Financing               | Private Investment                |
| Monopoly                | Data not available                |
| Routes Number           | Data not available                |
| Fleet Size              | Data not available                |
| Annual Passenger Number | Data not available                |

**Geographic Availability:**

Tomnaya service was observed around some metro stations where it is the only mass transport mode available, for example, passengers can only move from Ataba Metro Station to Al-Hussein Area by Tomnaya. The service is highly demand based and often competes with other modes, for example, a passenger can take a Tomnaya directly transport from Al-Malek Al-Saleh Metro Station to Al-Mokattam instead of taking a transport mode to Al-Sayeda Eisha first then take another transport mode to Al-Mokattam (TfC Fieldwork Notes)

Tomnaya service was also observed in some new cities like 6th Of October, Sheikh Zayed and New Cairo, where it plays a major role as local transport mode with relatively short routes. According to the New Urban Communities Authority (NUCA), 218 Suzuki Mini-Van vehicles operate as an inner-city transport mode in 6th Of October (NUCA Online Portal)

## METRO

|                         |                                                                                       |
|-------------------------|---------------------------------------------------------------------------------------|
| Ownership Status        | Public                                                                                |
| Regulatory Framework    | Governmental Egyptian Company for Metro Operation and Maintenance (EMC)               |
| License                 | Passenger Transport License                                                           |
| Routing                 | Fixed Routes                                                                          |
| Operation Model         | Direct Public Service                                                                 |
| Geographic Availability | Greater Cairo Region                                                                  |
| Geographic Coverage     | Geo-Data available for all of operating Metro Lines                                   |
| Financing               | Loans / Public Investments                                                            |
| Monopoly                | Yes                                                                                   |
| Routes Number           | <b>3</b><br>(3rd route incomplete)                                                    |
| Fleet Size              | <b>Line 1: 47</b><br><b>Line 2: 35</b><br><b>Line 3: 16</b><br>(Metro Company Portal) |
| Annual Passenger Number | <b>774,966,000</b><br>(GCR, 2013-2014, CAPMAS)                                        |



### Licensing and Regulatory Framework:

Egyptian Company for Metro Operation and Maintenance (EMC) operates a fleet of electric trains. EMC is a public sector company that belongs to Ministry of Transport and it has been in charge of operation and maintenance of the Metro since 2008, replacing the former operator: the Egyptian National Railway (ENR) (DRTPC Study Experts 2009)

### Financing:

Construction of Metro Line 1 was financed through a French Loan. Construction of Line 2 was financed completely by Ministry of Transport and Telecommunication, before the Ministry of Telecommunication was separated from Ministry of Transport in 2000. Construction of the first phase of Line 3 was arranged through loans from France and Japan (DRTPC Study Experts 2009).

The operation of the Metro is financed by fare box revenues in addition to annual subsidy covered by the national budget in order to keep fares stable (DRTPC Study Experts 2009).

## Fleet size and route numbers:

According to EMC, it operates a total of 98 trains on the 3 operating lines. Operation schedules are designed based on demand trends in working days, weekends and different seasons.

- Line 1 (AlMarg – Helwan) has a fleet of 47 trains making an average of 518 full trips daily.
- Line 2 (Shoubra – AlMounib) has a fleet of 35 trains making about 664 full trips daily.
- Line 3 (Imbaba – Cairo Airport) has a fleet of 16 trains making an average of 429 trips along the completed segment (Ataba – AlAhram) daily (Metro Company Portal)

### 5.3. Annex 3: Transit Data Availability matrix for GCTS beta<sup>10</sup>

|               |                                                                                              | <div> <div>Primary Data Available TfC\TICD</div> <div>Secondary Data Available</div> <div>Primary Data Obtainable TfC\</div> <div>No Available Data</div> <div>Measurement Methodology Available</div> </div> |              |                  |        |           |                          |
|---------------|----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|------------------|--------|-----------|--------------------------|
|               |                                                                                              | CTA Bus                                                                                                                                                                                                       | CTA Mini-bus | Private Mini-bus | Met-ro | Micro-bus | Suzuki Mini Van Tom-naya |
| Affordability | Trip Fare                                                                                    | ●                                                                                                                                                                                                             | ●            | ●                | ●      | ●         | ●                        |
|               | Time lost in transport due to congestion (as an indirect financial cost)                     |                                                                                                                                                                                                               |              |                  |        |           |                          |
|               | Transportation expenses share of total income for different income groups                    | ●                                                                                                                                                                                                             | ●            | ●                | ●      | ●         | ●                        |
| Availability  | System Responsiveness to ad-hoc events                                                       |                                                                                                                                                                                                               |              |                  |        |           |                          |
|               | Operating Time                                                                               | ●                                                                                                                                                                                                             | ●            | ●                | ●      |           |                          |
|               | Ability to operate in difficult weather condition                                            |                                                                                                                                                                                                               |              |                  |        |           |                          |
|               | Network Length Per Capita                                                                    | ●                                                                                                                                                                                                             | ●            | ●                | ●      | ●         | ●                        |
|               | Proportion of population with access to station or mode of transport within walking distance | ●                                                                                                                                                                                                             | ●            | ●                | ●      | ●         | ●                        |
| Accessibility | Stations and modes of transport are barrier-free                                             | ●                                                                                                                                                                                                             | ●            | ●                | ●      | ●         | ●                        |
|               | Modes of transport are gender sensitive                                                      | ●                                                                                                                                                                                                             | ●            | ●                | ●      | ●         | ●                        |
|               | The availability of passenger information systems                                            | ●                                                                                                                                                                                                             | ●            | ●                | ●      | ●         | ●                        |
|               | Coverage in low-income areas (trip coverage)                                                 | ●                                                                                                                                                                                                             | ●            | ●                | ●      | ●         | ●                        |
|               | Coverage in low-income areas (Spatial distribution)                                          | ●                                                                                                                                                                                                             | ●            | ●                | ●      | ●         | ●                        |
|               | Average travel distance in an hour                                                           | ●                                                                                                                                                                                                             | ●            | ●                | ●      | ●         | ●                        |
| Acceptability | Crowding                                                                                     | ●                                                                                                                                                                                                             | ●            | ●                | ●      | ●         | ●                        |
|               | Comfort                                                                                      | ●                                                                                                                                                                                                             | ●            | ●                | ●      | ●         | ●                        |
|               | Maintenance of modes of transport                                                            | ●                                                                                                                                                                                                             | ●            | ●                | ●      | ●         | ●                        |
|               | Availability and quality of amenities in and around stations                                 | ●                                                                                                                                                                                                             | ●            | ●                | ●      | ●         | ●                        |

<sup>10</sup> The current beta version of the matrix is a preliminary and non-comprehensive attempt to identify data availability and collection methodology availability for each mode of transport and for each indicator. It should not be viewed as a final product.

|                |                                                         |                                                            | CTA Bus                                                        | CTA Mini-bus | Private Mini-bus | Metro | Micro-bus | Suzuki Mini Van Tom-naya |
|----------------|---------------------------------------------------------|------------------------------------------------------------|----------------------------------------------------------------|--------------|------------------|-------|-----------|--------------------------|
| Safety         | Emergency preparedness                                  |                                                            | ●                                                              | ●            | ●                | ●     | ●         | ●                        |
|                | Surveillance                                            |                                                            | ●                                                              | ●            | ●                | ●     | ●         | ●                        |
|                | Safety and walkability of station's catchment area      |                                                            |                                                                |              |                  |       |           |                          |
|                | Safety of driving behaviour                             |                                                            | ●                                                              | ●            | ●                | ●     | ●         | ●                        |
|                | Equipment of modes with safety measures                 |                                                            | ●                                                              | ●            | ●                | ●     | ●         | ●                        |
|                | Deaths and injuries in transportation related accidents |                                                            | ●                                                              | ●            | ●                | ●     | ●         | ●                        |
|                | Number of theft incidents                               |                                                            | ●                                                              | ●            | ●                | ●     | ●         | ●                        |
|                | Number of gender-based harassment incidents             |                                                            | ●                                                              | ●            | ●                | ●     | ●         | ●                        |
|                | Number of ethnic-based harassment incidents             |                                                            | ●                                                              | ●            | ●                | ●     | ●         | ●                        |
| Sustainability | Environmental                                           | Energy Consumption per capita by mode and/or fuel          | ●                                                              | ●            | ●                | ●     |           |                          |
|                |                                                         | Transport Emissions of GHG per capita                      |                                                                |              |                  |       |           |                          |
|                |                                                         | Transport Emissions of air pollutants (Non-GHG) per Capita |                                                                |              |                  |       |           |                          |
|                |                                                         | Energy Efficiency                                          |                                                                |              |                  |       |           |                          |
|                |                                                         | Share of renewable energy in the transport sector          | ●                                                              | ●            | ●                | ●     | ●         | ●                        |
|                |                                                         | Share of clean energy in the transport sector              | ●                                                              | ●            | ●                | ●     | ●         | ●                        |
|                |                                                         | Noise pollution level                                      |                                                                |              |                  |       |           |                          |
|                | Financial / Economic                                    | Sustainability of financial models                         |                                                                |              |                  |       |           |                          |
|                |                                                         | Mode cost per capita                                       |                                                                |              |                  |       |           |                          |
|                | Social                                                  |                                                            |                                                                |              |                  |       |           |                          |
|                | Governance                                              | Capacity                                                   | Availability of capacity building for Human Resources          |              |                  |       |           |                          |
|                |                                                         |                                                            | Availability of public funding                                 |              |                  |       |           |                          |
|                |                                                         | Responsiveness                                             | Responsiveness to users needs (spatial, time-related, cost)    |              |                  |       |           |                          |
|                |                                                         |                                                            | Availability and effectiveness of channels for users' feedback |              |                  |       |           |                          |
|                |                                                         | Accountability                                             | Level and effectiveness of regulatory framework                |              |                  |       |           |                          |
|                |                                                         |                                                            | Transparency                                                   |              |                  |       |           |                          |

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MARG EL-DRASA EL-MONEEB SHOBRA EL-AHRAM  
NAHIA SAKR-KORESH CAIRO-UNI KORNESH MANYAL  
MATBAA RABAA EL-BASATEN ELHAY-ELSABAA MATRYA  
GESR-ELSWISS ELSAYEDA-ZEINAB EL-WARAK  
EL-SHOROUK EL-MAHKMA ZAHRAA OBOR MAKRAM  
ZAMALEK ROXI MOSTAFA-ELNAHAS ABO-WAFYA ESBIKO



GIZA TAHRIR ABBASYA RAMSIS GHAMRA DOKKI BOHOS  
EL-HEGAZ EIN-SHAMS MAZALAT ATABA EL-SALAM  
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EL-SALAM EL-SAWAH EL-MATAR AHMED-HELMY  
MADINET-BADR EL-NOZHA BOLAK AABOD EL-SODAN  
GIZA TAHRIR ABBASYA RAMSIS GHAMRA DOKKI BOHOS  
EL-HEGAZ EIN-SHAMS MAZALAT ATABA EL-SALAM